FINAL REPORT

EVALUATING ENVIRONMENTAL AND ECONOMIC IMPACT FOR BEEF PRODUCTION IN ALBERTA USING LIFE CYCLE ANALYSIS

Prepared For:

ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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EXECUTIVE SUMMARY

Alberta Agriculture and Rural Development (ARD) has engaged in a multiyear project to evaluate the environmental and economic impacts of beef production in Alberta using the Life Cycle Assessment (LCA) methodology. The LCA study addresses the significant environmental aspects and potential impacts generated throughout the life of the beef production system in Alberta.

The overall activities of this ARD project include:

- Technical analysis to quantitatively benchmark the carbon footprint and other environmental impacts of beef production in Alberta
- Economic analysis to examine the economics of adopting potential greenhouse gas (GHG) reducing practices related to beef production in Alberta

The results of the ARD project are intended to aid in product differentiation on environmental attributes, providing value-added products, market access, trade dispute resolution, nutrient and water use efficiency, production efficiency, competitiveness and potential carbon reduction offset credit project opportunities.

Conestoga-Rovers & Associates (CRA) and the Pembina Institute (Pembina) (Project Team) were retained to complete the technical analysis component of the project, which includes a first approximation of the carbon footprint intensity and other environmental impacts of beef production in Alberta. CRA is the lead entity in this study; Pembina has been subcontracted to provide CRA with guidance on LCA methodology and to aid in model development.

The objective of this assignment was to provide a first approximation of the carbon footprint intensity and other environmental impacts including water and nutrients, such as nitrogen and phosphorus, of the beef production industry in Alberta using the LCA approach.

The study has identified:

- First approximation of environmental impacts of beef production in Alberta
- First approximation of environmental impacts per functional unit

Note that this is a first approximation of the above impacts. The intent is to create a tool that allows for subsequent adjustment according to revised data, while also facilitating the inclusion of new processes if necessary. While the model has been constructed to provide a comprehensive understanding of the Alberta beef production cycle, the authors recognize that future research is likely to provide more Alberta-specific data for use in the model. As such, the model has been formulated to allow for such inclusions as appropriate.

Boundaries of the beef production system include production of seed for specific components of the diet (barley, barley silage, alfalfa grass), cultivation of diet components, fertilizer production and application, feed storage, grains processing and, eventually processing of feed for such components of the diet, and cattle feeding strategy; production and transportation of minerals/supplements, plastics, and bedding for cattle; livestock related activities, including activities within and outside the farm (cattle management, cattle rearing, storage and management of manure, finishing, transportation; garbage management (plastics); and the production, transportation and usage of energy by beef operations.

The specific scope of the study was designed to start with production of cattle feed and end at the door of the meat packing plant/slaughterhouse.

The LCA has been based on two different finishing scenarios, namely the yearling-fed and calf-fed systems. The current interest in grain for fuel has increased costs and decreased returns for the more traditional calf-fed finishing systems, spurring interest in increased use of forages prior to finishing. The duration of each of the finishing strategies and differences in diet (forages versus concentrates) and resources required to feed the animals has been quantified for both systems. Neither organic nor grass-fed beef production in Alberta has been considered in this study.

For the purposes of this study, the functional unit has been defined as one kg shrunk weight (one kg of live cattle at the door of the slaughterhouse). This allows for the estimation of environmental impacts up to the slaughterhouse door, which has been defined as the project boundary.

The life cycle inventory (LCI) was performed using primary and secondary data only, using specific data for the Alberta livestock production system where available, and supplemented by generic data from the literature or databases as necessary. Sources of data include industry experts (producers, auction mart managers, Livestock Identification Services), government agencies (Alberta Agriculture and Rural Development, Statistics Canada), industry organizations and associations (CanFax [a division of the Canadian Cattlemen's Association], Alberta Plastics Recycling Association), and independent research groups (universities, consultants). In addition, because of the complex nature of animal diet in the beef industry in Alberta, a ruminant nutritionist was retained to provide representative, balanced rations.

The Ecoinvent V2 database was chosen as the primary data source for quantification of the emission factors of the processes involved in the life cycle analysis. However, certain processes described in Ecoinvent are characteristic of geographic systems that differ from the Alberta context. Whenever necessary, the processes from Ecoinvent were adapted, as much as possible, to Alberta- and/or Canadian-specific conditions.

A variety of processes were described for the construction, operation and maintenance, and decommissioning components of the beef production cycle. The construction and decommissioning components were not included in the analysis. Some of the operations and maintenance items also removed from the inventory include: activities related to the production and transport of materials required for on-farm repairs and replacement; storage of seed in regional storehouses; treatment of harvested crop; vitamin and growth promotant production; and activities related to production and transportation of supplements and vaccinations/antibiotics.

The following environmental impact categories were considered in this study: global warming potential (GWP), eutrophication, acidification, and non-renewable energy resources. Modelling was undertaken according to the principles established by ISO 14040:2006 and 14044:2006. The GWP method as per Inter-governmental Panel on Climate Change (IPCC) 2007, with a time horizon of 100 years was used for quantification of the global warming impact category. IMPACT 2002+ was chosen as a life cycle impact assessment method for the aquatic acidification, aquatic eutrophication and non-renewable energy resources environmental impacts.

The life cycle of the project results in a carbon intensity of 14.5 kg CO_2e per kg of beef live (shrunk) weight for the entire calf crop, with a breakdown of 14.1 kg CO_2e per kg of beef live (shrunk) weight for the calf-fed system, and 14.8 kg CO_2e per kg of beef live (shrunk) weight for the yearling-fed system. Slaughterhouse emissions are not included as part of this analysis. It must be noted that this carbon intensity value is only a first approximation, based on provincial average estimates for all parameters, and based on both local and international estimation techniques. Therefore, comparison of this value to LCAs from other jurisdictions must include a confirmation that assumptions and boundaries are equivalent. Otherwise, any comparison with other jurisdictions may be invalid and misleading.

The largest components of the total emission figure include enteric emissions (51.1 percent of total), on-farm energy consumption activities (18.6 percent of total) and nitrous oxide emissions from soil and manure management (16.3 percent of total). The next largest category is total forage and cereal activities at 8.8 percent of total. The results for both the calf-fed and yearling-fed systems are similar to the percentage breakdown of the total emissions.

Within these categories, the largest contributors include enteric emissions from cows, on-farm diesel fuel usage, and nitrous oxide emissions from manure management and cropping activities.

The total acidification impact per calf crop is quantified as 0.0230 kg SO_2 eq per kg of beef live (shrunk) weight, with 0.0238 kg SO_2 eq per kg of beef live (shrunk) weight for the calf-fed system and 0.0224 kg SO_2 eq per kg of beef live (shrunk) weight for the yearling-fed system. The dominant categories of emissions contributing to this impact are related to on-farm energy consumption activities. The main contributor to acidification under energy consumption relates to the production of crude oil for diesel and gasoline formulation.

The total eutrophication impact is quantified as 0.00389 kg PO_4 eq per kg of beef live (shrunk) weight, with 0.00391 kg PO_4 eq per kg of beef live (shrunk) weight for the calf-fed system and 0.00388 kg PO_4 eq per kg of beef live (shrunk) weight for the yearling-fed system. The main contributors to the total (and each system) include total phosphorous emission from run-off (74.6 percent of total), on-farm energy consumption activities (16.6 percent of total), total forage and cereal activities (4.6 percent of total), and feedlot and pasture activities (3.9 percent of total).

The total non-renewable energy resources consumption impact is quantified as 242.8 MJ-eq per kg of beef live (shrunk) weight, with 244.8 MJ-eq per kg of beef live (shrunk) weight for the calf-fed system and 241.3 MJ-eq per kg of beef live (shrunk) weight for the yearling-fed system. On-farm energy consumption activities account for the highest fraction of the total (89.6 percent) followed by total forage and cereal activities (7.9 percent). In the on-farm energy consumption category, the majority of the impact category stems from production of crude, transportation, and combustion of diesel fuel.

A direct comparison to literature values from other LCAs is complicated by the use of differing project boundaries, functional units, precise description of assumptions utilized and modification in time of specific emissions equivalence factors (i.e., as per IPCC Fourth Assessment Report, a CO_2 equivalence factor of 25 is assigned for CH_4 for a 100-year GWP horizon). A standardized methodology for producing a beef production LCA is not available at this time. As this is only a first approximation of the beef production in Alberta, the final results of the study will change over time as further refinement of the data is conducted and additional processes are identified and included.

A number of data gaps and additional refinements of information are warranted for further study, including cattle input numbers related to cow and bull culls, type and fate of international cattle inputs, and within-province movement of cattle; feedlot and pasture data relating to quantities of waste production and destination; energy usage data including specific information related to on-farm use of fuel and transportation distances for fuel movement; lack of a standard methodology for the calculation of soil organic carbon sequestration on pasture; and additional data regarding transportation of feed, supplements, fertilizers, bedding and mortalities. Of these data gaps, it is expected that the amount of on-farm energy consumption will likely have the greatest impact on the overall life cycle results.

CRA supports a third-party review of the data and assumptions as a means of validating the approach and methodology utilized; however, CRA notes that the numerical inputs to the model will change over time as additional data becomes available, and specifically as Alberta-specific data becomes available.

As this is a first approximation for the beef production in Alberta, it is recommended that additional study be conducted on a number of items in this study in order to increase the accuracy of the results and to address the data gaps. Also, further research for more Canadian-specific emission factor data may be warranted for the next iterations.

ACKNOWLEDGMENT

Alberta Agriculture and Rural Development (ARD) would like to thank the Project Steering Committee that comprises of members from ARD, Alberta Livestock and Meat Agency, Alberta Cattle Feeders' Association, Canadian Cattlemen's Association, and the beef industry. The Steering Committee provided valuable contributions of their time, expertise and industry contacts in developing the project Terms of Reference, data, information and advice in the implementation of the project. Special thank you to Karen Haugen-Kozyra who represented Climate Change Central on the initial steering committee.

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TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

LIST OF FIGURES
(Following Text)

LIST OF FIGURES
(Following Text)

LIST OF FIGURES
(Following Text)

LIST OF TABLES
(Following Text)

LIST OF TABLES
(Following Text)

LIST OF APPENDICES

NOMENCLATURE

AR4	Fourth Assessment Report
ARD	Alberta Agriculture and Rural Development
BFB	Bone-free beef
CFCs	Chlorofluorocarbons
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e or CO_2eq	Carbon dioxide equivalent
CRA	Conestoga Rovers & Associates
CW	Carcass weight
CWE	Carcass weight
DDG	Dried distillers grains
DMI	Dry matter intake
eq	Equivalent
GEI	Gross energy intake
GHG	Greenhouse gas
GWP100	Global Warming Potential over 100 years
ha	Hectare
HCFCs	Hydrochlorofluorocarbons
IPCC	Inter-governmental Panel on Climate Change
ISO	International Standards Organisation
K	Potassium
K_2O	Potash
kg	Kilogram
kt	Kilotonne
kWh	Kilowatt Hour
L/ha	Litres/Hectare
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
m^3	Cubic metre
MJ	Megajoule
N	Nitrogen
N_2O	Nitrous Oxide
Na_2O	Sodium Oxide
NH_3	Anhydrous Ammonia
NO_3	Nitrate
NO_x	Nitrogen Oxide
NREL	National Renewable Energy Laboratory
P_2O_5	Phosphate
Pembina	The Pembina Institute
PO_4	Phosphate
S	Sulphur

NOMENCLATURE

SETAC	Society of Environmental Toxicology and Chemistry
Shrunk Weight	Weight of cattle at delivery to the slaughterhouse
SO_2	Sulphur Dioxide
TJ	Terajoule
t	tonnes
W	Watt

1.0 INTRODUCTION

1.1 BACKGROUND

Greenhouse gas (GHG) emissions resulting from agricultural practices have become increasingly important to global markets and consumers, particularly as global initiatives are formulated and promulgated for the reduction of GHG emissions to the atmosphere. The establishment of policies such as carbon emission caps and taxes, and the movement of some European jurisdictions toward carbon content labeling of food products, has allowed for the creation of markets for new environmental goods and services. A critical component of this market shift is the manner in which GHG and other environmental impacts associated with a particular activity or economic sector are quantified.

Life Cycle Analysis (LCA) has become an increasingly used tool in quantifying and improving the environmental performance of products and production systems. LCA studies attempt to address the environmental aspects and potential impacts throughout a product's life from raw material acquisition through production, use, and disposal (ISO 14040, 2006a; ISO 14040, 2006b). The quantification technique is intended to assess the spectrum of environmental impact associated with a product or activity. Given the wide range of processes involved in the life cycle of a product and the versatility of the LCA as an environmental assessment tool, LCA is widely used in product development and improvement, strategic planning, environmental performance indicator selection and marketing (ISO 14040, 2006a).

Based on the recent development of LCA methodologies, the use of LCA to assess agricultural and livestock food production is becoming more common. This trend is emphasized by the need for reliable and comprehensive environmental information, used by policy makers, producers and consumers for the selection of environmentally and economically sustainable agricultural products and practices. The LCA of food products yields information about the production system, identifies environmental impact hot-spots during the life-cycle of the product, and allows for short-term optimization plans and planning of long-term strategies (Ceuterick et al, 1998). The usefulness of an LCA study is dependant upon the process boundary and the activities selected for inclusion and exclusion from the LCA. Because of the choices made during boundary and activity selection, LCA studies of the same product may not be comparable, especially where there is no commonly accepted methodology for performing the LCA for that product.

Alberta Agriculture and Rural Development (ARD) has engaged in a multiyear project to evaluate the environmental and economic impacts of beef production in Alberta using LCA. The overall activities of this ARD project include:

- Technical analysis to quantitatively benchmark the carbon footprint and other environmental impacts of beef production in Alberta
- Economic analysis to examine the economics of adopting potential GHG reducing practices related to beef production in Alberta

The results of the ARD project are intended to aid in product differentiation on environmental attributes, providing value-added products, market access, trade dispute resolution, nutrient and water use efficiency, production efficiency, competitiveness and potential carbon reduction offset credit project opportunities.

Conestoga-Rovers & Associates (CRA) and the Pembina Institute (Pembina) (Project Team) were retained to complete the technical analysis component of the project, which includes a first approximation of the carbon footprint intensity and other environmental impacts of beef production in Alberta. CRA is the lead entity in this study; Pembina has been subcontracted to provide CRA with guidance on LCA methodology and to aid in model development.

1.2 SCOPE OF STUDY

The objective of this assignment was to provide a first approximation of the carbon footprint intensity and other environmental impacts including water and nutrients, such as nitrogen and phosphorus, of the beef production industry in Alberta using the LCA approach.

The study has identified:

- First approximation of environmental impacts of beef production in Alberta
- First approximation of environmental impacts per functional unit

Note that this is a first approximation of the above impacts. The intent is to create a tool that allows for subsequent adjustment according to revised data, while also facilitating the inclusion of new processes if necessary. While the model has been constructed to provide a comprehensive understanding of the Alberta beef production cycle, the authors recognize that future research is likely to provide more Alberta-specific data for use in the model. As such, the model has been formulated to allow for such inclusions as appropriate.

Boundaries of the beef production system include:

- Production of cattle feed, assessed from production of seeds for specific components of the diet (barley, barley silage, alfalfa grass), through cultivation, fertilizer production and application, feed storage, grains processing and, processing of feed for components of the diet, and cattle feeding strategy
- Production and transport of minerals/supplements, plastics, and bedding for cattle
- Livestock-related activities, including activities both on and off farm (cattle management, cattle rearing, storage and management of manure, finishing, transportation)
- Waste management (plastics)
- Production, transportation and usage of energy on beef farms

The specific scope of the study was designed to start with production of cattle feed and end at the door of the meat packing plant/slaughterhouse. This LCA is comprehensive, and will allow policy researchers and producers to identify environmental impacts of beef production systems in Alberta. Some elements of the LCA (such as energy requirements for the production of crude oil, diesel, and gasoline or transportation of these components) may be allocated to the oil and gas or the transportation sector in the future if warranted.

The LCA has been based on two different finishing scenarios, namely the yearling-fed and calf-fed systems. The current interest in grain for fuel has increased costs and decreased returns for the more traditional calf-fed finishing systems, spurring interest in increased use of forages prior to finishing. The duration of each of the finishing strategies and differences in diet (forages versus concentrates) and resources required to feed the animals has been quantified for both systems. Neither organic nor grass-fed beef production in Alberta has been considered in this study.

The technical study was discretized into the following components:

- Literature Review: review of beef LCA studies and databases, compilation of GHG parameters and processes, and definition of inputs and outputs for beef production.
- Data Collection: characterization of beef production scenarios, collection of primary producer and emission factor data, and definition of boundaries and methodologies.

- Benchmark Carbon Footprint: development of the first approximation of the GHG and environmental footprint of beef production in Alberta based on a final definition of the functional unit. This has been undertaken on the basis of a spreadsheet model.
- Preparation of Report: includes interpretation of the model results, definition of the environmental impacts, and identification of hotspots and data gaps.

In consultation with ARD and the Project Steering Committee, the following environmental impact categories were selected for study:

- Global warming potential
- Eutrophication
- Acidification
- Non-Renewable Energy Resources

A primary mandate in the completion of this work was to yield a tool that could be used by ARD to further refine the inputs and outputs of beef production, to modify the baseline date, and to incorporate other processes and factors as appropriate. To this end, the Project Team has developed a spreadsheet model that allows for future modifications of the LCA data.

2.0 SUMMARY OF EXISTING LITERATURE

There are many beef production LCAs that have been conducted in different jurisdictions worldwide. However, the assumption base, boundaries and methodologies have varied. Consequently, it is important to discuss the results of any study in the context of the work performed and assumptions used in each study. The literature review, prepared as the first phase of this work, is presented in Appendix A. Table 1 presents a summary of the other beef LCAs for comparison against the results of this study.

The general conclusions from the literature review are as follow:

- The enteric or gut methane (CH4) emissions from livestock and N2O emission from feed (crops) production are major contributors to global warming for beef production. Beef production in combination with milk production (surplus calves) can be carried out with fewer animals than solely in beef production systems, reducing the environmental burdens per product unit (Cederberg and Stadig, 2003).
- The increase in specialization of the dairy and the beef sectors make it difficult to reduce GHG emissions (Casey and Holden, 2006a). The advantages of less intensive and combined systems are obvious for (sub)tropical animal production systems, where a combination of milk and beef production is very frequent and livestock needs to be seen in the context of larger livelihood systems (Cederberg et al., 2009, Sumberg, 2002).
- Organic farming reduces pesticide use but requires more land and leads to higher global warming impacts than non-organic systems in United Kingdom conditions (Williams et al., 2006).
- The environmental impacts of beef finishing systems are dependent on the feeding length, feed production and type of feed, animal housing and manure storage (Ogino et al., 2002, 2004; Núñez et al., 2005, Williams et al., 2006; Nemecek, 2006). A shorter feeding length reduces the environmental impacts. The feeding stage is the most important factor for environmental impacts and the infrastructure is also relevant, especially for energy consumption and human toxicity (Erzinger et al., 2003; Núñez et al., 2005).

A broader conclusion is achieved through investigation of previous LCA studies of beef production worldwide. Generally, the level of data that is published regarding these studies makes it difficult to fully understand the boundaries and assumptions that were utilized. It is expected that a useful comparison of the results of the different studies can only be conducted if the original models, and not just the summary papers, are made available and analyzed. The model presented in this report encompasses dozens of different processes and assumptions; variations in these items between studies can significantly affect the meaningfulness of any comparison. For this reason, CRA does not believe that a rigorous comparison is possible at this time, and that commentary on the carbon intensity and environmental impacts associated with different beef production systems has limited value.

The overlying issues with comparison lie in the transparency of the information and also the lack of a standardized methodology for conducting beef LCAs. While ISO standards exist to prescribe the general framework of an LCA, no specific direction exists to guide the selection of project boundaries, assumptions and emission factors related to beef LCAs. Given the relative complexity of any one beef production cycle, such a methodology is likely required before meaningful comparisons can be made between different systems.

3.0 QUANTIFICATION METHODOLOGY

The current LCA study assessed the beef production system in Alberta, by quantifying the environmental impacts in terms of emissions and resource use. The fundamental principle was to follow the product, defined as the calf-crop, through its entire life cycle. The approach of the LCA method was based on the guideline principles established by:

- The Society of Environmental Toxicology and Chemistry (SETAC)
- Environmental management standards from the International Standards Organization (ISO) 14000 series: 14040:2006 and 14044:2006

The boundaries of the system were delineated to include the life cycle stages of beef production in Alberta and selected impact categories, identified according to expert opinion and experience.

The extensive literature review performed for the current study, as discussed in Section 2.0, included:

- Beef production LCA studies from different systems, in various geographical locations
- Alberta-specific information about management of crops, fertilizers, livestock, operation and maintenance activities at feedlots, and dynamics of cattle production operations

The structure of the current LCA of beef production study, within a multi-tiered approach, is intended to offer an enhanced level of transparency that will allow further review of the study findings.

The following sub-sections present a summary of the LCA methodology implemented for the current Alberta beef study.

3.1 GOAL DEFINITION AND SCOPING

The current study describes the beef production system in Alberta from "cradle-to-gate", starting with production of energy, crop inputs, and cattle feed, and ending with the delivery of live shrunk animals to the door of the slaughterhouse.

The primary goal of the study was to quantify the GHG emissions generated during all stages of beef production. Additionally, the environmental emissions were quantified in select environmental impact categories, including aquatic acidification, aquatic eutrophication and use of non-renewable energy resources. Two production scenarios are considered: calf-fed and yearling fed.

The findings of the current LCA study are designed to:

- Enhance the understanding of the relative environmental impacts associated with the processes involved in producing beef animals for slaughter in Alberta.
- Establish baseline information for the beef production system, with emphasis on the calf-fed and yearling-fed systems. The baseline consists of energy and resource requirements and environmental impacts from the processes within the beef production system. The baseline represents information that is used to analyze the effect of changing practices that are undertaken as a result of natural market factors or that are part of a concerted mitigation effort.
- Reveal the relative environmental burdens between alternative processes of beef production, namely between the calf-fed system and the yearling-fed systems.
- Identify the hot-spots of the two beef production systems and consider potential mitigation strategies.
- Rank the relative contribution of individual processes within the life cycle of beef production. The LCA results provide data regarding the individual contribution of each process identified during the life cycle of beef production to the footprint of the entire system. This information can be used to focus mitigation activities designed to reduce the overall environmental impacts.
- Allocate emissions associated with beef production.
- Identify the data gaps, by revealing areas in which data for particular processes are lacking, uncertain or of questionable quality. The Life Cycle Inventory (LCI) (a quantification of emissions generated by all processes considered within the boundaries of the beef production system), followed by the evaluation of the environmental impacts during a Life Cycle Impact Assessment (LCIA), aids in identifying the areas where data is missing or questionable.
- Provide information to the decision makers on the tradeoffs of alternative processes, products and materials involved in the life cycle of beef production in Alberta.
- Guide further improvement of the final product towards a net reduction of resource requirements and environmental emissions.

The boundaries of the current study describe the beef production system from "cradle-to-gate", including processes associated with the beef production system, such as production of cattle feed, feed transport, cattle feeding strategy, and livestock-related activities (cattle management, storage and management of manure, finishing, transportation, garbage, etc.). The biological activity of the animal and the treatment of cattle manure are also included in the system boundary. The life cycle ends at the door of the meat packing plant.

Prior to the LCI step, the following logistical procedures were defined:

- Documenting Assumptions – all assumptions are presented with the results of the LCA study. All additional assumptions and limitations to the initial scope necessary to complete the study with the available resources are documented. Documenting assumptions is crucial in order to place the study results in the correct context and to allow for appropriate interpretation of the findings.
- Quality Assurance Procedures – Pembina provided CRA with guidance on LCA methodology, data validation and model development.
- Reporting Requirements – the final report explicitly defines the beef production system and its boundaries. The basis for comparison between the two scenarios and all assumptions are presented. The presentation of results is consistent with the purpose of the study, to complete a first approximation of the carbon footprint and other environmental impacts associated with beef production in Alberta.

3.2 LIFE CYCLE INVENTORY

The LCI of the current study quantifies the energy and raw materials requirements, the atmospheric and waterborne emissions, solid wastes and any other releases associated with beef production in Alberta. All relevant data were collected and organized to evaluate the environmental impacts and to assess potential mitigation measures. The data level of accuracy and detail is reflected in the results of the LCA study.

The LCI was completed within the framework established by the following documents:

- ISO 14040, Environmental management — Life cycle assessment — Principles and framework
- ISO 14044: Environmental management — Life cycle assessment — Requirements and guidelines
- National Inventory Report 1990–2007: Greenhouse Gas Sources and Sinks in Canada

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Land Use
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
- IPCC Working Group III Fourth Assessment Report, Chapter 8 Agriculture
- Life Cycle Assessment – Inventory Guidelines and Principles - EPA 1993
- Guidelines for Assessing the Quality of Life Cycle Inventory Analysis, 1995

The LCI within the LCA study was performed using primary and secondary data (specific data for the Alberta livestock production, where available, and generic data from the literature or databases). Generic data is required where Alberta-specific information is not available; however, using generic data where required allows for an initial approximation of the given processes, and is a more reasonable approach than removing potentially significant processes. Additionally, construction of the model to include these processes allows for inclusion of Alberta-specific data as it becomes available.

The data used in the LCI of the beef production system was acquired using two approaches:

- Top-down Approach - based on national statistics representative of the livestock industry with focus on beef cattle. The statistics also accounted for other types of cattle in the livestock industry, where the other cattle types are interlinked with the beef industry. When available statistics did not allow enough detail to obtain the required data or the data was too aggregated or missing, additional information was acquired from advisory services, experts, research reports and agricultural practitioners.
- Bottom-up Approach - based on data representation of processes in the beef production system. Data for separate processes is aggregated and linked until the entire beef production system is modelled. Processes such as feed consumption, feed production, and fertilizer use were analyzed in detail, based on first-hand information from livestock producers and experts in Alberta.

The integration of the approaches has the benefit of installing a self-checking mechanism into the model, in that there is an inherent mutual verification of the data collected using each approach. Because both approaches model the same reality, in principle they should arrive at the same result. Bottom-up data tends to be more specific and has a greater resolution than top-down data. However, since the bottom-up approach relies on the LCA developer's knowledge and understanding of the system under consideration, it can be prone to data gaps.

In contrast, top-down data tends to lack resolution, and therefore, in most cases, cannot serve as stand-alone data. Most top-down data is also indirectly derived from bottom-up data, and may be subject to the same data omissions. However, because top-down data is integrated at the national level, it tends to have a higher degree of completeness because of the many options for verification of national data.

Activity maps (Figure 1a and Figure 1b) were developed to describe the processes from the beef production system. The boundaries of the system, determined during the goal and scope, contain all the processes, defined as individual units. The unit processes inside the boundaries of the system were linked together to form a complete life cycle picture of the required inputs and outputs (materials and energy) to the beef production system. The complexity of the activity map was designed to support greater accuracy and utility of the results of the LCA study.

To provide a framework for data collection and model development, the entire beef production system was classified into a series of subsystems (refer to activity maps, Figure 1a and Figure 1b), as follows:

A. Construction
B. Operation and Maintenance:
    - Forage and cereal sub-activities
    - Energy consumption activities
    - Operation and maintenance activities
    - Cereal activities
    - Forage activities
    - Feedlot and Pasture activities
    - Livestock activities
C. Decommissioning

The inventory analysis consists of a list containing the quantities of emissions to the environment and the amount of energy and materials consumed in beef production in Alberta. The LCI data from each process in the activity map quantifies emissions to environmental media (air, water, land).

While the structure of the entire system and subsystems within the boundaries of the study remained unchanged, the unit processes were grouped, where necessary, to replace the lack of specific data for individual processes with more complex data from processes already defined in existing databases. For example, for the four processes in Forage and Cereal sub-activities, identified as B6 Transport seed to processing centre, B10 Process seed, B12 Store seed and B13 Transport seed to the regional storehouse, were grouped as a single process defined in Ecoinvent as "seed, at regional storehouse: The seed produced at the farm is transported to the processing centre, treated [pre-cleaning, cleaning, eventually drying, chemical dressing (for integrated production) and bag filling], stored and afterwards transported to the regional storage centre".

Each unit process and respective subsystem requires inputs such as materials and energy, and information regarding the transportation of the products produced, and has outputs such as the products, co-products, atmospheric emissions, waterborne wastes, and solid waste. For each subsystem and process, the actual activities that take place were described, complemented by inventory data based on materials, energy sources and types of environmental releases. The environmental releases to air, water and soil were quantified by type of pollutant. Formal data quality indicators (DQI) such as accuracy, precision, representativeness and co-products were identified.

All transportation from one process location to another was included. Transportation was quantified in terms of distance and weight transported, and identified by the mode of transportation used. Transportation data was reported in kilometers (km) of distance, converted into units of tonne-kilometre (tkm), which is an expression involving both the weight and the distance of shipment. Transportation of cattle and all related materials within the boundaries of the study (feed components, fertilizers, pesticide, manure, crude, diesel, gasoline, natural gas, harvested crop, garbage, mortalities, bedding, mineral, vitamins etc) occurs by truck, rail, pipeline, and barge (i.e., barge in the case of transportation of certain vitamins, from overseas.

Based on the processes involved in the life cycle of beef production in Alberta, the LCI consisted of the following steps:

- Development of the data collection plan
- Collection of data

Additionally, the emissions from the biological activity of the cattle and soil cropping/management were assessed, based on specific quantification methodologies, developed from IPCC 2006 and adapted to the specific conditions in Alberta (Little et al, Holos, 2008).

Development of the data collection plan

The development of the LCI data collection plan was based on the following:

Identification of data quality goals: Site-specific data for raw materials, energy inputs, water consumption, air emissions, water effluents and waste generation were used where available. Where the level of detail of site-specific data did not support its use, data values from similar processes were utilized.

Identification of data quality indicators:

- Precision: An indication of the precision of the data is useful to know the range of uncertainty in the data, where available (i.e., Is the variability of the data provided?).
- Completeness: For life cycle data sets, it is important to know whether the data is sufficient for reaching the conclusions in accordance with the goal and scope definition (i.e., Is the data relevant and accurate for the LCA being completed?).
- Representativeness: A qualitative assessment of the data should indicate the degree to which the data set reflects the requirement of the data in the LCA (i.e., Does the data adequately represent the geographic area, time period and/or the technology coverage of the LCA?).
- Consistency: A qualitative assessment of the LCA study should indicate whether the methodology used for the activities within the life cycle are treated consistently in the study.
- Reproducibility: A qualitative assessment should indicate that a third party should be able to reproduce the results based on what is provided in the report.

Identification of data sources: A combination of several data sources was used to meet the LCI data requirements, such as: livestock industry data reports, Alberta and Canada government reports, journal publications, proceedings from conferences, reference books, trade association expertise, related and previous beef production life cycle studies, expert opinion, and public and commercially available databases. Assumptions were made when data could not be obtained. See Appendix B for a list of the sources of information used in the study.

Collection of data

Data collection involved a combination of research, direct communication with experts, and access to public and commercially available LCI packages. The Ecoinvent V2 database was used primarily as non-site specific, generic data, qualitatively descriptive of the processes presented in the activity maps. The processes described and quantified in Ecoinvent were used as proxy and adapted to specific conditions for the current project where possible.

All material requirements were initially included, as described in the activity maps. The material requirements were included in the initial stage of data collection, no matter how minor, as it is important to initially define the entire structure of the system for data collection. This way, a comprehensive overview of the system is allowed, pending the definition of reasonable boundaries.

Further refinement of data collection, by exclusion of certain processes, was implemented with explanations of the threshold of exclusion and justification for exclusion according to:

- Within the defined scope of the beef production LCA study, inputs of less than 1 percent or that were otherwise determined by expert opinion to be negligible within the life cycle, were excluded. The one percent rule historically has been useful in limiting the extent of analysis in inventories where the environmental consequences of quantitatively minor materials are not considered (USEPA, 2006). Caution was exercised when applying the one percent rule and only processes/materials that would not generate any significant environmentally impacts were excluded.
- The inputs related to capital equipment construction and replacements were excluded. The exclusion of these inputs within the boundaries of the study was based on the fact that construction activities have life spans greater than ten to twenty years. As the amount of land in Alberta used for beef production has reached its maximum (ARD, 2009a), no significant expansion/construction of cow-calf operations and feedlots is expected to occur in the very near future. All decommissioning phase activities have also been excluded from the analysis for the same reasons.

Energy requirements, combustion values and energy sources were also included in the data collection. Energy was incorporated within the processes defined in the activity maps depending on availability of data:

- The actual energy forms of the inputs, i.e., kilowatt-hours (kWh) of electricity or cubic feet (ft^3) of natural gas.
- The specific quantities of fuels used to generate the energy needed in the assessed processes.

The energy used in fuel combustion is only part of the total energy associated with the use of fuel. The amount of energy expended to acquire the fuel was accounted for, through energy required to extract fuel raw materials (drilling for oil and gas), process raw materials into usable fuels (oil processing into diesel or gasoline, natural gas sweetening) and transportation to the end user. Data on emissions from the production and use of energy reflect the actual production and use of energy in Alberta.

To date, there is no standardized requirement to report carbon dioxide (CO_2) equivalent emissions. While the majority of reports reviewed cover the main contributors to global warming potential (GWP), such as CO_2, carbon monoxide (CO), methane (CH_4), and nitrous oxide (N_2O), other emissions such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) are often omitted. This practice has resulted in a vast number of databases that contain only a limited number of emission factors that can be used for quantification of the related environmental impacts. When site-specific data within the boundaries of the analyzed system are required, the selection of data from the available databases becomes a challenging exercise. While Canadian, Albertan, American or North-American databases may contain the data required to quantify some of the impacts associated with a given process, they often do not provide sufficient data to quantify the other impact categories using LCIA methodologies.

Given this situation, two options were presented for the current LCA study:

First option: to include only the summary data available in more site-specific databases. The advantage of this option is the usage of geographically-specific data; the disadvantage is that a full data set is not available, leading to the exclusion of certain emissions/parameters that could be crucial within the overall quantification of an environmental impact. An example is the comparison between the NREL (National Renewable Energy Laboratory) database (North-American specific) and the Ecoinvent database (European specific). NREL reports a limited number of GHG emissions for a selected process, while Ecoinvent offers a wide range of comprehensive GHG emissions, which support the level of detail required for quantification of the GWP under the IPCC 2007 LCIA methodology. Exclusion of certain emission factors (such as CFCs and HCFCs) based on very low quantified emissions could be misleading, as those emissions may have a significant weight within the GWP category.

Second option: to report all data, whether uniformly available or not, by considering the most comprehensive databases available. This second option was used for the current study. However, it is recognized that an attempt to be comprehensive does not necessarily capture site- or region-specific needs. In an attempt to reconcile the need for reliable and comprehensive data with site-specific requirements, the processes, and consequently the emissions from Ecoinvent, were adjusted to reflect, as best as possible, the geographical and technological specificity of the current study.

The data collection was organized within a spreadsheet tailored to meet the needs of the current study. The activity maps framed the computational structure of the spreadsheet, where the relationships between the individual processes of the beef production system were numerically defined. Each process was interlinked within the spreadsheet in such a way that inadvertent omissions or double counting does not occur.

3.3 LIFE CYCLE IMPACT ASSESSMENT

The LCIA phase of the LCA represents the evaluation of the environmental impacts created by the environmental releases and resource consumption identified during the LCI. The LCIA attempts to establish a linkage between the product/process and corresponding environmental impacts.

The LCIA models used for the current study are suitable for relative comparison of the environmental impacts for different components of the beef production system as they are mid-point assessment methodologies. However, the assessment does not allow for evaluation of absolute risk or actual damage to human health and environment, as in the case of end-point LCIA methodologies. As a general rule, midpoint methods assess environmental effects based on the concentration of substances in the environment, while endpoint methods quantify issues of societal concern, such as such as human life span or incidence of illness, denominated at "damage level". The choice of a mid-point approach was based on several positive factors, such as minimizing assumptions, reflection of a higher level of societal concerns, and enhanced comprehension compared to the end-point models (Barre et al, 2003).

The key steps of the LCIA assessment performed during the current study consist of selection and definition of environmental impact categories, classification, and characterization, as described below:

a) Selection and definition of environmental impact categories - usually, the selection and definition of the significant impact categories is based on the ISO 14044 (2006) standards. A broader list of such impact categories consists of:

- Ecological Impacts
  - Global warming
  - Depletion of stratospheric ozone

  - Acidification
  - Eutrophication
  - Photochemical smog
  - Ecotoxicological impacts (terrestrial and aquatic toxicity)
- Human Health Impacts
  - Toxicological impacts
  - Non-toxicological impacts
  - Impacts in work environment
- Resources Impacts
  - Energy and Material
  - Land
  - Water

In the current study, the initial focus of the LCIA was to identify the significant environmental impacts that occur during the entire life cycle of beef production. To date, no scientific consensus has been reached regarding which impact categories should be considered when assessing the environmental impacts associated with beef production, and often there are limitations with respect to data and equivalence factors that render the exercise of limited value. A review of the available LCA studies of beef production shows that:

- In spite of the methodological differences, the greenhouse gas emission is unanimously selected as a relevant impact category. Several studies focused exclusively on the assessment of GHG gases (Casey and Holden, 2006a,b; Cederberg et al., 2009a,b)
- Several studies focused on global warming, acidification, eutrophication and energy consumption impacts (Ogino et al., 2004, 2007)
- Eutrophication and acidification are two of the impact categories broadly selected and quantified for the LCA studies of meat production (Chassot et al., 2005, Ogino et al., 2007, Ogino et al., 2004)
- One study used a specific LCIA methodology, TEAMTM (Chassot et al, 2005), where a broader selection of environmental impacts categories was assessed: global warming, eutrophication, acidification, photochemical smog, human toxicity, aquatic toxicity, and terrestrial toxicity

Based on previous practice, the contribution of the beef production system in Alberta to the following environmental impacts were examined:

- Global Warming
- Acidification
- Eutrophication
- Non-Renewable Resources Consumption

b) Classification – assigning the LCI results to the selected environmental impact categories.

Table 2 presents the classification of the LCI emissions into relevant environmental impact categories selected for the current study.

The purpose of classification is to organize and combine the LCI results (inputs and outputs as emissions) into the impact categories previously defined (for example, classifying carbon dioxide emissions to global warming potential).

The emissions from the processes described in the activity maps (Figures 1a and 1b) of beef production in Alberta were inventoried and grouped according to the environmental impact categories selected.

The emissions factors were selected and aggregated in accordance with the IPCC 2007 100 year GWP Method and IMPACT 2002+ methods. The emission factors were also grouped into environmental categories and subcategories. Such classification addresses, besides the category of the environmental impact (to air, water, soil), more elaborate concepts given the susceptibility of certain emissions to have a higher impact in environments with different geographic, social and ecological characteristics (high population density, low population density, etc).

c) Characterization – modelling the LCI results within impact categories using science-based conversion factors (for example, modelling the potential impact of carbon dioxide and methane on global warming potential). The characterization provides a direct way to compare the LCI results within each impact category, by translating different inventory inputs into directly comparable impact indicators.

The impact indicators were characterized using the following formula:

$$\sum \textit{(Inventory data x characterization factor) = Impact indicator}$$

In the case of the current study:

- All greenhouse gases grouped into the GWP category were expressed in terms of CO_2 equivalents by multiplying the relevant LCI data results by a CO_2 characterization factor
- Environmental releases grouped into the eutrophication category were expressed in terms of PO_4 equivalents by multiplying the relevant LCI data results by a PO_4 characterization factor
- Environmental releases grouped into the acidification category were expressed in terms of SO_2 equivalents by multiplying the relevant LCI data results by a SO_2 characterization factor
- Environmental usage of resources grouped into the non-renewable resources category were expressed in terms of MJ equivalents by multiplying the relevant LCI data results by a MJ characterization factor

Classification of the LCI results into environmental impact categories and assigning equivalence factors were performed based on the following LCIA methodologies:

- The GWP was quantified on a time horizon of 100 years, in agreement with the guidelines of the United Nations Framework Convention on Climate Change, Kyoto, 1997 (United Nations, 1998). The Global Warming impact category was quantified based on the IPCC Fourth Assessment Report (AR4) (IPCC 2007) indexes.
- Based on previous examples and the generic versatility of its methodology, IMPACT 2002+ was chosen as an LCIA method for the Aquatic Acidification, Aquatic Eutrophication, and Non-renewable Energy Resources Consumption environmental impacts.

It is recognized that Canadian LCA practitioners currently use European or American methodologies when conducting comprehensive impact assessments, despite the fact that these methods may not be specifically constructed for use in Canadian studies. Due to the lack of suitable models currently available, work is being undertaken to develop a Canadian LCIA methodology by adapting existing LCIA models to the Canadian context (Toffoletto et al., 2007). As Canada or Alberta-specific factors are not yet developed, generic GWP IPCC 2007 and IMPACT 2002+ terms were used. However, the LCA model was designed to accommodate any further changes of the emission parameters and equivalence factors, as the opportunity for Canadian specific factors will arise in the future.

Additional steps, such as the ones presented below, were excluded from the current LCA study:

d) Normalization – expressing potential impacts in ways that can be compared among impact categories
e) Grouping – assigning impact categories into sets by sorting or ranking the environmental indicators
f) Weighting – assigning a weight or relative value to different environmental impact categories, based on their perceived importance

ISO 14044 (2006) specifies the first three steps (a, b, and c) as being mandatory for LCIA, while the other ones (d, e, and f) are optional. Given the ISO specifications, the procedural concerns and subjectivity issues especially related to the use of weighting, the current study addressed the first three steps of an LCIA: selection of impact categories, classification, and characterization. The exclusion of normalization, grouping and weighting is meant to increase the reliability of the results of the LCA study.

Emissions associated with the biological activity of the cattle and the soil cropping were included in the LCI data used for the quantification of GWP as follows:

- Cattle Enteric Fermentation Emissions, as methane converted to CO2 equivalents
- Cattle Methane Emissions from Manure, as methane converted to CO2 equivalents
- Direct N2O Emissions From Manure Management, as N2O converted to CO2 equivalents
- Indirect N2O Emissions From Manure Management, as N2O converted to CO2 equivalents
- Direct CO2 Emissions From Managed Soils, as CO2
- Soil Carbon Change in Soil From Land Use, as CO2
- Total N2O Emissions from Cropping and Land Use, as N2O converted to CO2 equivalents

Emissions associated with the total phosphorus emissions generated by surface run-off from cropped land (Nemecek & Kagi, 2007), expressed as PO_4 equivalents, were included in the LCI data used for the quantification of aquatic eutrophication.

The LCIA concluded with the documentation of the results. Once the environmental impacts were calculated, the results were documented with the help of tabular outputs. The presentation of the results supports the LCA as defined in the goal and scope – to quantify the GWP, aquatic acidification, aquatic eutrophication and consumption of non-renewable energy resources as environmental impacts associated with beef production in Alberta.

4.0 PROJECT DEFINITION AND DATA

4.1 PROJECT BOUNDARIES

Boundaries of this study describe the beef production system from feed production to the door of the slaughterhouse, and include the following activities:

- Production of cattle feed (grain, forage, pasture, supplements)
- Feed transport
- Cattle feeding strategy
- Livestock related activities (cattle management, storage of manure, finishing, transport, litter management)
- Biological activity of the animal
- Treatment/disposal of cattle waste

Activity maps were created to illustrate the various processes and activities involved in beef production in Alberta. Two finishing scenarios were identified, namely the calf-fed and yearling-fed systems. The activity maps are presented on Figures 1a and 1b.

Various data points were selected and utilized as appropriate to develop the overall study. During consultation with ARD, the year 2001 was chosen to represent a baseline in this first approximation of the LCA for Alberta beef production, as 2002 was the year that Alberta initiated the Taking Action on Climate Change Strategy. Alberta's developing carbon offset market uses 2001 census data to represent the baseline conditions from which management changes are evaluated. It was decided that, where possible, the baseline date for data input to the model would be 2001 to be consistent with this practice. However, data from other periods was used where data from 2001 was not available. The spreadsheet model has been developed to allow for modification of the baseline and other data, as required. Table 3 presents a general description of the various categories of information and the year from which the data was obtained.

4.2 PROCESSES

As previously indicated, beef production in Alberta is principally divided between two production models, the calf-fed and yearling-fed systems. These two models account for roughly 99 percent of the beef produced in Alberta (ARD, 2009a). Alternative production models such as organic and grass-fed account for only one percent of Alberta beef (ARD, 2009a) and were therefore not included in this study. The calf-fed and yearling-fed calves have been tracked from birth until slaughter, which has been considered as a calf crop. All calculations have been conducted on the basis of one calf crop.

Both the calf-fed and yearling-fed models begin with the cow-calf pair on pasture. For this project, it has been assumed that calving occurs only in the spring. The cow-calf pair remains together on pasture until weaning in the fall. For this project, calves were assumed to be born in May and were assumed to be weaned at six months of age. Note that the timelines below were based on information provided by the ruminant nutritionist consulted for this project.

In the calf-fed model, calves are sold to a backgrounding/finishing feedlot after weaning, usually via an auction mart, where they are transitioned from a forage diet to a grain diet over three months (96 days). At nine months of age, the calves are put on a high grain diet until slaughter at 17 months (i.e., 8 months or 262 days on feed).

The yearling-fed model diverges from the calf-fed model after weaning. After weaning, yearling-fed calves are sold to backgrounding feedlots where they are fed high-forage, low grain diets for five months (144 days). After backgrounding, the calves are put back on pasture for four months (120 days) before entering a finishing feedlot for an additional five months (164 days). It was assumed that yearling-fed calves are slaughtered at 20 months of age.

The life cycle of beef production in Alberta can be separated into three distinct phases: construction, operation and maintenance, and decommissioning. Calf-raising constitutes a sub-activity of the operation and maintenance phase. Figures 1a and 1b present the activities for each phase of the beef production life cycle in Alberta.

4.2.1 CONSTRUCTION PHASE

The construction phase of the life cycle of beef production in Alberta is comprised of activities required to construct yards, buildings and other structures, and roads; this includes fuel, equipment, and machinery related to these activities. Example activities include developing water wells, converting native grasslands to pasture or crop, and constructing feedlots, barns, and offices. The activities included in this phase typically have life spans greater than ten to twenty years.

4.2.2 OPERATION AND MAINTENANCE PHASE

The operation and maintenance phase of the life cycle of beef production in Alberta is comprised of activities required on regular or semi-regular basis for the production of beef prior to slaughter. The operation and maintenance phase includes the following activities:

- Forage and Cereal Production: activities required to grow, harvest, and process forage and cereal crops used for cattle feed and bedding.
- Energy Generation: activities required to power buildings and equipment.
- Infrastructure Operation and Maintenance: activities required to operate and maintain buildings, lanes/roads, feedlots, and paddocks and pastures.
- Feedlot and Pasture Activities: activities required for animal care including manure management, providing feed and water, medical care, producing and feeding supplements and antibiotics, and mortality management.
- Livestock: activities required for animal management including transport to and from winter/summer pasture, auction, breeding and calving, backgrounding, and finishing feedlot. The livestock sub-activities also include those activities conducted by the dairy industry directly related to beef production.

The livestock activity is further subdivided into the following sub-activities:

- Cow: activities related to breeding, maintaining, and culling cows.
- Bull: activities related to breeding, maintaining, and culling bulls.
- Calf: activities related to the calf-fed and yearling-fed production models of raising calves.
- Dairy: activities limited to culling dairy cows and bulls, production of steers, and the transportation of dairy animals to various segments of the beef industry. Once dairy animals enter the beef industry, they are treated as the equivalent class of beef animals.

4.2.3 DECOMMISSIONING PHASE

The decommissioning phase of the life cycle of beef production in Alberta is comprised of activities required at the end of a feedlot, building, or pasture's useful life. These activities include demolition, waste disposal (recycle, reuse, landfill, incineration), and site rehabilitation.

4.2.4 PROCESSES NOT INCLUDED IN ANALYSIS

Several activities were determined to be insignificant for full consideration in the model. The activities in Figures 1a and 1b that have not been included in the analysis and the justification for the exclusion are as follows:

Construction Phase Activities

All construction activities have been excluded from the analysis. As mentioned in Section 4.2.1, the construction activities included typically have life spans greater than ten to twenty years. As the amount of land in Alberta used for beef production has reached its maximum (ARD, 2009a) for this point in the cycle, it is not expected that a major expansion of the beef production industry in Alberta will occur, and therefore no significant construction of cow-calf operations and feedlots will occur in the near future. The model is set up to account for these activities; however, the emissions from these activities are expected to be minimal to the overall system.

Operation and Maintenance Activities

Several activities have not been included in the analysis due to lack of adequate data to quantify the amount of materials used on beef farms in Alberta, and due to the expectation that the emissions associated with these activities will be minimal compared to the energy requirements, including the following:

- Operation and Maintenance:
  - Produce materials for replacement components, manufacture and transport replacement components (R1, R4, R7).
  - Transport used steel, wood, concrete for recycling or further end use, recycle steel and wood (R5a, R5b, R5c, R8a, R8b).
  - Extract and transport gravel materials (R3, R6).
- Forage and Cereal Sub-Activities: The activity to Store Seed in the Regional Storehouse (B14) has not been included in the analysis because adequate data quantifying emissions for this activity are not available.
- Cereal Activities: The activity to Treat Harvested Crop (grain) (CC10) was not included in the analysis given the lack of accurate and reliable data regarding energy and resources consumption related to grain storage conditions in Alberta. While this process is expected to have a minimal contribution to the assessed environmental

impacts, a placeholder has been inserted to mark the data gap; further quantification may be performed depending on future availability of data.

- Feedlot and Pasture Activities:
  - Activities FL20 and FL32 for the production and transport of protein supplement were not included in the analysis. Activity FL32, transportation of the protein supplement, was replaced with transportation of the mill-run carrier as feed additive, activity FL 37.
  - Activities FL21 and FL22 for the production of vitamins and growth promotants were not included as reliable emissions data for production of vitamins and growth promotants were not available.
  - Activities FL23 and FL35 for the production and transport of vaccination/antibiotics were not included in the analysis. The total amount of vaccinations/antibiotics administered and data quantifying the associated emissions was not available.
  - Millrun is considered a waste product from wheat processing facilities and therefore the emissions should be attributed to the processing activity. DDG and other feed additives were not included in the diet representative of 2001 practices as obtained from the nutritionist.

Decommissioning Phase Activities

All decommissioning phase activities have been excluded from the analysis. Similarly to the construction phase, the life span of cow-calf operations and feedlots is typically greater than ten to twenty years. Beef production in Alberta is not significantly declining, and therefore, it is not expected that cow-calf operations and feedlots will be decommissioned to any significant degree.

The model has been created in a manner that can incorporate excluded activities in the event that future revisions to the model are desired or additional data of reliable quality becomes available.

4.3 FUNCTIONAL UNIT

In an LCA of beef production, the most common one-dimensional functional unit is based on mass, typically one kilogram (kg). Mass is a simple measurement of the quantity of the product and is often used to quantify the price of the product.

When defining the functional unit based on mass, it is critical to define when the mass is measured. Typically, there are three distinct points of measurement: live weight (LW), shrunk weight (SW), and warm carcass weight (WCW). The live weight is the weight of the animal on farm, before transportation to the slaughterhouse. The shrunk weight is the weight of the live animal when it arrives at the slaughterhouse. The warm carcass weight is the weight of the muscle and bones immediately after the animal has been slaughtered and dressed.

The reduction of live weight to shrunk weight varies with conditions to which the animals are exposed during transport to the slaughterhouse. Typically, shrunk weights are 96% of live weight (Lardy, 1999).

During the slaughter processing phase, the dressing percentage of a beef animal ranges from as low as 40 percent for cows and bulls to as high as 60 percent for steers and heifers, varying with factors such as breed, age, gender, frame size, diet prior to slaughter, and travel time to slaughter (McKiernan et al., 2007; Alberta Feeder Associations Ltd., 2009).

For the purposes of this LCA, the functional unit has been defined as one kg live shrunk weight. This allows for the estimation of environmental impacts up to the slaughterhouse door, which has been defined as the project boundary. The results have been presented for the entire calf crop (i.e., both calf-fed and yearling-fed systems) combined as well as reported separately for the calf-fed and yearling fed production models.

4.4 DATA QUALITY ASSESSMENT METHODOLOGY

The data used in the model and data checks are contained within the Beef Data and Emission Factor Data tabs of the model spreadsheet. A data check was conducted to verify the quality and the relevancy of the data to the project. A selection of the most applicable data was conducted where more than one data source was available based on the results of the data check.

The procedure used to conduct the data check was adapted from Pembina's methodology for data selection, which is based on guidance obtained from ISO 14040 Environmental Management – Life Cycle Assessment – Principles and Framework, and ISO 14044 Environmental Management – Life Cycle Assessment – Requirements and Guidelines. One of the more important principles is to understand the technology and the regional contexts. This main principle was supplemented with a detailed review of each data set to consider the vintage, geography, precision, completeness, representativeness, consistency, reproducibility, source and uncertainty of the data set.

The beef data and emission factor data used in the model have been provided in Appendices B and C of this report, respectively, for reference. Note that the ration data used during this study was provided by a ruminant nutritionist, and therefore, has been included in a separate appendix (Appendix D). This information has not been duplicated in Appendix B (beef production data).

4.5 BEEF PRODUCTION DATA SOURCES

The beef production data is summarized in the Beef Data tab of the model spreadsheet along with the specific sources for each item, and has been provided in Appendix B for reference. In general, the sources of data include industry experts (producers, auction mart managers, Livestock Identification Services), government agencies (Alberta Agriculture and Rural Development, Statistics Canada), industry organizations and associations (CanFax [a division of the Canadian Cattlemen's Association], Alberta Plastics Recycling Association), and independent research groups (universities, consultants). In addition, because of the complex nature of animal diet in the beef industry in Alberta, a ruminant nutritionist was retained to provide representative, balanced rations.

4.5.1 RATION DATA

Well-balanced rations are a crucial component of any livestock operation. Ration quality influences factors such as fertility in breeding animals, as well as growth rate, finishing age, and carcass quality in slaughter animals. Consequently, rations play a similarly important role in an LCA of beef production. In an LCA, rations influence upstream emissions related to feed production, in that they dictate the crops grown. Of particular importance is the influence of rations on downstream emissions, especially from the biological activity of the animals.

Given the amount of variation in production systems and feeds, a single ration cannot be representative of the entire beef life cycle. Consequently, CRA retained an expert ruminant nutritionist (Mr. Dwight Karren of Feedlot Nutrition) familiar with the Alberta beef production systems to develop rations representative of each stage of an animal's life in the Alberta beef production system, averaged both regionally and temporally.

The information obtained from Mr. Dwight Karren is provided in Appendix D. These rations are not intended for use.

The beef production system is complex. Cattle typically produce one calf per year. However, the consumer market demands that beef be readily available every day of the year. Consequently, a flexible production system is required. Cows can be bred to calve at any time of the year; however the spring and fall are the most common periods. For this project, spring calving has been assumed.

Time from calving to market is dictated largely by growth rate, mature weight, and grade. These factors in turn vary by breed, climatic conditions, and diet.

Ranchers in Northern Alberta tend to have relatively small land bases (which limit their space for homegrown crop production and manure management) and raise larger heavy milking breeds of beef cattle. Their breeding cycle and climatic conditions typically require that cows calve while on winter feeds.

In contrast, ranchers in Southern Alberta tend to have larger land bases (providing more room for homegrown crop production and manure management) and raise smaller British breeds. Their breeding cycle and climatic conditions typically result in cows calving while on new spring grass.

In Alberta, most cattle are finished in large feedlots that feed year-round. Traditionally, feedlots select rations based upon purchased barley grain, homegrown barley silage, and purchased supplements.

The rations provided by the nutritionist as representative of the average for Alberta are for a cow herd on pasture (or winter feed equivalent) for 365 days a year, as well as the various stages of the calf-fed and yearling-fed production models. In feedlot, the rations consist of barley grain, barley silage, and alfalfa hay, and make provisions for minerals while on pasture and supplements while in the feedlot. It is acknowledged that there are a variety of diet practices amongst producers and that the average rations will not necessarily mirror all operations. However, for the purposes of this project, an average, reasonable representative diet was required. The diet and approximate consumption is not intended nor recommended to be implemented but rather has been formulated specifically for the purposes of this study.

4.6 EMISSION FACTOR DATA SOURCES

The emission factor data incorporated in the model has been summarized in the Emission Factor Data tab of the model along with the specific sources for each item, and has been provided in Appendix C for reference. In general, each process presented in the Activity Map was described in terms of environmental emissions to air, water, and soil.

The Ecoinvent V2 database contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services. The data in Ecoinvent V2 covers the vast majority of processes included in the Activity Maps for the current project. Ecoinvent V2 offers one of the highest levels of detail in terms of emission factors for the assessed processes. The significant level of detail of emissions from the processes described in Ecoinvent V2 allows the selection of appropriate emissions for further quantification of environmental impacts, as described in Section 3.2.

Given the considerations above, Ecoinvent V2 was chosen as the primary data source for quantification of the emission factors of the processes involved in the LCA. However, certain processes described in Ecoinvent V2 are characteristic for different geographic regions, not necessarily representative of Alberta conditions. Where appropriate, processes from Ecoinvent V2 were adapted to Canadian and Alberta specific conditions, as follows (refer to Table 12 for more information):

- Emission factors from Canadian and Alberta specific databases were used to replace the corresponding factors in the original processes from Ecoinvent.
- The agricultural practices described in Ecoinvent were adjusted to be more representative for Alberta practices. The emissions from the agricultural processes described in the activity map were quantified based on the emissions generated by similar processes described and quantified in the Ecoinvent V2 database. However, while the result of the agricultural process is the same for both systems, Canadian and, in the case of Ecoinvent, either generic or European, the technology behind the process may differ. The technical notes documenting the agricultural processes in Ecoinvent and the calculation methodology for the corresponding environmental emissions (Agriculture 15, Ecoinvent V2, Nemecek and Kagi, 2007) were used to adjust the emissions, to better reflect the conditions for Alberta. The adjustment of emissions was based on the fuel consumption for the same agricultural process for Alberta and, respectively, Ecoinvent-specific conditions. Details of the calculations can be found in the Cereal Activities and Forage Activities tabs of the model.

- The energy consumption activities (such as production of crude, transportation of crude, refining of crude into diesel/gasoline etc) were quantified by using proxy of similar processes from Ecoinvent. In an attempt to preserve the detail of data offered by Ecoinvent while reflecting characteristics of the energy consumption system in Alberta, Canada, and North-America, the emission factors were adapted to the project-specific boundaries. Details of the calculations performed can be found in the Emission Factor Data tab of the model, for each of the processes involved in the energy consumption.
- Where included in a process module, transportation distances were analyzed and adapted for the specifics of the model.

4.7 DESCRIPTION OF MODELLING PROCESS

Please refer to Appendix E for a discussion of the model, which includes a description of the modelling process and an overview of the calculations performed in the model.

5.0 INVENTORY DATA AND RESULTS

5.1 ANIMAL PRODUCTION

5.1.1 INVENTORY DATA

Table 4 provides a detailed breakdown of the cattle population numbers included in the boundaries of the beef production in Alberta (cows, bulls, calf-fed calves, and yearling-fed calves). Refer to Appendix E for a description of the methodology used to calculate these values.

Table 5 provides a summary of the slaughtered cattle included in the study. These results allow for the calculation of the total emissions in units of kg carbon dioxide equivalents (CO_2e) per kg of shrunk weight (functional unit). The total slaughtered weight has also been divided for both the calf-fed and yearling-fed systems in order to differentiate the total emissions from each system. The 45 percent calf-fed and 55 percent yearling-fed ratio as provided by ARD (mentioned previously) was used to divide the weights for all animals. It is understood that yearling-fed cattle tend to be slightly heavier than calf-fed cattle from the feedlot. However, the final weight at feedlot was provided for both systems (calf-fed and yearling-fed) with the ration data, and therefore, these weights were used as they are more suited for the rations. A breakdown between heifers and steers was also assumed based on the Statistics Canada May 15, 2001 census data.

5.1.2 ASSUMPTIONS

As outlined in Appendix E, the May 15, 2001 census data from Statistics Canada (Statistics Canada, 2001) were used as starting values for each animal type in Alberta's beef industry, and the number of slaughtered cattle from Alberta Agriculture Statistics Yearbook (Alberta Agriculture Statistics Yearbook, 2008) was used with other references to track the number of cattle throughout the time period considered in this study. The ratio of calf-fed calves to yearling-fed calves in Alberta is 45 percent and 55 percent, respectively (ARD, 2009a). The calves have been allocated into each system according to this assumption.

The life of the cows, bulls, and replacement animals were considered for all of 2001, and the life of the calves (both calf-fed and yearling-fed calves) were considered from birth in 2001 to arrival at the door of the slaughterhouse in 2002. The emissions associated with exported animals were included in the calculations up to the time of export, and none of the emissions associated with imported animals prior to the time of import were included in the calculations.

Replacement heifers were considered cows for this analysis. It was assumed that there were no cow imports.

The number of replacement bulls was not known for May 2001, therefore the difference in the Statistics Canada May 15, 2001 census data for bulls and the Statistics Canada number for bulls in January 2001 (Statistics Canada, 2002) was assumed to be the number of replacement bulls. Replacement bulls were considered as breeding bulls for this analysis. It was assumed that there were no bull imports.

It was assumed that calves were born by May 1, 2001. The number of bulls and calves from Statistics Canada May 15, 2001 census data was reduced to account for the number of animals in the dairy system based on the percentage of each animal type compared to the total number of each animal type within Alberta. Beef cow and replacement heifer numbers were recorded as total numbers in beef operations in Alberta and did not require adjustment.

The number of cows, bulls, replacement heifers and bulls, and calves were tracked to quantify the feed consumption (and therefore crop production), enteric fermentation emissions, and manure generation of each animal type for the period of the study.

Assumptions were made to account for the import and export times, including the following:

- Cows and bulls were exported before feedlot and before slaughter
- Cows and bulls from the dairy industry in Alberta entered the beef system at the feedlot
- Cow and bull culls entered the beef system at the gate of the slaughterhouse
- Calves were imported and exported before feedlot and before slaughter
- Calves from the dairy industry in Alberta entered the beef system at backgrounding/feedlot

The transportation of imported cattle is included in the study. However, all activities prior to transportation to Alberta are excluded. Activities associated with cattle that are exported are included until they are delivered to their destination. The transportation of mortalities to rendering plants is also considered in the study. All transportation calculations are based on a weight and distance basis, such that the total weight of the animals transported and the assumed transportation distance is used to calculate the emissions from transportation.

Cattle emit both CO_2 and CH_4 into the atmosphere. CO_2 from livestock respiration is not included in this study as CO_2 from respiration is considered to be biogenic. The CO_2 consumed by plants during photosynthesis is returned to the atmosphere as CO_2 during plant and herbivore respiration (IPCC, 2006). This CO_2 is part of a closed loop system, and there is no net emission of CO_2 to the atmosphere. Unlike CO_2, methane is not immediately available for plant consumption, and is persistent for several years in the atmosphere. Methane emissions have therefore been included in the study.

Emissions from enteric fermentation were estimated using a modified IPCC 2006 Tier 2 approach. For animals older than six months of age (i.e., after weaning), dry matter intake (DMI) was taken from the rations developed by Mr. Dwight Karren. These values were used, in conjunction with IPCC 2006 values for gross energy and methane loss, in the IPCC 2006 Tier 2 equations to estimate methane emissions.

IPCC 2006 does not include a methodology for estimating emissions from enteric fermentation for nursing calves (i.e., animals under six months). Based upon consultation with industry experts, notably Dr. John Basarab, it was decided that the exclusion of these emissions might represent a significant omission. Based on animal physiology, it was decided that emissions from nursing calves age 0 to 3 months could be excluded. For nursing calves 3 to 6 months old, estimated values of DMI and methane loss (personal communication with Dr. Basarab) were used in the IPCC Tier 2 equations to estimate methane emissions.

*Description of Calculation for "Cattle * Days"*

Animals were tracked through the system as cattle * days to accurately calculate the total amount of feed required, the total amount of manure generated, the total enteric fermentation emissions, and other totals as relevant. It was not possible to account for one total number of each type of animal through the study as this would not accurately account for mortalities, imports, exports, and animals from the dairy industry. Therefore, the number of cattle per stage (i.e., winter feeding, pasture, backgrounding, feedlot, auction, transportation) was calculated for each type of animal. A total number of days was set for each stage (typically based on rations). The total number of cattle * days were calculated by summing up the cattle * days per stage. The cattle * days per stage were calculated by multiplying the number of animals in each stage by the total number of days spent in each stage. Table 6 provides an example of calculations for the cattle * days for cows.

5.1.3 EMISSIONS

Tables 7 and 8 summarize the emissions from enteric fermentation calculated for the study, based on cattle type and diet, and are divided into total enteric fermentation emissions for the calf-fed and yearling-fed systems. Appendix F presents the calculation table used in the spreadsheet model, to provide more information regarding the values used to calculate enteric fermentation emissions. Refer to Section 6.0 for further analysis of the cattle enteric fermentation emissions.

5.2 FEED

The cattle feed inventory data is related to a chain of processes that include the production of cereal, silage, forage, and supplemental ingredients as required in the cattle diet. The feed requirements were calculated from the information provided by the ruminant nutritionist (refer to Section 4.5.1) based on the rations representative of each stage of an animal's life in the Alberta beef production system.

The following subsystems were considered in the production of cattle feed, as outlined in Figure 1a:

- Forage and Cereal Sub-Activities
- Cereal Activities
- Forage Activities
- Feedlot and Pasture Activities (partially – other activities in Figure 1b)

5.2.1 INVENTORY DATA

The inventory data inputs for the cattle feed production were based on the total feed by type (barley, barley silage, alfalfa, supplements), as outlined in the cattle diets.

The overall feed requirements for the entire beef production system in Alberta, presented in Table 9 as amounts of basic ingredients and supplements, were used to calculate the outputs for the Forage and Cereal Sub-Activities, as follows:

- Area of land required for cultivation of cereal and forage
- Quantity of seed
- Area of land required for seed production
- Amount of synthetic fertilizer applied to crops
- Amount of pesticides applied to crops
- Amount of manure used as fertilizer

The presented area required for feed production is not indicative of the actual land area used for crop production in Alberta. The calculated area required for feed production is instead based on the total feed requirements of the calf-crop (i.e., over a period of 15 to 20 months) and the average yields of barley, barley silage, and alfalfa in Alberta. This approach was taken to facilitate the quantification of related emissions over the entire study period.

The production of cereal and silage was quantified by data related to agricultural practices for Cereal Activities and Forage Activities (refer to Figure 1a), as follows:

- Cultivation of soil
- Application of fertilizers
- Irrigation (where applicable)
- Application of mechanical and chemical treatment
- Harvesting

The Feedlot and Pasture Activities quantified by data related to the feed requirements are as follows:

- Final production of feed, including treatment and mixing of cereal grains
- Production of diet supplements

5.2.2 <u>ASSUMPTIONS</u>

The feed production consists of a variety of processes, including the production of seeds, cereal grains and forage needs (as per diet requirements) and the feed mixing activity.

Fertilizers

The manufacturing and transport of synthetic fertilizers used for feed production takes into account the equipment and infrastructure related to the production of nitrogen (N), monoammonium phosphate (P_2O_5), potassium oxide (K_2O), and ammonium sulphate (S) synthetic fertilizers. The production data for synthetic fertilizers was imported from the Ecoinvent V2 database. The generation of organic fertilizers (manure) was not included in the Forage and Cereal Sub-Activities; however, the impact of organic fertilizer (i.e., manure) production was included in subsequent life cycle steps in the beef production system (See Figure 1a).

The fertilizer quantities were calculated based on expert evaluation of Alberta fertilizer guidelines. Table 10 presents the fertilizer consumption on a nutrient basis assuming no manure is applied for the grain and forage components of the diet.

Manure was assumed to be utilized as fertilizer, and therefore, the amount of synthetic fertilizers needed to meet crop requirements was accordingly reduced. The required amounts of synthetic fertilizer were calculated based on the contribution of N, P_2O_5, K_2O, and S from manure. Synthetic fertilizers fulfill the remaining grain production requirements as follows: 70 percent for N, 52 percent for P_2O_5, 0 percent for K_2O and 39 percent for S.

It is acknowledged that there are a variety of fertilizer practices amongst producers and that the approach provided here to calculate fertilizer requirements from manure and synthetic fertilizers will not necessarily mirror all operations. The fertilizer application rates presented in the model and in this report are neither intended nor recommended to be implemented but rather are intended only for the purposes of this study.

Based on retail sales statistics (Canadian Fertilizer Institute, 2006), 78 percent of the nitrogen contribution comes from urea usage, while 22 percent comes from anhydrous ammonia. The nitrogen content in the compound fertilizers as monoammonium phosphate and ammonium sulphate displace only the use of anhydrous ammonia.

To provide a comparison between fertilizers, the manufacturing processes as analyzed in Ecoinvent allocate environmental impacts based on the mass and energy of the nutrients. In most of the cases, the compound fertilizer nutrients are held with the same molecule (for the current case, the P_2O_5 fertilizer molecule). Based on this allocation, all allocated molecules belonging to a specific fertilizer must be used together to account adequately for all the individual components and the modelled nutrient rations correspond to the actual nutrient ratios of fertilizers. Consequently, the fertilizer requirements presented in Table 11 do not represent the actual quantities of synthetic fertilizers used in the field, but rather the values used by Ecoinvent to quantify the production of required fertilizers.

Grain and Forage Production

The CO_2 and N_2O emissions from grain and forage production were estimated using HOLOS (Little et al, 2008), a whole-farm modelling software program that estimates GHG emissions based on information entered for individual farms. The following emissions were calculated:

- Cropping – direct soil N2O emissions
- Cropping – indirect soil N2O emissions due to leaching or runoff and volatilization
- Carbon storage and emissions from soil/land use management
- Soil organic carbon change in pasture

The calculation algorithms used in the HOLOS model are generally based on the Intergovernmental Panel on Climate Change (IPCC, 2006) and the Environment Canada National Inventory Report 1990-2007, Tier 2 (Environment Canada, 2009) methods. The modelling parameters and emissions selected for the calculations were modified for Canadian conditions, with focus on the Prairie region (Rochette et al. 2008).

Cropping/Land Use – Direct and Indirect Soil N_2O Emissions

Nitrous oxide is directly emitted from Canadian farms through the processes of nitrification and denitrification. As the amount of nitrogen added is increased to support higher yields, so do losses as N_2O emissions to the atmosphere increase (Bouwman and Boumans, 2002a,b).

Direct soil N_2O emissions from cropping and land use were calculated as follows:

- Emissions due to nitrogen inputs from:
  - Application of fertilizer
  - Crop residues (above and below ground)
  - Mineralization
  - Application of manure on land

- Emissions due to tillage
- Emissions due to soil texture
- Emissions due to irrigation
- Emissions due to landscape/topography
- Emissions due to fallow

The calculation of nitrogen inputs of the farm such as nitrogen fertilizer, above and below ground crop residue decomposition, nitrogen mineralization, and nitrogen from land applied manure were based on HOLOS algorithms. The emission estimates accounted for the crop rotation information, fertilizer and herbicide inputs, crop yields and irrigation usage. Default values related to location and soil type were used for fertilizer inputs and crop yields. The tillage system (intensive, reduced or no-till) was selected to reflect the tillage practices of the entire cropped area in Alberta.

Indirect sources of N_2O from soils come from redeposition of nitrogen from agricultural soils to surrounding soil or water. When synthetic fertilizer or manure is applied to agricultural soils, some of the nitrogen is transported off-site through volatilization, redeposition or leaching, erosion, and runoff. This nitrogen can then go through subsequent nitrification and denitrification after loss from the farm, producing N_2O; this is referred to as indirect emissions.

Indirect soil N_2O emissions from cropping and land use were calculated as follows:

- Emissions due to leaching and run-off
- Emissions due to volatilization

<u>Soil/Land Use Management - Soil Carbon Storage and Emissions</u>

In Canadian soils, large amounts of carbon are stored in organic matter. Some of this organic matter carbon is lost when tillage accelerates decomposition and the removal of harvests, resulting in less carbon returning to the soil. The amount of CO_2 produced by a farm varies according to management practices. The amount of carbon potentially stored also varies across Canadian farms due to regional conditions and past farm management practices.

Soil carbon storage and emissions were calculated based on the methodology developed for the National Inventory Report, the Canadian Agriculture Monitoring Accounting and Reporting System, CanAG-MARS, 2007 (previously titled National Soil Carbon and

Greenhouse Gas Accounting and Verification System) to estimate CO_2 emissions or removal from soil carbon change. The calculation of carbon gains and losses were based on changes in management practices (tillage, fallow, perennial crops, permanent cover or grassland), the area affected by the change in management, and the time since the change. The various carbon factors associated with each situation were taken from the CENTURY model (McConkey et al., 2003).

The soil carbon change in soil from land use was calculated as carbon change in mineral soils due to changes in tillage practices and the time since the management change. For the purposes of this project, a time period of two years was assumed.

As more accurate data becomes available, the model allows further refinement of calculations of carbon change in mineral soils due to:

- Fallow area
- Perennial/annual crop areas
- Grassland

CO_2 fossil emissions from urea usage were calculated according to the 2006 IPCC guidelines, where 100 percent of carbon atoms from urea are emitted as CO_2.

The following Alberta-specific information was used in the calculations (Alberta Online Encyclopedia, N.D.):

- 25 percent of the lands included in the current study are Black and Grey soil zones
- 75 percent of the lands included in the current study are Brown and Dark Brown soil zones
- The topographic flatness factor Ftopo was estimated at 11 percent for both zones
- Three different cropping methods are used for the entire harvesting surfaces: 27 percent no-till, 36 percent reduced-till and 37 percent full-till (2001 data)

The emissions from the processes related to production of grain and forage presented on Figures 1a and 1b were quantified based on processes from the Ecoinvent V2 database, and adjusted to reflect Alberta-specific characteristics, based on fuel consumption per hectare. The Ecoinvent processes used are shown in Table 12.

The data related to the feed production includes the production of feed mixes and supplements. The processing and mixing of cereal grains inventory was based on specific feed mill data. Accordingly, activities FL11 Process (roll) grain and FL16 Mix Feed were quantified with specific feed mill energy consumption data. The emissions for the remaining components of the diet were inventoried based on data availability. Where such data has not been available, placeholders were marked as data gaps.

The Ecoinvent processes used to define the production of supplements are shown in Table 13.

Table 14 provides a breakdown of the energy requirements for farm machinery in Alberta. This information, as provided by ARD (ARD, 2009b), was used to adjust the Ecoinvent processes to better reflect Alberta-specific conditions.

Soil Organic Carbon Change in Pasture

Recently, much emphasis has been placed on the potential for agricultural practices to increase the carbon sequestering potential of agricultural lands as a means of reducing the effects of carbon dioxide levels on climate change. In particular, changing cropping and pasture management practices may alter the degree to which plants uptake and store carbon dioxide in their tissues (Skinner, 2008; AAFC, 2005; Soil Conservation Council of Canada, 2001; Moulin et al, N.D.).

Carbon is constantly in a state of flux, sometimes being sequestered and sometimes being released. Natural systems have a tendency to approach a state of equilibrium, so that the net carbon flux is zero – where as much carbon is being stored as is being released. A stand of pristine native prairie is a suitable example. Although point readings may give the impression of a carbon debit or credit, over the course of a year, or at worst several years, there likely is no net change in carbon (AAFC, 2005).

The pasture carbon balance is a function of several processes: photosynthetic uptake (plants), ecosystem respiration (plants, microorganisms, herbivores), and net biome productivity (losses from fire, export of harvested biomass, inputs from manure) (Skinner, 2008; Soil Conservation Council of Canada, 2001). In turn, these processes are dependant upon climate (number of sun-hours, precipitation, temperature), species present, and many other variables. Determining a carbon sequestration coefficient for a pasture is a relatively complex exercise.

A review of existing literature indicates that the science of carbon sequestration by pasture systems is still fairly new and highly controversial. Studies have shown that net carbon flux ranges from positive to negative, i.e., pastures may act as a net sink of carbon or they may act as a net source of carbon emissions depending upon the state of variables discussed above (Skinner, 2008; AAFC, 2005; Soil Conservation Council of Canada, 2001; Moulin et al, N.D.).

For the purposes of this first-approximation LCA of the beef industry in Alberta, only approximate estimates of the carbon sequestration of grazed pasture have been made. The rate of soil organic carbon (SOC) sequestration has been estimated based upon expert opinion (ARD, 2010).

SOC sequestration was estimated based upon the total area of pasture in Alberta multiplied by the estimation of SOC sequestration on pasture from ARD (expressed as T ha^{-1} yr^{-1}). It was assumed that only one year of sequestration applied to the current calf-crop, in that the pastures, as with the breeding animals on them, would be allocated to the following calf-crop after the first year.

The completed calculations make no allowance for the original pool of stored carbon in the soils, soil type, or climate. The equations allow for differences in biomes in that sequestration rates for both managed and native pasture have been estimated. However, the calculations have only made use of a single average sequestration rate and the total pasture land area of Alberta used for beef production. Due to the highly approximate nature of this estimation, it has been included only for discussion purposes and the amount of carbon dioxide sequestered by pastures has not been included in the total footprint reported by this LCA study of beef production in Alberta. Due to the potential for SOC by pasture lands to mitigate the environmental impacts of beef production in Alberta, it is strongly recommended that future iterations of the model include a more detailed and complete assessment of carbon sequestration, along with a specific assessment of the appropriateness of including this factor as it relates to the carbon cycle. Based on the availability of an appropriate calculation methodology in the future, the total pasture carbon balance may be included in future iterations of the model.

Transportation

The transportation distances for seeds, fertilizers, pesticides and feed ingredients were based on specific data for Alberta agricultural and livestock practices, and on reasonable assumptions where data gaps were encountered.

5.2.3 EMISSIONS

The emissions from the processes described in the activity map and the processes related to manure, soil and cropping management were inventoried and grouped according to the environmental impact categories selected for further LCIA, as presented in Section 3.2.

Cropping/Land Use – direct and indirect soil N_2O emissions are summarized in Table 15. Details of the calculations are provided in the Summary soil N_2O Crop, Land Use tab of the model.

The total soil carbon change in soil from land use emissions for the entire calf crop is -236,033,981 kg CO_2 (2 year period). Details of the calculations are presented in the C Change in Soil From Land Use tab of the model. The model accounts for the soil carbon change from land use emissions for two years (one calf-crop), but uses annualized data calculated from a five-year average based on tillage information for 2001 and 2006, as these years are the only ones for which reliable data was available. To account for the full time period considered in this study, the annualized value was multiplied by two. These calculations may be refined in future iterations of the model as additional data becomes available.

The direct CO_2 emissions from managed soils for the entire calf crop, where N synthetic fertilizers are used, are 134,473,208 kg CO_2 for barley, 54,510,680 kg CO_2 for barley silage, and 0 kg CO_2 for alfalfa grass. Details of the calculations are presented in the CO_2 Direct Soils tab of the model.

Refer to Section 6.0 for further analysis of emissions from feed activities.

5.3 MANURE

Animal production inventory data from Section 5.1.1 were used to calculate the total amount of manure generated in the study. The estimated amount of generated manure was used to calculate the CH_4 and both direct and indirect N_2O emissions from manure management, as presented in the following subsections.

5.3.1 INVENTORY DATA

Tables 16 and 17 provide the manure generation rates, the total manure generated, and the breakdown of manure generated for the calf-fed and yearling-fed systems.

5.3.2 ASSUMPTIONS

The energy required to collect manure on the farms is included in the total energy used on beef farms in Alberta (refer to Section 5.4).

Both N_2O and CH_4 are emitted as a result of manure management. Depending on the manure storage system, the manure characteristics (animal source, solid versus liquid) and the quantity of manure, the amount and type of GHG produced are different. Manure begins to decompose shortly after it is excreted. Under anaerobic conditions, CH_4 is predominately produced (along with CO_2, which is considered to be biogenic in this context), while aerobic conditions will produce N_2O. Consequently, the covered manure storage facilities are exposed to little oxygen and will primarily produce CH_4 and little N_2O, while open-air manure storage facilities will produce more N_2O and little CH_4 (Environment Canada, 2009).

Emissions are calculated for each cattle category (calves before weaning, cows/bulls, backgrounding - calf-fed, calf-fed heifer, calf-fed steer, backgrounding - yearling-fed, pasture – yearling-fed, yearling-fed heifer, yearling-fed steer) and corresponding diet. Note that the digestible energy percentage of the rations for calves before weaning (3 to 6 months) was assumed to be the same as the pasture, as no other information was available. The calculations followed the IPCC 2006 methodology adapted within HOLOS. The energy in feed, dry matter intake and average daily gain are determined in the model. The HOLOS algorithms used for estimation of cattle manure emissions depend on the cattle cycle as selected by the choice of beef cow scenario.

Manure CH_4 emissions were estimated based on volatile solids production and the manure management system. For cow-calf livestock (excluding backgrounders), all manure is assumed to be deposited on pasture.

Manure direct and indirect N_2O emissions were estimated based on:

- Protein intake, as a function of dry matter intake and the protein content of the feed
- Nitrogen excretion rates, depending on protein intake and retention

The nitrogen excretion rates, along with the manure handling system, are used to estimate manure N_2O emissions, both direct and indirect. Manure from backgrounder manure handling systems is eventually land-applied. These emissions are calculated in the soil N_2O component.

5.3.3 EMISSIONS

Table 18 presents the results of CH_4 emissions calculations from manure, by different classes of cattle within the beef cow production system.

Table 19 presents the summary results of manure N_2O direct and indirect emissions calculations, by different classes of cattle within the beef cow production system. Tables 19a and 19b present, respectively, the detailed calculations of manure N_2O direct and indirect emissions.

5.4 ENERGY

Energy requirements on beef farms include the operation of farm machinery, heat and light use, and other miscellaneous uses including the operation of pumps to provide water to the cattle. The subsystem Energy Consumption activities were considered in the production of energy for beef farms (Figure 1a).

5.4.1 INVENTORY DATA

Table 20 provides a breakdown of the energy used on all beef farms in Alberta.

Propane was excluded from the analysis, as the percent of energy derived from propane is less than 1 percent of the total energy used, and therefore negligible.

5.4.2 ASSUMPTIONS

The reference for energy used on beef farms in Alberta included categories such as trucks and auto, farm machinery, heat and light, other uses, and non-farm, with minimal description of what was specifically included in each category (Khakbazan, 2000). It was assumed that the non-farm category was not relevant to this study as it provided a value for energy used off-farm. In addition, the trucks and auto category was assumed to be outside the project boundaries as farm machinery is included in its own category and the use of personal vehicles for farmers has been included in the "other" category. This reference includes energy usage from 1997. Also, according to the ARD experts and the Steering Committee, the volume of gasoline in relation to the volume of diesel consumed as presented in Khakbazan (2000) is unrealistically high. Therefore, the volume of gasoline consumed on beef farms was adjusted to be 10 to 15 percent of the volume of diesel consumed based on the advice of the ARD and the Steering Committee. A more recent and accurate analysis of energy used on farms may be warranted in further LCA studies for the production of beef in Alberta.

The energy consumption values in Table 20 were used to calculate the following activities:

- Diesel – produce crude, transport crude, refine crude into diesel/coloured diesel, transport diesel/coloured diesel, operate trucks and farm machinery
- Gasoline - produce crude, transport crude, refine crude into coloured gasoline, transport coloured gasoline, operate trucks and farm machinery
- Natural gas – produce natural gas, transport natural gas, process natural gas, transport processed natural gas, heat and light farm
- Electricity – generate electricity, transmit electricity, heat and light farm and other farm-related uses

The emissions from the processes presented on the activity map were quantified based on processes from the Ecoinvent V2 database, adjusted to reflect Alberta specific characteristics. The Ecoinvent processes used as proxy are shown in Table 21.

IPCC 2006 emission factors for the combustion of diesel and gasoline in agricultural equipment (off-road mobile sources and machinery) were used in the study.

5.4.3 EMISSIONS

The emissions from processes described in Table 21 were inventoried and grouped according to the environmental impact categories selected for further LCIA, as presented in Section 3.2. Refer to Section 6.0 for further analysis of the energy usage emissions.

5.5 WASTE

The majority of waste generated on farms includes the plastics involved in the production and packaging for transport of feed (i.e., silage plastic covers and bailer twine), bedding, feed supplements, antibiotics, growth promotants, and other miscellaneous items. Most of the waste produced on beef farms is associated with transport and storage of feed.

5.5.1 INVENTORY DATA

Table 22 provides a summary of the waste generated on Alberta beef farms and the method of disposal as discussed in Section 5.5.2 below.

5.5.2 ASSUMPTIONS

The Alberta Plastics Recycling Association provided an estimate of the amount of polyethylene and polypropylene to be marketed in 2008 for the agricultural sector of Alberta (Alberta Plastics, 2008). This value was used to estimate the total waste generated on Alberta beef farms, as no other data sources were available. Alberta farm cash receipts were used to calculate the total percentage from the beef industry. This percentage was used to estimate the total amount of plastics used in the beef industry of Alberta. This value may require further study for any additional LCA studies to obtain a more accurate result of the emissions from the production and management of waste from Alberta beef farms. In addition, this estimate is based on 2008 data and may not be completely representative of 2001 data. It is not clear whether the production of plastics has been included in the processes used for this study, and therefore, the production of some of the plastics may be double-counted. Due to a lack of specific details regarding which plastics were included and which were excluded, the production of all plastics has been included for conservative purposes.

The energy required to collect waste on the farms is included in the total energy used on beef farms in Alberta (refer to Section 5.4).

The majority of the waste generated on Alberta beef farms in 2001 was either burned or buried. A breakdown of 75 percent burned and 25 percent buried was assumed, based on the lack of actual data. Therefore, there were no emissions associated with Activity FL13, transport of garbage. The only emissions associated with Activity FL25, disposal of garbage are the emissions created by burning the plastics. Emission factors for burning plastic were calculated based on 2006 IPCC Guidelines and USEPA Emission Factors and AP 42.

5.5.3 EMISSIONS

Table 23 provides a summary of the emissions associated with the production and combustion of agricultural plastics.

5.6 BEDDING

Bedding material is required both on cow-calf operations and feedlots. Bedding provides comfort and insulates the animals from snow and ice from the ground. The activities associated with bedding are outlined on Figure 1b under Feedlot and Pasture Activities.

5.6.1 INVENTORY DATA

Table 24 provides the breakdown of the bedding requirements in cow-calf operations and feedlots.

5.6.2 ASSUMPTIONS

Based on the data collected for this study, 95 percent of all bedding used on Alberta beef farms is straw, with 5 percent being wood chips. Therefore, for this analysis, it was assumed that the required bedding material was straw.

The emissions from Activity FL5, production of bedding material, were quantified based on the process "straw, from straw areas, at field" from the Ecoinvent V2 database. The emissions from the Activity FL10, Transport Bedding, were quantified on a weight and distance basis. Emissions associated with Activity FL15, Store Bedding, were assumed to be insignificant. The emissions associated with Activity FL27, Bed Livestock, are included in the total energy used on beef farms in Alberta (Section 5.4).

5.6.3 EMISSIONS

The total emissions (for the entire calf crop) associated with the production and transport of the required bedding are 89.5 kilotonnes CO_2e and 1.17 kilotonnes CO_2e, respectively. The energy required to move the bedding around the site and to bed the animals is assumed to be included in the on-farm energy usage. These emissions have been incorporated into the total emissions for feedlot and pasture activities.

6.0 ENVIRONMENTAL IMPACT QUANTIFICATION AND ANALYSIS

Four environmental impact categories were quantified and assessed in the following sub-sections:

- Global Warming Potential, GWP 100a, as per IPCC 2007
- Aquatic eutrophication, as per IMPACT 2002+
- Aquatic acidification, as per IMPACT 2002+
- Non-renewable energy resources consumption, as per IMPACT 2002+

6.1 GREENHOUSE GAS EMISSIONS

The life cycle of the project as described in Figures 1a and 1b results in a carbon intensity of 14.5 kg CO_2e per kg of beef live (shrunk) weight for the entire calf crop, with a breakdown of 14.1 kg CO_2e per kg of beef live (shrunk) weight for the calf-fed system, and 14.8 kg CO_2e per kg of beef live (shrunk) weight for the yearling-fed system. Slaughterhouse emissions are not included as part of this analysis. Refer to Table 25 for a summary of the total GHG emissions per calf crop and the GHG emissions for both the calf-fed and yearling-fed systems. It must be noted that this carbon intensity value is only a first approximation, based on provincial average estimates for all parameters, and based on both local and international estimation techniques. Therefore, strict comparison of this value to LCAs from other jurisdictions must include an analysis that assumptions and boundaries are equivalent. Otherwise, any comparison with other jurisdictions may be invalid and misleading. Additionally, equivalence factors for different emissions are subject to changes over time, as improved information and research becomes available. Specifically, in the case of CO_2 equivalents for methane, the IPCC Second Assessment Report (1995) indicates a value of 21, while the most recent Fourth Assessment Report (2007) indicates an equivalence factor of 25. Given the time span of different LCA studies as presented in the specific literature, a meaningful comparison between CO_2 equivalent emissions must be made with full understanding of the respective global warming potentials utilized.

Even though the yearling-fed and calf-fed production models are substantially different in feeding strategies and age at slaughter, the carbon intensity associated with each model only differs by approximately 0.7 kg CO_2e per kg of beef live (shrunk) weight. The yearling-fed system, by virtue of feeding strategy and the extra age of animals at slaughter, has a higher enteric fermentation emission in comparison to the calf-fed system of approximately 1.2 kg CO_2e per kg of beef live (shrunk) weight. However, because of the feeding strategy employed by the calf-fed model, the calf-fed model has elevated Forage and Cereal emissions in comparison to the yearling-fed system of approximately 0.5 kg CO_2e per kg of beef live (shrunk) weight. The net result of these differences accounts for the observed difference of 0.7 kg CO_2e per kg of beef live (shrunk) weight.

The most significant GHGs associated with the production of beef in Alberta are methane, carbon dioxide and nitrous oxide.

The overall carbon intensity of the beef production system is comprised entirely of emissions from the activities related to the Operation and Maintenance. Emissions related to Construction and Decommissioning were deemed to be insignificant and were not included in the model calculations. The various elements comprising Operations and Maintenance include:

- Forage and Cereal sub-activities relating to production and transport of seed, fertilizer and pesticides/herbicides; the transportation of and application of manure; and irrigation.
- Energy Consumption activities relating to the use of energy on cattle farms. This includes: the production, refinement and transportation of crude oil into diesel and gasoline; the production, processing and transportation of natural gas; and the generation and transmission of electricity. All emissions from the use of fuels on cattle farms are included in this category.
- Physical Operations and Maintenance activities required on cattle farms. This includes production, transportation and installation of replacement materials.
- Cereal activities related to the production of barley. This includes planting, application of fertilizer, irrigation, harvesting, and transport of crop.
- Forage activities related to the production of barley silage and alfalfa. This includes cultivation, application of fertilizer, planting and irrigation, chemical treatment application, harvesting, and transport of crop.
- Feedlot and Pasture activities including deposition, collection, storage, and disposal of manure; collection, handling and disposal of garbage; collection, handling and disposal of mortalities; production, handling and use of bedding; transport, handling, processing and use of feed including associated minerals, supplements and vitamins; production and transportation of growth promotants and vaccinations/antibiotics; transport of other feed additives; and supplying water to livestock.

- Livestock activities including feeding and transportation activities relating to cows, bulls, cattle from dairy, and calves under the yearling-fed and calf-fed systems.

In addition to these activities are direct emissions from the animals. Figure 2 presents the relative contribution to GHG emissions of each of the above stages of the beef production system, divided into the calf-fed and yearling-fed systems.

As shown on Figure 2, the largest contributors to the overall carbon intensity are related to four main categories: Forage and Cereal sub-activities, Energy Consumption, Enteric Fermentation Emissions, and N_2O from GHG Beef Activity, Soil, and Crops. These four categories cumulatively account for approximately 94.8 percent of the total footprint for both systems. Figure 3 presents the same data as on Figure 2, but with the cereal and forage activities combined into one category.

Approximately 10.0 percent of the total calf-fed carbon footprint is related to forage and cereal activities. Of this total, 68 percent is related to cereal and 32 percent is related to forage.

Approximately 7.9 percent of the total yearling-fed carbon footprint is related to cereal and forage activities. Of this total, 53 percent is related to cereal and 47 percent is related to forage.

The categories representing greater than 5 percent each of the total GHG emissions are discussed in greater detail in the subsequent sections. For this analysis, forage and cereal were combined into one category for discussion purposes. The specific activities related to the yearling-fed and calf-fed systems, in the definitions used in the activity mapping, are mostly related to transportation of the animals. The feed production and enteric emissions components associated with the animals themselves are captured in other categories.

6.1.1 FORAGE AND CEREAL

Forage and cereal activities represent approximately 10.0 percent of the carbon footprint for the calf-fed system. Figure 4 presents the breakdown of barley, barley silage and alfalfa utilized in the calf-fed system. Barley, barley silage and alfalfa represent 67.9 percent, 16.6 percent and 15.5 percent, respectively, of the forage and cereal emissions. The three largest emissions categories within barley are the production of fertilizer, the production of seed, and the processing of seed. The three largest emissions categories within barley silage are the production of fertilizer, the processing of seed, and crop harvesting. The three largest emissions categories within alfalfa are crop harvesting, transportation of the harvested crop (feed), and the production of fertilizer. The largest emission category for barley and barley silage is the production of fertilizer. The largest emission category for alfalfa is crop harvesting.

Forage and cereal activities represent approximately 7.9 percent of the carbon footprint for the yearling-fed system. Figure 5 presents the breakdown of barley, barley silage and alfalfa utilized in the yearling-fed system. Barley, barley silage, and alfalfa represent 53.2 percent, 28.1 percent and 18.8 percent, respectively, of the forage and cereal emissions. The three largest emissions categories within barley silage are the production of fertilizer, the processing of seed, and crop harvesting. The three largest emissions categories within alfalfa are crop harvesting, transportation of the harvested crop (feed), and the production of fertilizer. The largest emission category for barley and barley silage is the production of fertilizer. The largest emission category for alfalfa is crop harvesting.

Figure 6 provides a summary of the total emissions for both systems normalized on a tonne of feed basis, for comparison purposes. The production of barley on a per mass basis produces the majority of related GHG emissions, followed by barley silage, then alfalfa.

Figure 7 presents the individual contributions for significant activities (greater than 5 percent of total emissions) for the cereal and forage components, divided into the calf-fed and yearling-fed systems. Figure 7 indicates that the largest GHG emission components of cereal and forage activities are: production of fertilizer, crop harvesting, transporting the harvested crop (feed), processing of feed, production of seed, and transportation of manure, together representing 75.8 and 77.2 percent of the total emissions from this category for the calf-fed and yearling-fed systems, respectively. The emissions from seed production and processing, and the transportation of harvested crop (feed) and manure are very similar, each representing five to eight percent of the total emissions.

Figure 8 presents the fertilizer emissions components due to different subcategories of fertilizer used for cereal and forage.

6.1.2 ON-FARM ENERGY CONSUMPTION ACTIVITIES

On-farm energy consumption represents approximately 19.1 percent of the total carbon footprint for the calf-fed system and 18.2 percent for the yearling-fed system. Figure 9 presents the total amount of energy derived from each of the different energy sources in terajoules (TJ). Diesel fuel usage represents more than half of the total energy utilized on beef farms in Alberta.

Figure 10 presents the total GHG emissions due to energy processes and usages on cattle farms for each of diesel, gasoline, natural gas and electricity usage. The production, transportation and refining of the fuels is included, as are combustion-related components for the energy sources except electricity. Note that these emissions have not been divided between the calf-fed and yearling-fed systems, as an accurate method of dividing these emissions between the two systems is not available at this time. As there is no exact method for determining the amount of on-farm energy consumed for each of the systems (calf-fed and yearling-fed) based on the available information, the results in Figure 10 provide the total GHG emissions for the entire beef production in Alberta. The total GHG emissions may be divided by assuming that 45 percent of the total emissions are associated with the calf-fed system and 55 percent are associated with the yearling-fed system (ratio as provided by ARD). These emissions have been divided using this method for the overall comparison between the two systems; however, the individual system results have not been provided here.

Diesel fuel consumption on-farm is the largest contributor to GHG emissions (approximately 58.9 percent). Electricity-related emissions are low due to the relatively low consumption of electricity on beef farms.

Of the diesel fuel total, a breakdown relative to sub-activities is provided on Figure 11. The results have been segregated based on the calf-fed and yearling-fed ratio of 45 percent to 55 percent for illustration purposes only. The combustion of diesel represents over 61 percent of the total energy profile.

6.1.3 CATTLE ENTERIC FERMENTATION EMISSIONS

Enteric emissions represent 51.1 percent of the total carbon footprint (49.0 percent of the calf-fed system and 52.8 percent of the yearling-fed system). Figure 12 identifies the differences in enteric emissions as a function of type of animal, on a normalized tonnes of CO_2e basis. As shown on Figure 12, cows from both the calf-fed and yearling-fed systems represent the largest source of enteric emissions at 62.3 percent of the total. The calf-fed system represents 42 percent of the total enteric fermentation emissions per calf crop, while the yearling-fed system represents 58 percent of the total.

For cows and bulls, the total enteric emissions according to diet per calf crop are presented on Figure 13. Generally, the GHG emission profile is comparable according to feeding stage (winter diet, calving diet, breeding diet, pasture).

As enteric emissions were apportioned as a function of individual diets for animals in the yearling and calf-fed systems, it is possible to identify which diet is responsible for the majority of emissions. Figures 14 and 15 present the breakdowns according to diets for calf-fed and yearling-fed systems, respectively.

For animals in the calf-fed system, backgrounding and the finishing diets for heifers and steers represent 65.4 percent of the enteric emissions for this system.

For animals in the yearling-fed system, the backgrounding, pasture and the finishing diets for heifers and steers represent the vast majority of enteric GHG emissions, representing nearly 89.4 percent of the enteric emissions for this system.

Table 7 provides a summary of the enteric fermentation emissions based on the calf-fed and yearling-fed systems. Table 8 provides a summary of the enteric fermentation emissions from the calf-fed system and the yearling-fed system per functional unit. The enteric fermentation emissions from the calf-fed system account for 3.1 kg CO_2e/kg live (shrunk) weight, and the emissions from the yearling-fed system account for 4.3 kg CO_2e/kg live (shrunk) weight. Figure 16 illustrates the differences in emissions per functional unit for both the calf-fed and the yearling-fed systems. Appendix F provides the calculation table included in the spreadsheet model to provide more information regarding the values used to calculate enteric fermentation emissions.

6.1.4 N_2O EMISSIONS FROM GHG BEEF ACTIVITY, AND SOIL CROPPING

The total quantity of N_2O emissions generated from manure management and soil cropping are summarized in Table 26. Details about the calculation methodology for N_2O direct and indirect emissions from manure are presented in Section 5.3.

Examination of the data shows that the contributions to GHG emissions from the manure management and soil cropping practices involved in the entire life cycle of the beef cattle are 2.36 kg CO_2e/kg live (shrunk) weight (also the result for each system), which is 16.3 percent of the overall GHG emissions (16.8 percent for the calf-fed system and 15.9 for the yearling-fed system). This result indicates that the manure management and soil cropping practices play an important role in the generation of GHGs.

6.1.5 SOIL ORGANIC CARBON CHANGE

The total soil organic carbon change in pasture for the production of beef in Alberta per calf crop was calculated to be -7,017.8 kt CO_2e, or -4.92 kg CO_2e/kg live shrunk weight. Note that these values have not been accounted for in the total emissions for the study, as the analysis of the entire carbon cycle has not been included in this study. This specific issue requires further study and a determination should be made of the appropriateness of including this in a beef LCA study on an absolute basis and as it reflects common practice in other beef LCAs. Refer to Section 5.2.2 for more information.

6.2 AQUATIC ACIDIFICATION

Aquatic acidification as an environmental impact category was assessed in accordance with the IMPACT 2002+ method. The IMPACT 2002+ method uses a mid-point characterization approach for assessment of aquatic acidification. Midpoint characterization factors are based on equivalency principles, such as midpoint characterization scores and are expressed in kg-equivalents of a substance compared to a midpoint reference substance, specifically kilograms sulphur dioxide equivalent (kg SO_2 eq) into the air in the case of aquatic acidification (Joliet et al., 2003). The overall long-term effects are considered through the use of infinite time horizons (approximated by a 500 years horizon).

The characterization factors for aquatic acidification are adapted from Hauschild and Wenzel (1998), which also correspond to Guinee & et al. (2002). Updated midpoint characterization factors for kg SO_2 eq into the air can be downloaded from http://www.epfl.ch/impact.

Analysis of the project as described on Figures 1a and 1b results in a total aquatic acidification quantification of 32.8 kt SO_2 eq, which translates to an intensity of 0.0230 kg SO_2 eq per kg of beef live (shrunk) weight. The total aquatic acidification effect for the calf-fed and yearling-fed systems are 15.3 kg SO_2 eq and 17.5 kg SO_2 eq, respectively, equating to intensities of 0.0238 kg of SO_2 eq per kg of beef live (shrunk) weight for the calf-fed system and 0.0224 kg of SO_2 eq per kg of beef live (shrunk) weight for the yearling-fed system. Slaughterhouse emissions are not included as part of this analysis. Table 27 and Figure 17 presents the contribution of different activities to the acidification effect.

Figures 18 through 22 describe the contribution of different processes from the activity map to the aquatic acidification effect, as follows:

- For the Cereal and Forage activities, the contribution of the main components of the diet, specifically barley, barley silage and alfalfa (Figures 18 and 19).
- For the Feedlot and Pasture activities, the individual contribution of the main processes as described in the appropriate section of the Activity Map (Figure 20).
- For the Cattle Transportation activities, the individual contribution to the acidification effect for transportation of each type of cattle (Figure 21).
- For the Energy Consumption activities, the individual contribution to the acidification effect of each type of fuel (diesel, gasoline and natural gas) and electricity (Figure 22).

For the above categories, the results are presented as follows:

- Overall, per calf crop
- For the individual contribution of the calf-fed and yearling-fed systems

The overall SO_2 acidification intensity of the beef production system is comprised mostly of emissions from total Forage and Cereal activities (forage and cereal sub-activities, cereal activities, forage activities) (39.9%), followed by Energy Consumption activities (39.5 percent), and Feedlot and Pasture activities (17.7%) (see Figures 1a and 1b and Table 27).

Figure 18 illustrates the contribution of barley, barley silage and alfalfa within the Forage and Cereal activities to the aquatic acidification impact. The Forage and Cereal Activities include Forage and Cereal sub-activities, Cereal Activities, and Forage activities, each with a contribution to the overall acidification effect of, respectively, 24.9, 7.8, and 7.2 percent. The most significant contribution comes from the production of fertilizers and harvesting of the forage crop. The significant emissions from the harvesting of the forage crop relate to the extent of the area cultivated for forage and the fuel consumption for harvesting. Among different crop practices in the field, harvesting is the most intensive in terms of fuel consumption.

Figure 19 presents the summary of aquatic acidification emissions per calf crop from major Cereal and Forage activities. The contribution of the two systems to aquatic acidification is relatively similar, as shown on Figure 19.

Examination of Figure 20 shows that the major contribution to acidification from the Feedlot and Pasture activities is generated by production of mineral. Again, as observed on Figure 20, the contribution of the two systems to aquatic acidification is relatively similar, with a slightly higher contribution from the yearling-fed system with a total of 3.20 kt SO_2 eq compared to 2.60 kt SO_2 eq for the calf-fed system.

Within the Cattle Transportation results, Figure 21 presents the total acidification emissions per calf crop. As observed from the figure, the major contribution to the aquatic acidification effect is generated by transportation of the cattle to the slaughterhouse. This significant contribution to acidification is a result of the total number of cattle being transported to the slaughterhouse, at the end of the studied period of the life cycle of beef production.

Within the energy consumption results, Figure 22 presents the total aquatic acidification emissions per calf crop due to the production of energy. Examination of the figure reveals that similar contributions to the aquatic acidification effect are generated by production of diesel, natural gas and electricity.

6.3 AQUATIC EUTROPHICATION

Aquatic eutrophication as an environmental impact category was assessed in accordance with the IMPACT 2002+ method. At the present time, aquatic eutrophication in Alberta is being studied, and there is currently no Alberta-specific data that can be adapted for existing methodologies for calculating the eutrophication effect. The IMPACT 2002+ method uses a mid-point characterization approach for assessment of aquatic eutrophication. Midpoint characterization factors are based on equivalency principles, such as midpoint characterization scores and are expressed in kg-equivalents of a substance compared to a midpoint reference substance, specifically kilograms of phosphate equivalent (kg PO_4 eq) into the water in the case of aquatic eutrophication (Joliet et al., 2003). The overall long-term effects are considered through the use of infinite time horizons (approximated by a 500 year horizon).

Eutrophication literally means "nutrient enrichment", and generally refers to nitrogen and phosphorus. The greatest risk for Alberta agriculture eutrophication contribution is generally from soil amendments (synthetic fertilizers and manure). Surface water is at risk for increased eutrophication if additional nutrients are transported via run-off (snowmelt runoff, rainfall runoff, or irrigation runoff are transport mechanisms).

Phosphorus losses from agricultural lands are recognized as a significant contributor to surface water degradation. Livestock production systems, including cow-calf operations and confined feeding operations, are considered the primary sources of agricultural phosphorus loss. For cow-calf operations, direct access of cattle to streams is limited to reduce risk. Generally, contributions from direct runoff from feedlot pens and/or lagoons are minimal risk due to operational practices and feedlot locations relative to surface water. However, manure spreading related to feedlots is a significant source of excess phosphorus in surface water. Other potential risks could relate to erosion concerns - tillage, stream bank erosion for livestock access, dust from the homestead and roads, etc.

In terms of eutrophication, the risk of surface runoff is varied across the province. For this reason it is important to recognize that the eutrophication values are a generalized value for the province, but do not reflect specific regions.

The characterization factors for aquatic eutrophication are adapted from Hauschild and Wenzel (1998), which also correspond to Guinee & et al. (2002). Updated midpoint characterization factors for kg PO_4 eq into the water can be downloaded from http://www.epfl.ch/impact.

Aquatic eutrophication is divided into two classes, for P-limited and N-limited watersheds. The values for P-limited watersheds are applied by default as recent evidence shows that phosphorus ultimately is the relevant compound in most cases. This can be explained by the fact that cyanobacteria in lakes and rivers are fixing atmospheric N when nitrates are limiting in the aquatic media. Therefore, in the long term, increases in nitrate concentration will not influence the ecosystem's development, whilst an increase in phosphate will lead to an increasing impact (Barroin 2003).

Analysis of the project as described on Figures 1a and 1b, and including the phosphorus run-off to surface waters, results in a eutrophication impact of 5.56 kt PO_4 eq, which translates to an intensity of 0.00389 kg PO_4 eq per kg of beef live (shrunk) weight. The total aquatic eutrophication effect for the calf-fed and yearling-fed systems are 2.51 kt PO_4 eq and 3.05 kt PO_4 eq, respectively, equating to intensities of 0.00391 kg PO_4 eq per kg of beef live (shrunk) weight for the calf-fed system and 0.00388 kg PO_4 eq per kg of beef live (shrunk) weight for the yearling-fed system. Slaughterhouse emissions are not included as part of this analysis. Table 28 and Figure 23 present the contribution of different activities to the eutrophication effect.

The total emissions from phosphorus run-off account for 74.6 percent of the total eutrophication effect.

Figures 24 through 28 describe the contribution of different processes from the Activity Map to the aquatic eutrophication effect, as follows (the structure of the presentation of results is identical to the structure previously described in Section 6.1, for the GHG emissions):

- For the Cereal and Forage activities, the contribution of the main components of the diet, specifically barley, barley silage and alfalfa
- For the Feedlot and Pasture activities, the individual contribution of the main processes as described in the appropriate section of the Activity Map
- For the Cattle Transportation activities, the individual contribution to the eutrophication effect for transportation of each type of cattle
- For the Energy Consumption activities, the individual contribution to the eutrophication effect for each type of fuel (diesel, gasoline and natural gas) and electricity

For the above categories, the results are presented as follows:

- Overall, per calf crop
- For the individual contribution of the calf-fed and yearling-fed systems

Significant contributions to the aquatic eutrophication impact category are generated by:

- Phosphorus run-off activities contribute 74.6 percent of the total eutrophication effect.
- Energy generation activities contribute 16.6 percent of the total eutrophication effect. Within these activities, diesel and gasoline have the highest contributions through the refining of crude.
- Forage and Cereal activities, with contributions from the Forage and Cereal sub-activities, Cereal activities, and Forage activities with, respectively, 3.6, 0.5 and 0.4 percent to the overall eutrophication impact (Figure 24). Examination of Figure 25 shows that within the Forage and Cereal activities, Production of seed, Processing of seed and Production of fertilizer represent major contributors to the eutrophication effect. The calf-fed and yearling-fed systems have similar contributions, slightly higher for the yearling-fed system with 0.128 kt PO4 eq compared to 0.126 kt PO4 eq for the calf-fed system.
- Feedlot and Pasture activities, with 3.90 percent of the total eutrophication effect. Within this category, FL17, Production of Bedding and Production of Mineral have

the most significant contributions (Figure 26). Within the Feedlot and Pasture Activities, the calf-fed and yearling-fed systems have similar contributions, slightly higher for the yearling-fed system with 0.121 kt PO4 eq compared to 0.098 kt PO4 eq for the calf-fed system.

Figure 27 (Cattle Transportation activities) has been provided to remain consistent with the figures in Section 6.1.

6.4 NON-RENEWABLE ENERGY RESOURCES

The non-renewable energy resources consumption as an environmental impact category was assessed in accordance with the Impact 2002+ method. The IMPACT 2002+ method uses a mid-point characterization approach for assessment of non-renewable energy resources consumption. Midpoint characterization factors are based on equivalency principles, such as midpoint characterization scores, and are expressed in megajoule (MJ) equivalents compared to a midpoint reference. In the case of the non-renewable energy resources as a mid point category, the midpoint reference substance is the primary non-renewable source of energy as MJ equivalents (or one kg of crude oil).

Characterization factors for non-renewable energy resources consumption, in terms of the total primary energy extracted, are calculated with the upper heating value (Frischknecht et al. 2003). Updated midpoint characterization factors for kg MJ equivalents can be downloaded from http://www.epfl.ch/impact.

Analysis of the project as described on the Activity Map results in a non-renewable energy resources consumption of 346,483 TJ eq, which translates to an intensity of 242.8 MJ eq per kg of beef live (shrunk) weight. The total non-renewable energy resources effect for the calf-fed and yearling-fed systems are 157,149 TJ eq and 189,334 TJ eq, respectively, equating to intensities of 244.8 MJ eq per kg of beef live (shrunk) weight for the calf-fed system and 241.3 kg of MJ eq per kg of beef live (shrunk) weight for the yearling-fed system. Slaughterhouse emissions are not included as part of this analysis. Table 29 and Figure 29 present the contribution of different activities to the non-renewable energy resources consumption effect.

Figures 30 through 34 describe the contribution of different processes from the Activity Map to the consumption of non-renewable energy resources, as follows (the structure of the presentation of results is identical to the structure previously described in Section 6.1, for the GHG emissions):

- For the Cereal and Forage activities, the contribution of the main components of the diet, barley, specifically barley silage and alfalfa (Figures 30 and 31)
- For the Feedlot and Pasture activities, the individual contribution of the processes as described in the appropriate section of the Activity Map (Figure 32)
- For the Cattle Transportation activities, the individual contribution to the eutrophication effect for transportation of each type of cattle (Figure 33)
- For the Energy Consumption activities, the individual contribution to the consumption of non-renewable energy resources of each type of fuel (diesel, gasoline and natural gas) and electricity (Figure 34)

For the above categories, the results are presented as follows:

- Overall, for the entire beef production system
- For the individual contribution of the calf-fed and yearling-fed systems to the entire beef production system

The most significant contributions to the non-renewable energy resources consumption impact is from refinery activities and activities with intensive fuel consumption, as described below:

- Energy Consumption Activities, with 89.6 percent of the total effect. Within this category, Production, Transportation and Refining of crude into diesel are the most intensive activities (Figure 34).
- Forage and Cereal activities, with contributions from Forage and Cereal sub-activities, Cereal activities, and Forage activities of, respectively, 5.3, 1.4 and 1.2 percent of the overall impact (Figure 31). Within the category of Forage and Cereal activities, the most important contribution is represented by the production of fertilizers, followed by harvesting of the crop (Figure 32). The contributions within the Forage and Cereal activities are slightly higher for the yearling-fed system with 13,814 MJ eq compared to the calf-fed system with 13,729 MJ eq.

7.0 ANALYSIS OF RESULTS

7.1 GAP IDENTIFICATION

During the process of data collection, gaps initially encountered were addressed, as much as possible, by extensive research of databases, literature sources and expert opinion. Based on the current data inventory, the following data gaps currently remain:

- Energy requirements for grains storage practices in Alberta
- Energy requirements for treatment of harvested cereal grains
- Production of growth promotant
- Production of vitamins, as part of the cattle supplement diet
- Production of vaccines/antibiotics
- Production of trace mineral
- Lack of a standard methodology and sufficient data for the calculation of soil organic carbon sequestration on pasture

Further, with reference to the Activity Maps, the Construction and Decommissioning Phases, and the Operation and Maintenance Phase as it relates to Operation and Maintenance Activities with the feedlots, were not included in the analysis as they were considered to not represent a significant source of emissions within the life cycle of beef cattle. Accordingly, calculation of their contribution to the overall emissions in the current study was deemed unnecessary. However, as the LCA model is designed to support further enhancement, aspects related to construction, operation and decommissioning can be quantified if required.

In addition to the data gaps identified, several factors and assumptions were selected based on the best available data. However, as more current data is published in the future, refinement of these factors and assumptions, including the following, should be completed:

Cattle Inputs:

- Percent of cow and bull culls transported directly to slaughterhouse from cow-calf operation (not sent to feedlot)
- Breakdown of animal type and destination (feedlot, slaughterhouse, etc.) for international import data
- Interprovincial movement of cattle (imports and exports) for 2001-2002 (2007-2008 data currently being used)

Feedlot and Pasture:

- Actual quantities and types of garbage generated on beef farms in Alberta
- Actual breakdown of disposal methods for the garbage generated on beef farms in Alberta

Energy Usage:

- Actual energy usage breakdown for Alberta beef farms
- Transport distance of natural gas to natural gas processing (not readily obtainable)
- Transport distance of natural gas to consumer (not readily obtainable)

Transportation:

- Average cereal transportation distance
- Average forage transportation distance
- Average mineral transportation distance
- Average growth promotant transportation distance
- Average vitamins A, D, and E transportation distances
- Average nitrogen-based and phosphorous-based fertilizer transportation distance
- Average pesticide transportation distance
- Average bedding material transportation distance
- Average mortalities transportation distance

7.2 HOTSPOT IDENTIFICATION AND MITIGATION

Hotspots are identified in Section 6.0 as part of the analysis. CRA notes that mitigation approaches are part of a subsequent component of the overall project design; the main purpose of this study is to identify hotspots, as presented in Section 6.0 and as summarized here, but some examples of mitigation techniques have also been provided in this section. This is not intended to be a comprehensive description of mitigation, however.

In terms of GHG emissions, the main hotspots in the life cycle of beef production are generated by emission of CO_2, CH_4, and N_2O.

The following sources are examples of where these emissions are generated within the study:

- Carbon dioxide
  - The burning of fossil fuels for equipment and facilities
  - Losses in soil organic matter
- Methane
  - Enteric fermentation by ruminant animals
  - Livestock manure
- Nitrous oxide
  - Fertilizer usage, predominately synthetic N fertilizer
  - Decomposing crop residues
  - Manure on pasture and in storage

In terms of the Activity Map, the main hot-spot items are cattle enteric emissions, on-farm energy consumption, nitrous oxide emissions from beef biological activity and soil cropping, and forage and cereal activities. These categories represent approximately 95 percent of total GHG emissions.

In the case of cattle enteric fermentation, microbial fermentation in the rumen and hindgut of livestock produces CH_4 gas as a by-product. On average about 4 to 12 percent of gross energy intake (GEI) in the feed is converted to CH_4 gas (Manitoba and Climate Change, 2001). Enteric fermentation emissions per calf crop are dominated by emissions from cows (Figure 12), but the overall mitigation strategy and approach is not straightforward. In the calculation base, total dry matter intake (DMI) is the main correlated link to estimation of enteric emissions, and this parameter is directly linked to the feed requirements for individual animals, which is somewhat inflexible.

<u>There are a number of options for reducing enteric fermentation emissions, as follows.</u>

Promotion of high quality forages in ruminant feeding and grazing systems:

- Use of high quality forages. Boadi et al. (2000) showed that CH4 emissions of grazing steers that had access to high quality pastures declined by 50 percent compared to emissions from matured pastures.
- Use of legumes in grazing rotations. McCaughey et al. (1999) observed lower CH4 emissions (7.1 percent of GEI) from alfalfa-grass pasture than grass -only pastures (9.5 percent of GEI) in Brandon, Manitoba.

Feed and Animal Management (Wittenberg & Boadi, 2001):

- Formulate and evaluate diets to avoid overfeeding and under feeding of nutrients (protein and minerals)
- Diets formulated by qualified professional animal nutritionist
- Use of rotational grazing
- Use of high grain to forage ratios in rations can reduce CH_4 emissions to 2 to 3 percent of GEI (Johnson et al. 1996)
- Grinding and pelleting of feed (20 to 40 percent of total CH_4 emissions)

Feed Additives:

- Use of ionophores: Research has shown that ionophores may decrease CH_4 emissions.. Ionophores, specifically monensin, have been included in the feedlot diets considered in this study.
- Addition of edible oils to grain diets: Methane emissions were reduced by 33 percent when 4 percent canola oil was added to a diet containing 85 percent concentrate in a feedlot study (Mathison et al. 1997). Edible oils cannot be added to diets more than 5 to 6 percent of ration, as excessive amounts of edible oils depresses fiber digestion.
- Compounds that inhibit CH_4 production: Compounds that reduce CH_4 production (e.g., bromoethanosulfonate) have been successful in reducing CH_4 emission by 71 percent, but effects have only lasted 3 days in sheep (Dong et al. 1997). There are concerns of adaptation and animal toxicity.
- Defaunation: Compounds that eliminate the protozoal community from the rumen may reduce methane emissions. However, there are concerns of animal toxicity.

Significant research has been and continues to be done on developing mitigation strategies for enteric methane production.

<u>On-farm energy consumption emissions:</u>

On-farm energy consumption activities are dominated by the use of diesel fuel in machinery and for other on-farm activities (Figure 9). It is expected that emissions related to diesel fuel production and combustion are relatively constant. Total diesel fuel consumption on-farm is an area of some potential mitigation activity, although it would be counter-productive to affect on-farm activities adversely. In addition, there is some uncertainty in the total fuel consumption on-farm, and more detailed information is required with respect to this issue to accurately quantify emissions.

Options for reducing nitrous oxide emissions:

Nitrous oxide emissions from manure management are an important component of the overall emissions and relate to manure management and cultivation (Table 26). The ratio of emissions from each contributor is relatively even.

Mitigation approaches for nitrous oxide emission from soil management include increased use of no-till cropping methods. In addition, nitrous oxide emissions can potentially be mitigated by type and time of land application of manure, as follows:

- Fall application of manure may lead to high level of denitrification prior to winter and in early spring (Tessier and Marquis 1998).
- Liquid manure applied in bands may produce more N2O than manure applied uniformly on the soil surface, as the former creates more favorable conditions for denitrification by concentrating the nitrogen and carbon (Janzen et al. 1999).
- Injecting the manure directly into the soil or cultivation of land immediately after application can reduce N-volatilization by about 90 percent compared to normal surface spreading (DeVos et al. 1998).
- Managing in controlled systems such as anaerobic lagoons for the capture of emissions. It can be expected that in a well-operated system, biogas production can be initiated, with subsequent utilization/combustion of biogas for control of emissions to the atmosphere.

Alberta beef operations manage both liquid and solid manure, with approximately one percent being liquid manure. Therefore, the mitigation options outlined above for liquid manure handling may not have a significant effect on the overall emissions from beef production in Alberta. Emphasis should be placed on solid manure management to reduce nitrous oxide emissions.

The above mentioned potential mitigation measures are intended to be a preliminary discussion only, and further measures should be developed and evaluated as part of future studies.

7.3 COMPARISON TO EXISTING LITERATURE

As identified during the review of existing literature, several LCAs have been completed on beef industries around the world. Unfortunately, most of the results of these LCAs are not directly comparable to the results presented in this report. Comparison difficulties arise due to differing functional units, differing project boundaries, and a scarcity of detailed information regarding processes or activities that were excluded or included in the other assessments. Currently, a standard approach for completing a beef production LCA is not available, and therefore, each beef production LCA will differ based on which processes are included and which are not. There are no direct means of comparing previous beef LCAs to the results of this Alberta beef production LCA, as the approach of the other LCAs are not known. As such, a comparison of this study with the results from other beef LCAs is not productive at this time, and can potentially lead to misinterpretation of results.

Further, it should be noted that this is a first approximation of the impacts associated with the Alberta beef production system. Data gaps have been identified, as have issues related to availability of data for the baseline year. It is expected that further research and data gathering will address these issues over time, leading to a more accurate approximation. However, even if this is the case, the lack of uniformity in how beef LCAs are conducted may continue to hinder any meaningful ability to compare results between studies.

A particular and important aspect of this study is that it has attempted to be comprehensive in terms of mapping out the beef production system in Alberta. All pertinent factors have been included up-front, and although some processes have not been considered in the analysis because they have been deemed to be insignificant, the intent was to capture a broad set of project boundaries. It is unclear if other beef LCAs utilize a similar approach or establish a more specific definition of project boundaries. One example of this can be a definition of project boundaries that only includes factors that are demonstrably within the control of farmers.

A common example of the scarcity of detailed information regarding inclusion/exclusion of activities is the phrase "inclusion of energy generation". This phrase implies that the project includes the emissions associated with the direct production of energy, such as the combustion of fossil fuels. However, it is not clear whether the project has gone further upstream in the energy production process to include the emissions associated with extracting and refining fuels (included in this LCA study). This uncertainty appears in defining the boundaries of other supporting activities. Consequently, it is difficult to establish the boundaries of other projects outside of the actual beef production cycle, and a comparison between studies is not straightforward.

One comparison that can be conducted is the results of the enteric fermentation emissions to literature values (Table 30). The results indicate that the enteric fermentation emissions calculated in this study are similar to literature values.

8.0 LIMITATIONS OF STUDY

The current LCA study encompasses the Alberta beef production system to the door of the slaughterhouse. The main scope of the LCA study is to offer an understanding of the beef production system within the broader perspective of complex environmental interactions.

Performing any LCA is an intensive and challenging process. The complexity of the beef system in Alberta and its interaction with adjacent livestock systems and practices makes the task of performing the current LCA even more challenging and sensitive.

It is acknowledged that availability of reliable data can greatly impact the accuracy of the final results. Therefore, emphasis was placed on gathering information from updated, reliable, and expert sources.

Some of the limitations that can have an impact on the final results are:

- Delineation of the boundaries of the system is dependent on user definition. While efforts were made to include the entire life cycle of all the logistic and processes involved in the life cycle of beef cattle, some of the processes were omitted due to the lack of both primary and secondary data.
- Estimation of environmental emissions generated by the diverse and interlinked processes within the system is a key point of success for building a comprehensive inventory. However, the databases currently available do not reach a consensus in methodological terms and accuracy when reporting emissions. Every effort was made to use the most reliable environmental emissions for the processes involved in the analysis.
- Where primary and secondary data gaps were encountered, educated assumptions were made to capture relevant processes in the calculations.
- The complexity and diversity of different methods for modelling the transfer processes in the manure management and cropping practices can have an effect on the final outcomes. In addition to the recognized IPCC 2006 and Environment Canada 2008 Tier 2 standard methodologies, new methodologies developed specifically for conditions in Canada, and specifically Alberta, can lead to different results in emissions from manure management and cropping practices.
- While industrial processes are relatively well defined and characterized in terms of environmental emissions, agricultural practices tend to be more variable. The generic data used to quantify environmental emissions from agricultural practices in different geographic settings may introduce a source of uncertainty in the results.

However, every effort was made to adjust the generic agricultural practices and associated emissions to conditions specific for the area of the current study.

- The LCIA methodology and equivalence factors used to quantify some environmental impacts are generic. To date, representative factors for Alberta have not been developed.
- The LCIA results were based on the IPCC 2007 GWP (100 years) quantification methodology and IMPACT 2002+.

The results presented in this report are subject to these and other inherent limitations as they relate to data inputs and the ability of the various models and techniques utilized to accurately reflect actual conditions. It is also recognized that this is a first approximation of the life cycle of the Alberta beef sector, and that additional refinement and analysis of input parameters will yield more robust results.

9.0 CONCLUSIONS AND RECOMMENDATIONS

As this is the first approximation of the beef production system in Alberta, the results will change over time as further study and detail is added to the study in order to improve the accuracy of the results.

The total first approximation of GHG emissions for the Alberta beef production sector is 14.5 kg CO_2e per kg of live (shrunk) weight. This figure includes emissions per calf crop up to the door of the slaughterhouse. The total GHG emission from the calf-fed system is 14.1 kg CO_2e per kg of live (shrunk) weight. The total GHG emission from the yearling-fed system is 14.8 kg CO_2e per kg of live (shrunk) weight.

The largest components of the total emission figure include enteric emissions (51.1 percent of total); on-farm energy consumption activities (18.6 percent of total); and nitrous oxide emissions from soil and manure management (16.3 percent of total). The next largest category is total forage and cereal activities at 8.8 percent of total. The results for both the calf-fed and yearling-fed systems are similar to the percentage breakdown of the total emissions.

Within these categories, the largest contributors include enteric emissions from cows, on-farm diesel fuel usage, and nitrous oxide emissions from manure management and cropping activities.

The total acidification impact per calf crop is quantified as 0.0230 kg SO_2 eq per kg of beef live (shrunk) weight, with 0.0238 kg SO_2 eq per kg of beef live (shrunk) weight for the calf-fed system and 0.0224 kg SO_2 eq per kg of beef live (shrunk) weight for the yearling-fed system. The dominant categories of emissions contributing to this impact are related to total Forage and Cereal activities (forage and cereal sub-activities, cereal activities, forage activities) (39.9 percent), followed by Energy Consumption activities (39.5 percent), and Feedlot and Pasture activities (17.7 percent).

The total eutrophication impact is quantified as 0.00389 kg PO_4 eq per kg of beef live (shrunk) weight, with 0.00391 kg PO_4 eq per kg of beef live (shrunk) weight for the calf-fed system and 0.00388 kg PO_4 eq per kg of beef live (shrunk) weight for the yearling-fed system. The main contributors to the total (and each system) include total phosphorous emission from run-off (74.6 percent of total), on-farm energy consumption activities (16.6 percent of total), total forage and cereal activities (4.6 percent of total), and feedlot and pasture activities (3.9 percent of total).

The total non-renewable energy resources consumption impact is quantified as 242.8 MJ-eq per kg of beef live (shrunk) weight, with 244.8 MJ-eq per kg of beef live (shrunk) weight for the calf-fed system and 241.3 MJ-eq per kg of beef live (shrunk) weight for the yearling-fed system. On-farm energy consumption activities (including the production, transportation, and combustion of fuels) account for the highest fraction of the total (89.6 percent) followed by total forage and cereal activities (7.9 percent). In the on-farm energy consumption category, the majority of the impact category stems from production of crude, transportation, and combustion of diesel fuel.

A direct comparison to literature values from other LCAs is complicated by the use of differing project boundaries, functional units, and precise description of assumptions utilized. A standardized methodology for producing a beef production LCA is not available at this time. As this is only a first approximation of the beef production in Alberta, the final results of the study will change over time as further refinement of the data is conducted and additional processes are identified and included.

A number of data gaps and additional refinements of information are warranted for further study, including cattle input numbers related to cow and bull culls, type and fate of international cattle inputs, and within-province movement of cattle; feedlot and pasture data relating to quantities of waste production and destination; energy usage data including specific information related to on-farm use of fuel and transportation distances for fuel movement; and additional data regarding transportation of feed, supplements, fertilizers, bedding and mortalities. Of these data gaps, it is expected that the amount of on-farm energy consumption will likely have the greatest impact on the overall life cycle results.

CRA supports a third-party review of the data and assumptions as a means of validating the approach and methodology utilized; however, CRA notes that the numerical inputs to the model will change over time as additional data becomes available, and specifically as Alberta-specific data becomes available.

As this is a first approximation for the beef production in Alberta, it is recommended that additional study be conducted on a number of items in the study in order to increase the accuracy of the results and to address the data gaps. Also, further research for more Canadian-specific emission factor data may be warranted for the next iterations.

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All of which is respectfully submitted,

CONESTOGA-ROVERS & ASSOCIATES LTD.

Stephen D. Ball, M.S., P.Eng., CEA

Tej Gidda, Ph.D., P.Eng.

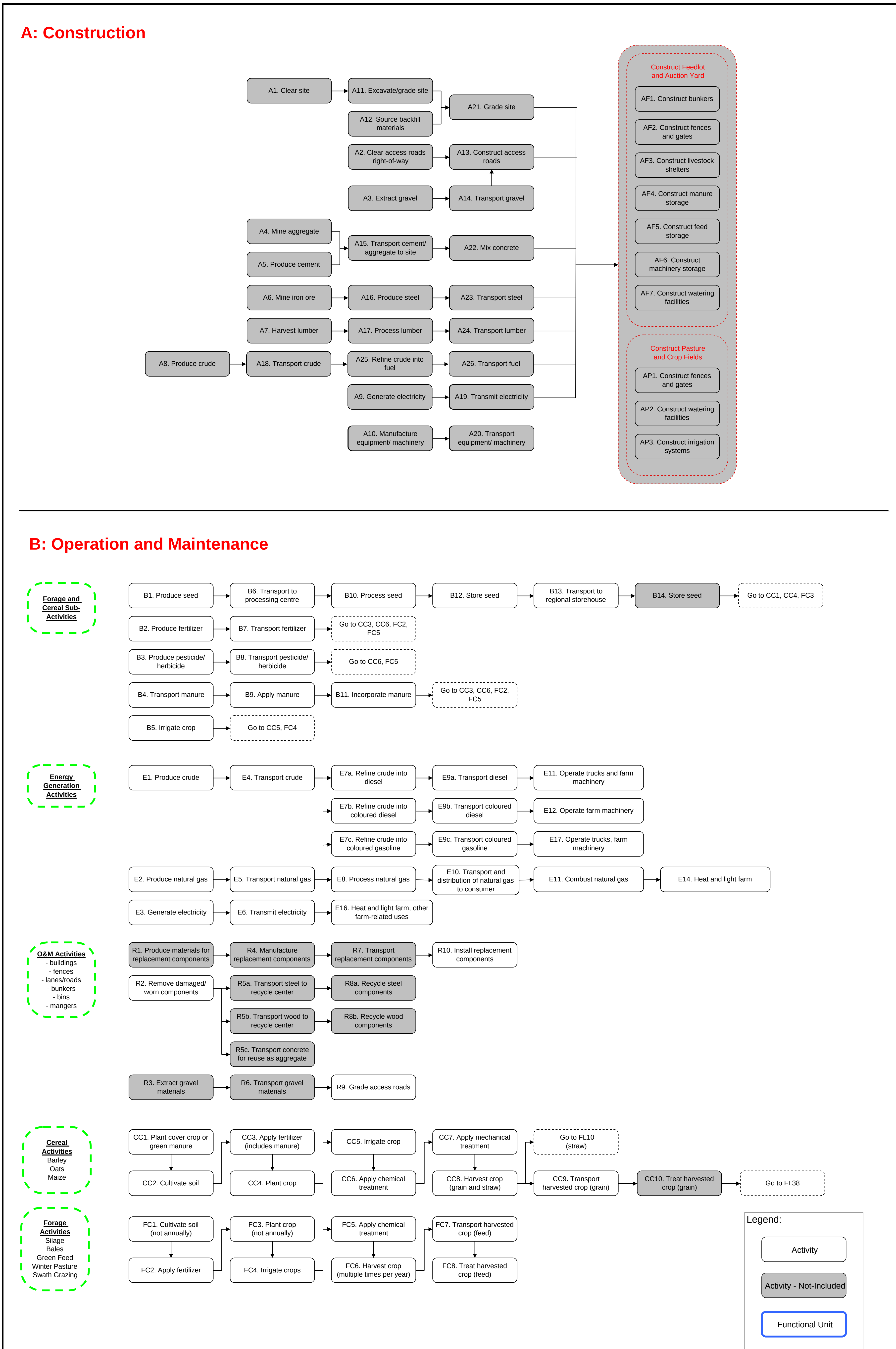


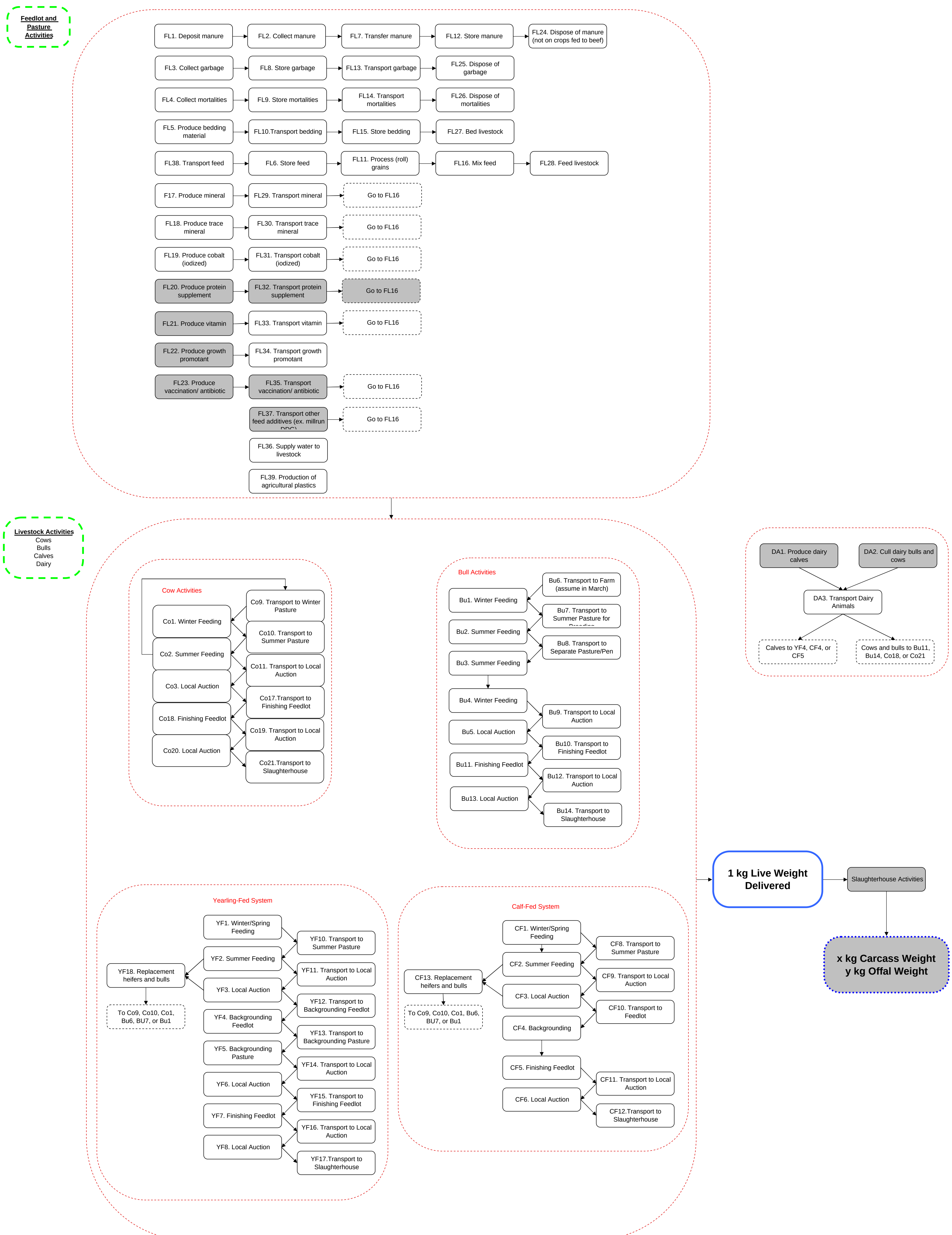
FIGURE 1a

ACTIVITY MAP
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

CRA

the PEMBINA institute
Sustainable Energy Solutions

B: Operation and Maintenance



C: Decommissioning

FIGURE 1b

ACTIVITY MAP - DETAILED OPERATION AND MAINTENANCE
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

CRA

the PEMBINA institute
Sustainable Energy Solutions

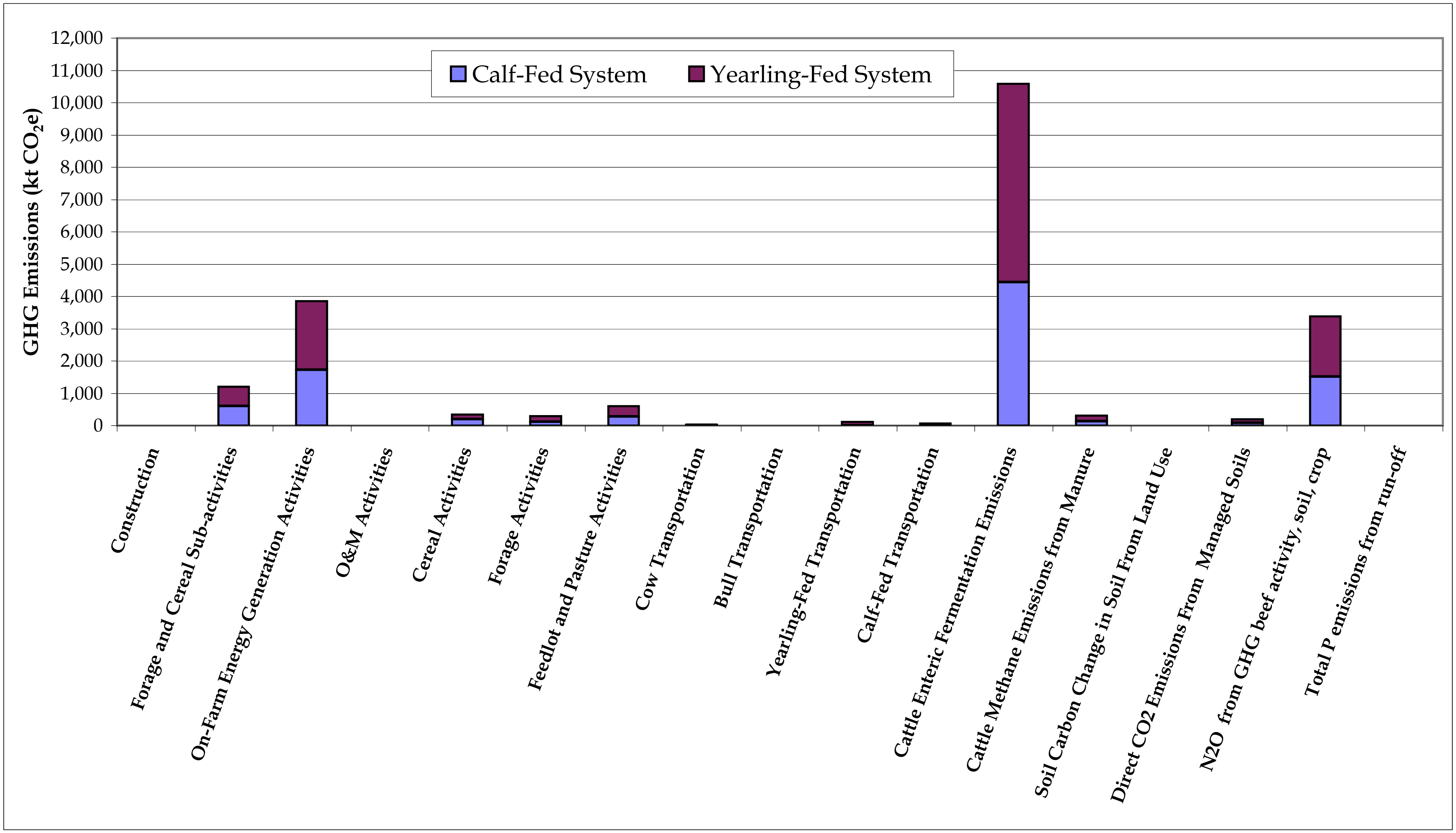


figure 2

SUMMARY OF TOTAL GHG EMISSIONS PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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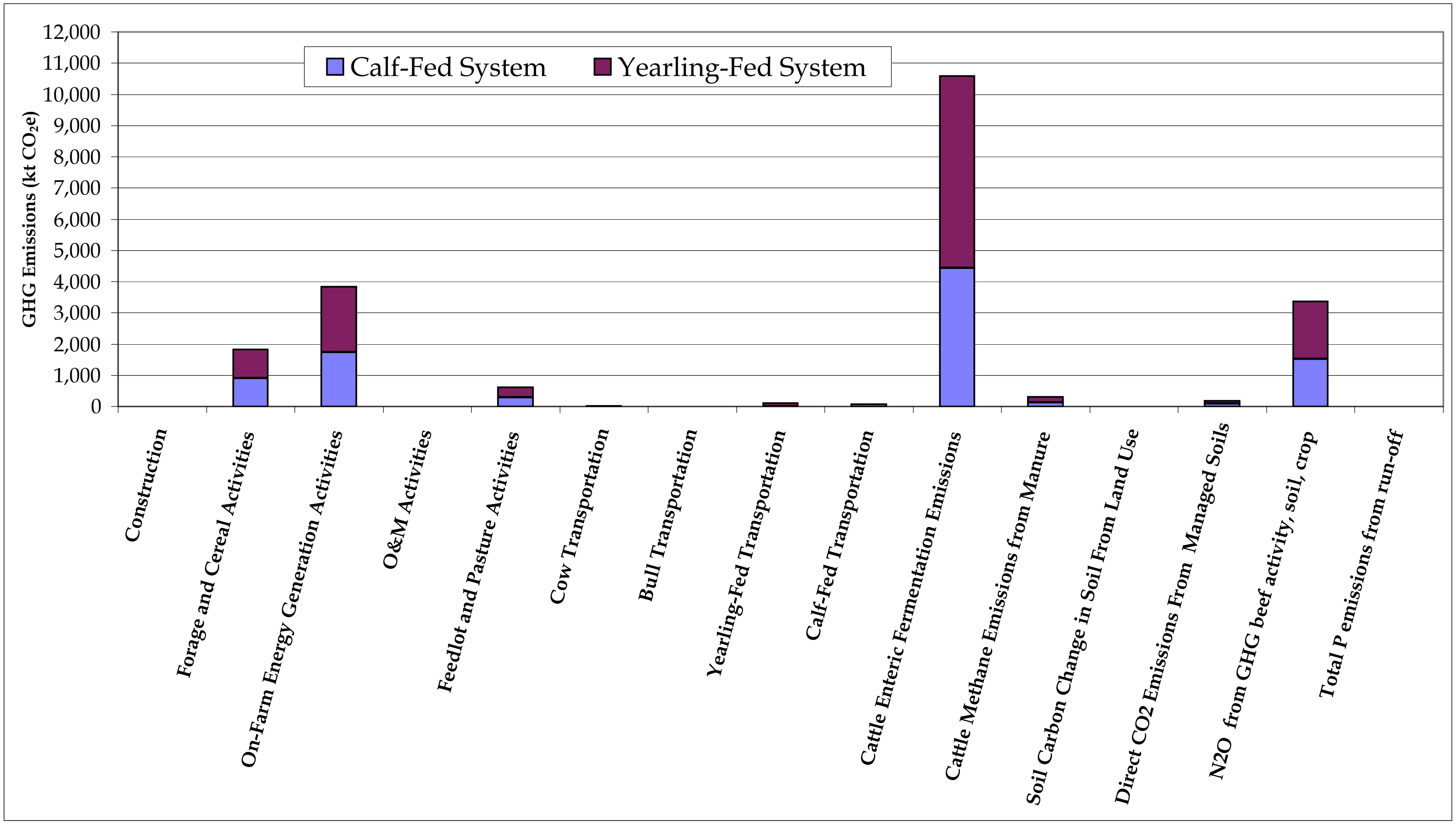

figure 3

SUMMARY OF TOTAL GHG EMISSIONS PER CALF CROP
(CEREAL AND FORAGE ACTIVITIES COMBINED)
LIFE CYCLE ASSESSMENT - BEEF
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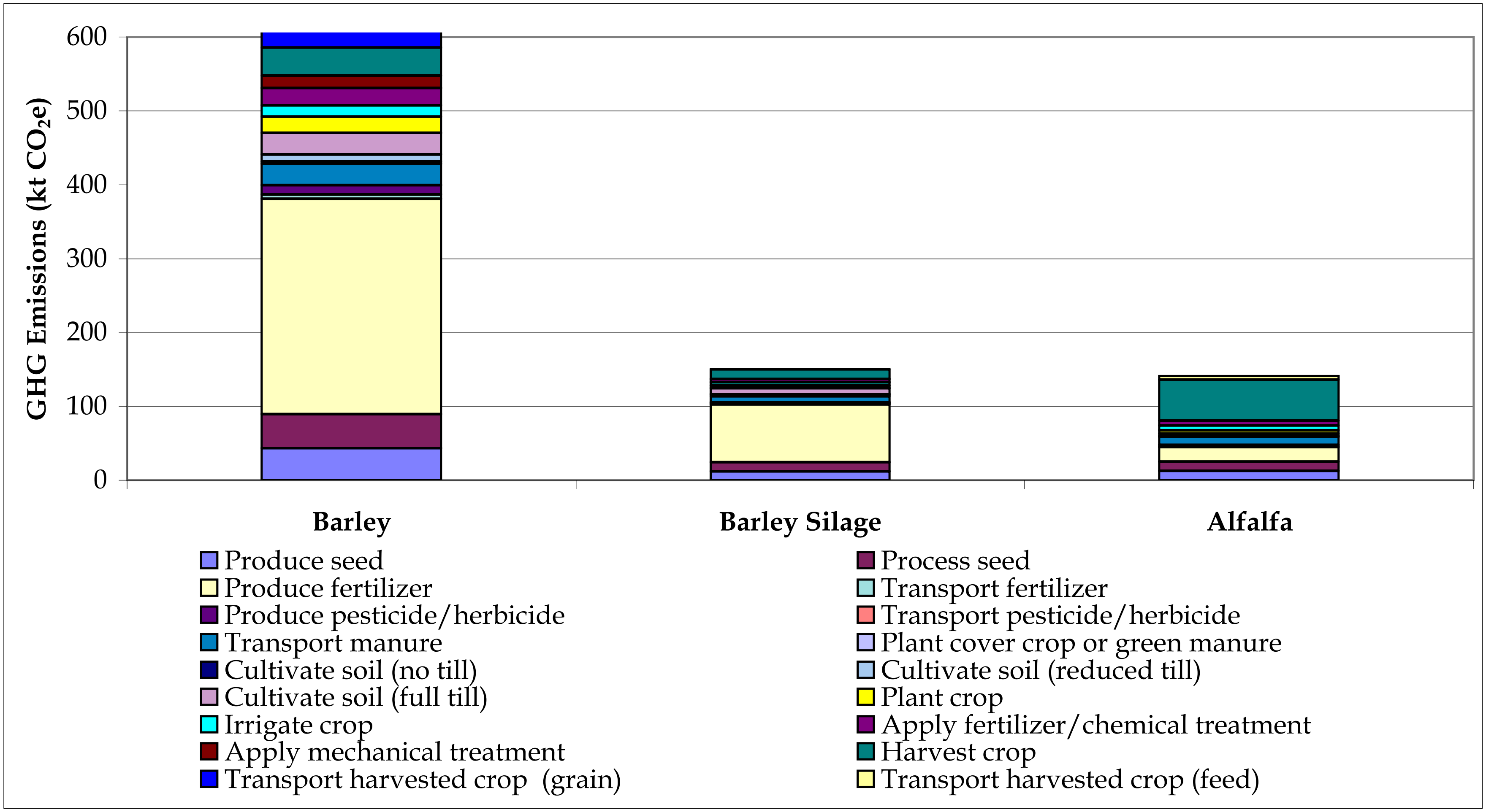

figure 4

GHG EMISSIONS - CEREAL AND FORAGE ACTIVITIES
(CALF-FED SYSTEM) PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
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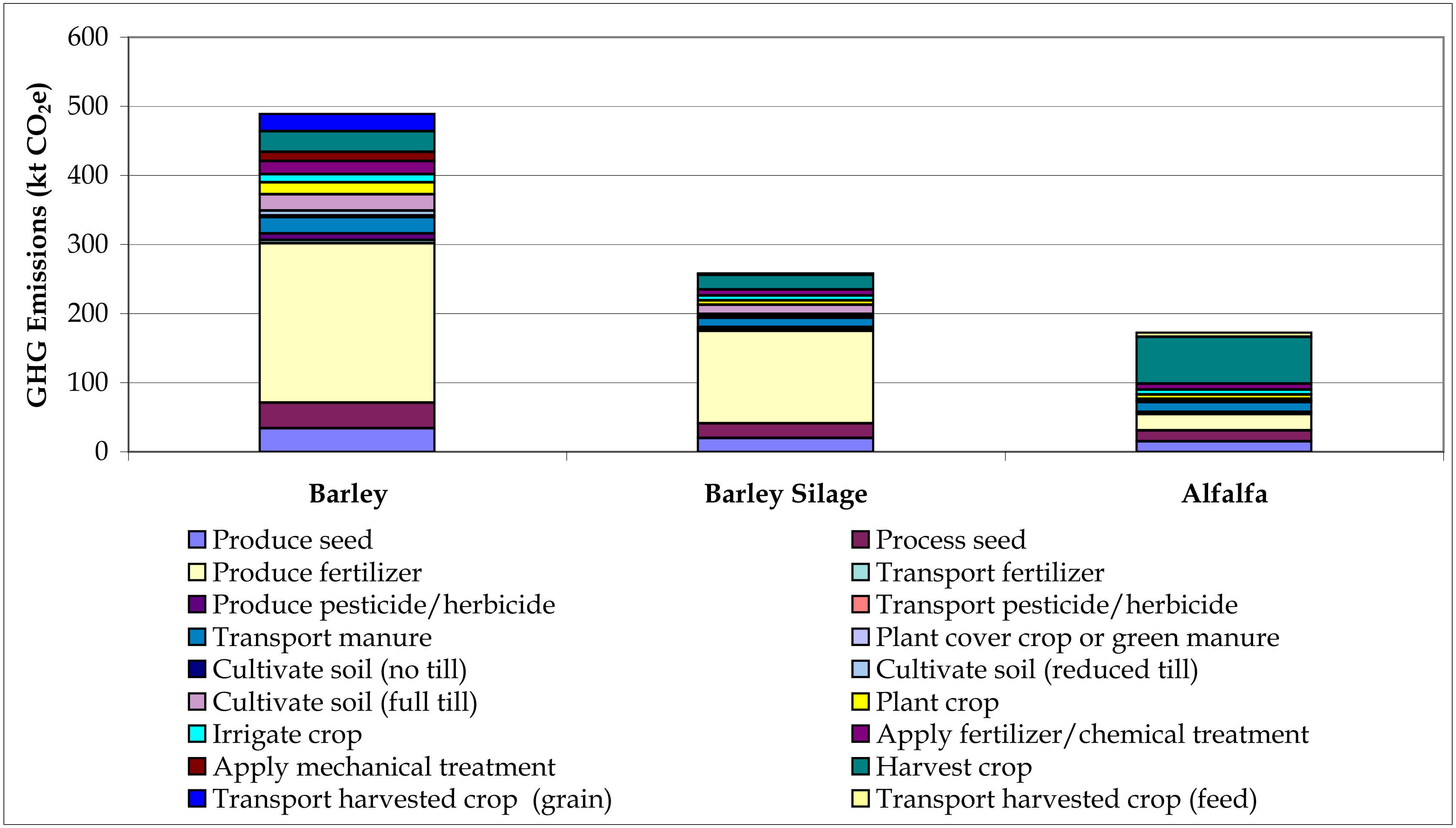

figure 5

GHG EMISSIONS - CEREAL AND FORAGE ACTIVITIES
(YEARLING-FED SYSTEM) PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
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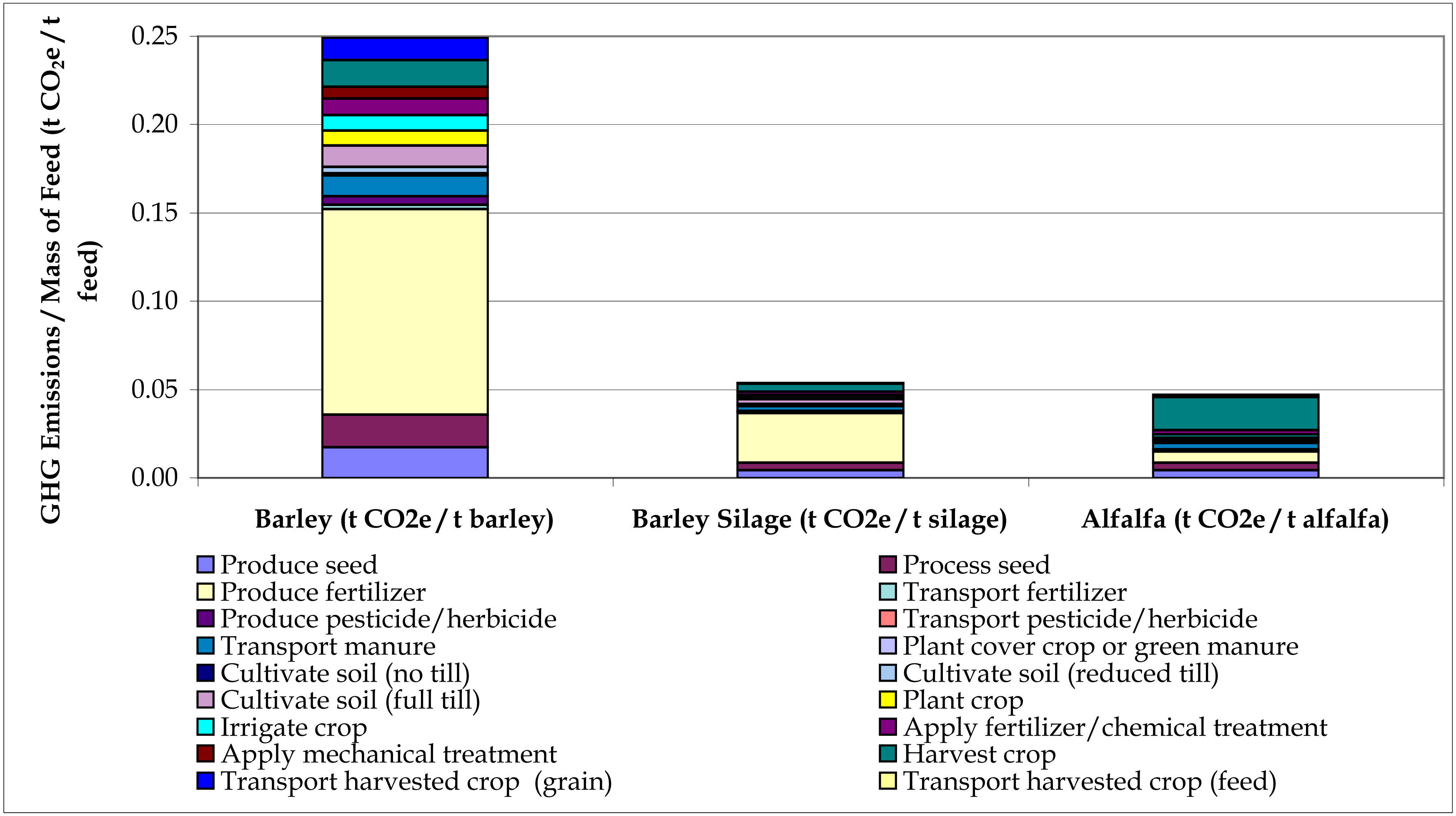

figure 6

TOTAL GHG EMISSIONS PER MASS OF FEED PER CALF CROP
CEREAL AND FORAGE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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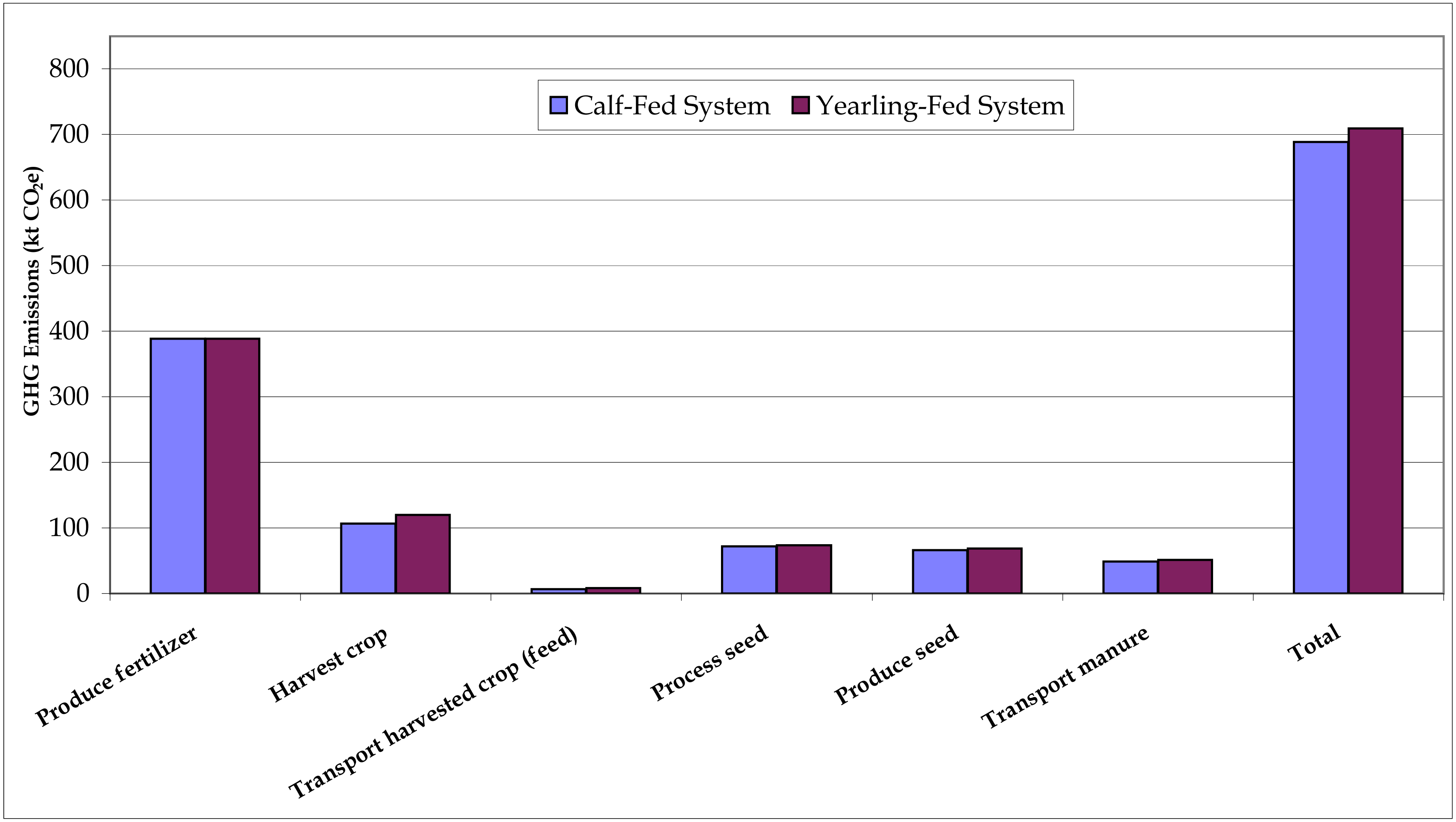

figure 7

GHG EMISSIONS PER CALF CROP - SUMMARY OF MAJOR CEREAL AND FORAGE COMPONENTS
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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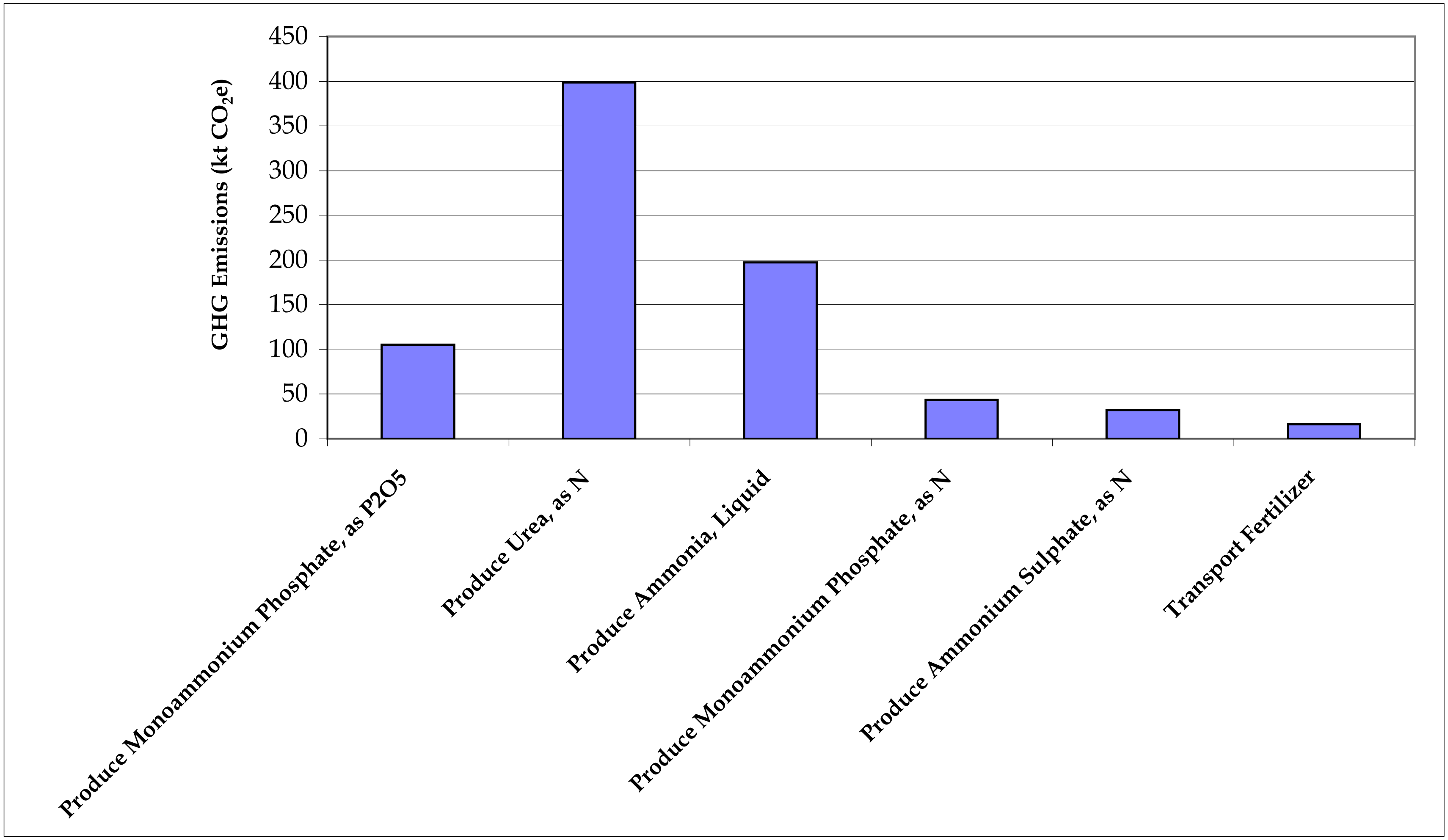

figure 8

GHG EMISSIONS PER CALF CROP - SUMMARY OF FERTILIZER SUB-CATEGORIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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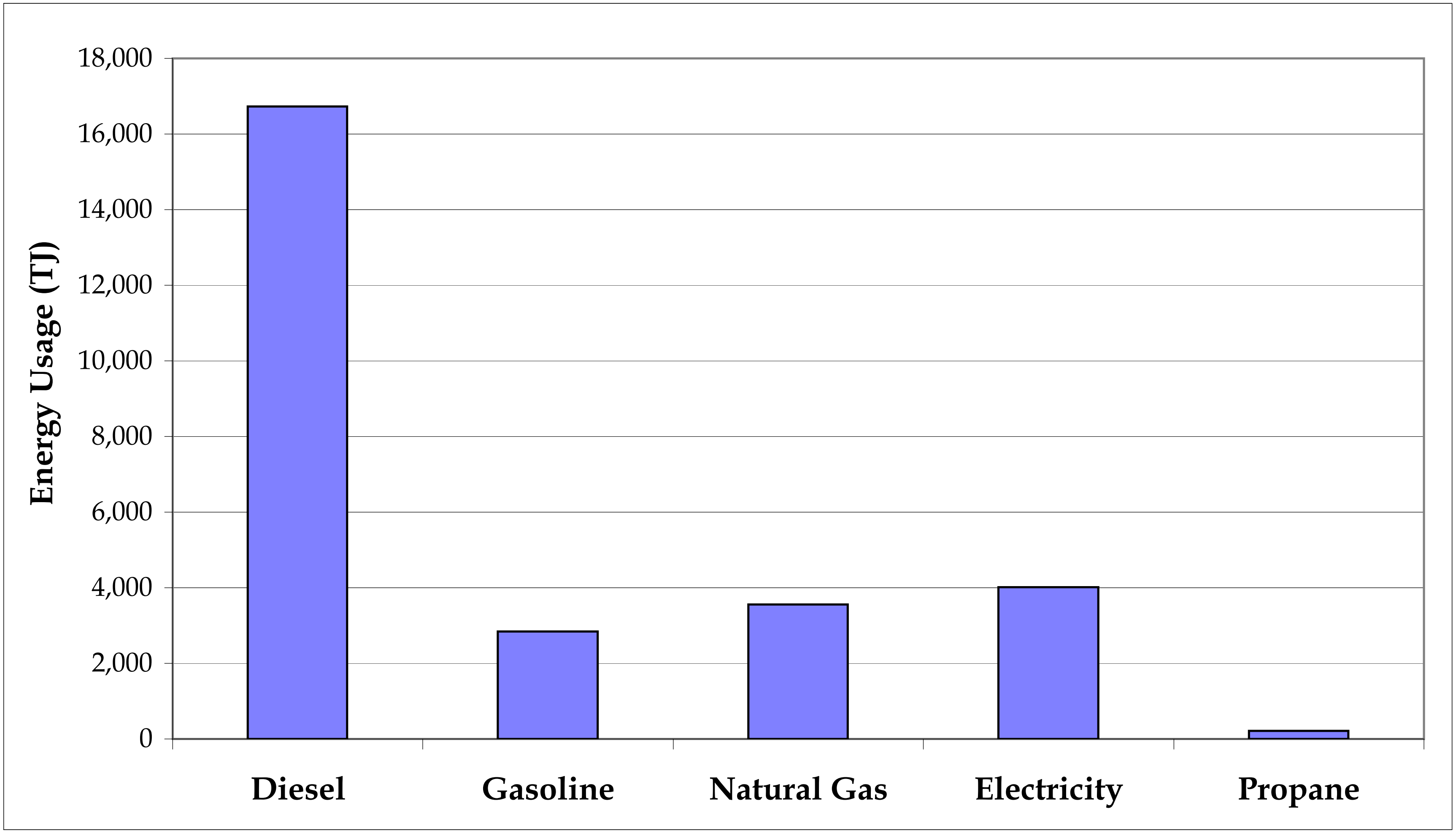

figure 9

TOTAL ON-FARM ENERGY USAGE FOR ALBERTA BEEF FARMS PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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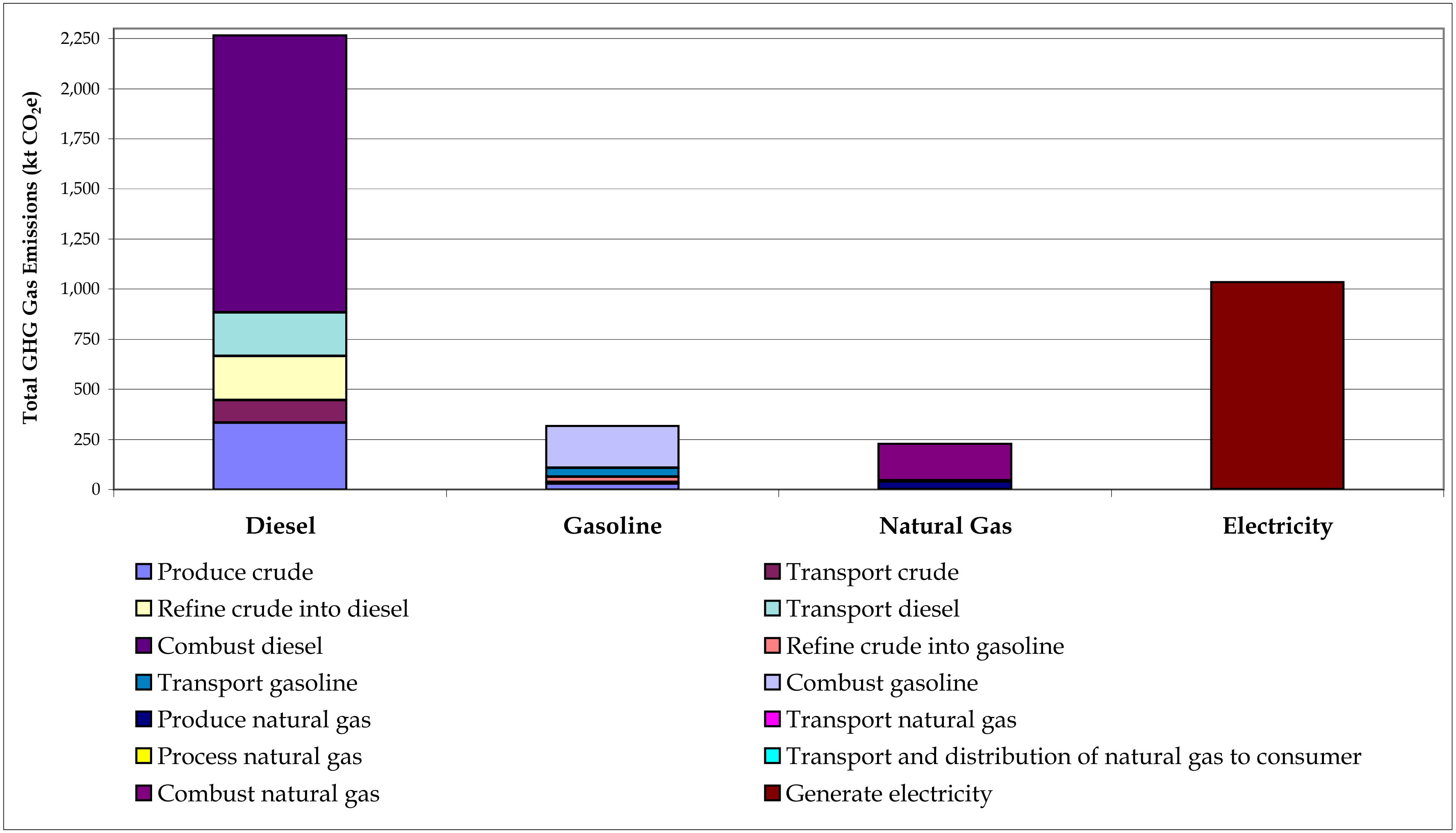

figure 10

TOTAL GHG EMISSIONS PER CALF CROP - ENERGY USAGE
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

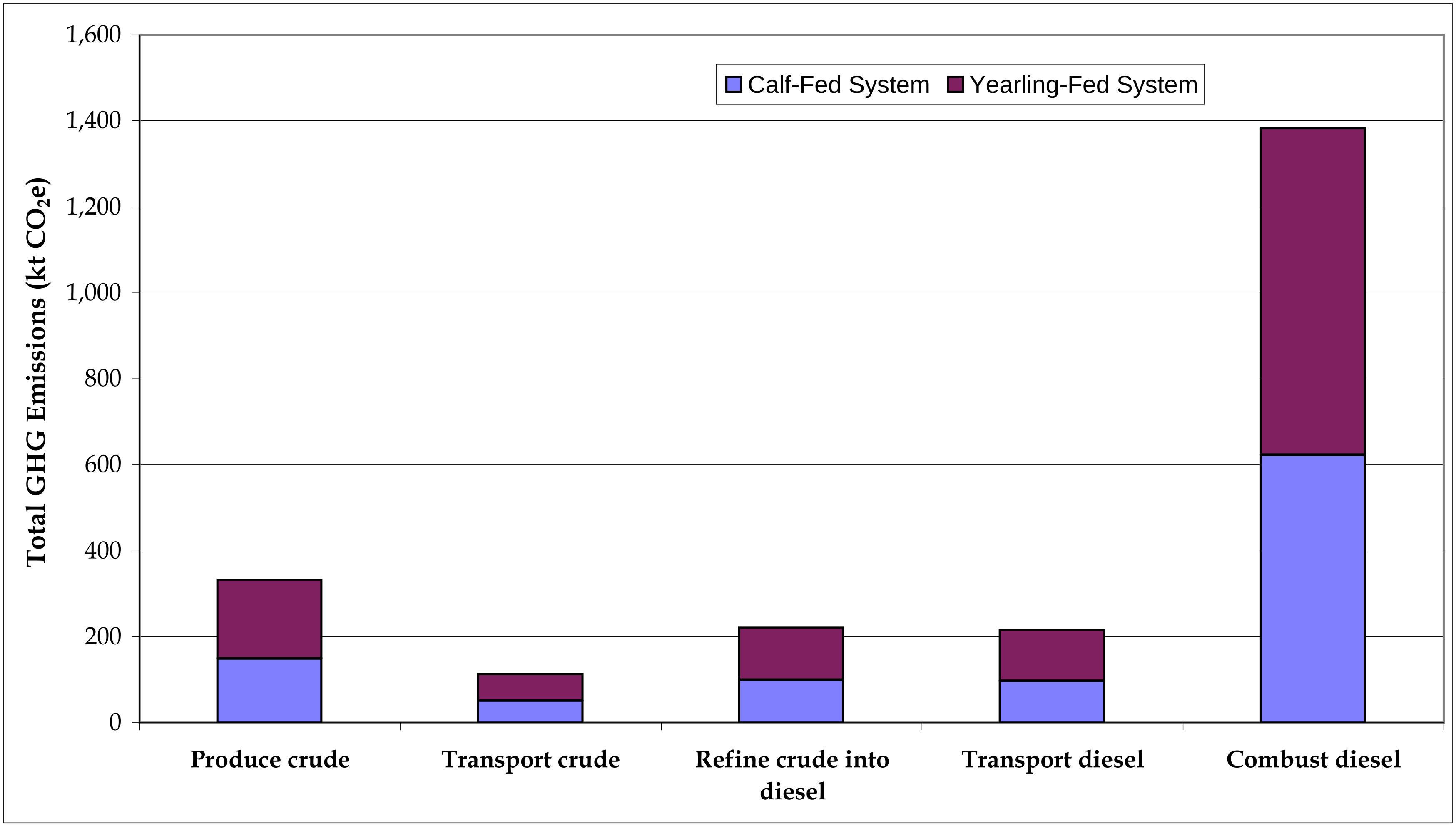

figure 11

TOTAL GHG EMISSIONS PER CALF CROP - SUMMARY OF DIESEL SUB-CATEGORIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

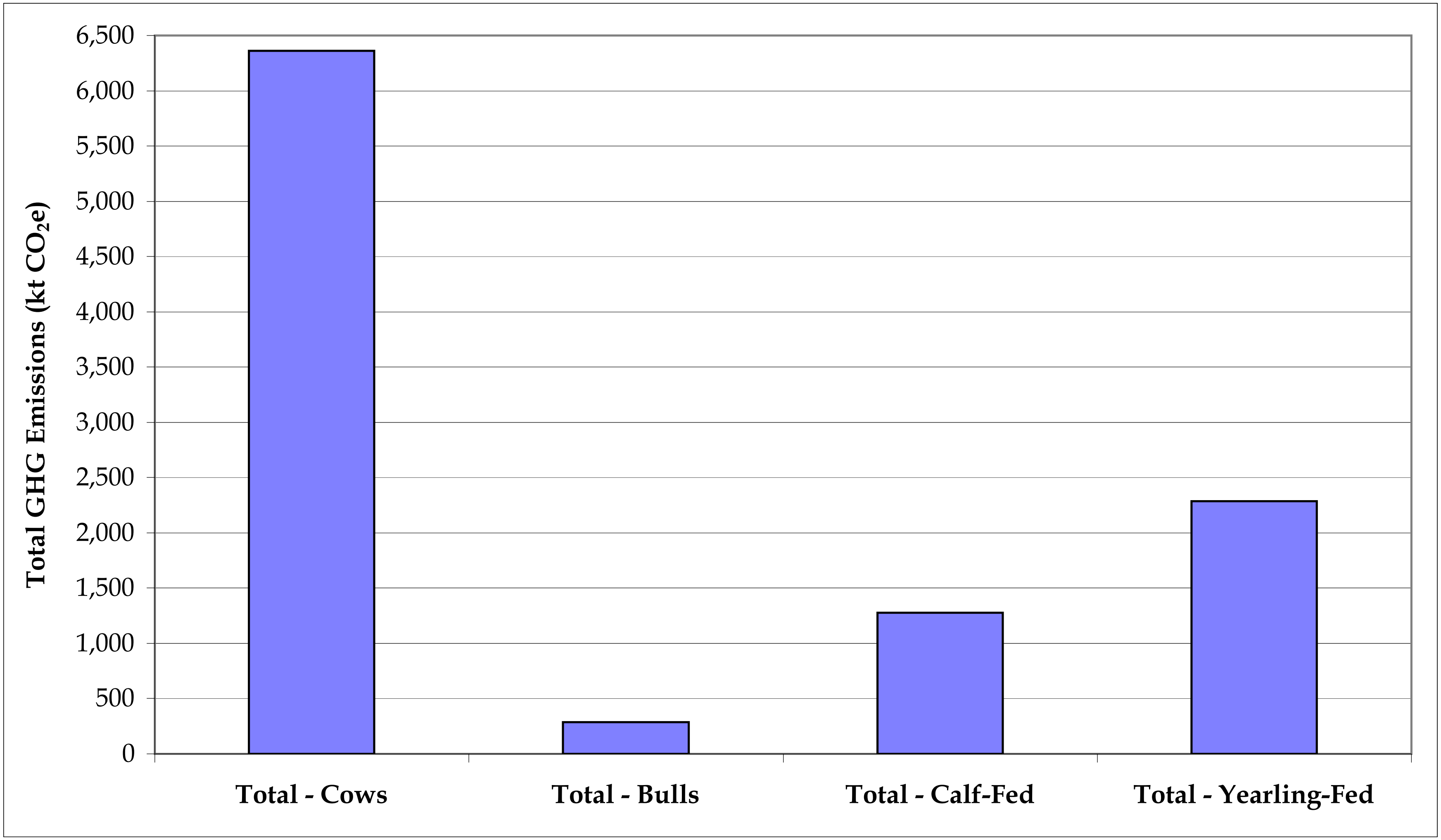

figure 12

TOTAL GHG EMISSIONS FROM ENTERIC FERMENTATION - PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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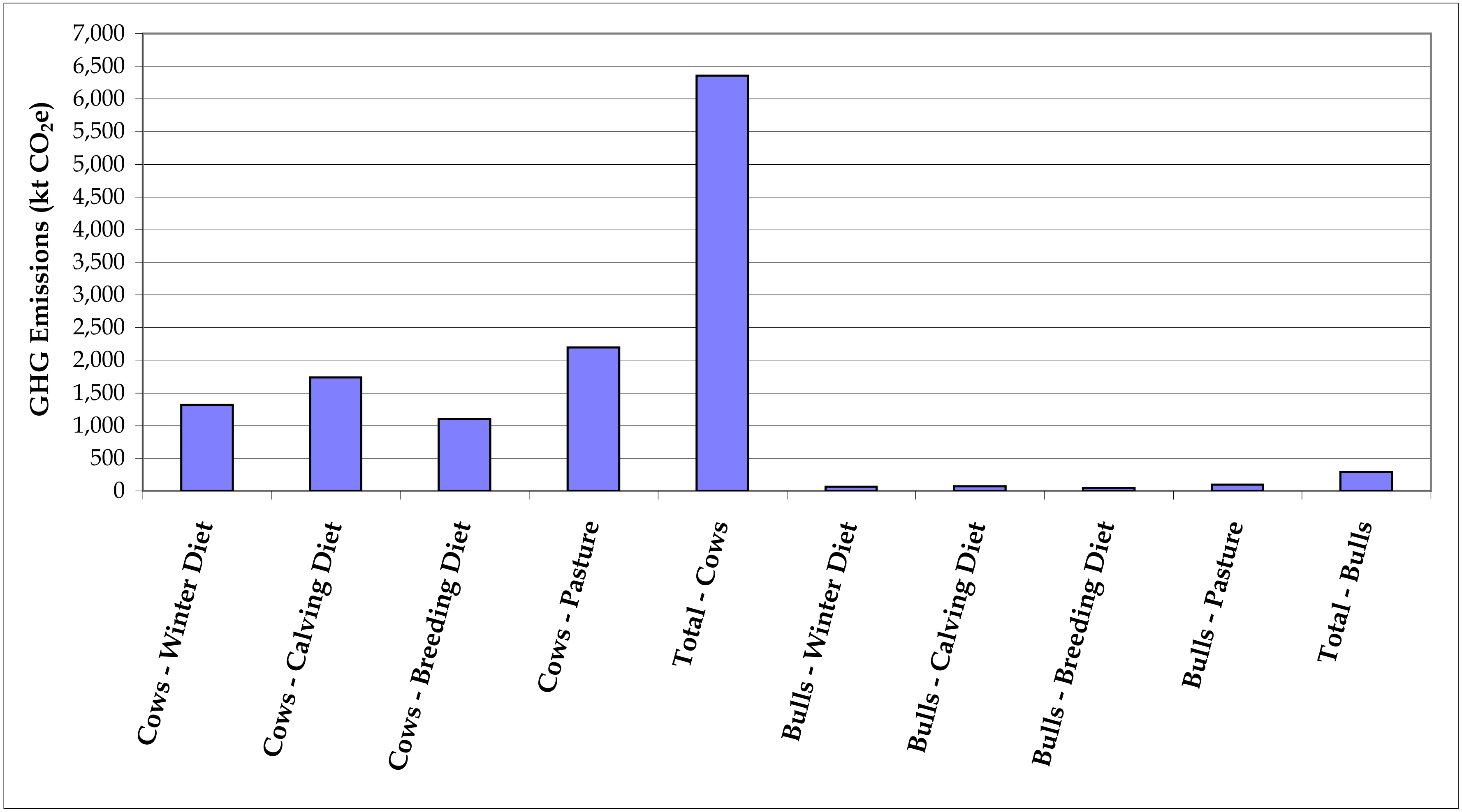

figure 13

TOTAL GHG EMISSIONS FROM ENTERIC FERMENTATION - COWS AND BULLS
PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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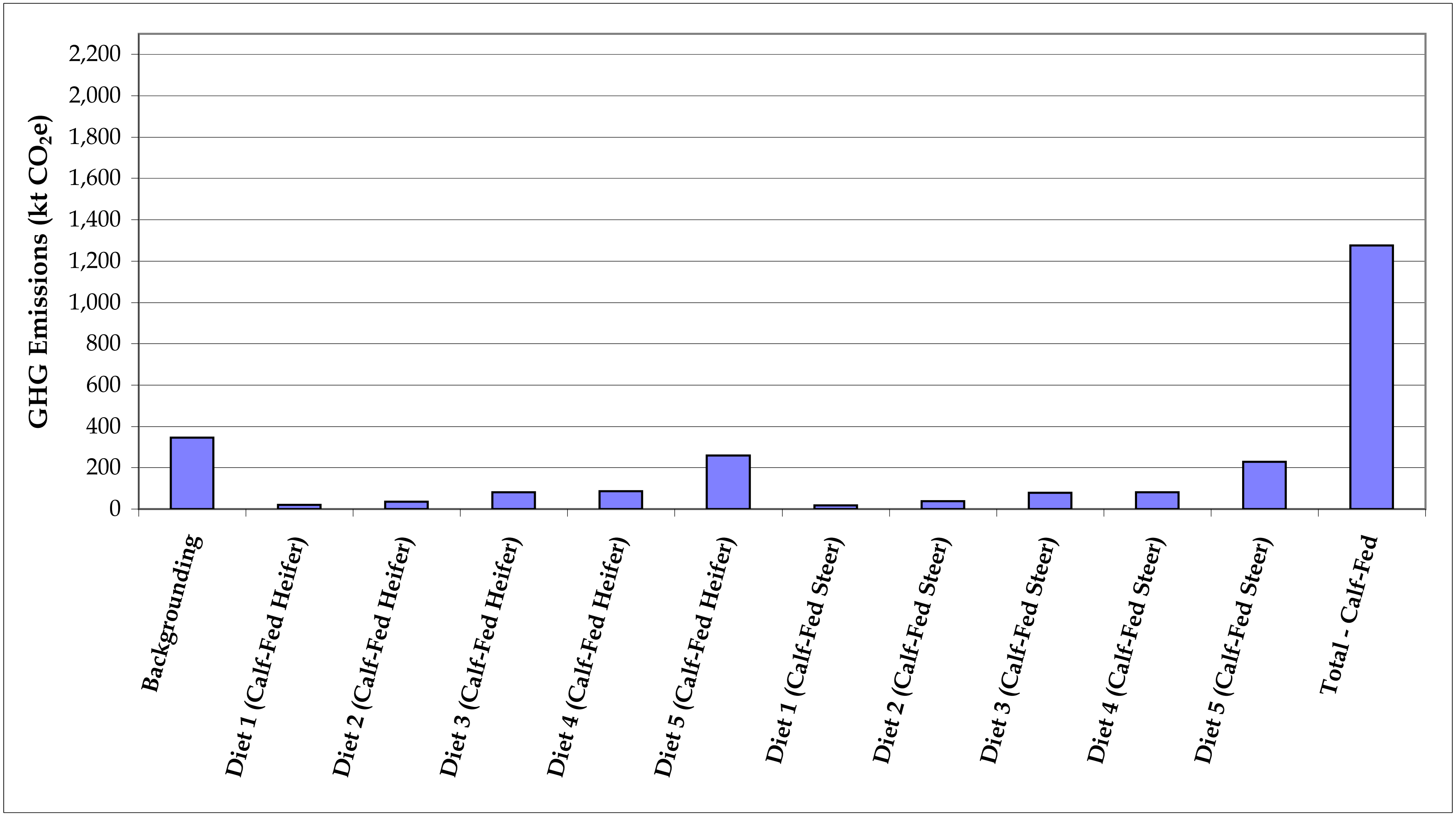

figure 14

TOTAL GHG EMISSIONS FROM ENTERIC FERMENTATION - CALF-FED SYSTEM
PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
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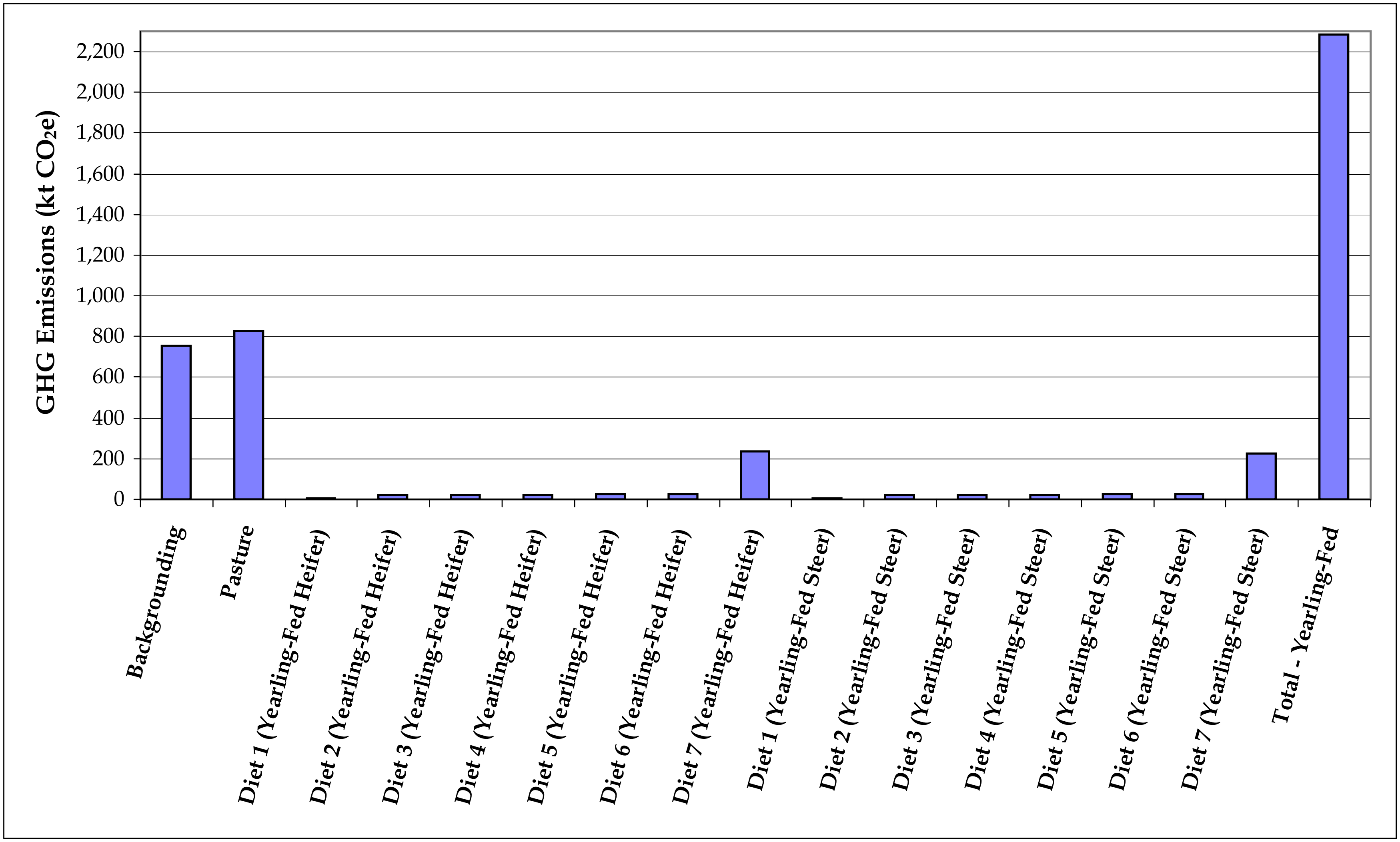

figure 15

TOTAL GHG EMISSIONS FROM ENTERIC FERMENTATION - YEARLING-FED SYSTEM
PER CALF CROP
LIFE CYCLE ASSESSMENT - BEEF
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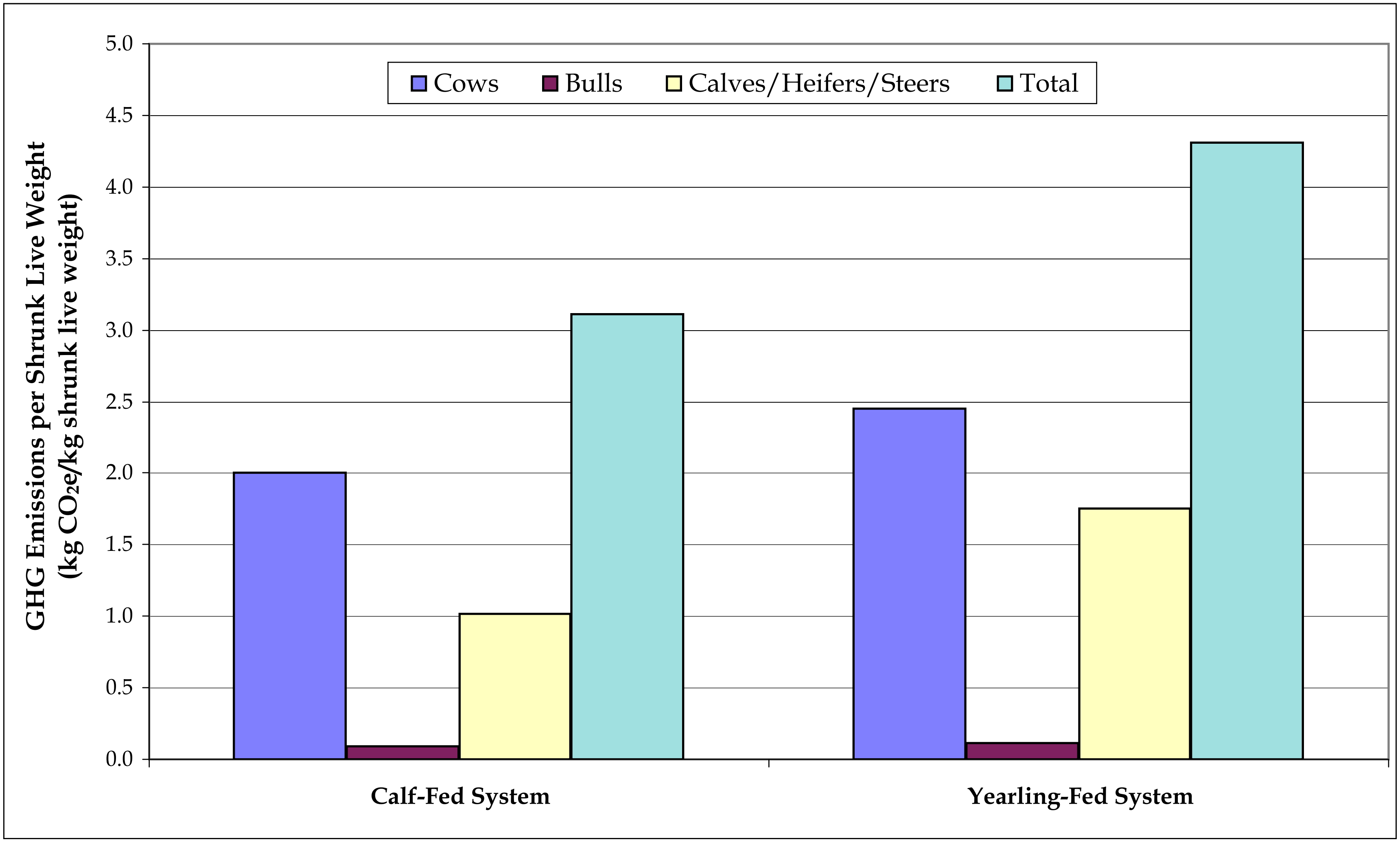

figure 16

GHG EMISSIONS FROM ENTERIC FERMENTATION - CALF-FED AND YEARLING-FED SYSTEMS PER CALF CROP

LIFE CYCLE ASSESSMENT - BEEF

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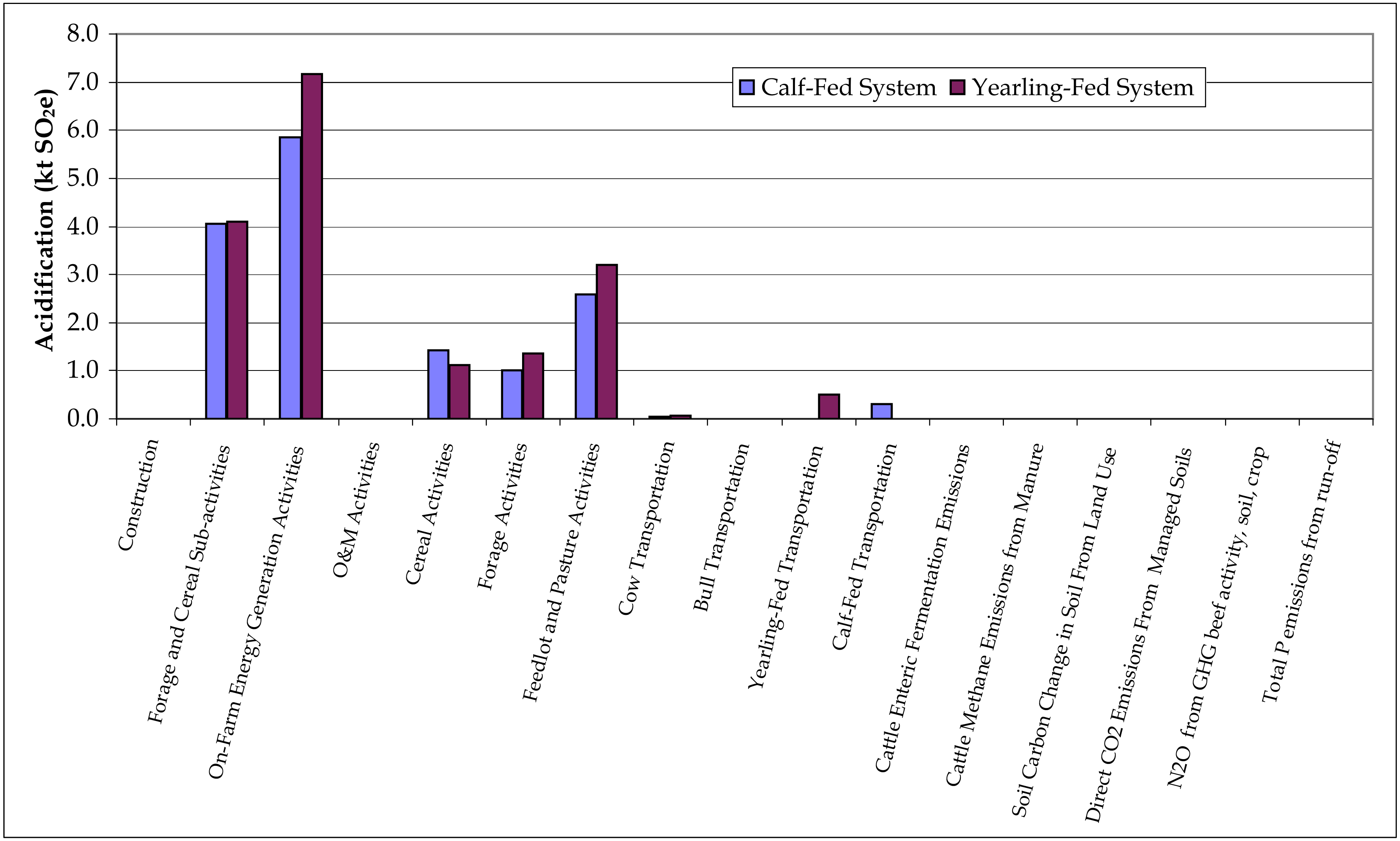

figure 17

CONTRIBUTION OF ACTIVITIES TO AQUATIC ACIDIFICATION EFFECT
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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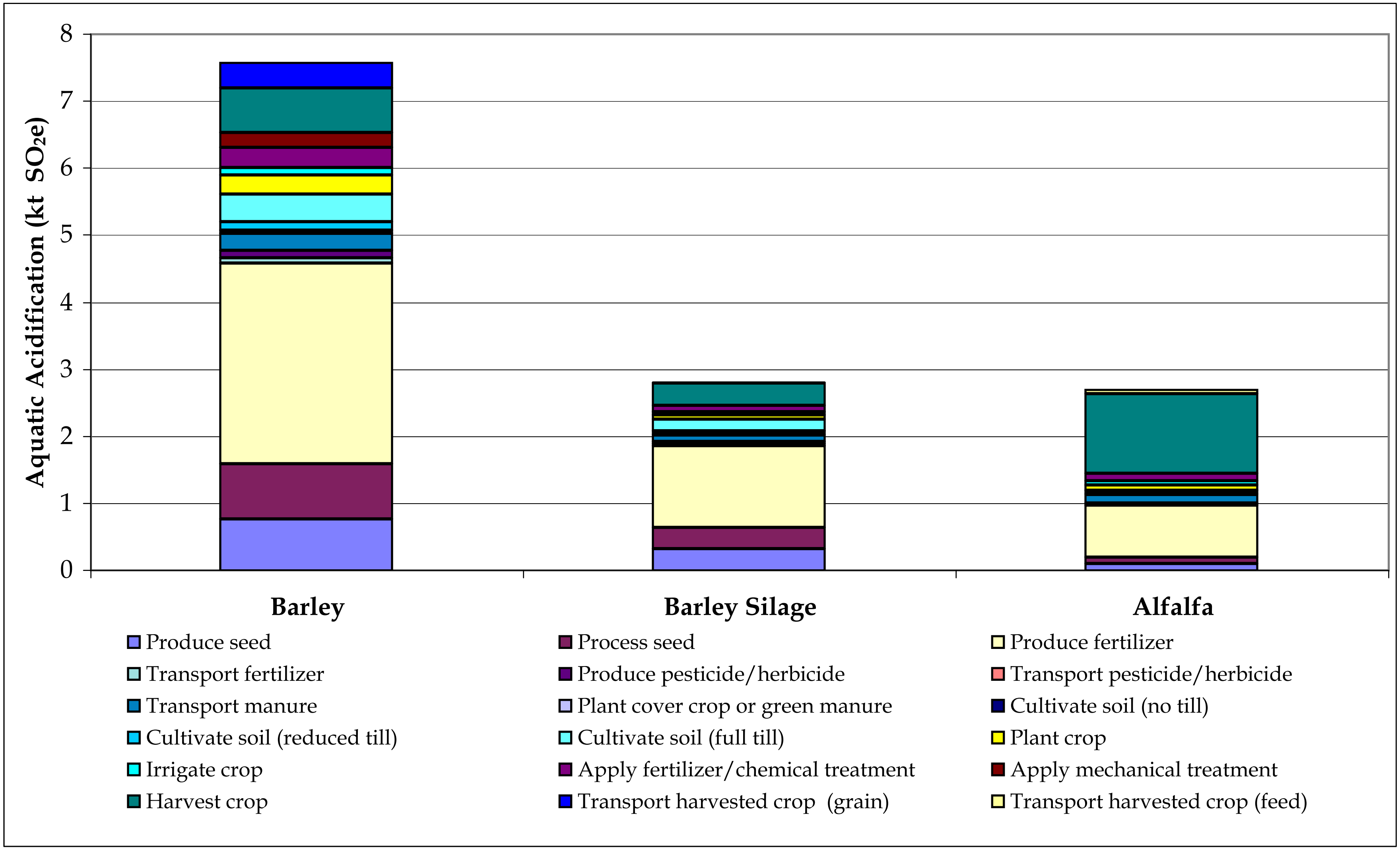

figure 18

TOTAL AQUATIC ACIDIFICATION EMISSIONS PER CALF CROP
CEREAL AND FORAGE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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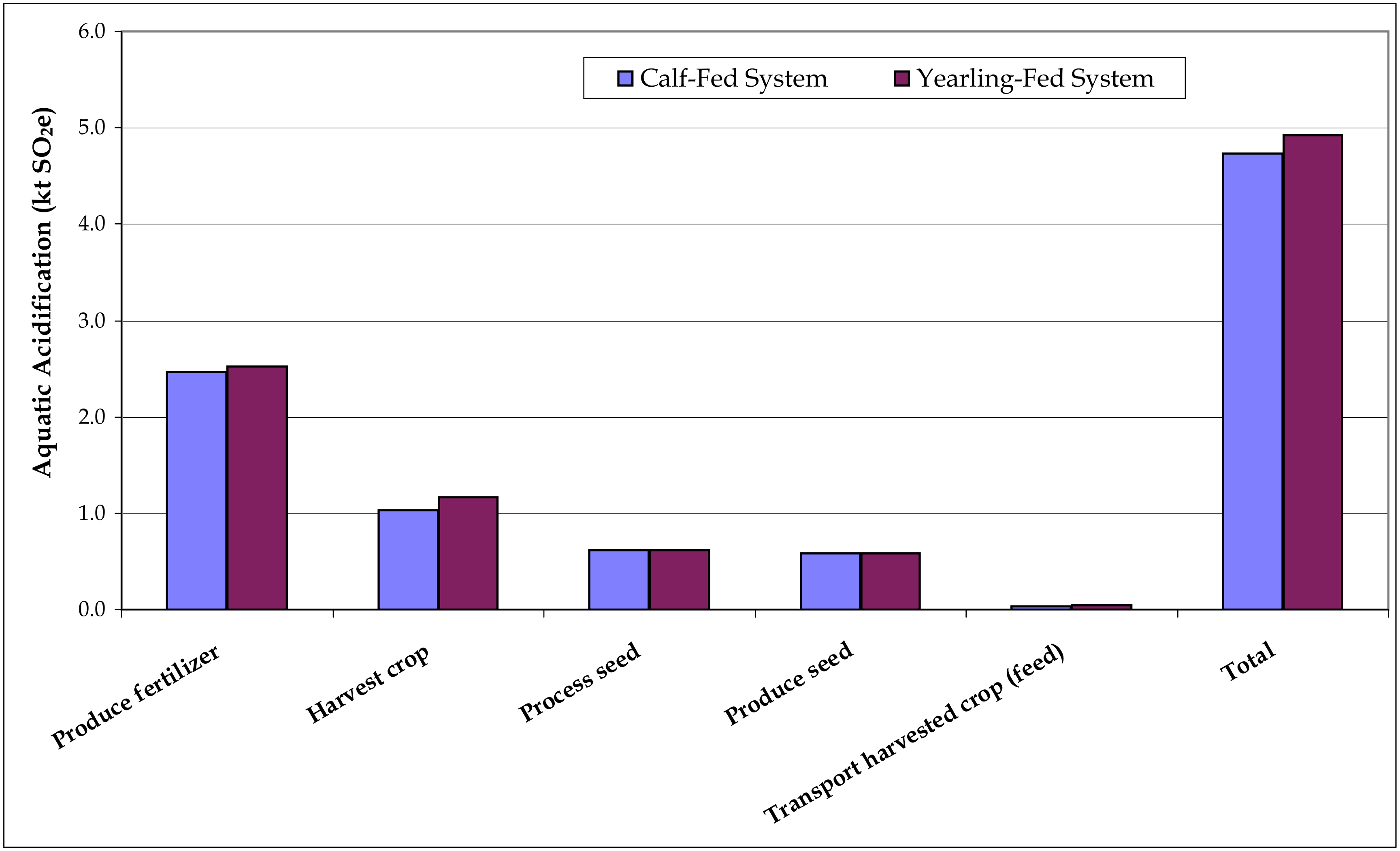

figure 19

AQUATIC ACIDIFICATION EMISSIONS PER CALF CROP - SUMMARY OF MAJOR CEREAL AND FORAGE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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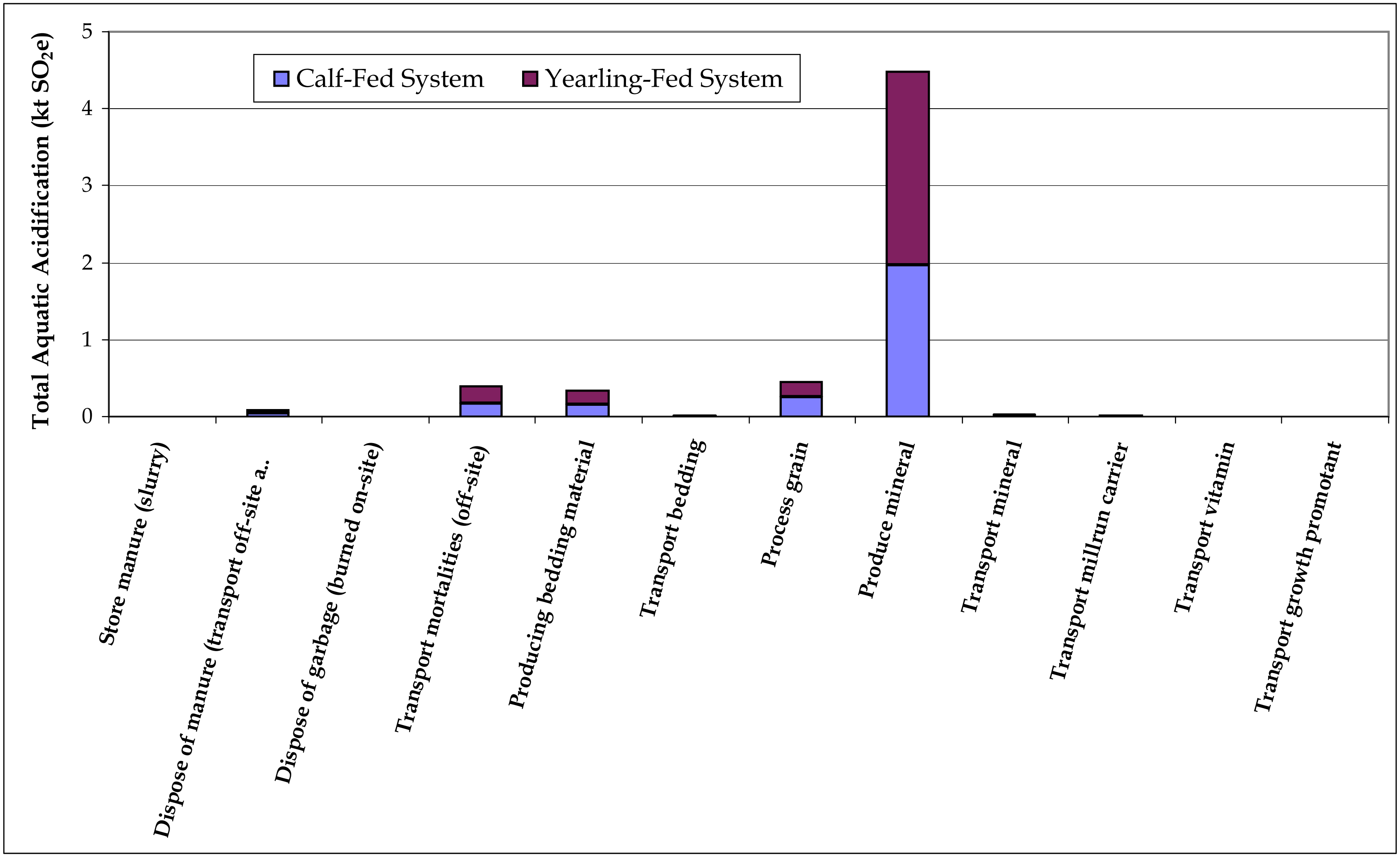

figure 20

TOTAL AQUATIC ACIDIFICATION EMISSIONS PER CALF CROP
FEEDLOT AND PASTURE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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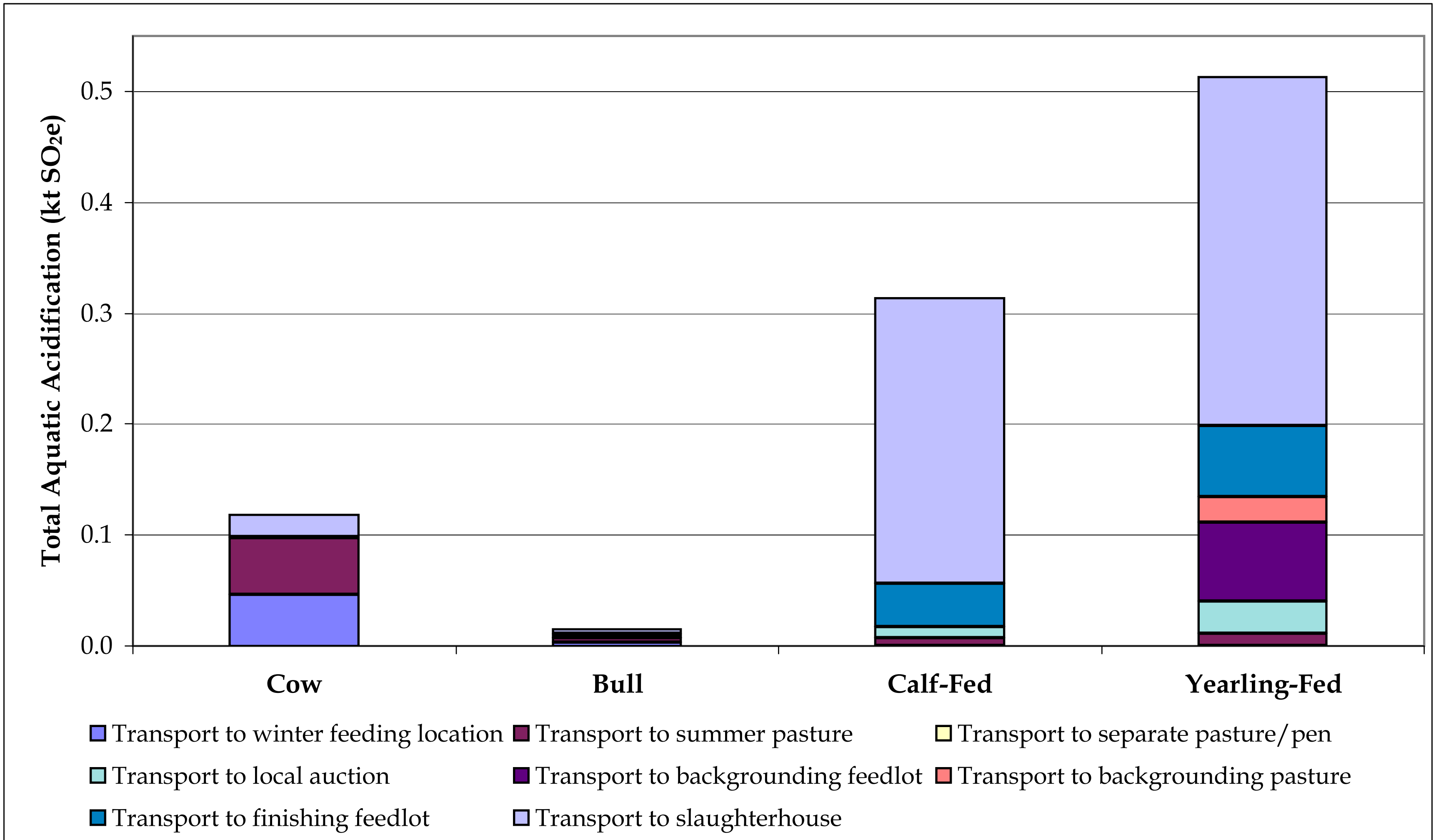

figure 21

TOTAL AQUATIC ACIDIFICATION EMISSIONS PER CALF CROP
CATTLE TRANSPORTATION
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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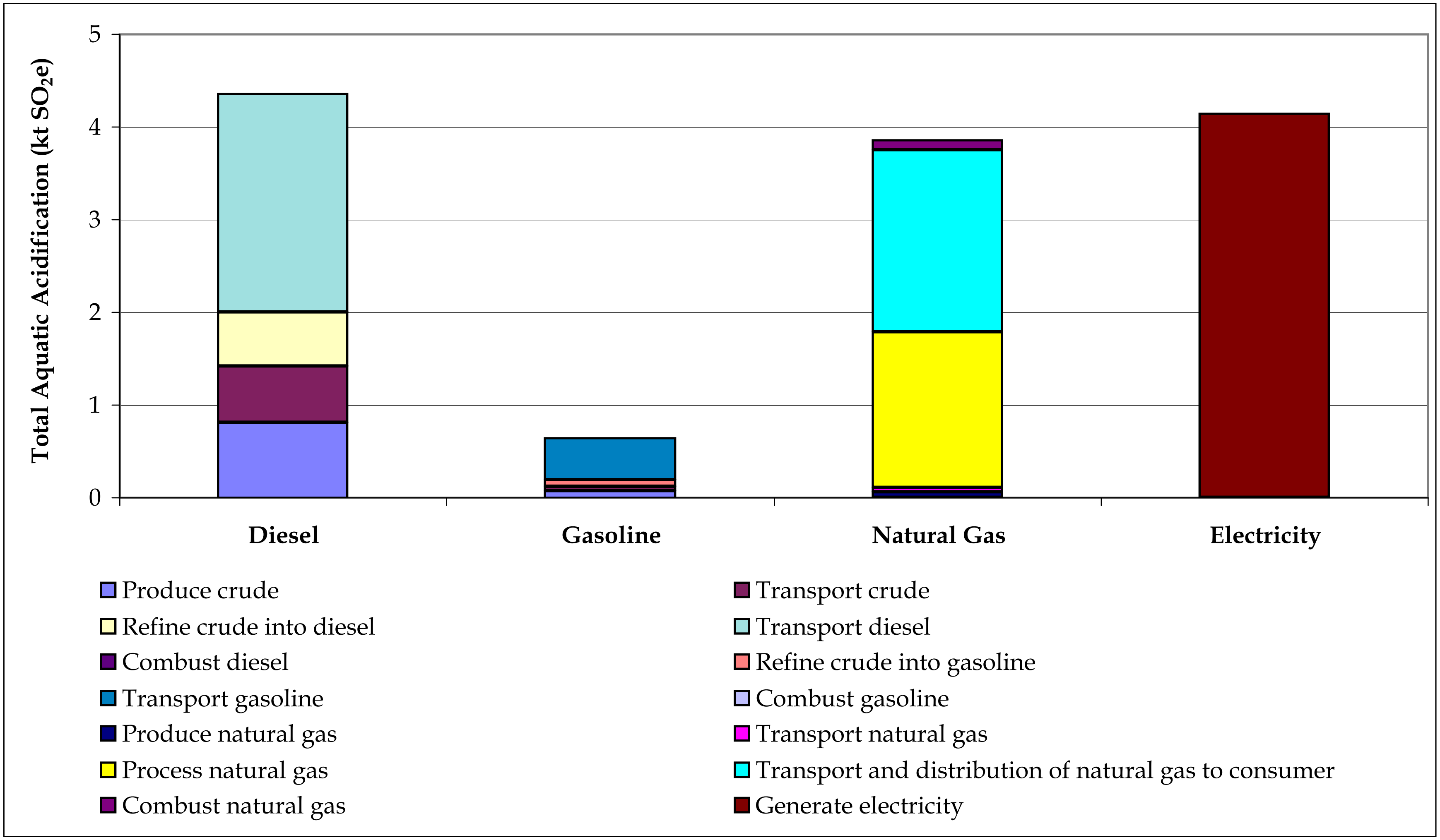

figure 22

TOTAL AQUATIC ACIDIFICATION EMISSIONS PER CALF CROP
ENERGY CONSUMPTION
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

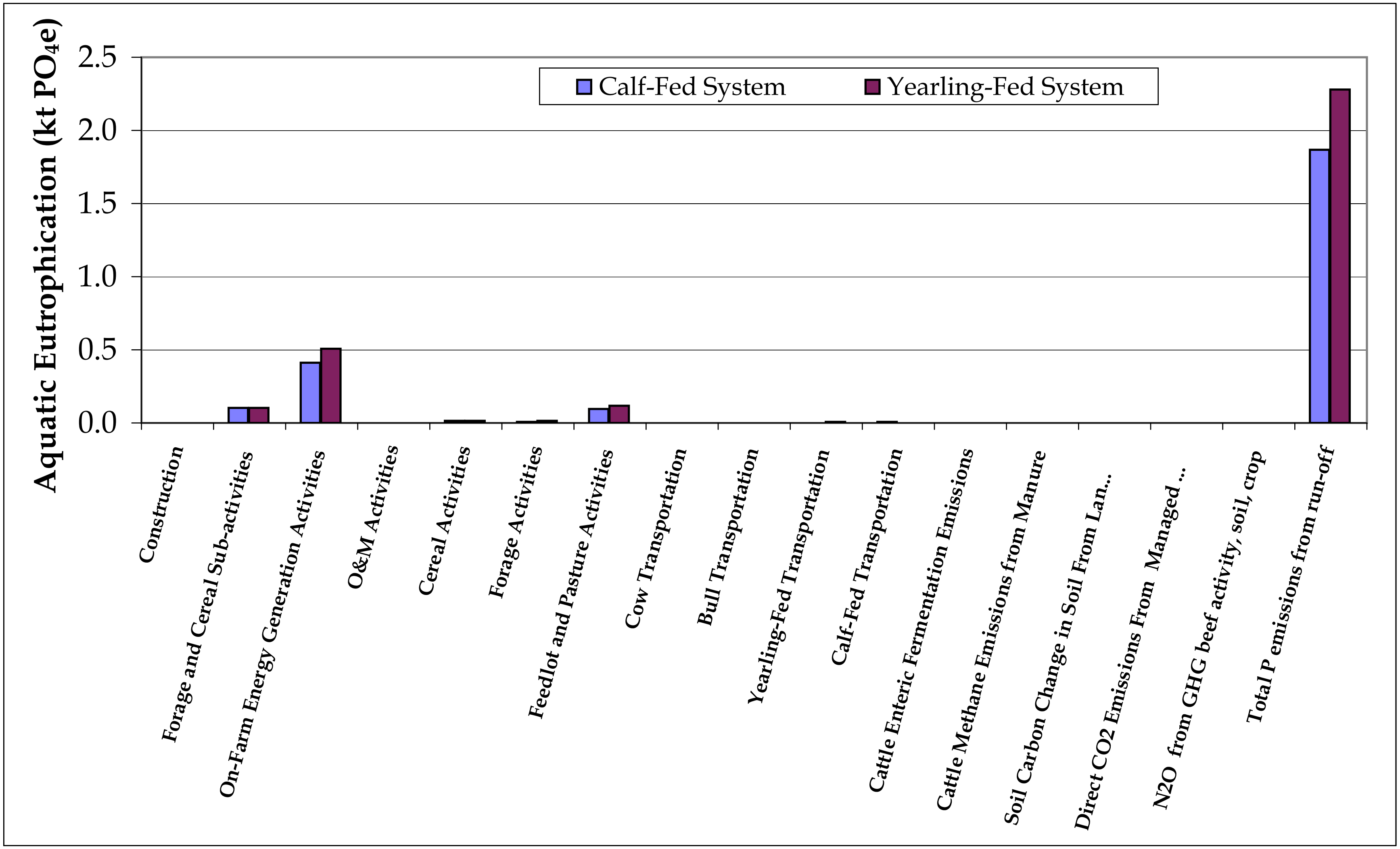

figure 23

CONTRIBUTION OF ACTIVITIES TO AQUATIC EUTROPHICATION EFFECT
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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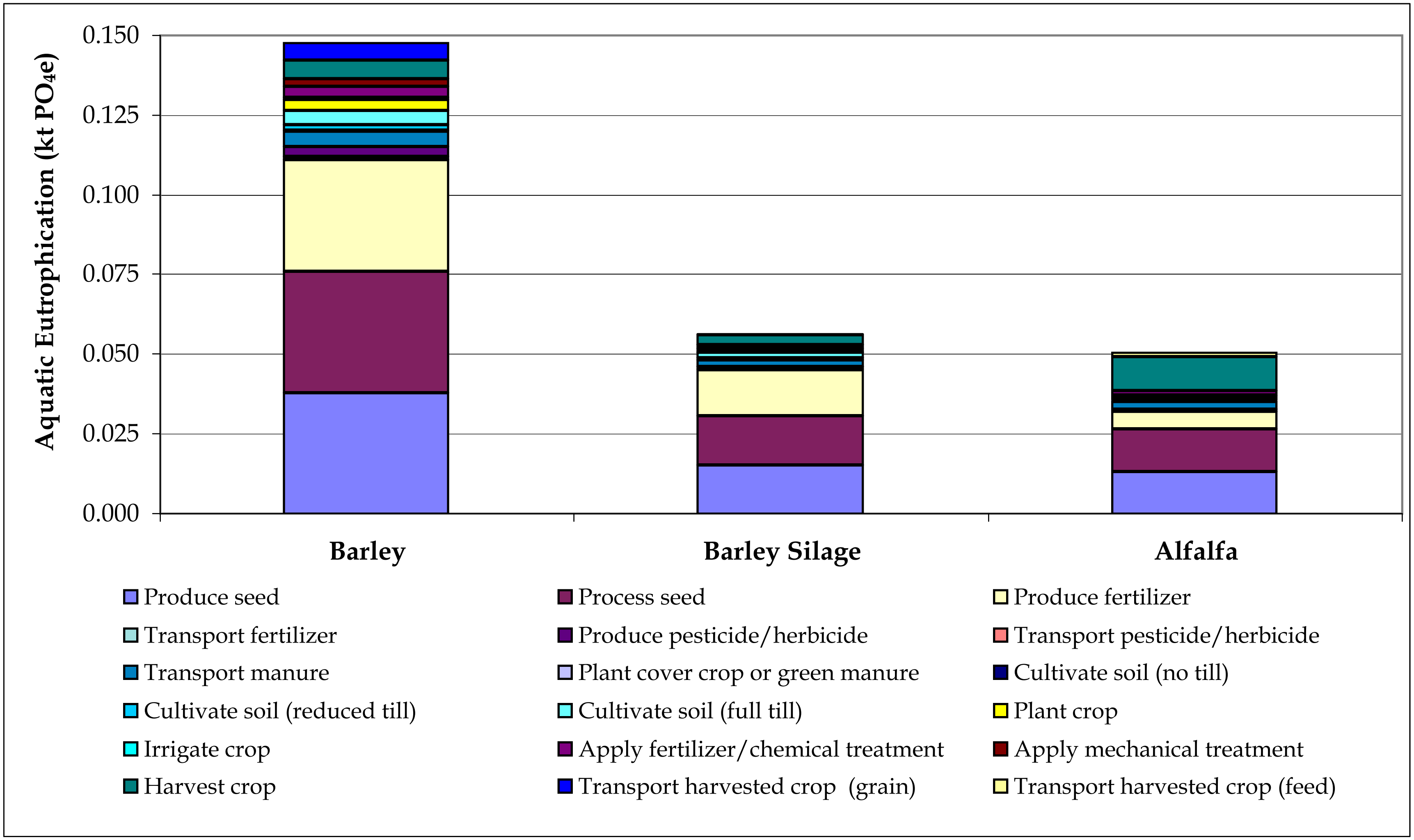

figure 24

TOTAL AQUATIC EUTROPHICATION EMISSIONS PER CALF CROP
CEREAL AND FORAGE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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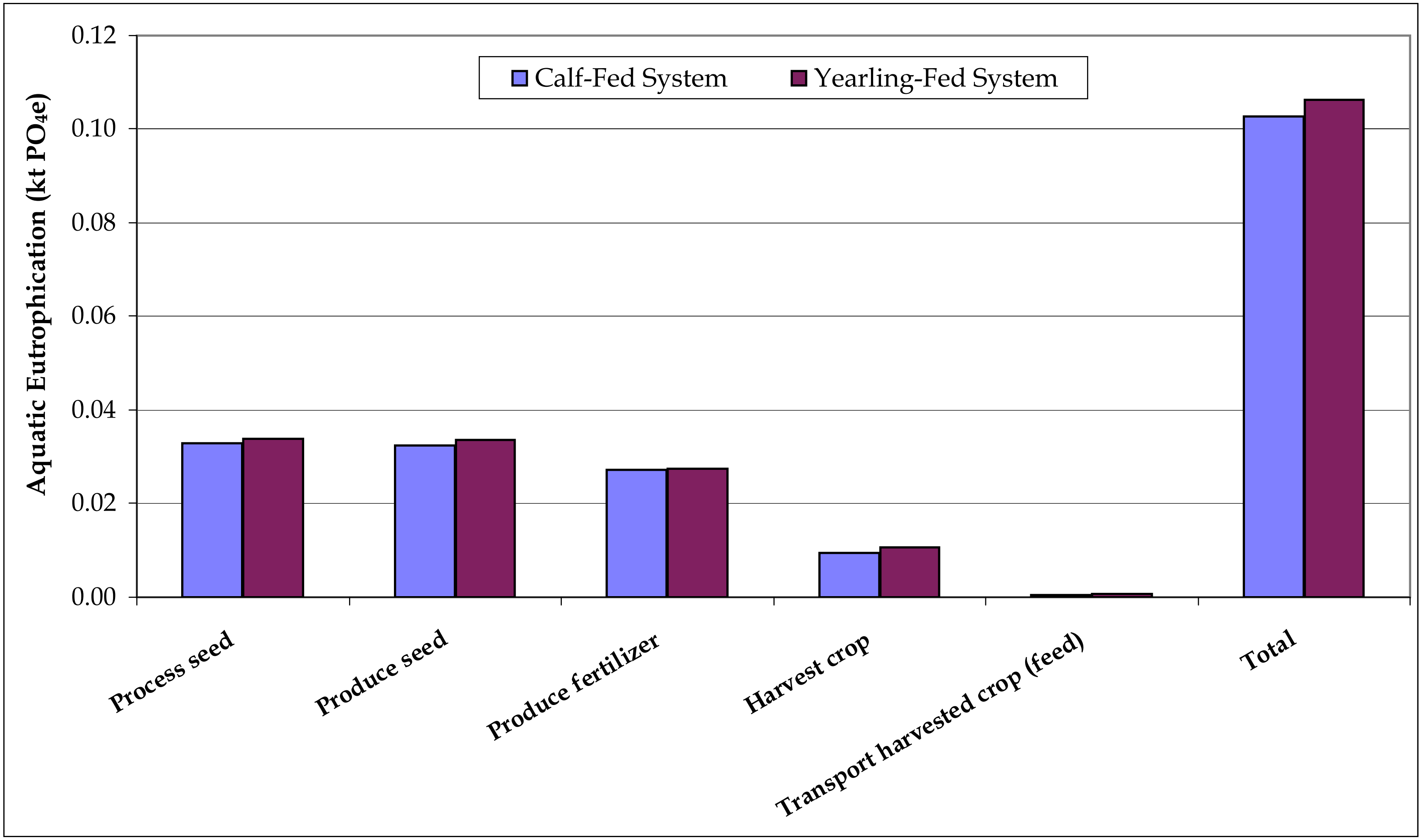

figure 25

AQUATIC EUTROPHICATION EMISSIONS PER CALF CROP - SUMMARY OF MAJOR CEREAL AND FORAGE COMPONENTS
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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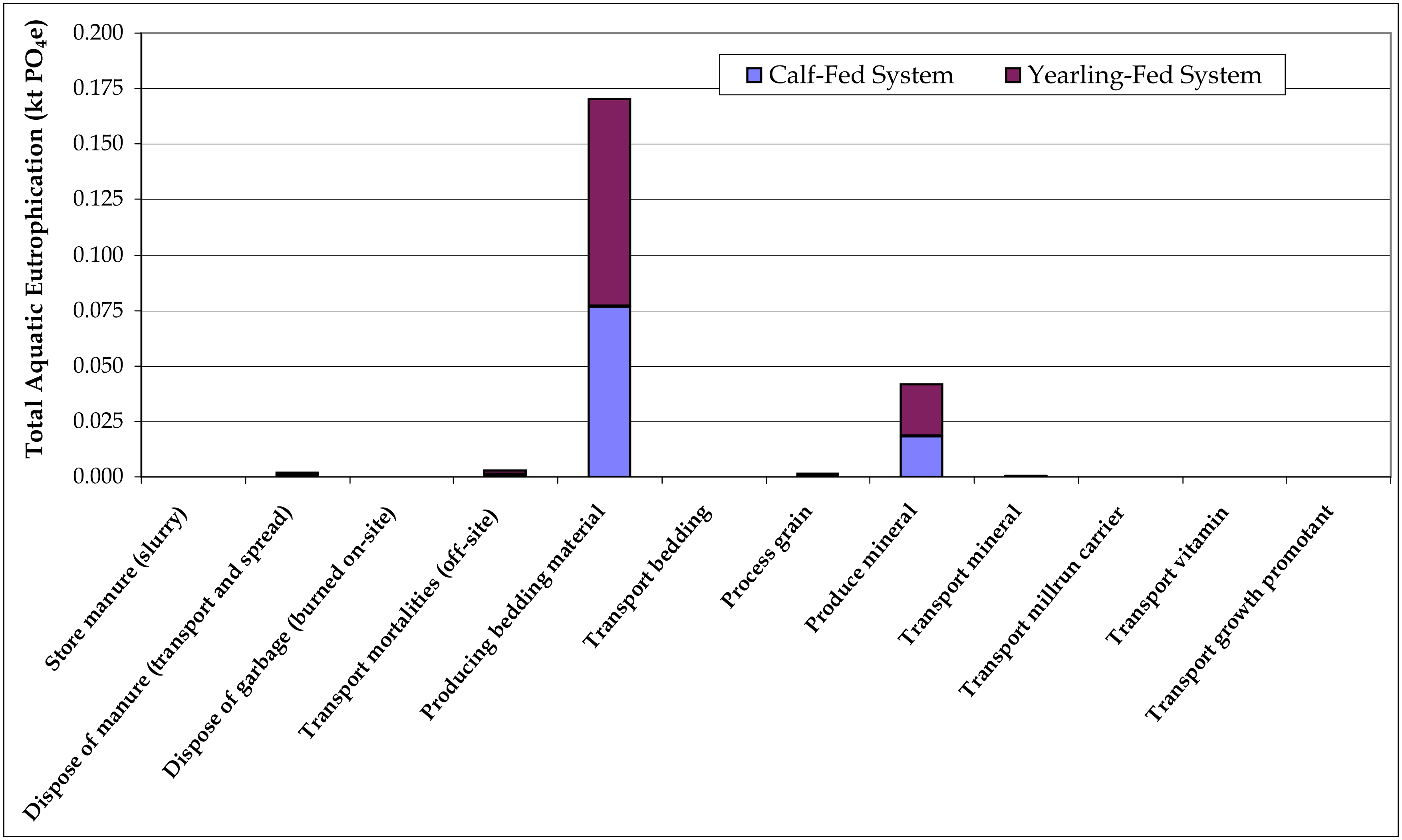

figure 26

TOTAL AQUATIC EUTROPHICATION EMISSIONS PER CALF CROP
FEEDLOT AND PASTURE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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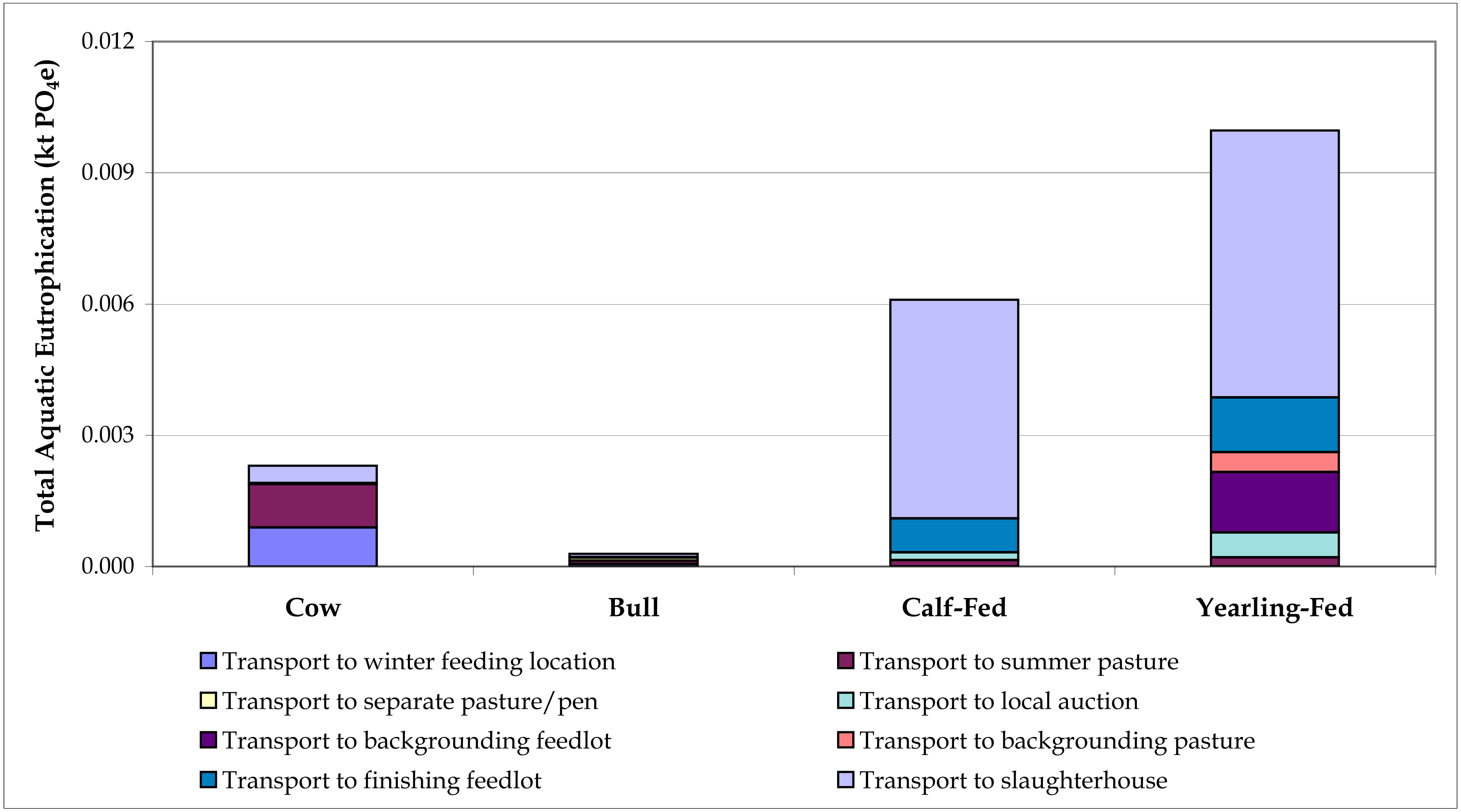

figure 27

TOTAL AQUATIC EUTROPHICATION EMISSIONS PER CALF CROP
CATTLE TRANSPORTATION
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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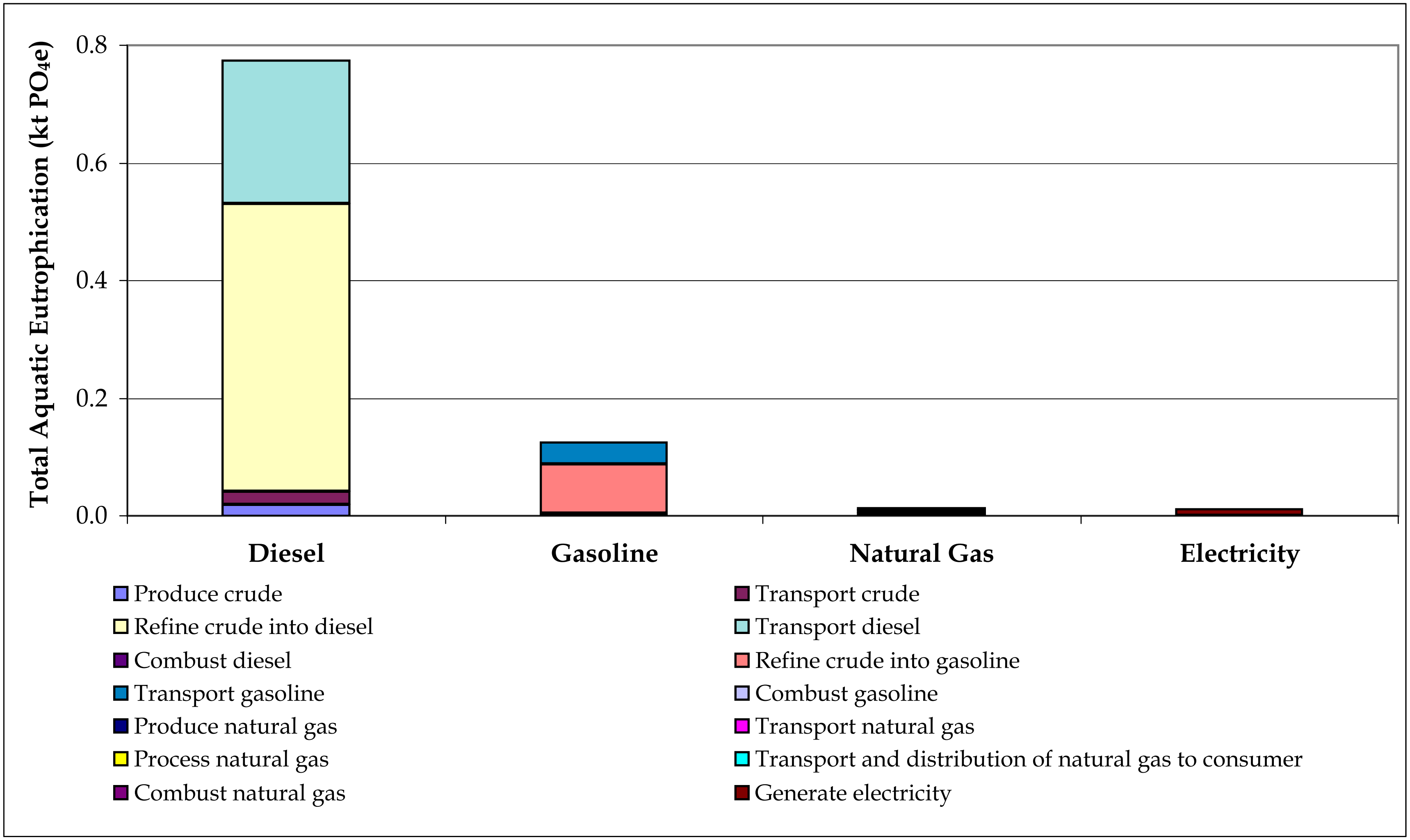

figure 28

TOTAL AQUATIC EUTROPHICATION EMISSIONS PER CALF CROP
ENERGY CONSUMPTION
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

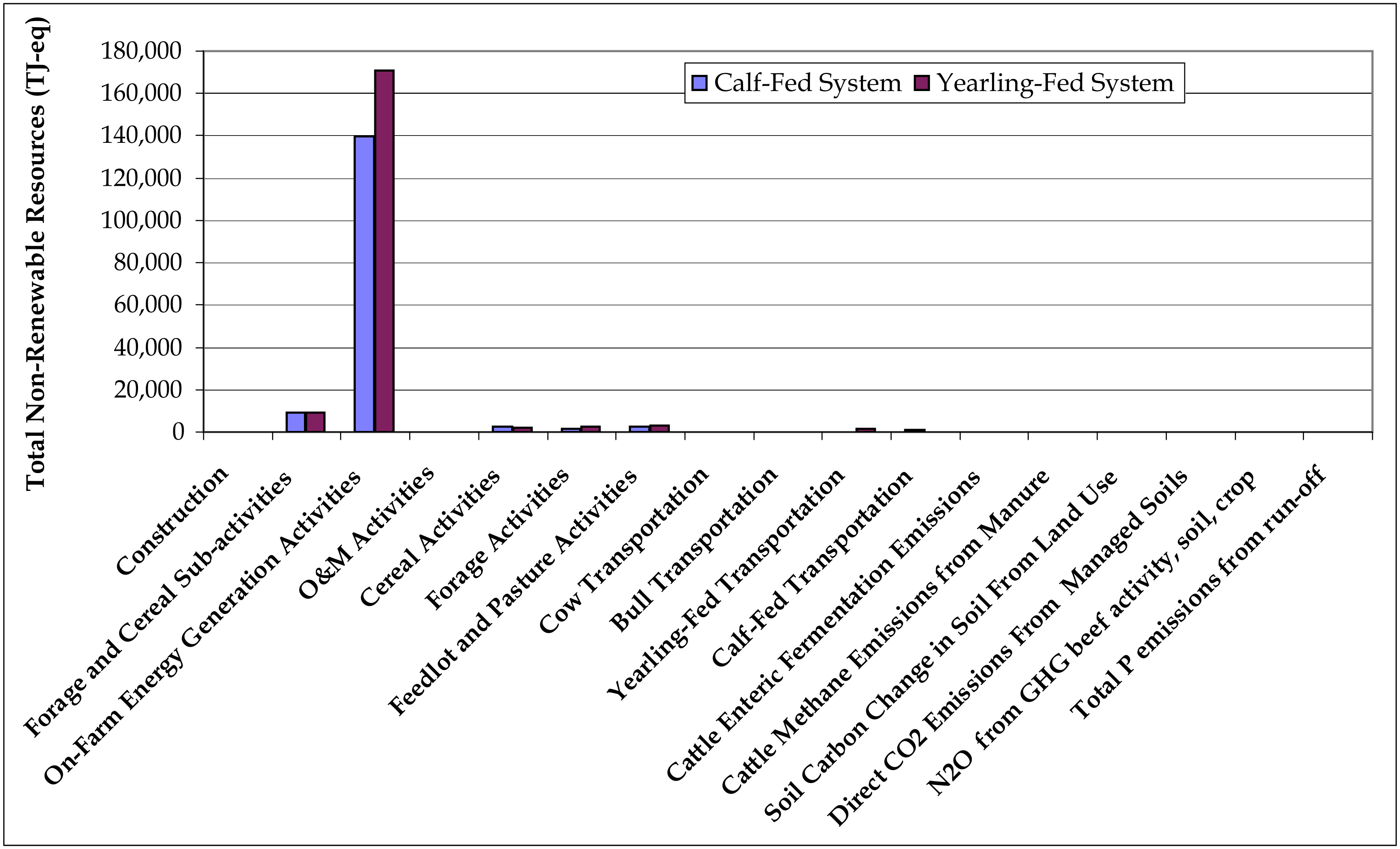

figure 29

CONTRIBUTION OF ACTIVITIES TO NON-RENEWABLE
ENERGY CONSUMPTION EFFECT
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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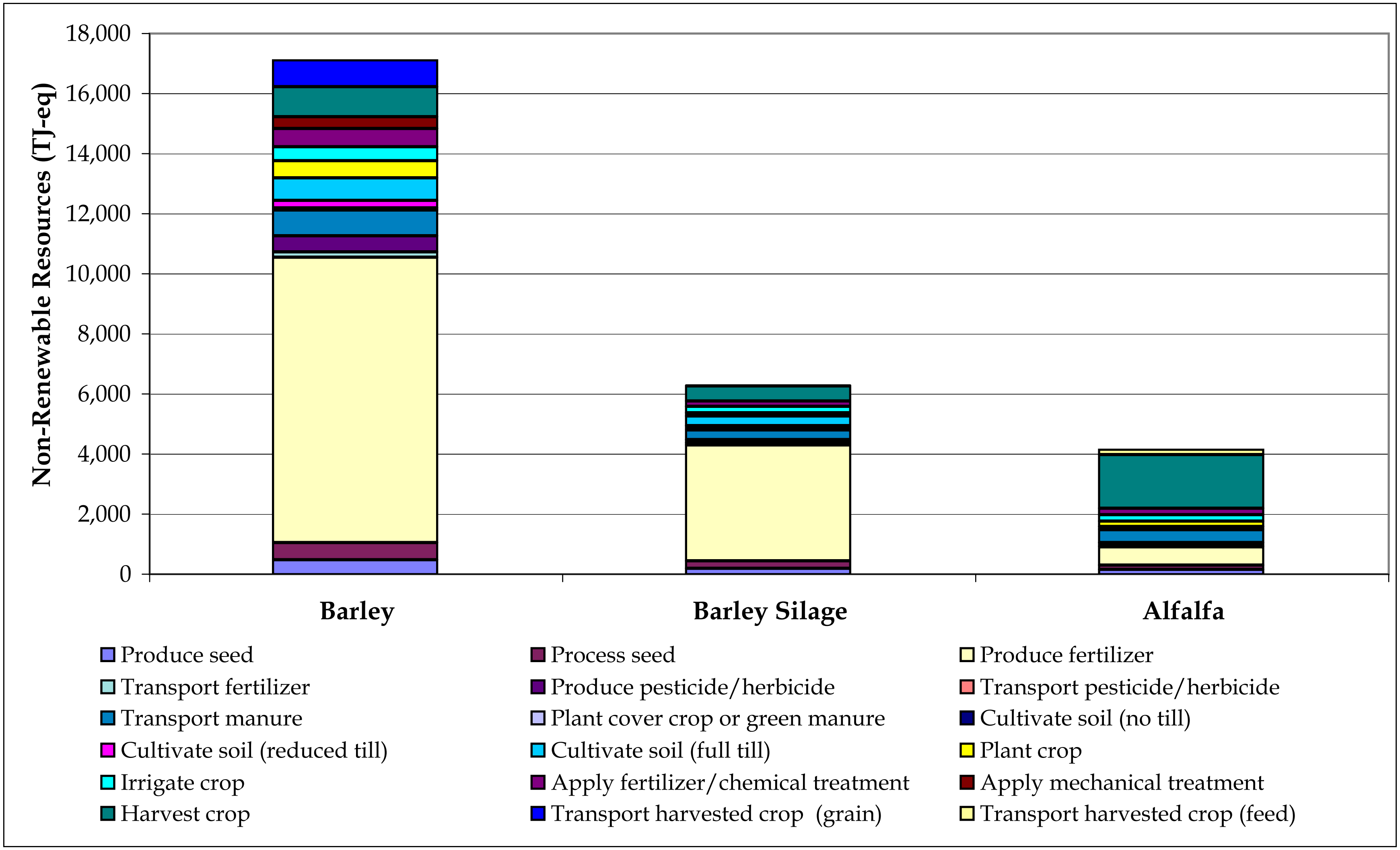

figure30

TOTAL NON-RENEWABLE ENERGY RESOURCES EMISSIONS PER CALF CROP
CEREAL AND FORAGE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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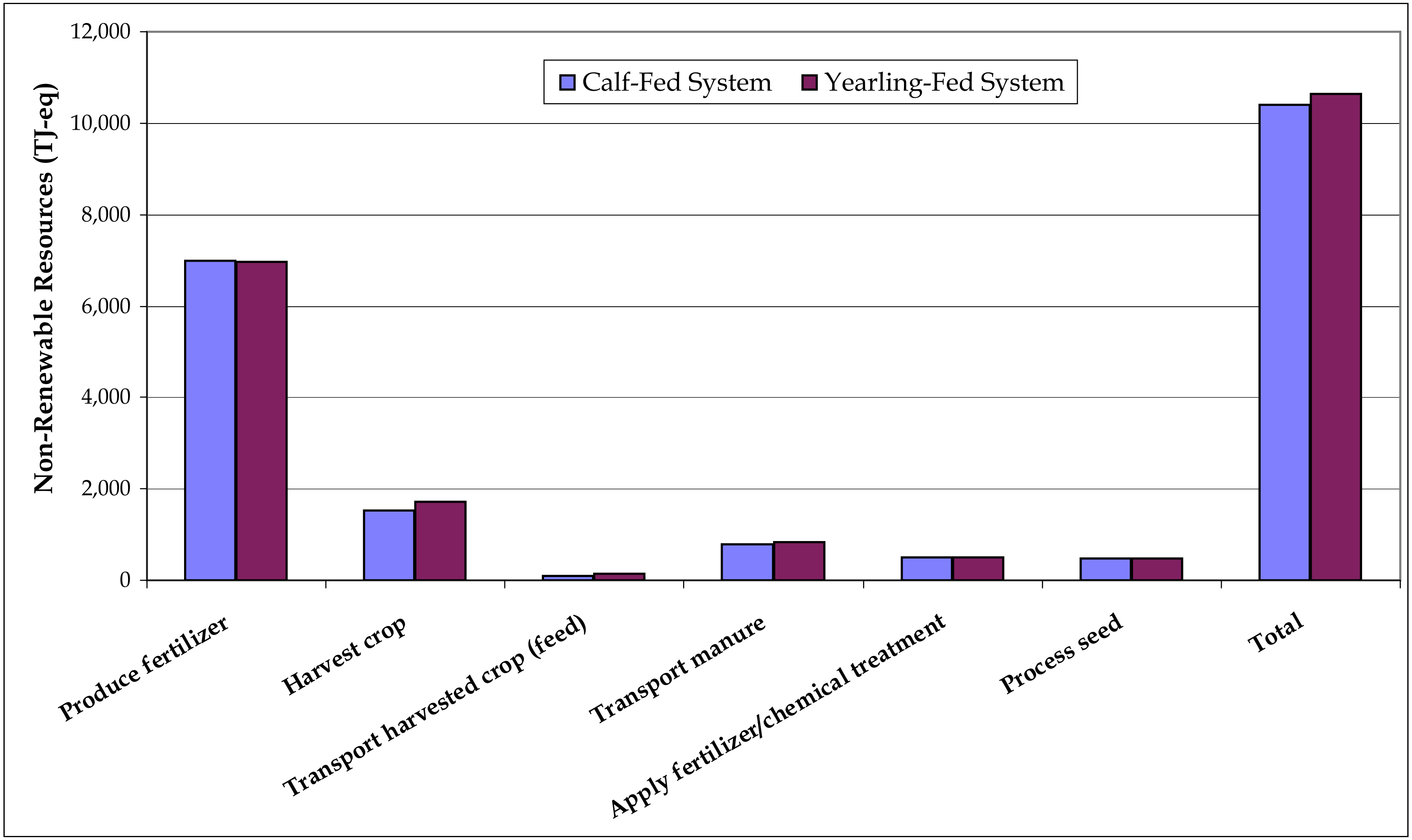

figure 31

NON-RENEWABLE ENERGY RESOURCES EMISSIONS PER CALF CROP
SUMMARY OF MAJOR CEREAL AND FORAGE COMPONENTS
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

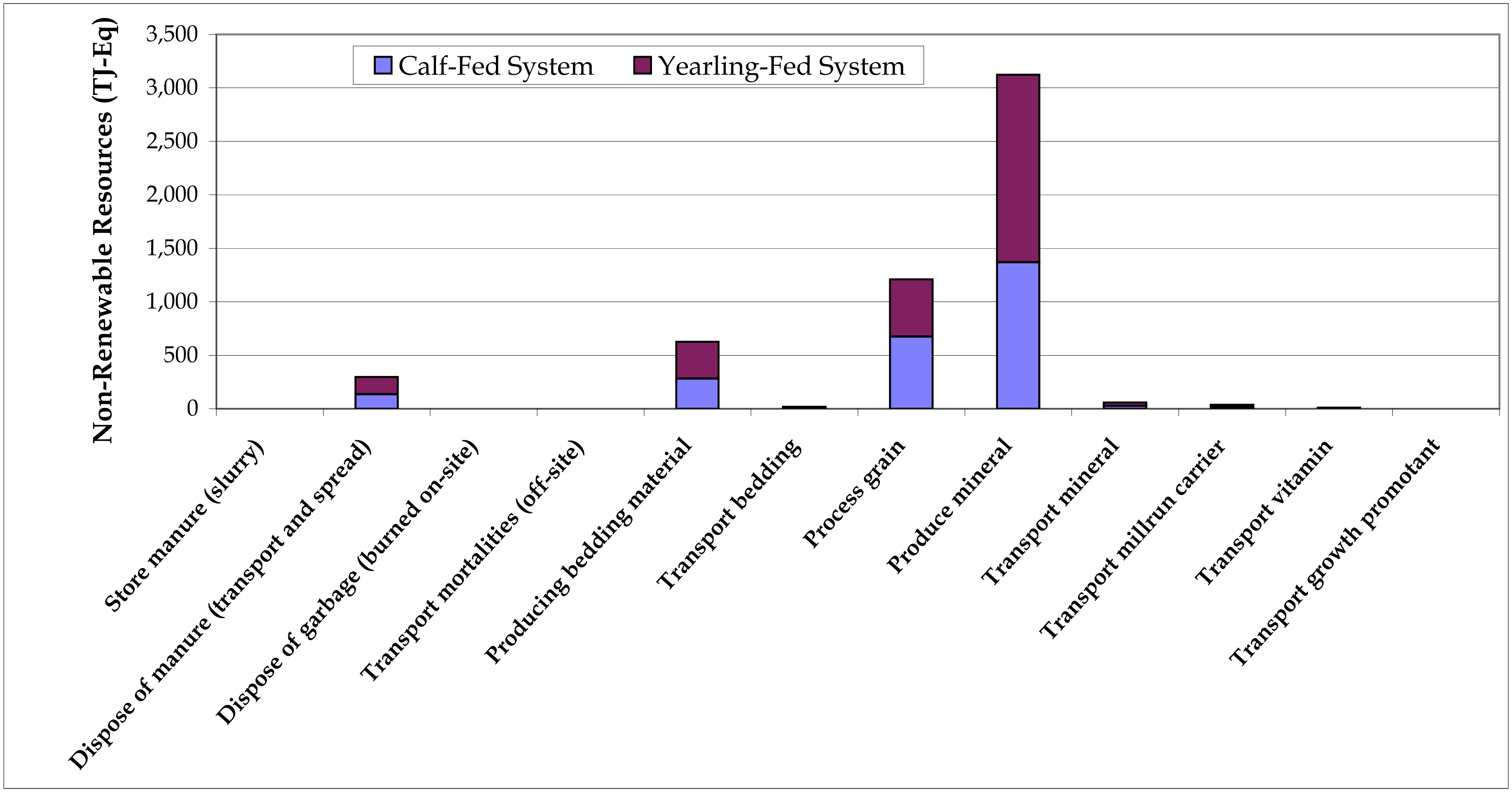

figure 32

TOTAL NON-RENEWABLE ENERGY RESOURCES EMISSIONS PER CALF CROP
FEEDLOT AND PASTURE ACTIVITIES
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

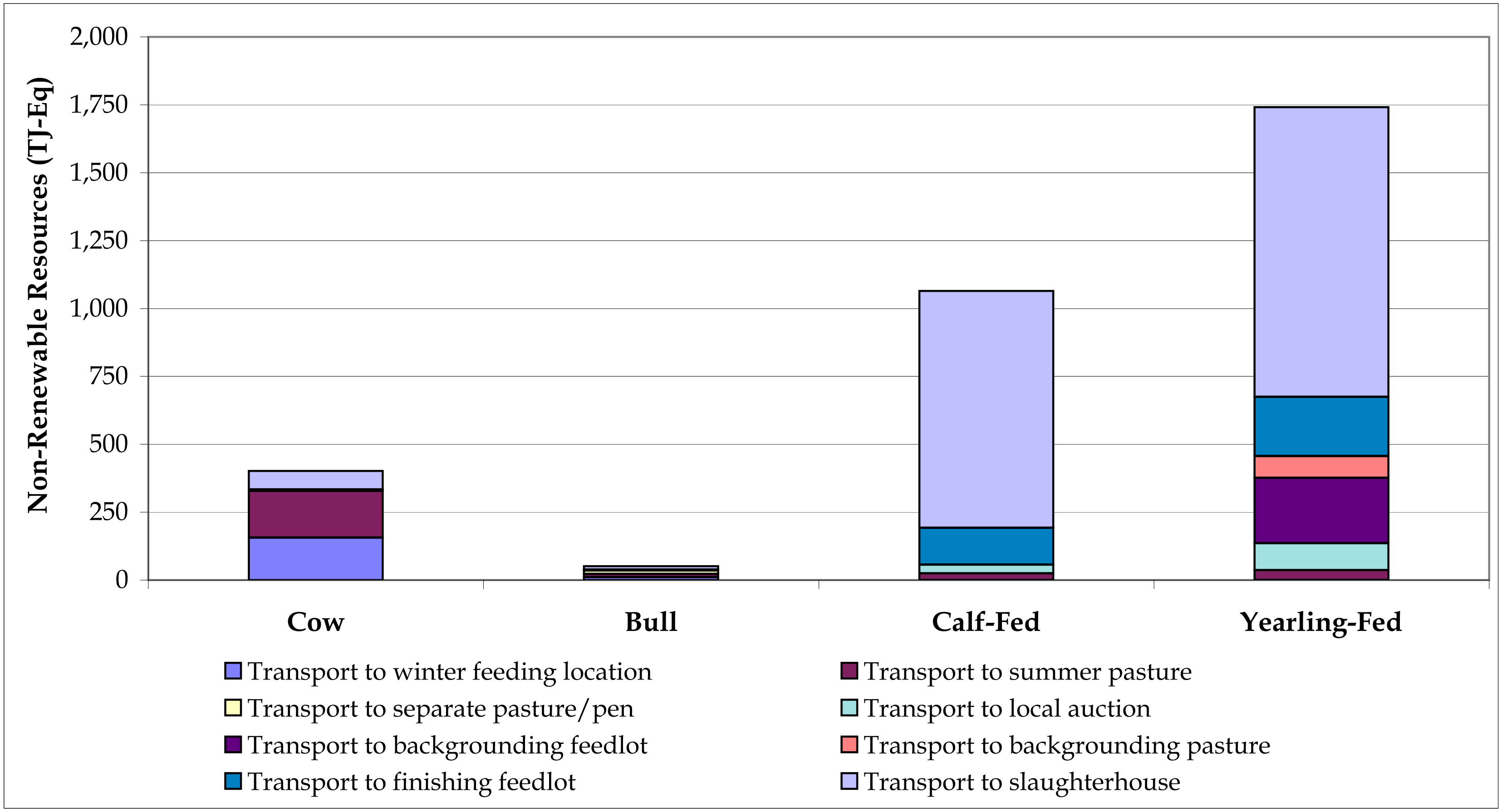

figure 33

TOTAL NON-RENEWABLE ENERGY RESOURCES EMISSIONS PER CALF CROP
CATTLE TRANSPORTATION
LIFE CYCLE ASSESSMENT - BEEF
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
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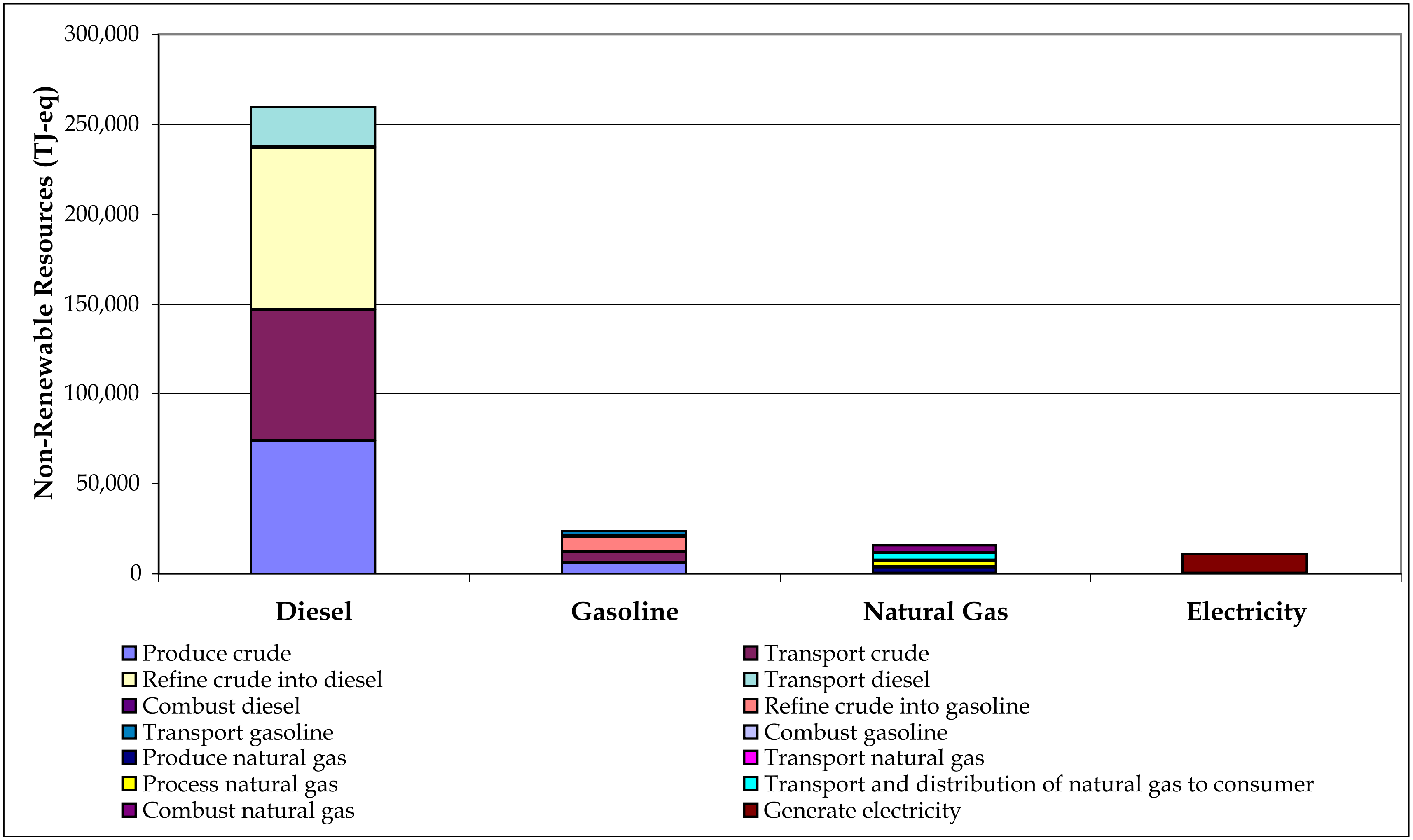

figure 34

TOTAL NON-RENEWABLE ENERGY RESOURCES EMISSIONS PER CALF CROP
ENERGY GENERATION
LIFE CYCLE ASSESSMENT - BEEF
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TABLE 1

SUMMARY OF LITERATURE REVIEW OF BEEF LCAs
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Study	GHG Emissions	Comments
Cederberg et al. (2009)	28 kg CO_2 (eq) / kg CWE	Estimated for the average Brazilian beef production in 2005 approximately at the farm-gate. The emissions are generated by primary production and do not include emissions from land use changes.
Cederberg et al. (2009)	41 kg CO_2 (eq)/ kg BFB	Estimated for the entire life cycle of Brazilian beef, from primary production via slaughterhouse and transports to Europe (Stockholm).
Ogino et al. (2007)	4550 kg CO_2 (eq)	The total contributions of one beef calf throughout its life cycle to global warming.
Casey and Holden (2006a)	13.0 kg CO_2 (eq)/kg LW beef/yr	The average emissions per kilogram of live weight beef from the conventional farms units. The system was based on the physical limits of the beef units, from crops, to livestock and manure management.
Casey and Holden (2006a)	12.2 kg CO_2 (eq)/kg LW beef/yr	The average emissions per kilogram of live weight beef from the agri-environmental farms units. The system was based on the physical limits of the beef units, from crops, to livestock and manure management.
Casey and Holden (2006a)	11.1 kg CO_2 (eq)/kg LW beef/yr	The average emissions per kilogram of live weight beef from the organic farms units. The system was based on the physical limits of the beef units, from crops, to livestock and manure management.
Casey and Holden (2006b)	11.26 kg CO_2 (eq)/kg LW beef/yr	For the typical suckler-beef production system.
Ogino et al. (2004)	32.3 kg CO_2 (eq)/kg	Beef gain during the fattening stage of the animal (based on a beef yield of 40%). The estimate did not account for whole system emissions (source cow is excluded).
Cederberg and Darelius (2002)	17 kg CO_2 (eq)/kg (bone and fat free meat)	For animals supplied from a dairy herd. Most of the feed ingredients were grown on the farm and therefore had no transport or processing. The functional unit encompassed the entire 576 days of an animal's life.
Subak (1999)	7.4 kg CO_2 (eq)/ kg/ (LW)/ yr	4396 kg CO_2 (eq) from a US feed lot system producing a 550 kg animal that is equivalent to 7.4 kg CO_2 (eq)/ kg/ (LW)/yr, excluding the cow phase.

TABLE 1

SUMMARY OF LITERATURE REVIEW OF BEEF LCAs
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

References

Casey, J.W., and Holden N.M., 2006b. Quantification of GHG emissions from suckler-beef production in Ireland. Agricultural Systems, 90 (1-3), pg. 79-98.

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Subak, S., 1999. Global environmental costs of beef production. Ecological Economics 30, 79–91.

TABLE 2

EMISSION FACTORS, AGGREGATION, AND CHARACTERIZATION FACTORS FOR LCIA CATEGORIES
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Environmental Category	Environmental Subcategory	LCIA unit	Eq factor	Eq units
GWP, 100, IPCC 2007 (IPCC 2007)					
Carbon dioxide, fossil	air	high population density	kg	1	kg CO_2
Carbon dioxide, fossil	air	low population density	kg	1	kg CO_2
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO_2
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO_2
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO_2
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO_2
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO_2
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO_2
Chloroform	air	high population density	kg	30	kg CO_2
Chloroform	air	low population density	kg	30	kg CO_2
Chloroform	air	unspecified	kg	30	kg CO_2
Dinitrogen monoxide	air	high population density	kg	298	kg CO_2
Dinitrogen monoxide	air	low population density	kg	298	kg CO_2
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO_2
Dinitrogen monoxide	air	unspecified	kg	298	kg CO_2
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO_2
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO_2
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO_2
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO_2
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO_2
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO_2
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO_2
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-11	air	low population density	kg	10000	kg CO_2
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO_2
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO_2
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO_2
Methane, biogenic	air	high population density	kg	25	kg CO_2
Methane, biogenic	air	low population density	kg	25	kg CO_2
Methane, biogenic	air	unspecified	kg	25	kg CO_2
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO_2
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO_2
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO_2
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO_2
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO_2
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO_2
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO_2
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO_2
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO_2
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO_2
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO_2
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO_2
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO_2
Methane, fossil	air	high population density	kg	25	kg CO_2
Methane, fossil	air	low population density	kg	25	kg CO_2
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO_2

TABLE 2

**EMISSION FACTORS, AGGREGATION, AND CHARACTERIZATION FACTORS FOR LCIA CATEGORIES
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA**

	Environmental Category	Environmental Subcategory	LCIA unit	Eq factor	Eq units
Methane, fossil	air	unspecified	kg	25	kg CO_2
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO_2
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO_2
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO_2
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO_2
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO_2
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO_2
Sulfur hexafluoride	air	high population density	kg	22800	kg CO_2
Sulfur hexafluoride	air	low population density	kg	22800	kg CO_2
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO_2
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO_2
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO_2
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO_2
Nitrogen fluoride	air	high population density	kg	17200	kg CO_2
Aquatic acidification, IMPACT 2002+ (Joliet et al, 2002)					
Ammonia	air	high population density	kg	1.88	kg SO_2-Eq
Ammonia	air	low population density	kg	1.88	kg SO_2
Ammonia	air	unspecified	kg	1.88	kg SO_2
Hydrogen chloride	air	high population density	kg	0.88	kg SO_2
Hydrogen chloride	air	low population density	kg	0.88	kg SO_2
Hydrogen chloride	air	unspecified	kg	0.88	kg SO_2
Hydrogen fluoride	air	high population density	kg	1.6	kg SO_2
Hydrogen fluoride	air	low population density	kg	1.6	kg SO_2
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO_2
Hydrogen sulfide	air	high population density	kg	1.88	kg SO_2
Hydrogen sulfide	air	low population density	kg	1.88	kg SO_2
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO_2
Nitrogen oxides	air	high population density	kg	0.7	kg SO_2
Nitrogen oxides	air	low population density	kg	0.7	kg SO_2
Nitrogen oxides	air	unspecified	kg	0.7	kg SO_2
Sulfur dioxide	air	high population density	kg	1	kg SO_2
Sulfur dioxide	air	low population density	kg	1	kg SO_2
Sulfur dioxide	air	unspecified	kg	1	kg SO_2
Hydrogen sulfide	water	river	kg	1.88	kg SO_2
Sulfuric acid	soil	agricultural	kg	0.65	kg SO_2
Phosphoric acid	air	high population density	kg	0.98	kg SO_2
Sulfuric acid	air	low population density	kg	0.65	kg SO_2
Aquatic eutrophication, IMPACT 2002+ (Joliet et al, 2002)					
Phosphorus	air	high population density	kg	3.06	kg PO4
Phosphorus	air	low population density	kg	3.06	kg PO4
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4
Phosphorus	air	unspecified	kg	3.06	kg PO4
Phosphorus	soil	agricultural	kg	3.06	kg PO4
Phosphorus	soil	industrial	kg	3.06	kg PO4
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4

TABLE 2

EMISSION FACTORS, AGGREGATION, AND CHARACTERIZATION FACTORS FOR LCIA CATEGORIES
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Environmental Category	Environmental Subcategory	LCIA unit	Eq factor	Eq units
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4
Phosphate	water	river	kg	1	kg PO4
Phosphorus	water	river	kg	3.06	kg PO4
Phosphorus	water	unspecified	kg	3.06	kg PO4
Phosphoric acid	air	high population density	kg	0.97	kg PO4
Non-renewable resources and energy consumption, IMPACT 2002+ (Joliet et al, 2002)					
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm^3	39.8	MJ
Gas, natural, in ground	resource	in ground	Nm^3	38.293	MJ
Oil, crude, in ground	resource	in ground	kg	45.8	MJ
Peat, in ground	resource	biotic	kg	9.9	MJ

Notes:

kg - kilogram
MJ - Megajoules
Nm^3 - Normalized cubic metres
CO2 - carbon dioxide
PO4 - phosphate
SO2 - sulphur dioxide

References

Intergovernmental Panel on Climate Change (IPCC) 2007, IPCC Fourth Assessment Report: Climate Change 2007 (AR4).

Jolliet O, Margni M, Charles R, Humbert S, Payet J, Rebitzer G and Rosenbaum R, 2003. IMPACT 2002+: A New Life Cycle Impact Assessment Methodology. Int J LCA 8 (6) 324-330.

TABLE 3

SUMMARY OF DATA AND REFERENCE YEAR
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Category	**Year**
Alberta Cattle Information	
Alberta Cattle Numbers	2001, 2002
Carcass Weights	2001, 2008
Cattle Sales Method (%)	1986, 1989
Cattle Transportation (Imports and Export Numbers)	2009
Alberta Slaughtered Cattle and Calves	2001, 2002, 2007, 2008
Feedlot and Slaughterhouse Locations and Capacities	2008
Forage, Cereal, etc.	
Field crops, yield	2008
Seeding Rates	2007
Tillage Practices	2001, 2006
Fertilizer Needs	2008
Fertilizer Application Methods	2001
Manure	
Manure Generation	2001
Manure Treatment Methods	2001
Garbage	
Garbage Generation	2008
Garbage Management Methods	2008 - 2009
Mortalities	
Mortality Rates	2002
Mortality Disposal Methods	2009
Energy Usage on Farms	1997
Bedding	2004 - 2009
Water Consumption	2000
Transportation	
Cereal and Grain Transportation	1997/1998, 2008
Forage Transportation	Assumed values
Mineral Transportation	
Growth promotant Transportation	
Pesticide Transportation	
Materials Transportation	
Bedding Transportation	
Mortalities Transportation	
Vitamin Transportation	
Manure Transportation	2009
Fertilizer Transportation	2009
Animal Transportation	2006 - 2009

TABLE 4

BREAKDOWN OF BEEF CATTLE POPULATION NUMBERS
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Breakdown of Cows (2001)

Cow herd (January)	2,099,288
Replacement heifers	359,291
Mortalities	24,586
Dairy cows entering beef system	4,202
Dairy cow culls to slaughterhouse	18,364
Exported cows	23,658
Slaughtered cows	217,408

Breakdown of Bulls (2001)

Bull herd (January)	96,200
Replacement bulls	13,228
Mortalities	1,094
Dairy bull culls to slaughterhouse	98
Exported bulls	16,237
Slaughtered bulls	4,180

Breakdown of Calf-Fed Calves (May 1, 2001 – October 26, 2002)

Calves born in May 2001	951,001
Calves deemed for replacement	117,282
Pre-weaning mortalities	19,600
Backgrounding mortalities	23,077
Feedlot mortalities	11,308
Dairy calves to calf-fed system	1,266
Feedlot imports	238,973
Feedlot exports	46,765
Slaughterhouse imports	8,198
Slaughterhouse exports	168,064
Slaughtered calf-fed system animals	959,612

Breakdown of Yearling-Fed Calves (May 1, 2001 – January 2, 2003)

Calves born in May 2001	1,162,340
Calves deemed for replacement	143,345
Pre-weaning mortalities	23,955
Backgrounding mortalities	28,206
Feedlot mortalities	13,821
Dairy calves to yearling-fed system	1,547
Feedlot imports	292,078
Feedlot exports	57,158
Slaughterhouse imports	10,020
Slaughterhouse exports	205,411
Slaughtered yearling-fed system animals	1,172,859

TABLE 4

BREAKDOWN OF BEEF CATTLE POPULATION NUMBERS
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

References

Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm

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Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003. Available at:http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd7799/$file/beef_live_cattle_five_year.pdf?OpenElement

Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.

Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003

Cattle Marketings for the Year 2002, Government of Saskatchewan.

http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf

TABLE 5

SUMMARY OF SLAUGHTERED CATTLE NUMBERS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Total Number Slaughtered		Weight Leaving Feedlot	Shrunk Live Weight at Slaughterhouse	Total Shrunk Weight at Slaughterhouse	Calf-Fed System Total Shrunk Weight at Slaughterhouse	Yearling-Fed System Total Shrunk Weight at Slaughterhouse
	2001	2002	(kg)	(kg)	(kg)	(kg)	(kg)
Cows	217,408	0	606	581	126,384,484	56,873,018	69,511,466
Bulls	4,180	0	998	958	4,004,386	1,801,974	2,202,412
Calf-Fed Steers	0	442,380	658	631	279,318,695	125,693,413	153,625,282
Calf-Fed Heifers	0	517,232	612	588	304,057,765	136,825,994	167,231,771
Yearling-Fed Steers	0	540,686	658	631	341,389,516	153,625,282	187,764,234
Yearling-Fed Heifers	0	632,172	612	588	371,626,157	167,231,771	204,394,386
TOTAL					**1,426,781,002**	**642,051,451**	**784,729,551**

Notes
Weight leaving feedlot as provided by ruminant nutritionist based on rations.
It is understood that yearling-fed animals are typically heavier than calf-fed animals at the feedlot, however, the values as calculated by the nutritionist based on the rations have been used.
Shrunk live weight at the slaughterhouse was based on 4% reduction in weight from the feedlot to the slaughterhouse.

References
Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Cattlemen's Go To Feedlot Lingo. Dr. Greg Lardy, Beef Specialist, North Dakota State University. January 1999. Available at: http://www.ag.ndsu.edu/pubs/ansci/beef/as1161w.htm

TABLE 6

EXAMPLE CALCULATION OF CATTLE * DAYS FOR COWS
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Stage / Feeding Period	Total # of Cows	Days Per Stage / Feeding Period	Cattle * Days
Winter feeding (cows and replacement heifers)	2,458,579	59	145,056,161
Calving	2,458,579	92	226,189,268
Breeding	2,458,579	61	149,973,319
Transport to summer pasture	2,458,579	1	2,458,579
Summer pasture	2,458,579	121	297,488,059
Transport to winter feeding location	2,211,291	1	2,211,291
Winter feeding	2,211,291	30	66,338,730
Transport to local auction from winter feeding location	8,623	1	8,623
Local Auction	8,623	2	17,246
Transport to finishing feedlot (from auction, directly from winter feeding location, exports, cattle from dairy system)	12,319	1	12,319
Finishing feedlot	9,952	22	218,944
Transport to local auction	498	1	498
Local auction	498	2	996
Transport to slaughterhouse (from auction, directly from feedlot to slaughterhouse, directly from cow/calf operation to slaughterhouse, exports, and dairy culls)	220,336	2	440,672
Total slaughtered cows in Alberta (2001)	217,408		
TOTAL CATTLE * DAYS			**890,414,696**

TABLE 7

SUMMARY OF TOTAL GHG EMISSIONS FROM ENTERIC FERMENTATION BASED ON DIET
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

		No. of Days on Diet (days)	Average Weight (kg)	Methane Emission Factor (kg CH_4/ head/day)	Total Methane Emissions (kg CH_4)	Methane Emissions per Shrunk Live Weight (kg CH_4/ kg shrunk live weight)	GHG Emissions per Shrunk Live Weight (kg $CO2_e$/ kg shrunk live weight)
Calves before weaning - stage 1		92	45	0	0	0.0000	0.000
Calves before weaning - stage 2		92	130	0.08060	15,347,240	0.0108	0.269
Cows	Winter Diet	90	605.55	0.24633	52,789,081	0.0370	0.925
	Calving Diet	90	605.55	0.30791	69,645,466	0.0488	1.220
	Breeding Diet	60	605.55	0.29325	43,979,021	0.0308	0.771
	Pasture	125	605.55	0.29325	87,958,042	0.0616	1.541
Bulls	Winter Diet	90	997.90	0.29325	2,706,673	0.0019	0.047
	Calving Diet	90	997.90	0.29325	2,952,213	0.0021	0.052
	Breeding Diet	60	997.90	0.29325	1,957,446	0.0014	0.034
	Pasture	125	997.90	0.29325	3,914,892	0.0027	0.069
Backgrounding - Calf-Fed	Backgrounding	96	226.80	0.12518	13,866,766	0.0097	0.243
Calf-Fed (Heifer)	Diet 3	14	229.00	0.09426	804,355	0.0006	0.014
	Diet 4	14	238.00	0.16727	1,427,336	0.0010	0.025
	Diet 5	28	263.00	0.19276	3,289,540	0.0023	0.058
	Diet 6	28	302.00	0.20198	3,447,005	0.0024	0.060
	Diet 7	178	467.00	0.09530	10,336,565	0.0072	0.181
Calf-Fed (Steer)	Diet 3	14	252.00	0.09843	718,359	0.0005	0.013
	Diet 4	14	263.00	0.21284	1,553,346	0.0011	0.027
	Diet 5	28	293.00	0.21627	3,156,726	0.0022	0.055
	Diet 6	28	336.00	0.22454	3,277,399	0.0023	0.057
	Diet 7	178	508.00	0.09864	9,150,440	0.0064	0.160
Backgrounding - Yearling-Fed	Backgrounding	144	272.16	0.14939	30,197,219	0.0212	0.529
Yearling - Pasture	Pasture	120	340.19	0.19550	33,084,591	0.0232	0.580
Yearling-Fed (Heifer)	Diet 1	3	340.00	0.11018	246,233	0.0002	0.004
	Diet 2	7	343.00	0.16303	850,137	0.0006	0.015
	Diet 3	7	347.00	0.15818	824,843	0.0006	0.014
	Diet 4	7	352.00	0.14609	761,802	0.0005	0.013
	Diet 5	7	358.00	0.21265	1,108,870	0.0008	0.019
	Diet 6	7	367.00	0.19854	1,035,292	0.0007	0.018
	Diet 7	126	492.00	0.10073	9,451,138	0.0066	0.166
Yearling-Fed (Steer)	Diet 1	3	386.00	0.11902	227,486	0.0002	0.004
	Diet 2	7	388.00	0.17116	763,356	0.0005	0.013
	Diet 3	7	393.00	0.21102	941,154	0.0007	0.016
	Diet 4	7	400.00	0.19465	868,115	0.0006	0.015
	Diet 5	7	408.00	0.21984	980,486	0.0007	0.017
	Diet 6	7	418.00	0.24200	1,079,305	0.0008	0.019
	Diet 7	126	541.00	0.11169	8,962,495	0.0063	0.157
TOTAL					**423,660,431**	**0.3**	**7.4**

Note

Emissions calculated based on IPCC 2006 Tier 2 methodology using ruminant nutritionist information for the dry matter intake of the diet, information from John Basarab for the dry matter intake of calves 3 to 6 months, and IPCC 2006 values for methane conversion factor and energy ensity of the feed. See Appendices D and F for more details.

TABLE 8

ENTERIC FERMENTATION EMISSIONS PER CALF CROP FOR CALF-FED AND YEARLING-FED SYSTEMS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

		Total Methane Emissions ($kg\ CH_4$)	Methane Emissions per Shrunk Live Weight ($kg\ CH_4$/ kg shrunk live weight)	GHG Emissions per Shrunk Live Weight ($kg\ CO2_{e/}$ kg shrunk live weight)
Calf-Fed System	Cows	114,467,224	0.080	2.0
	Bulls	5,189,051	0.004	0.1
	Calves/Heifers/Steers	57,934,096	0.041	1.0
	Total	**177,590,371**	**0.124**	**3.1**
Yearling-Fed System	Cows	139,904,385	0.098	2.5
	Bulls	6,342,173	0.004	0.1
	Calves/Heifers/Steers	99,823,503	0.070	1.7
	Total	**246,070,061**	**0.172**	**4.3**

TABLE 9

TOTAL FEED AND LAND REQUIREMENTS FOR CROPS PER CALF CROP
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Barley			Barley Silage			Alfalfa		
	Total for Calf Crop (tonnes)	**Calf-Fed System (tonnes)**	**Yearling-Fed System (tonnes)**	**Total for Calf Crop (tonnes)**	**Calf-Fed System (tonnes)**	**Yearling-Fed System (tonnes)**	**Total for Calf Crop (tonnes)**	**Calf-Fed System (tonnes)**	**Yearling-Fed System (tonnes)**
Total feed required	4,485,161	2,502,055	1,983,106	7,576,370	2,794,761	4,781,608	6,589,780	2,965,401	3,624,379
	Barley			**Barley Silage**			**Alfalfa**		
	Total for Calf Crop (10^3 ha)	**Calf-Fed System (10^3 ha)**	**Yearling-Fed System (10^3 ha)**	**Total for Calf Crop (10^3 ha)**	**Calf-Fed System (10^3 ha)**	**Yearling-Fed System (10^3 ha)**	**Total for Calf Crop (10^3 ha)**	**Calf-Fed System (10^3 ha)**	**Yearling-Fed System (10^3 ha)**
Total land required to grow feed	1,820	1,015	805	738	272	466	878	395	483

TABLE 10

FERTILIZER REQUIREMENTS FOR GRAIN AND FORAGE ASSUMING NO MANURE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

		N	P_2O_5	K_2O	S
Barley	kg/ha	82.20	33.63	9.34	4.48
Barley Silage	kg/ha	82.20	33.63	9.34	4.48
Alfalfa Grass	kg/ha	0.00	15.20	0.00	0.00

References

Comment from ARD during the Life Cycle Analysis of Beef Production in Alberta - Project Kick-Off Meeting. ARD, CRA, and Pembina. September 28, 2009.
Alberta Fertilizer Guide. Revised June 2004. Available at:
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3894/$file/541-1.pdf?OpenElement
Additional correspondence with Alberta Agriculture and Rural Development

TABLE 11

FERTILIZER REQUIREMENTS AS PER ECOINVENT
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Barley (kilotonnes)	Barley Silage (kilotonnes)	Alfalfa (kilotonnes)
Urea, as N	85.59	34.70	0.00
Monoammonium phosphate, as P_2O_5	67.06	27.18	0.00
Monoammonium phosphate, as N	33.28	13.49	19.13
Ammonium sulphate, as N	7.81	3.16	4.49
Ammonia, liquid	8.52	3.46	0.00

Reference

Ecoinvent. 2003. Ecoinvent data 1.3. Final reports Ecoinvent 2000 NO. 1-15. Ecoinvent Centre. Swiss Centre for Life Cycle Inventories, Uster.

TABLE 12

ECOINVENT PROCESSES USED FOR ACTIVITIES
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Construction	AF1	Construct bunkers	Ecoinvent	building, hall
	AF2	Construct fences and gates		data gap
	AF3	Construct livestock shelters	Ecoinvent	tied housing system, cattle, construction
	AF4	Construct manure storage	Ecoinvent	slurry tanker, production
	AF5	Construct feed storage	Ecoinvent	shed
	AF6	Construct machinery storage	Ecoinvent	building, hall
	AF7	Construct watering facilities	Ecoinvent	water supply network
	AP1	Construct fences and gates	Ecoinvent	
	AP2	Construct watering facilities	Ecoinvent	water supply network
	AP3	Construct irrigation systems	Ecoinvent	pump station

Forage and cereal sub-activities	B1	Produce seed (barley, corn, wheat)	Ecoinvent	barley, grains IP, at farm; clover seed IP, at farm
	B6	Transport seed to processing center	Ecoinvent	seed barley, clover IP, at regional storehouse, CH
	B10	Process seed	Ecoinvent	
	B12	Store seed after being processed	Ecoinvent	
	B13	Transport seed to regional storehouse	Ecoinvent	
	B14	Store seed in the regional storehouse	Ecoinvent	data gap
	B2	Produce fertilizer	Ecoinvent	Urea, as N, urea, as N, at regional storehouse chemicals_organics RER
	B7	Transport fertilizer	Ecoinvent	transport, lorry >16t, fleet average, RER
	B3	Produce pesticide/herbicide	Ecoinvent	pesticide unspecified, at regional storehouse, CH
	B8	Transport pesticide/herbicide	Ecoinvent	transport, lorry >16t, fleet average, RER
	B4	Transport manure	Ecoinvent	transport, lorry >32t, EURO4, RER
	B9	Apply manure	Ecoinvent	Solid manure loading and spreading, by hydraulic loader and spreader , CH
	B11	Incorporate manure	Ecoinvent	tillage, cultivating, chiseling
	B5	Irrigate crop	Ecoinvent	Irrigating , CH

Energy generation activities	E1	Produce crude	Ecoinvent	proxy of crude oil, at production onshore, RME, see calculations on EF data tab
	E4	Transport crude	Ecoinvent	crude oil, production NO, at long distance transport
	E7a	Refine crude into diesel	Ecoinvent	proxy of diesel, at refinery, RER, see calculations on EF data tab
	E9a	Transport diesel	Ecoinvent	diesel, at regional storage oil_fuels(deliver to end user)_RER
	E7b	Refine crude into coloured diesel	Ecoinvent	proxy of diesel, at refinery, RER, see calculations on EF data tab
	E9b	Transport coloured diesel	Ecoinvent	diesel, at regional storage oil_fuels(deliver to end user)_RER
	E2	Produce natural gas	Ecoinvent (NREL)	proxy of natural gas, unprocessed, at extraction, RNA, see calculations on EF data tab
	E5	Transport natural gas		transport, natural gas, pipeline, long distance, RER
	E8	Process natural gas	Ecoinvent (NREL)	proxy of natural gas, at production, RNA, see calculations on EF data tab
	E10	Combust natural gas	Ecoinvent	proxy of natural gas, burned in industrial furnace >100kW, RER, see calculations on EF
	E3	Generate electricity	Ecoinvent (NREL)	proxy of electricity, low voltage, at grid, US, see calculations on EF data tab
	E6	Transmit electricity		Included in E3 above.

O&M activities	R1	Produce materials for replacement components	Ecoinvent	tied housing system, cattle, operation, CH
	R4	Manufacture replacement components		
	R7	Transport replacement components		
	R10	Install replacement components		
	R2	Remove damaged/worn components	Ecoinvent	Remove damaged steel: disposal, building, reinforcement steel, to recycling waste
	R5a	Transport steel to recycle center	Ecoinvent	transport, lorry >32t, EURO4, RER
	R8a	Recycle steel components	Ecoinvent	disposal, building, reinforcement steel, to recycling
	R5b	Transport wood to recycle center	Ecoinvent	disposal, building, waste wood, untreated, to final disposal
	R8b	Recycle wood components		No recycling. Wood is considered waste. See R2
	R5c	Transport concrete for reuse as aggregate	Ecoinvent	transport, lorry >32t, EURO4, RER
	R3	Extract gravel materials	Ecoinvent	mining, gravel / sand+ gravel, crushed, at mine (2 processes)
	R6	Transport gravel materials	Ecoinvent	transport, lorry >32t, EURO4, RER
	R9	Grade access roads	data gap	

TABLE 12

ECOINVENT PROCESSES USED FOR ACTIVITIES
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Cereal activities	CC1	Plant cover crop or green manure	Ecoinvent	not applicable for Alberta agricultural practices	
	CC2	Cultivate soil		For adjustment or processes based on fuel consumption see appropriate tabs : Cereal	
		no till	combination of different processes, adjusted as proxy based on fuel consumption	Alberta practice - heavy harrow, every four years	Ecoinvent proxy tillage, harrowing, by spring tine harrow
		reduced till		Alberta practice -3 inch chisel plow, every year	Ecoinvent proxy - tillage, cultivating, chiseling
				Alberta practice - heavy harrow, every two years	Ecoinvent proxy -tillage, harrowing, by spring tine harrow
		full till		Alberta practice - 3 inch chisel plow, every year	Ecoinvent proxy - tillage, cultivating, chiseling
				Alberta practice - field cultivator, multiple times per year	Ecoinvent proxy - tillage, cultivating, chiseling
				Alberta practice - heavy off-set disk, every two years	Ecoinvent proxy - tillage, rotary cultivator
	CC3	Apply fertilizer (includes manure)	combination of different processes, adjusted as proxy based on fuel consumption	For adjustment or processes based on fuel consumption see appropriate tabs : Cereal activity	
		Broadcasting	For adjustment or processes based on fuel consumption see appropriate tabs	Alberta practice - sprayer	Ecoinvent proxy - tillage, rotary cultivator
		Injected or knifed in	For adjustment or processes based on fuel consumption see appropriate tabs	Alberta practice - anhydrous applicator	Ecoinvent proxy- Reduced tillage, rotary harrow
		Post-plant Top/Side Dressing	Ecoinvent	Same processes as above, applied after the plant starts growing. Add 50/50% to previous	
		Banded	Ecoinvent	When seeding. Should not require additional fuel consumption. Assumption.	
		Applied with Seed	Ecoinvent	When seeding. Should not require additional fuel consumption. Assumption.	
		Other	Ecoinvent		
	CC4	Plant crop	For adjustment or processes based on fuel consumption see appropriate tabs	Alberta practice - air drill, once per year	Ecoinvent proxy- planting
	CC5	Irrigate crop_CC	Ecoinvent	Irrigating, CH	
	CC6	Apply chemical treatment	For adjustment or processes based on fuel consumption see appropriate tabs	Alberta practice - sprayer, two times per crop	Ecoinvent proxy- application of plant protection products, by field sprayer
	CC7	Apply mechanical treatment	For adjustment or processes based on fuel consumption see appropriate tabs	Alberta practice -spike tooth harrow, once per year	Ecoinvent proxy- tillage, currying, by weeder
	CC8	Harvest crop (grain and straw)	For adjustment or processes based on fuel consumption see appropriate tabs	Alberta practice -combine (small grain), once per year	Ecoinvent proxy- combine harvesting
	CC9	Transport harvested crop (grain)	Ecoinvent		

TABLE 12

ECOINVENT PROCESSES USED FOR ACTIVITIES
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Forage activities	FC1	Cultivate soil (not annually)	Ecoinvent	see above, cultivate soil, CC2
	FC2	Apply fertilizer	Ecoinvent	see above, apply fertilizer, CC3
	FC3	Plant crop (not annually)	Ecoinvent	see above, planting, CC4
	FC4	Irrigate crops	Ecoinvent	Irrigating, CH
	FC5	Apply chemical treatment	Ecoinvent	see above, apply chemical treatment, CC6
	FC6	Harvest crop (multiple times per year)	Ecoinvent	see above, harvesting, CC8
	FC7	Transport harvested crop (feed)	Ecoinvent	transport, lorry >32t, EURO4, RER
	FC8	Treat harvested crop (feed)		no treatment necessary

Feedlot and pasture activities	FL1	Deposit manure		emissions covered under biological activity of cattle
	FL2	Collect manure		Included in total energy used on beef farms
	FL7	Transfer manure	Ecoinvent	Included in total energy used on beef farms
	FL12	Store manure	Ecoinvent	slurry store and processing , CH
	FL24	Dispose of manure (not on crops fed to beef)	Ecoinvent	Transport of manure off site+ spreading. Spreading is not accounted for, as the manure leaves the beef production system.
	FL3	Collect garbage		Included in total energy used on beef farms.
	FL8	Store garbage		No emissions associated with this activity
	FL13	Transport garbage	Ecoinvent	transport, lorry >32t, EURO4, RER
	FL25	Dispose of garbage		burned , combustion
	FL4	Collect mortalities (on-site)		Included in total energy used on beef farms
	FL9	Store mortalities		No emissions involved in this activity
	FL14	Transport mortalities	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL26	Dispose of mortalities		Rendering. Emissions from rendering are cut-off.
	FL5	Produce bedding material	Ecoinvent	straw, from straw areas , CH
	FL10	Transport bedding	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL15	Store bedding		No emissions involved in this activity
	FL27	Bed livestock		Included in total energy used on beef farms
	FL6	Store feed	Ecoinvent	Included in total energy used on beef farms
	FL11	Store feed		Feedmill consumptions (source Pork LCA), see calculations on next tab "feed processing"
	FL16	Transport feed		
	FL28	Feed livestock		Included in total energy used on beef farms
	F17	Produce mineral	Ecoinvent	lime, from carbonation, at regional storehouse
	FL29	Transport mineral	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL18	Produce trace mineral		Included in minerals above (FL29) (minerals comprising of less than 1% of the total
	FL30	Transport trace mineral	Ecoinvent	Not applicable - see FL 18
	FL19	Produce cobalt (iodized)		Cobalt Iodized Salt Block - considered within the sodium chloride production
	FL31	Transport cobalt (iodized)	Ecoinvent	Cobalt Iodized Salt Block - considered within the sodium chloride production
	FL20	Produce millrun carrier		Millrun carrier production is considered outside the boundaries of the system as it is a
	FL32	Transport millrun carrier	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL21	Produce vitamin		data gap
	FL33	Transport vitamin	Ecoinvent	transport distance Calgary, AB- New York-Paris (estimated from Google Earth)
	FL22	Produce growth promotant		data gap
	FL34	Transport growth promotant	Ecoinvent	Transport, van <3.5t, RER
	FL23	Produce vaccination/antibiotic		data gap
	FL 35	Transport vaccination/antibiotic		data gap
	FL39	Production of plastic	Ecoinvent	polypropylene, granulate, at plant, RER
	FL36	Supply water to livestock		Included in total energy used on beef farms

Notes

RER	Europe
CH	Switzerland
RNA	North America

TABLE 13

**ECOINVENT PROCESSES USED TO DEFINE THE PRODUCTION OF SUPPLEMENTS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA**

	Process on the Activity Map	**Ecoinvent Proxy**
FL11	Process (roll) grains	Feed mill data
FL16	Mix feed	
FL 17	Produce mineral	
	Lime	Lime, from carbonation, at regional storehouse
	Sodium phosphate	Sodium phosphate at plant
	Sodium chloride	Sodium chloride, powder, at plant
	Potassium Chloride	Potassium chloride, as K2O
	Zinc Oxides	Zinc oxide, at plant
FL 18	Produce trace mineral	Included in minerals above (FL29)
FL 19	Produce cobalt (iodized)	Not considered. Very low quantities
FL 20	Produce protein supplement	Not in the diet
FL 21	Produce vitamin	Data gap
FL 22	Produce growth promotant	Data gap
FL 23	Produce vaccination/antibiotic	Data gap

TABLE 14

FUEL CONSUMPTION TABLE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Machine			No Till						Reduced Till						Full Till					
Description		Consumption	Cereal		Canola		Pea		Cereal		Canola		Pea		Cereal		Canola		Pea	
		(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)	(operations/acre)	(gallons/acre)
Plow, moldboard (8-inch		1,68		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
* Plow, chisel (3-inch depth)		0,45		0,00		0,00		0,00	1	0,45	1	0,45	1	0,45	1	0,45	1	0,45	1	0,45
Plow, chisel (3-inch depth)		1,1		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Disk, tandem	Corn stalks	0,45		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	Chisel plowed	0,55		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	Moldboard plowed	0,65		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Disk, heavy offset		0,95		0,00		0,00		0,00		0,00		0,00		0,00	0,5	0,48	0,5	0,48	0,5	0,48
Field Cultivator		0,6		0,00		0,00		0,00		0,00		0,00		0,00	1,5	0,90	1,5	0,90	1,5	0,90
Harrow, heavy		0,21	0,25	0,05		0,00		0,00	0,5	0,11		0,00		0,00		0,00		0,00		0,00
Cultivator, row crop		1,45		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Rolling cultivator		0,35		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Rotary hoe		0,25		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Anhydrous applicator		0,65		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Planter, row crop	Conventional	0,5		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	No-till	0,35		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
** Air drill		0,45	1	0,45	1	0,45	1	0,45	1	0,45	1	0,45		0,00		0,00		0,00		0,00
Grain drill		0,35		0,00		0,00		0,00		0,00		0,00	1	0,35	1	0,35	1	0,35	1	0,35
Corn picker		1,15		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Combine	Small grain	1	1	1,00	1	1,00	1	1,00	1	1,00	1	1,00	1	1,00	1	1,00	1	1,00	1	1,00
	Soybeans	1,1		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	Corn and milo	1,6		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Mower	Cutterbar	0,35		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	Rotary	0,8		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	Mow-condition	0,6		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Swather		0,55	0,5	0,28	1	0,55	0,25	0,14	0,5	0,28	1	0,55	0,25	0,14	0,5	0,28	0,75	0,41	0,25	0,14
Rake		0,25		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Baler		0,45		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
Sprayer		0,1	2,5	0,25	3	0,30	3	0,30	2	0,20	2,5	0,25	2,5	0,25	1,5	0,15	2	0,20	2	0,20
Forage harvester	Green chop	0,95		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	Haylage	1,25		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
	Corn silage	3,6		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00		0,00
		Total	**5,25**	**2,03**	**6**	**2,3**	**5,25**	**1,89**	**6**	**2,48**	**6,5**	**2,70**	**5,75**	**2,19**	**7**	**3,6**	**7,75**	**3,79**	**7,25**	**3,51**

Reference

ARD, 2009b. Alberta Agriculture & Rural Development (ARD). A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing.

TABLE 15

SUMMARY OF SOIL N2O EMISSIONS FROM CROPPING AND LAND USE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Direct N_2O Emissions Per Calf Crop

Emissions for total N inputs (fertilizer, residue, mineral	***kg N_2 O-N***	***(kg N2O)***
Barley	517,544	813,284
Barley silage	423,413	665,363
Alfalfa grass	344,520	541,388
Emissions for total N inputs (land manure)	***kg N_2 O-N***	***(kg N2O)***
Black and grey zone area	15,627	24,556
Brown and dark zone area	9,376	14,734
Emissions from total N_2 O-N inputs tillage	***kg N_2 O-N***	***(kg N2O)***
Barley	-65,462	-102,869
Barley silage	-53,556	-84,159
Alfalfa grass	-43,577	-68,478
Emissions due to soil texture	***kg N_2 O-N***	***(kg N2O)***
Barley	0	0
Barley silage	0	0
Alfalfa grass	0	0
Emissions due to irrigation	***kg N_2 O-N***	***(kg N2O)***
Barley	112,238	176,374
Barley silage	91,824	144,295
Alfalfa grass	74,715	117,409
Emissions due to landscape/topography	***kg N_2 O-N***	***(kg N2O)***
Barley	245,510	385,801
Barley silage	200,857	315,632
Alfalfa grass	163,431	256,821

Indirect N_2O Emissions Per Calf Crop

Emissions due to leaching and run-off	***kg N_2 O-N***	***(kg N2O)***
Barley	1,164	1,830
Barley silage	953	1,497
Alfalfa grass	775	1,218
Emissions for total N inputs (land manure)	56	88
Emissions due to volatilization	*kg N_2 O-N*	***(kg N2O)***
Barley	518	813
Barley silage	423	665
Alfalfa grass	345	541
Emissions for total N inputs (land manure)	25	39

TABLE 16

TOTAL QUANTITY OF MANURE GENERATED PER CALF CROP
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Manure Generation Rate (kg/head/day)	Total Manure Generated (kilotonnes)
Cows	36.8	32,797
Bulls	42.1	1,655
Calves	11.8	5,708
Heifers	24.4	6,874
Steers	26.3	6,341
Total		**53,374**

Reference

Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001.
Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)

TABLE 17

TOTAL MANURE GENERATED BASED ON CALF-FED AND YEARLING-FED SYSTEMS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

		Total Manure Generated (kilotonnes)
Calf-Fed System	Cows	14,758
	Bulls	745
	Calves	1,311
	Heifers	3,895
	Steers	3,593
	TOTAL	**24,302**
Yearling-Fed System	Cows	18,038
	Bulls	910
	Calves	4,396
	Heifers	2,979
	Steers	2,748
	TOTAL	**29,072**

TABLE 18

METHANE AND GHG EMISSIONS FROM MANURE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Diet	No. of Animals * Days	Average Dry Matter Intake, DMI	Average Dry Matter Intake, DMI	Energy Density of Feed	Gross Energy Intake	Ash	DE	Volatile solids	Bo	MCF _solid	MCF _lagoon	MCF _slurry
		(head * day)	(lbs dry matter / head / day)	(kg dry matter / head / day)	(MJ/kg)	(MJ / head / day)	(%)	(%)	(kg / head / day)	(m^3 CH_4 / kg VS)			
			(nutritionist)				*mineral content of the manure*	*digestible energy of the ration*		*biodegradability of manure*	*methane conversion factor*	*methane conversion factor*	*methane conversion factor*
								expert opinion: Darryl Gibb, Karen Beauchemin, Sean McGinn, AAFC, Holos, table A4-9, page 102	*eq 3.26, Holos*		*solid storage, cool, 10-14 Celsius average temperature*	*lagoon, cool*	*slurry with natural crust cover, cool*
Type of Animal							(IPCC, 2006)		(IPCC, 2006)	(IPCC, 2006)	(IPCC, 2006)	(IPCC, 2006)	(IPCC, 2006)
Calves before weaning - stage 1	0-3 months	194,427,747	0.00	0.00	18.45	0.00	8	65	0.00	0.19	0.02	0.66	0.1
Calves before weaning - stage 2	3-6 months	190,420,680	8.25	3.74	18.45	69.00	8	65	1.34	0.19	0.02	0.66	0.1
Cows	Winter Diet	214,305,471	25.20	11.43	18.45	210.89	8	65	4.10	0.19	0.02	0.66	0.1
	Calving Diet	226,189,268	31.50	14.29	18.45	263.62	8	65	5.13	0.19	0.02	0.66	0.1
	Breeding Diet	149,973,319	30.00	13.61	18.45	251.06	8	65	4.88	0.19	0.02	0.66	0.1
	Pasture	299,946,638	30.00	13.61	18.45	251.06	8	65	4.88	0.19	0.02	0.66	0.1
Bulls	Winter Diet	9,230,053	30.00	13.61	18.45	251.06	8	65	4.88	0.19	0.02	0.66	0.1
	Calving Diet	10,067,374	30.00	13.61	18.45	251.06	8	65	4.88	0.19	0.02	0.66	0.1
	Breeding Diet	6,675,106	30.00	13.61	18.45	251.06	8	65	4.88	0.19	0.02	0.66	0.1
	Pasture	13,350,213	30.00	13.61	18.45	251.06	8	65	4.88	0.19	0.02	0.66	0.1
Backgrounding - Calf-Fed	Backgrounding	110,770,800	12.81	5.81	18.45	107.18	8	70	1.82	0.19	0.02	0.66	0.1
Calf-Fed (Heifer)	Diet 3	8,532,928	9.64	4.37	18.45	80.71	8	81	0.93	0.19	0.02	0.66	0.1
	Diet 4	8,532,928	17.11	7.76	18.45	143.21	8	81	1.64	0.19	0.02	0.66	0.1
	Diet 5	17,065,856	19.72	8.94	18.45	165.03	8	81	1.89	0.19	0.02	0.66	0.1
	Diet 6	17,065,856	20.66	9.37	18.45	172.93	8	81	1.98	0.19	0.02	0.66	0.1
	Diet 7	108,459,610	21.12	9.58	18.45	176.79	8	81	2.03	0.19	0.02	0.66	0.1
Calf-Fed (Steer)	Diet 3	7,298,065	10.07	4.57	18.45	84.27	8	81	0.97	0.19	0.02	0.66	0.1
	Diet 4	7,298,065	21.77	9.88	18.45	182.23	8	81	2.09	0.19	0.02	0.66	0.1
	Diet 5	14,596,131	22.13	10.04	18.45	185.16	8	81	2.12	0.19	0.02	0.66	0.1
	Diet 6	14,596,131	22.97	10.42	18.45	192.24	8	81	2.20	0.19	0.02	0.66	0.1
	Diet 7	92,763,625	21.86	9.92	18.45	182.98	8	81	2.10	0.19	0.02	0.66	0.1
Backgrounding - Yearling-Fed	Backgrounding	202,133,931	15.28	6.93	18.45	127.90	8	70	2.17	0.19	0.02	0.66	0.1
Yearling - Pasture	Pasture	169,233,166	20.00	9.07	18.45	167.38	8	65	3.25	0.19	0.02	0.66	0.1
Yearling-Fed (Heifer)	Diet 1	2,234,814	11.27	5.11	18.45	94.33	8	81	1.08	0.19	0.02	0.66	0.1
	Diet 2	5,214,567	16.68	7.57	18.45	139.58	8	81	1.60	0.19	0.02	0.66	0.1
	Diet 3	5,214,567	16.18	7.34	18.45	135.43	8	81	1.55	0.19	0.02	0.66	0.1
	Diet 4	5,214,567	14.95	6.78	18.45	125.08	8	81	1.43	0.19	0.02	0.66	0.1
	Diet 5	5,214,567	21.75	9.87	18.45	182.06	8	81	2.09	0.19	0.02	0.66	0.1
	Diet 6	5,214,567	20.31	9.21	18.45	169.98	8	81	1.95	0.19	0.02	0.66	0.1
	Diet 7	93,824,961	22.33	10.13	18.45	186.86	8	81	2.14	0.19	0.02	0.66	0.1
Yearling-Fed (Steer)	Diet 1	1,911,398	12.18	5.52	18.45	101.90	8	81	1.17	0.19	0.02	0.66	0.1
	Diet 2	4,459,929	17.51	7.94	18.45	146.54	8	81	1.68	0.19	0.02	0.66	0.1
	Diet 3	4,459,929	21.59	9.79	18.45	180.67	8	81	2.07	0.19	0.02	0.66	0.1
	Diet 4	4,459,929	19.91	9.03	18.45	166.65	8	81	1.91	0.19	0.02	0.66	0.1
	Diet 5	4,459,929	22.49	10.20	18.45	188.22	8	81	2.16	0.19	0.02	0.66	0.1
	Diet 6	4,459,929	24.76	11.23	18.45	207.19	8	81	2.38	0.19	0.02	0.66	0.1
	Diet 7	80,246,863	24.76	11.23	18.45	207.18	8	81	2.38	0.19	0.02	0.66	0.1

Note:
Heifer replacements are included in the calf-fed, yearling-fed, and cow numbers.
Based of HOLOS methodology, used for the current model

eq. 3.26 Holos, IPCC 2006
VS=[GE*(1-DE/100)+(0.04*GE)]*(1-ASH/100)*(1/18.45)
VS - volatile solids (kg/head/day)
GE - gross energy intake (MJ/head/day)
DE - Percent digestible energy in feed (Table A4-9, by diet, in Holos)
ASH - ash content of manure (5)
18.45 - conversion factor for gross energy per kg of dry matter (MJ/kg)

eq. 3.27 Holos, IPCC 2006
CH4 manure_rate= VS*B0*MCF*0.67
CH4 manure_rate - manure CH4 emission rate (kg/head/day)
B0 - methane producing capacity
MCF - methane conversion factor (table A4-11, by handling system, in Holos)
0.67 - conversion factor from volume to mass (kg/m3)

eq. 3.28 Holos, IPCC 2006
CH4manure= CH4maure_rate*cattle days
CH4manure - manure CH4 emissio (kg CH4)
cattle days - numer of cattle and days in period

References

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Methodology & algorithms for version 1.1.x
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TABLE 18

METHANE AND GHG EMISSIONS FROM MANURE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Diet	No. of Animals * Days	MCF _pasture	Factor	CH4 manure rate = VS*Bo*0.67*MCF for solid storage	Total CH4 manure emission for solid storage	CH4 manure rate = VS*Bo*0.67*MCF for pasture/range	Total CH4 manure emission for pasture/range	Total CH4 manure emission for solid storage and pasture/range
		(head * day)		($kg\ CH_4/m^3$)	(kg / head / day)	kg CH4	(kg / head / day)	kg CH4	kg CH4
			methane conversion factor	*conversion factor from volume to mass*					
			Pasture/Range/Paddock, cool		*eq 3.27, Holos*		*eq 3.27, Holos*	*eq 3.28, Holos*	
Type of Animal			(IPCC, 2006)	(IPCC, 2006)	(IPCC, 2006)	(IPCC, 2006)	(IPCC, 2006)	(IPCC, 2006)	
Calves before weaning - stage 1	0-3 months	194,427,747	0.01	0.67	0.000	0	0.000	0	0
Calves before weaning - stage 2	3-6 months	190,420,680	0.01	0.67	0.003	305,770	0.002	156,138	461,907
Cows	Winter Diet	214,305,471	0.01	0.67	0.010	1,051,740	0.005	537,059	1,588,798
	Calving Diet	226,189,268	0.01	0.67	0.013	1,387,577	0.007	708,550	2,096,126
	Breeding Diet	149,973,319	0.01	0.67	0.012	876,213	0.006	447,428	1,323,641
	Pasture	299,946,638	0.01	0.67	0.012	1,752,426	0.006	894,856	2,647,282
Bulls	Winter Diet	9,230,053	0.01	0.67	0.012	53,926	0.006	27,537	81,463
	Calving Diet	10,067,374	0.01	0.67	0.012	58,818	0.006	30,035	88,853
	Breeding Diet	6,675,106	0.01	0.67	0.012	38,999	0.006	19,914	58,913
	Pasture	13,350,213	0.01	0.67	0.012	77,998	0.006	39,829	117,827
Backgrounding - Calf-Fed	Backgrounding	110,770,800	0.01	0.67	0.005	240,854	0.002	122,989	363,843
Calf-Fed (Heifer)	Diet 3	8,532,928	0.01	0.67	0.002	9,451	0.001	4,826	14,277
	Diet 4	8,532,928	0.01	0.67	0.004	16,771	0.002	8,564	25,335
	Diet 5	17,065,856	0.01	0.67	0.005	38,651	0.002	19,737	58,388
	Diet 6	17,065,856	0.01	0.67	0.005	40,501	0.003	20,682	61,183
	Diet 7	108,459,610	0.01	0.67	0.005	263,145	0.003	134,372	397,517
Calf-Fed (Steer)	Diet 3	7,298,065	0.01	0.67	0.002	8,441	0.001	4,310	12,751
	Diet 4	7,298,065	0.01	0.67	0.005	18,251	0.003	9,320	27,571
	Diet 5	14,596,131	0.01	0.67	0.005	37,091	0.003	18,940	56,031
	Diet 6	14,596,131	0.01	0.67	0.006	38,509	0.003	19,664	58,172
	Diet 7	92,763,625	0.01	0.67	0.005	232,949	0.003	118,953	351,902
Backgrounding - Yearling-Fed	Backgrounding	202,133,931	0.01	0.67	0.006	524,500	0.003	267,830	792,330
							0.000		
Yearling - Pasture	Pasture	169,233,166	0.01	0.67	0.008	659,159	0.004	336,592	995,750
Yearling-Fed (Heifer)	Diet 1	2,234,814	0.01	0.67	0.003	2,893	0.001	1,477	4,371
	Diet 2	5,214,567	0.01	0.67	0.004	9,989	0.002	5,101	15,090
	Diet 3	5,214,567	0.01	0.67	0.004	9,692	0.002	4,949	14,641
	Diet 4	5,214,567	0.01	0.67	0.004	8,951	0.002	4,571	13,522
	Diet 5	5,214,567	0.01	0.67	0.005	13,029	0.003	6,653	19,682
	Diet 6	5,214,567	0.01	0.67	0.005	12,164	0.002	6,212	18,376
	Diet 7	93,824,961	0.01	0.67	0.005	240,604	0.003	122,862	363,466
Yearling-Fed (Steer)	Diet 1	1,911,398	0.01	0.67	0.003	2,673	0.001	1,365	4,038
	Diet 2	4,459,929	0.01	0.67	0.004	8,969	0.002	4,580	13,549
	Diet 3	4,459,929	0.01	0.67	0.005	11,058	0.003	5,647	16,705
	Diet 4	4,459,929	0.01	0.67	0.005	10,200	0.002	5,209	15,409
	Diet 5	4,459,929	0.01	0.67	0.005	11,520	0.003	5,883	17,403
	Diet 6	4,459,929	0.01	0.67	0.006	12,682	0.003	6,476	19,157
	Diet 7	80,246,863	0.01	0.67	0.006	228,165	0.003	116,510	344,674
								TOTAL	**12,559,943** kg CH_4

Global Warming Potential of Methane **25**
Source: http://www.ipcc-wg1.unibe.ch/publications/wg1-ar4/ar4-wg1-chapter2.pdf Table 2.14 (100 year)

kg CO_2eq **313,998,565**

Note:
Heifer replacements are included in the calf-fed, yearling-fed, and cow numbers.
Based of HOLOS methodology, used for the current model

eq. 3.26 Holos, IPCC 2006
VS=[GE*(1-DE/100)+(0.04*GE)]*(1-ASH/100)*(1/18.45)
VS - volatile solids (kg/head/day)
GE - gross energy intake (MJ/head/day)
DE - Percent digestible energy in feed (Table A4-9, by diet, in Holos)
ASH - ash content of manure (5)
18.45 - conversion factor for gross energy per kg of dry matter (MJ/kg)

eq. 3.27 Holos, IPCC 2006
CH4 manure_rate= VS*B0*MCF*0.67
CH4 manure_rate - manure CH4 emission rate (kg/head/day)
B0 - methane producing capacity
MCF - methane conversion factor (table A4-11, by handling system, in Holos)
0.67 - conversion factor from volume to mass (kg/m3)

eq. 3.28 Holos, IPCC 2006
CH4manure= CH4maure_rate*cattle days
CH4manure - manure CH4 emissio (kg CH4)
cattle days - numer of cattle and days in period

References

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Methodology & algorithms for version 1.1.x
http://dsp-psd.pwgsc.gc.ca/collection_2009/agr/A52-136-2008E.pdf

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yields on biological efficiency and profit of beef production
from birth to slaughter, J. Anim. Sci, 1999. 77:344-352.

TABLE 19

SUMMARY OF N_2O DIRECT AND INDIRECT EMISSIONS FROM MANURE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Diet	No. of Days on Diet (days)	Average Weight (kg)	N_2O-N Direct Emissions From Solid Storage and Pasture/Range (kg N_2O-N)	N_2O-N Indirect Emissions Leaching and Volatilization (kg N_2O-N)
Calves before weaning - stage 1	0-3 months	92	45.00	44,654	15,526
Calves before weaning - stage 2	3-6 months	92	130.00	168,525	58,596
Cows	Winter Diet	90	605.55	457,062	158,920
	Calving Diet	90	605.55	537,690	186,954
	Breeding Diet	60	605.55	409,712	142,456
	Pasture	125	605.55	701,469	243,900
Bulls	Winter Diet	90	997.90	25,216	8,767
	Calving Diet	90	997.90	27,503	9,563
	Breeding Diet	60	997.90	18,236	6,341
	Pasture	125	997.90	36,471	12,681
Backgrounding - Calf-Fed	Backgrounding	96	226.80	108,273	37,646
Calf-Fed (Heifer)	Diet 3	14	229.00	6,497	2,259
	Diet 4	14	238.00	9,931	3,453
	Diet 5	28	263.00	21,335	7,418
	Diet 6	28	302.00	23,005	7,999
	Diet 7	178	467.00	181,242	63,017
Calf-Fed (Steer)	Diet 3	14	252.00	5,948	2,068
	Diet 4	14	263.00	10,972	3,815
	Diet 5	28	293.00	21,461	7,462
	Diet 6	28	336.00	23,124	8,040
	Diet 7	178	508.00	169,829	59,049
Backgrounding - Yearling-Fed	Backgrounding	144	272.16	252,928	87,943
Pasture - Yearling-Fed	Pasture	120	340.19	261,638	90,971
Yearling-Fed (Heifer)	Diet 1	3	340.00	2,368	823
	Diet 2	7	343.00	7,240	2,517
	Diet 3	7	347.00	6,870	2,389
	Diet 4	7	352.00	6,453	2,244
	Diet 5	7	358.00	8,507	2,958
	Diet 6	7	367.00	7,862	2,734
	Diet 7	126	492.00	172,642	60,027
Yearling-Fed (Steer)	Diet 1	3	386.00	2,216	771
	Diet 2	7	388.00	6,716	2,335
	Diet 3	7	393.00	7,923	2,755
	Diet 4	7	400.00	7,449	2,590
	Diet 5	7	408.00	7,993	2,779
	Diet 6	7	418.00	8,692	3,022
	Diet 7	126	541.00	174,331	60,615

Total kg N_2O-N	**3,949,979**	**1,373,403**
Total kg N_2O	**6,207,111**	**2,158,205**

Note:
See Tables 19a and 19b, for details of calculations for direct and, respectively, indirect of N2O emissions from manure

TABLE 19a

N2O DIRECT EMISSIONS FROM MANURE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Diet	No. of Animals * Days	N excretion rate	EF by handling system	EF by handling system	EF by handling system	EF by handling system	EF by handling system	N2O-N direct rate from solid storage	N2O-N direct manure from solid storage	N2O-N direct rate from pasture/range	N2O-N direct manure from pasture/range	N2O-N direct manure from solid storage and pasture/range	Total N_2O direct manure
		(head * day)	(kg N / head / day)	(kg NO_2-N / kg N)	(kg NO_2-N / kg N)	(kg NO_2-N / kg N)	(kg NO_2-N / kg N)	(kg N_2O-N / kg N)	kg/head/day	(kg N_2O-N)	kg/head/day	(kg N_2O-N)	(kg N_2O-N)	(kg N_2O)
			eq 3.36, Holos, Nat Research Council 2000, from IPCC 2006	*Tab A4-11, Holos*	*Tab A4-11, Holos*	*Tab A4-11, Holos*	*Tab A4-11, Holos*	*Tab A4-11, Holos*	*eq 3.37, Holos, IPCC 2006*	*eq 3.38 Holos, IPCC 2006*	*eq 3.37, Holos, IPCC 2006*	*eq 3.38 Holos, IPCC 2006*		
				pasture/range	*solid storage*	*compost-intensive*	*compost-passive*	*deep bedding*						
Type of Animal														
Calves before weaning - stage 1	0-3 months	194,427,747	0.02	0.02	0.005	0.1	0.01	0.01	0.0001	8,781	0.0004	35,873	44,654	70,171
Calves before weaning - stage 2	3-6 months	190,420,680	0.07	0.02	0.005	0.1	0.01	0.01	0.0004	33,141	0.0015	135,384	168,525	264,825
Cows	Winter Diet	214,305,471	0.18	0.02	0.005	0.1	0.01	0.01	0.0009	89,882	0.0036	367,179	457,062	718,240
	Calving Diet	226,189,268	0.20	0.02	0.005	0.1	0.01	0.01	0.0010	105,738	0.0040	431,952	537,690	844,942
	Breeding Diet	149,973,319	0.23	0.02	0.005	0.1	0.01	0.01	0.0011	80,571	0.0046	329,141	409,712	643,832
	Pasture	299,946,638	0.20	0.02	0.005	0.1	0.01	0.01	0.0010	137,946	0.0039	563,523	701,469	1,102,308
Bulls	Winter Diet	9,230,053	0.23	0.02	0.005	0.1	0.01	0.01	0.0011	4,959	0.0046	20,257	25,216	39,624
	Calving Diet	10,067,374	0.23	0.02	0.005	0.1	0.01	0.01	0.0011	5,409	0.0046	22,094	27,503	43,219
	Breeding Diet	6,675,106	0.23	0.02	0.005	0.1	0.01	0.01	0.0011	3,586	0.0046	14,650	18,236	28,656
	Pasture	13,350,213	0.23	0.02	0.005	0.1	0.01	0.01	0.0011	7,172	0.0046	29,299	36,471	57,312
Backgrounding - Calf-Fed	Backgrounding	110,770,800	0.08	0.02	0.005	0.1	0.01	0.01	0.0004	21,292	0.0016	86,981	108,273	170,143
Calf-Fed (Heifer)	Diet 3	8,532,928	0.06	0.02	0.005	0.1	0.01	0.01	0.0003	1,278	0.0013	5,219	6,497	10,209
	Diet 4	8,532,928	0.10	0.02	0.005	0.1	0.01	0.01	0.0005	1,953	0.0019	7,978	9,931	15,605
	Diet 5	17,065,856	0.10	0.02	0.005	0.1	0.01	0.01	0.0005	4,196	0.0021	17,139	21,335	33,526
	Diet 6	17,065,856	0.11	0.02	0.005	0.1	0.01	0.01	0.0006	4,524	0.0023	18,481	23,005	36,150
	Diet 7	108,459,610	0.14	0.02	0.005	0.1	0.01	0.01	0.0007	35,642	0.0028	145,600	181,242	284,808
Calf-Fed (Steer)	Diet 3	7,298,065	0.07	0.02	0.005	0.1	0.01	0.01	0.0003	1,170	0.0014	4,778	5,948	9,347
	Diet 4	7,298,065	0.13	0.02	0.005	0.1	0.01	0.01	0.0006	2,158	0.0025	8,814	10,972	17,242
	Diet 5	14,596,131	0.12	0.02	0.005	0.1	0.01	0.01	0.0006	4,220	0.0025	17,241	21,461	33,725
	Diet 6	14,596,131	0.13	0.02	0.005	0.1	0.01	0.01	0.0007	4,547	0.0027	18,577	23,124	36,338
	Diet 7	92,763,625	0.15	0.02	0.005	0.1	0.01	0.01	0.0008	33,397	0.0031	136,432	169,829	266,874
Backgrounding - Yearling-Fed	Backgrounding	202,133,931	0.10	0.02	0.005	0.1	0.01	0.01	0.0005	49,739	0.0021	203,189	252,928	397,458
Yearling - Pasture	Pasture	169,233,166	0.13	0.02	0.005	0.1	0.01	0.01	0.0006	51,452	0.0026	210,186	261,638	411,145
											0.0000			
Yearling-Fed (Heifer)	Diet 1	2,234,814	0.09	0.02	0.005	0.1	0.01	0.01	0.0004	466	0.0018	1,902	2,368	3,721
	Diet 2	5,214,567	0.12	0.02	0.005	0.1	0.01	0.01	0.0006	1,424	0.0023	5,816	7,240	11,377
	Diet 3	5,214,567	0.11	0.02	0.005	0.1	0.01	0.01	0.0006	1,351	0.0022	5,519	6,870	10,796
	Diet 4	5,214,567	0.10	0.02	0.005	0.1	0.01	0.01	0.0005	1,269	0.0021	5,184	6,453	10,140
	Diet 5	5,214,567	0.14	0.02	0.005	0.1	0.01	0.01	0.0007	1,673	0.0027	6,834	8,507	13,368
	Diet 6	5,214,567	0.13	0.02	0.005	0.1	0.01	0.01	0.0006	1,546	0.0025	6,316	7,862	12,354
	Diet 7	93,824,961	0.15	0.02	0.005	0.1	0.01	0.01	0.0008	33,951	0.0031	138,692	172,642	271,295
Yearling-Fed (Steer)	Diet 1	1,911,398	0.10	0.02	0.005	0.1	0.01	0.01	0.0005	436	0.0019	1,780	2,216	3,483
	Diet 2	4,459,929	0.13	0.02	0.005	0.1	0.01	0.01	0.0006	1,321	0.0025	5,395	6,716	10,554
	Diet 3	4,459,929	0.15	0.02	0.005	0.1	0.01	0.01	0.0007	1,558	0.0030	6,365	7,923	12,451
	Diet 4	4,459,929	0.14	0.02	0.005	0.1	0.01	0.01	0.0007	1,465	0.0028	5,984	7,449	11,705
	Diet 5	4,459,929	0.15	0.02	0.005	0.1	0.01	0.01	0.0007	1,572	0.0030	6,421	7,993	12,561
	Diet 6	4,459,929	0.16	0.02	0.005	0.1	0.01	0.01	0.0008	1,709	0.0033	6,982	8,692	13,658
	Diet 7	80,246,863	0.18	0.02	0.005	0.1	0.01	0.01	0.0009	34,283	0.0036	140,049	174,331	273,949
												Total	**3,949,979**	**6,207,111**
												Reduced emissions based on the usage of ionophores	**3,791,980**	**5,958,826**

TABLE 19a

N2O DIRECT EMISSIONS FROM MANURE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Note:
Heifer replacements are included in the calf-fed, yearling-fed, and cow numbers.
Based on expert opinion, the N excretion rate is too high for cattle in feedlots, however, no data was obtained to support this theory.
N_2O emissions have been decreased based on the assumption that ionophores are given to all cattle.

Manure management (beef data tab)		
Unmanaged (left on pasture range and paddock)	48	%
Stored on farms as solid	47	%
Stored on farms as liquid	1	%

eq. 3.36 Holos, derived from IPCC 2006
Nexcretion_rate= PI/6.25-(PRfetal/6.25+PRlactation/6.38+Prgain/6.25)
Nexcretion_rate - N excretion rate (kg/head/day)
6.25 - conversion from dietary protein to dietary N
6.38 - conversion from milk protein to milk N

eq. 3.37 Holos, IPCC 2006
N2O-Ndirect_rate Nexcretion_rate*EFdirect
N2O-Ndirect_rate - emission factor (kg N2O-N/kg N) , Table A4-11, Holos, by handling system

eq. 3.38 Holos, IPCC 2006
N2O-Ndirectmanure=N2O-Ndirect_rate*#cattle*#days
N2O-Ndirect manure- manure direct emission (kg N2O-N)
cattle - number of cattle
days = number of days in period

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TABLE 19b

N2O INDIRECT EMISSIONS FROM MANURE
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Type of Animal	Diet	No. of Animals * Days	N excretion rate	Fraction volatilization by handling system	Fraction volatilization by handling system	Fraction volatilization by handling system	EF volatilization by handling system	N2O-N volatilization rate for solid storage	N2O-N volatilization for solid storage	N2O-N volatilization rate for pasture	N2O-N volatilization for pasture	N2O-N volatilization for solid storage and pasture	Fraction leached by handling system	Fraction leached by handling system	EF leached by handling system	N_2O-N leaching rate	N_2O-N leaching	N_2O-N indirect manure leaching and volatilization	N_2O-N manure (both direct and indirect emissions)	N land manure (N available for land application)
		(head * day)	day)	dimensionless	dimensionless	dimensionless	kg N2O-N/kg N	(kg / head / day)	(kg N_2O-N)	(kg / head / day)	(kg N_2O-N)	(kg N_2O-N)			(kg N_2O-N / kg N)	(kg / head / day)	(kg N_2O-N)	(kg N_2O-N)	(kg N_2O-N)	kg N
			eq 3.36, Holos, Nat Research Council 2000, from IPCC 2006	*Table A4-11, Holos pasture/range*	*Table A4-11, Holos solid storage compost intensive compost passive*	*Table A4-11, Holos deep bedding*	*Table A4-11, Holos all handling systems*	*eq 3.39, Holos, IPCC 2006*	*eq 3.40, Holos, IPCC 2006 total*	*eq 3.39, Holos, IPCC 2006*	*eq 3.40, Holos, IPCC 2006 total*		*Table A4-11, Holos pasture/range value from eq 1.22, Holos*	*Table A4-11, Holos all syst, except pasture*	*Table A4-11, Holos all handling systems*	*eq 3.41, Holos, IPCC 2006*	*eq 3.42, Holos, IPCC 2006 total*	*eq 3.43, Holos*	***eq 3.44, Holos***	*eq 3.45, Holos*
Calves before weaning - stage 1	0-3 months	194,427,747	0.02	0.20	0.45	0.30	0.01	9.E-05	7,903	4.E-05	3,587	11,490	0.30	0	0.0075	4.32E-05	4,036	15,526	**60,180**	
Calves before weaning - stage 2	3-6 months	190,420,680	0.07	0.20	0.45	0.30	0.01	3.E-04	29,827	1.E-04	13,538	43,365	0.30	0	0.0075	1.67E-04	15,231	58,596	**227,121**	
Cows	Winter Diet	214,305,471	0.18	0.20	0.45	0.30	0.01	8.E-04	80,894	4.E-04	36,718	117,612	0.30	0	0.0075	4.02E-04	41,308	158,920	**615,982**	
	Calving Diet	226,189,268	0.20	0.20	0.45	0.30	0.01	9.E-04	95,164	4.E-04	43,195	138,360	0.30	0	0.0075	4.48E-04	48,595	186,954	**724,644**	
	Breeding Diet	149,973,319	0.23	0.20	0.45	0.30	0.01	1.E-03	72,514	5.E-04	32,914	105,428	0.30	0	0.0075	5.14E-04	37,028	142,456	**552,168**	
	Pasture	299,946,638	0.20	0.20	0.45	0.30	0.01	9.E-04	124,151	4.E-04	56,352	180,504	0.30	0	0.0075	4.40E-04	63,396	243,900	**945,369**	
Bulls	Winter Diet	9,230,053	0.23	0.20	0.45	0.30	0.01	1.E-03	4,463	5.E-04	2,026	6,489	0.30	0	0.0075	5.14E-04	2,279	8,767	**33,983**	
	Calving Diet	10,067,374	0.23	0.20	0.45	0.30	0.01	1.E-03	4,868	5.E-04	2,209	7,077	0.30	0	0.0075	5.14E-04	2,486	9,563	**37,066**	
	Breeding Diet	6,675,106	0.23	0.20	0.45	0.30	0.01	1.E-03	3,227	5.E-04	1,465	4,692	0.30	0	0.0075	5.14E-04	1,648	6,341	**24,576**	
	Pasture	13,350,213	0.23	0.20	0.45	0.30	0.01	1.E-03	6,455	5.E-04	2,930	9,385	0.30	0	0.0075	5.14E-04	3,296	12,681	**49,152**	
Backgrounding - Calf-Fed	Backgrounding	110,770,800	0.08	0.20	0.45	0.30	0.01	4.E-04	19,163	2.E-04	8,698	27,861	0.30	0	0.0075	1.84E-04	9,785	37,646	**145,919**	2,342,138
Calf-Fed (Heifer)	Diet 3	8,532,928	0.06	0.20	0.45	0.30	0.01	3.E-04	1,150	1.E-04	522	1,672	0.30	0	0.0075	1.43E-04	587	2,259	**8,756**	
	Diet 4	8,532,928	0.10	0.20	0.45	0.30	0.01	4.E-04	1,758	2.E-04	798	2,555	0.30	0	0.0075	2.19E-04	898	3,453	**13,384**	
	Diet 5	17,065,856	0.10	0.20	0.45	0.30	0.01	5.E-04	3,776	2.E-04	1,714	5,490	0.30	0	0.0075	2.35E-04	1,928	7,418	**28,753**	
	Diet 6	17,065,856	0.11	0.20	0.45	0.30	0.01	5.E-04	4,072	2.E-04	1,848	5,920	0.30	0	0.0075	2.54E-04	2,079	7,999	**31,003**	
	Diet 7	108,459,610	0.14	0.20	0.45	0.30	0.01	6.E-04	32,077	3.E-04	14,560	46,637	0.30	0	0.0075	3.15E-04	16,380	63,017	**244,259**	
Calf-Fed (Steer)	Diet 3	7,298,065	0.07	0.20	0.45	0.30	0.01	3.E-04	1,053	1.E-04	478	1,531	0.30	0	0.0075	1.53E-04	538	2,068	**8,016**	
	Diet 4	7,298,065	0.13	0.20	0.45	0.30	0.01	6.E-04	1,942	3.E-04	881	2,823	0.30	0	0.0075	2.83E-04	992	3,815	**14,787**	
	Diet 5	14,596,131	0.12	0.20	0.45	0.30	0.01	6.E-04	3,798	2.E-04	1,724	5,522	0.30	0	0.0075	2.77E-04	1,940	7,462	**28,923**	
	Diet 6	14,596,131	0.13	0.20	0.45	0.30	0.01	6.E-04	4,093	3.E-04	1,858	5,950	0.30	0	0.0075	2.98E-04	2,090	8,040	**31,164**	
	Diet 7	92,763,625	0.15	0.20	0.45	0.30	0.01	7.E-04	30,058	3.E-04	13,643	43,701	0.30	0	0.0075	3.45E-04	15,349	59,049	**228,878**	
Backgrounding - Yearling-Fed	Backgrounding	202,133,931	0.10	0.20	0.45	0.30	0.01	5.E-04	44,765 0	2.E-04	20,319	65,084	0.30	0	0.0075	2.36E-04	22,859	87,943	**340,870**	5,471,278
Yearling - Pasture	Pasture	169,233,166	0.13	0.20	0.45	0.30	0.01	6.E-04	46,307	3.E-04	21,019	67,325	0.30	0	0.0075	2.91E-04	23,646	90,971	**352,609**	
Yearling-Fed (Heifer)	Diet 1	2,234,814	0.09	0.20	0.45	0.30	0.01	4.E-04	419	2.E-04	190	609	0.30	0	0.0075	1.99E-04	214	823	**3,191**	
	Diet 2	5,214,567	0.12	0.20	0.45	0.30	0.01	5.E-04	1,281	2.E-04	582	1,863	0.30	0	0.0075	2.61E-04	654	2,517	**9,758**	
	Diet 3	5,214,567	0.11	0.20	0.45	0.30	0.01	5.E-04	1,216	2.E-04	552	1,768	0.30	0	0.0075	2.48E-04	621	2,389	**9,259**	
	Diet 4	5,214,567	0.10	0.20	0.45	0.30	0.01	5.E-04	1,142	2.E-04	518	1,660	0.30	0	0.0075	2.33E-04	583	2,244	**8,696**	
	Diet 5	5,214,567	0.14	0.20	0.45	0.30	0.01	6.E-04	1,506	3.E-04	683	2,189	0.30	0	0.0075	3.07E-04	769	2,958	**11,465**	
	Diet 6	5,214,567	0.13	0.20	0.45	0.30	0.01	6.E-04	1,391	3.E-04	632	2,023	0.30	0	0.0075	2.84E-04	711	2,734	**10,595**	
	Diet 7	93,824,961	0.15	0.20	0.45	0.30	0.01	7.E-04	30,555	3.E-04	13,869	44,425	0.30	0	0.0075	3.46E-04	15,603	60,027	**232,669**	
Yearling-Fed (Steer)	Diet 1	1,911,398	0.10	0.20	0.45	0.30	0.01	4.E-04	392	2.E-04	178	570	0.30	0	0.0075	2.18E-04	200	771	**2,987**	
	Diet 2	4,459,929	0.13	0.20	0.45	0.30	0.01	6.E-04	1,189	3.E-04	540	1,728	0.30	0	0.0075	2.84E-04	607	2,335	**9,051**	
	Diet 3	4,459,929	0.15	0.20	0.45	0.30	0.01	7.E-04	1,402	3.E-04	637	2,039	0.30	0	0.0075	3.34E-04	716	2,755	**10,678**	
	Diet 4	4,459,929	0.14	0.20	0.45	0.30	0.01	6.E-04	1,318	3.E-04	598	1,917	0.30	0	0.0075	3.14E-04	673	2,590	**10,038**	
	Diet 5	4,459,929	0.15	0.20	0.45	0.30	0.01	7.E-04	1,415	3.E-04	642	2,057	0.30	0	0.0075	3.37E-04	722	2,779	**10,772**	
	Diet 6	4,459,929	0.16	0.20	0.45	0.30	0.01	7.E-04	1,538	3.E-04	698	2,237	0.30	0	0.0075	3.67E-04	786	3,022	**11,714**	
	Diet 7	80,246,863	0.18	0.20	0.45	0.30	0.01	8.E-04	30,854	4.E-04	14,005	44,859	0.30	0	0.0075	4.09E-04	15,755	60,615	**234,946**	
																	Total	**1,373,403**	**5,323,382** (kg N_2O-N)	**7,813,416** kg N
																		2,158,205	**8,365,315** kg N_2O	

Note:
Heifer replacements are included in the calf-fed, yearling-fed, and cow numbers.

volatilization
run-off

eq. 3.39 Holos, IPCC 2006
N2O-Nvolatilization_rate= Nexcretion_rate*Frac volatilization*EF volatilization
N2O-N volatilization_rate - manure volatilization N emission rate (kg/head/day)
Frac volatilization - volatilization fraction (Table A4-11, Holos, by handling system)
EF volatilization - emission factor for volatilization (kg N2O-N/kg N) (table A4-11, Holos, by handling system)

eq. 3.40 Holos, IPCC 2006
N2O-N volatilization = N2O-N volatilization_rate*#cattle*#days
N2O-N volatilization - manure volatilization N emission (Kg N2O-N)

eq. 3.41 Holos, IPCC 2006
N2O-N leaching_rate= N excretion_rate*Frac leach*EF leaching
N2O-N leaching_rate - manure leaching N emission rate (kg/head/day)
Frac leaching - leaching fraction (Table A4-11, Holos, by handling system)
EF leaching - emission factor for leaching (kg N2O-N/kg N) (Table A4-11, Holos, by handling system)

eq. 3.42 Holos, IPCC 2006
N2O-N leaching = N2O-N leaching_rate*#cattle*# days
N2O-N leaching - manure leaching N emission (kg N2O-N)

eq. 3.43 Holos
N2O-N indirectmanure= N2O-N volatilization+ N2O-N leaching
N2O-N indirect manure - manure indirect emission (kg N2O-N)

eq. 3.44 Holos
N2O-N manure = N2O-N directmanure + N2O-N indirect manure
N2O-N manure - manure N emission (kg N2O-N)

eq. 3.45 Holos, IPCC 2006
N landmanure = (N excretion_rate*#cattle*#days)*[1 -(Frac volatilization +Frac leach)]
N landmanure - manure available for land application (kg N)

References

2006 IPCC Guidelines for National Greenhouse Gas Inventories
http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

Little, S., Lindeman, J., Maclean, K., Janzen, H., 2008. HOLOS - A tool to estimate and reduce greenhouse gases from farms. Methodology & algorithms for version 1.1.x
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National Research Council. 2000. Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. National Academy Press, Washington, USA.

TABLE 20

TOTAL ON-FARM ENERGY USAGE FOR ALBERTA BEEF FARMS PER CALF CROP
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Energy (TJ)	% Total Energy	Volume of Fuel (m^3)
Diesel	16,722	61.1%	477,053
Gasoline	2,845	10.4%	85,902
Natural Gas	3,564	13.0%	94,706
Electricity	4,007	14.7%	N/A
Propane	210	0.8%	4
Total	**27,348**	**100%**	**657,666**

Reference

Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000.
Available at: http://www.usask.ca/agricult

TABLE 21

ECOINVENT PROCESSES USED FOR ENERGY PRODUCTION AND CONSUMPTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Process on the Activity Map	**Ecoinvent Process**
E1	Produce crude	proxy of crude oil, at production onshore
E4	Transport crude	crude oil, production , at long distance transport
E7a, E7b	Refine crude into diesel/coloured diesel	proxy of diesel, at refinery
E9a, E9b	Transport diesel/coloured diesel	Diesel at regional storehouse (transport to end user)
E7c	Refine crude into coloured gasoline	proxy of petrol, unleaded, at refinery
E9a, E9b	Transport diesel/coloured diesel	Oil fuels (transport to end user)
E9c	Transport coloured gasoline	Petrol, unleaded, at regional storage RER
E2	Produce natural gas	proxy of natural gas, unprocessed, at extraction
E5	Transport natural gas	transport, natural gas, pipeline, long distance
E8	Process natural gas	proxy of natural gas, at production. Processing of natural gas including sweetening
E10	Transport and distribution of natural gas	Natural gas at consumer
E11	Combust natural gas	Natural gas, burned in industrial furnace >100 kW
E3, E6	Generate and transmit electricity	proxy of electricity, low voltage, at grid

TABLE 22

TOTAL WASTE GENERATED ON ALBERTA BEEF FARMS PER CALF CROP
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Amount Buried (tonnes)	Amount Burned (tonnes)
Polypropylene	344	1,031
Polyethylene	463	1,390
Total	**807**	**2,421**

TABLE 23

TOTAL EMISSIONS FOR THE PRODUCTION AND COMBUSTION OF AGRICULTURAL PLASTICS PER CALF CROP
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Quantity of Plastic Produced (tonnes)	Emissions From Plastics Production (tonnes CO_2e)	Emissions From Burning Plastics (75%) (tonnes CO_2e)
Polypropylene	1,374	2,721	1,858
Polyethylene	1,854	3,429	2,505
Total	**3,228**	**6,151**	**4,363**

Reference
Calculated based on data from Alberta Plastics Recycling Association. Volume 4. Spring 2008.
Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf

TABLE 24

TOTAL BEDDING REQUIREMENTS FOR ALBERTA BEEF FARMS PER CALF CROP
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Bedding Required (kg/head/day)	Total Bedding (tonnes)
Cow/Calf Operations	0.55	509,445
Feedlots	0.42	422,074
Total	**0.97**	**931,519**

References

Cow/Calf Operations: From conversation with Dale Kaliel with Agriprofit$; aggregate data, 5 year average for cow-calf operations

Feedlots: From Meeting with ARD and Steering Committee on November 30, 2009.

TABLE 25

SUMMARY OF TOTAL GHG EMISSIONS AND GHG EMISSIONS PER CALF-FED AND YEARLING-FED SYSTEMS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Total Emissions		**Emissions from Calf-Fed System**		**Emissions from Yearling-Fed System**	
	kt CO_2e	**% of total**	**kt CO_2e**	**% of total**	**kt CO_2e**	**% of total**
Construction	0	0.0	0	0.0	0	0.0
Forage and Cereal Sub-activities	1,205	5.8	600	6.6	605	5.2
On-Farm Energy Generation Activities	3,846	18.6	1,730	19.1	2,115	18.2
O&M Activities	0	0.0	0	0.0	0	0.0
Cereal Activities	338	1.6	189	2.1	149	1.3
Forage Activities	286	1.4	120	1.3	166	1.4
Feedlot and Pasture Activities	609	2.9	282	3.1	327	2.8
Cow Transportation	25	0.1	11	0.1	14	0.1
Bull Transportation	3	0.0	1	0.0	2	0.0
Yearling-Fed Transportation	108	0.5	0	0.0	108	0.9
Calf-Fed Transportation	66	0.3	66	0.7	0	0.0
Cattle Enteric Fermentation Emissions	10,592	51.1	4,440	49.0	6,152	52.8
Cattle Methane Emissions from Manure	314	1.5	127	1.4	178	1.5
Soil Carbon Change in Soil From Land Us	-236	-1.1	-105	-1.2	-131	-1.1
Direct CO_2 Emissions From Managed Soi	189	0.9	84	0.9	105	0.9
N_2O from GHG beef activity, soil, crop	3,374	16.3	1,519	16.8	1,856	15.9
Total P emissions from run-off	0	0.0	0	0.0	0	0.0
Total Emissions	**20,718**	**100.0**	**9,065**	**100.0**	**11,645**	**100.0**
Total Emissions Per Functional Unit (kg CO_2e/kg shrunk live weight)	**14.521**		**14.118**		**14.840**	
Total Emissions Per Functional Unit without Soil Carbon Change (kg CO_2e/kg shrunk live weight)	**14.687**		**14.281**		**15.007**	

TABLE 26

SUMMARY OF N_2O EMISSIONS FROM MANURE MANAGEMENT AND SOIL CROPPING
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	kg N2O-N	kg N2O
Direct N2O Emissions From Manure Management	3,791,980	5,958,826
Indirect N2O Emissions From Manure Management	1,373,403	2,158,205
N2O emissions from cropping and land use	2,040,662	3,206,754
Total N2O emissions	7,206,045	11,323,785

Total kg CO2e **3,374,487,812**

TABLE 27

CONTRIBUTION OF ACTIVITIES TO AQUATIC ACIDIFICATION EFFECT
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Total Acidification		Calf-Fed System Acidification		Yearling-Fed System Acidification	
	kt SO_2e	% of total	kt SO_2e	% of total	kt SO_2e	% of total
Construction	0.0	0	0.0	0	0.0	0
Forage and Cereal Sub-activities	8.2	24.9	4.1	26.5	4.1	23.4
On-Farm Energy Generation Activities	13.0	39.5	5.9	38.3	7.2	40.8
O&M Activities	0.0	0	0.0	0	0.0	0
Cereal Activities	2.6	7.8	1.4	9.3	1.1	6.4
Forage Activities	2.4	7.2	1.0	6.5	1.4	7.8
Feedlot and Pasture Activities	5.8	17.7	2.6	17.0	3.2	18.2
Cow Transportation	0.1	0.4	0.1	0.3	0.1	0.4
Bull Transportation	0.0	0.0	0.0	0.0	0.0	0.0
Yearling-Fed Transportation	0.5	1.6	0.0	0	0.5	2.9
Calf-Fed Transportation	0.3	1.0	0.3	2.1	0.0	0
Cattle Enteric Fermentation Emissions	0.0	0	0.0	0	0.0	0
Cattle Methane Emissions from Manure	0.0	0	0.0	0	0.0	0
Soil Carbon Change in Soil From Land Use	0.0	0	0.0	0	0.0	0
Direct CO_2 Emissions From Managed Soils	0.0	0	0.0	0	0.0	0
N_2O from GHG beef activity, soil, crop	0.0	0	0.0	0	0.0	0
Total P emissions from run-off	0.0	0	0.0	0	0.0	0
Total Aquatic Acidification	**32.8**	**100**	**15.3**	**100**	**17.5**	**100**
Total Acidification Per Functional Unit (kg SO_2e/kg shrunk live weight)	**0.0230**		**0.0238**		**0.0224**	

TABLE 28

CONTRIBUTION OF ACTIVITIES TO AQUATIC EUTROPHICATION EFFECT
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Total Eutrophication		**Calf-Fed System Eutrophication**		**Yearling-Fed System Eutrophication**	
	kt PO_4e	**% of total**	**kt PO_4e**	**% of total**	**kt PO_4e**	**% of total**
Construction	0.000	0	0.000	0.0	0.000	0
Forage and Cereal Sub-activities	0.203	3.6	0.100	4.0	0.103	3.4
On-Farm Energy Generation Activities	0.920	16.6	0.415	16.5	0.508	16.7
O&M Activities	0.000	0	0.000	0.0	0.000	0
Cereal Activities	0.028	0.5	0.015	0.6	0.012	0.4
Forage Activities	0.024	0.4	0.010	0.4	0.014	0.4
Feedlot and Pasture Activities	0.218	3.9	0.098	3.9	0.121	4.0
Cow Transportation	0.002	0	0.001	0.0	0.001	0
Bull Transportation	0.000	0	0.000	0.0	0.000	0
Yearling-Fed Transportation	0.010	0	0.000	0.0	0.010	0
Calf-Fed Transportation	0.006	0	0.006	0.2	0.000	0
Cattle Enteric Fermentation Emissions	0.000	0	0.000	0.0	0.000	0
Cattle Methane Emissions from Manure	0.000	0	0.000	0.0	0.000	0
Soil Carbon Change in Soil From Land Use	0.000	0	0.000	0.0	0.000	0
Direct CO_2 Emissions From Managed Soils	0.000	0	0.000	0.0	0.000	0
N_2O from GHG beef activity, soil, crop	0.000	0	0.000	0.0	0.000	0
Total P emissions from run-off	4.146	74.6	1.866	74.3	2.281	74.8
Total Aquatic Eutrophication	**5.56**	**100.0**	**2.51**	**100.0**	**3.05**	**100.0**
Total Eutrophication Per Functional Unit (kg PO_4e/kg shrunk live weight)	**0.00389**		**0.00391**		**0.00388**	

TABLE 29

CONTRIBUTION OF ACTIVITIES TO NON-RENEWABLE ENERGY CONSUMPTION EFFECT
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Total Energy		**Calf-Fed System Energy**		**Yearling-Fed System Energy**	
	TJ-eq	**% of total**	**TJ-eq**	**% of total**	**TJ-eq**	**% of total**
Construction	0	0	0	0	0	0
Forage and Cereal Sub-activities	18,373	5.3	9,186	5.8	9,188	4.9
On-Farm Energy Generation Activities	310,298	89.6	139,634	88.9	170,664	90.1
O&M Activities	0	0	0	0	0	0
Cereal Activities	4,988	1.4	2,782	1.8	2,205	1.2
Forage Activities	4,182	1.2	1,761	1.1	2,421	1.3
Feedlot and Pasture Activities	5,383	1.6	2,517	1.6	2,865	1.5
Cow Transportation	402	0.1	181	0.1	221	0
Bull Transportation	51	0	23	0	28	0
Yearling-Fed Transportation	1,741	0.5	0	0	1,741	0.9
Calf-Fed Transportation	1,065	0.3	1,065	1	0	0
Cattle Enteric Fermentation Emissions	0	0	0	0	0	0
Cattle Methane Emissions from Manure	0	0	0	0	0	0
Soil Carbon Change in Soil From Land Use	0	0	0	0	0	0
Direct CO_2 Emissions From Managed Soils	0	0	0	0	0	0
N_2O from GHG beef activity, soil, crop	0	0	0	0	0	0
Total P emissions from run-off	0	0	0	0	0	0
Total Non-Renewable Energy (TJ-eq)	**346,483**	**100**	**157,149**	**100**	**189,334**	**100**
Total Energy Per Functional Unit (MJ-eq/kg shrunk live weight)	**242.8**		**244.8**		**241.3**	

TABLE 30

COMPARISON OF ENTERIC FERMENTATION EMISSIONS TO EXISTING LITERATURE
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Alberta	*Peters et al (2009)* [1]	*Beauchemin and McGinn (2005)* [2]	*DeRamus et al (2003)* [3]	*Johnson and Johnson (1995)* [4]	*Guan et al (2006)* [5]	*Basarb et al (2005)* [6]	*Basarb et al (2005)* [7]	*Basarb et al (2005)* [8]
Average	0.184	-	-	-	0.322	-	0.220	0.180	0.159
Cows and Bulls	0.289	-	-	0.230	-	-	0.346	0.327	0.242
Calf-Fed	0.157	0.180	0.108	-	-	-	0.177	0.133	0.125
Yearling-Fed	0.169	0.180	0.185	-	-	0.123	0.210	0.147	0.159

NOTES:

All values in kilograms of methane per head*day (kg CH_4 $head^{-1}$ d^{-1})

1 - Value reported from cattle yielding 200-250 kg Hot Standard Carcass Weight (HSCW)
2 - Values for barley backgrounding and finishing diets.
Values adjusted to account for reduced feed intake during the study.
3 - Average value for mature Simbah cows
4 - Value reported for a "typical beef animal"
5 - Average value for Angus yearling steers fed high- and low-concentrate diets
6 - Values based on those presented in Table 5 (CowBytes)
7 - Values based on those presented in Table 4 (Western Canada literature)
8 - Values based on those presented in Table 3 (IPCC Tier 2)

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APPENDIX A

TECHNICAL MEMORANDUM PREPARED BY CONESTOGA-ROVERS & ASSOCIATES FOR ALBERTA AGRICULTURE AND RURAL DEVELOPMENT, ENTITLED "LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION LITERATURE REVIEW", DATED NOVEMBER 25, 2009

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TECHNICAL MEMORANDUM

TO:	Emmanuel Laate, Alberta Agriculture and Rural Development	REF. NO.:	057586
FROM:	Monica Radulescu/Stephen Ball/Tej Gidda (CRA)/cb/1	DATE:	November 25, 2009
RE:	**Life Cycle Assessment of Alberta Beef Production** **Literature Review** **Alberta Agriculture and Rural Development** **Economics and Competitiveness Division**		

1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) and the Pembina Institute (Pembina) (Project Team) have been retained by Alberta Agriculture and Rural Development (ARD) to perform a first approximation of the carbon footprint intensity and other environmental impacts including water and nutrients, such as nitrogen and phosphorus, of the beef production industry in Alberta using Life Cycle Analysis (LCA). The study will identify the environmental impacts of beef production in Alberta per functional unit.

This technical memorandum is part of Phase 1 of the project – Literature Review and is structured within five sections, as follows:

1.0 Introduction
2.0 Overview of LCA methodologies on beef production
3.0 Case studies
4.0 Recommendations
5.0 References

A glossary has also been included at the end of this literature review to explain some of the terms that are present in literature sources. CRA notes that terminology utilized in literature sources has been described in this review without interpretation or translation, in order to be consistent with the original studies. The glossary has been added to explain the various important terms that are present in the literature. It should also be noted that, in some cases, the objectives of these other studies are different from those of this assignment, and thus some comparators or items may be raised in this review that are not directly pertinent to the present study.

The main topics of the present memo are:

- Literature review and database identification

- Compilation of GHG parameters and processes, where inputs and outputs for all processes of beef production are identified
- Identification and documentation of standardized Beef LCA approaches

The literature review addressed the most recent and significant published scientific articles, conference papers and grey literature documenting LCA advances of beef production.

Firstly, a comprehensive overview of the state-of-the-art LCA literature on food production, with special emphasis on beef production, was performed. The literature review was used as a base to compile knowledge about current LCA methodologies, including:

- Definition of the goal and scope of the LCA
- Setting-up of the system boundaries
- Definition of the functional unit
- Selection of a co-product allocation method (when necessary)
- Building of the life cycle inventory based on primary and secondary data resources
- Implementation of the life cycle impact assessment methodologies

Secondly, specific LCA of beef production studies were reviewed. The selection of the reviewed LCA case studies encompassed a variety of beef production systems, mainly from cradle-to-farm gate, performed in different geographic locations (Japan, Ireland, Switzerland, and Brazil). Overall conclusions were summarized, including:

- Identification of methodological inconsistencies between the different LCA studies
- Presentation of the numerical results of greenhouse gases (GHG) emissions
- Identification of the hot-spots during the life cycle of beef production, from cradle-to-farm gate

Finally, based on the knowledge presented in the literature review and the Project Team's experience with greenhouse gas analysis, agricultural knowledge including the livestock industry and LCA expertise, a summary of recommendations for the current LCA of beef production in Alberta was presented. The recommendations included definition of goal and scope of the study, delineation of the system boundaries, selection of the functional unit, identification of data needs and database resources (including primary and secondary data) as part of the life cycle inventory (LCI), and assessment of the available life cycle impact assessment (LCIA) methods that will fit best the nature of data acquired during the LCI.

1.1 Background

Provision of food has always been a basic human need. With the development of the society and industrialization, the traditional extensive food production systems have been replaced by intensive strategies, in an attempt to meet the growing demands of a growing population. However, the shift towards intensive strategies is made on the expense of the depletion of natural resources and pollution (Kramer et al., 1999, Nonhebel 2004, Tukker et al., 2005).

The traditional human work force used in the past has been replaced by mechanical power, which leads to increased use of nonrenewable fossil energy resources. Inputs to the agricultural farms and livestock production are often imported from different production systems. Fertilizers, manure and feed are purchased outside the farm, resulting in increased transportation and production of by-products that cannot be used by the farm. Outputs from the farm system are transported to the market or handled as waste. Economic feasibility considerations have shifted the tradition of mixed crop to monoculture. All of the above-mentioned factors are translated into increased environmental loads.

In light of public concerns and legislative requirements, Life Cycle Analysis (LCA) becomes an increasingly used tool in improving the environmental performance of products and production systems. LCA studies address the environmental aspects and potential impacts throughout a product's life from raw material acquisition through production, use, and disposal (ISO 14040, 1997). Given the wide range of processes involved in the life cycle of a certain product and the versatility of the LCA as an environmental assessment tool, LCA is widely used in product development and improvement, strategic planning, environmental performance indicator selection and marketing (ISO 14040, 2006).

Based on the recent development of LCA methodologies, the use of LCA in agricultural and livestock food production presents a rapidly increasing trend. This trend is emphasized by the need for reliable and comprehensive environmental information, used further by the policy makers, producers and consumers for the selection of the most sustainable agricultural products. The LCA of food products brings information about the production system, identification of the hot-spots during the life-cycle of the product, short-term optimization plans and long-term strategic planning (Ceuterick et al, 1998).

To date, several reviews have documented the advance of agricultural and livestock LCA studies (Foster et al., 2006; Boer, 2002; Ekvall and Finnveden, 2001; Adisa, 1999; Andersson et al., 1994, Poritosh et al., 2009). Specific LCA studies have also addressed the environmental impacts created by agricultural and livestock production (Cederberg and Stadig, 2003, Cederberg and Darelius, 2002, Ogino et al, 2004, Ogino et al, 2007, Casey and Holden, 2006a,b).

A review of the LCA literature indicates that the agricultural and livestock production is the hot-spot in the life cycle of food products.

2.0 OVERVIEW OF LCA METHODOLOGIES ON BEEF PRODUCTION

At a time when international trade on food products, including beef and other meat, continue to increase, the LCA methodology is applied more and more often to agricultural and livestock products and processes. Various LCA studies carried out so far involved agricultural and livestock products, specifically beef production. LCA studies on beef production seldom extended beyond the beef production stage. Studies which cover more of the life cycle indicate that agricultural production is an important source of impacts in the life cycle of meat products, including beef (Foster et al., 2006, Roy et al., 2008).

Several of the reviewed LCA studies, of particular interest to the LCA beef production, are listed below and also referenced though the text:

- Evaluating environmental impacts of the Japanese beef cow–calf system by the life cycle assessment method, Ogino et al, 2007

- Greenhouse Gas Emissions from Conventional, Agri-Environmental Scheme, and Organic Irish Suckler-Beef Units, Casey and Holden, 2006a
- Quantification of GHG emissions from sucker-beef production in Ireland, Casey and Holden, 2006b
- Comparative life cycle assessment of beef, pork and ostrich meat: a critical point of view, Núñez et al., 2005
- Environmental impacts of the Japanese beef-fattening system with different feeding lengths as evaluated by a life cycle assessment method, Ogino et al., 2004
- System expansion and allocation in life cycle assessment of milk and beef production, Cederberg and Stadig, 2003
- Life cycle assessment of Japanese beef-fattening system: influence of feeding length on environmental loads, Ogino et al., 2002
- Using LCA methodology to assess the potential environmental impact of intensive beef and pork production, Cederberg and Darelius, 2002

2.1 System Boundaries

In LCA, the system boundary should ideally be set where nature ends and the technological system proceeds. However, for food production, the choice of system boundaries is problematic because the inclusion of biological processes renders the distinction between technological systems and nature unclear (Berlin and Uhlin 2004, Berlin 2002). Two aspects have to be taken into account when setting the system boundaries:

- Where to set the system boundaries between the system under study and other man-made systems
- Where to set the system boundaries between the technosphere (as part of the physical environment affected through building or modification by humans) and nature

The boundaries between technosphere and nature are of particular interest especially at the beginning of the food life cycle, because the life cycle of food products is tightly interlinked with nature.

Ideally, LCA should include all phases of the food life cycle, from raw materials to consumption and waste disposal. To date, only a few studies have attempted to cover the entire life cycle of a food product. The majority of the LCA research studies cover only those aspects of the product life cycle that are considered most significant. Figure 2.1 depicts the general life cycle of most products. For food products, the production phase represents agricultural and livestock activity.

While the LCA studies of beef product usually omit the beef consumption and waste handling phases, Jungbluth et al. (2000) showed that the direct environmental impact of the consumption and waste handling phases were of minor importance relative to the production phase. However, the minimization of product loss in the consumption phase is important because all the environmental impact in the life cycle is related to the product which is actually consumed (Poritosh et al., 2009).

2.2 The Functional Unit

The primary function of food is to satisfy the human body's need for nutrition, followed by other functions, such as providing energy and nutrients for the body and maintaining a good quality over time. The functional unit can reflect one or several of these aspects.

In LCA of beef production, the most common, one-dimensional functional unit is based on mass (1 kg) alone. The mass is a simple measurement of the quantity of the product and is often used to quantify the price of the product.

When the functional unit is based on mass, the water content of the beef product can be crucial (Schau and Fet, 2008). Water adds both mass and volume to the beef product while other functions or quality aspects, like nutrients, energy and protein content remain the same or similar. If the functional unit is based on mass of the beef product, than the quantity of water in the product can have an important significance. Using the total dry mass as a basis for the functional unit could be used to compare the same products with different preservation techniques (dried or fresh). Using mass as the basis for the functional unit, as is the case for the majority of the LCA's of beef production, is straightforward and easy to understand, but ignores an important function of beef products.

However, other functional units can be used for beef as a product. Essentially, it is important to find a common unit that the environmental impact of the products can be evaluated against.

The functional unit can be chosen to reflect the quality of the beef product described by the nutrient content, based on a range of factors like the amount of carbohydrate, essential amino acids, fat and protein in the beef. Marshall (2001) used the nutrient content as the functional unit in three different ways:

- Amount to provide 1 kilogram of a nutrient
- Amount to provide the daily recommended dietary intake (RDI) for a nutrient
- Amount to provide the summation of the amounts that provide the daily RDI for each nutrient

The functional unit can also be based solely on energy content of the food. Martin and Seeland (1999) related the emission of nitrogen (N), phosphorus (P) and methane (CH_4) to the protein output for human consumption from beef production systems. Energy content is usually presented together with the content of fat and protein. One possible explanation why energy content alone is rarely used as a functional unit in LCA may be that the fat content which influences the energy content varies for some beef products between different locations and seasons. Such variations make energy content as a functional unit more complex to use compared to mass.

The protein content is also a main physical function of food. The protein content of beef depends on breed of cattle and diet. The choice of diet affects the environmental impact of the system; as a result, using protein content as a functional unit may be useful (Schau and Fet, 2008).

Köllner (2003) mentions the possibility of basing the functional unit on biodiversity. Land use, in addition to serving as a basis for the functional unit, is increasingly used as an impact category in many studies. The development of a land use impact category is described in Lindeijer 2000, Lindeijer et al. 2002, and Udo de Haes 2006.

A functional unit based on mass, such as the annual beef consumption per person or typical portion or packaging, is relatively easy to understand but can vary according to personal behavior of people and product packaging. As meals are usually different from day to day, the most appropriate functional unit for food can be reflected by the one-year consumption.

Ideally, the economic value used as functional unit should allow comparisons between ranges of different products. However, the difference in prices for beef products with the same function can create rebound effects and using only economic value as the functional unit may not be sufficient for a buying decision.

Another approach to the value of the product is the so-called "emotional value" (Dutilh and Kramer, 2000). The emotional value is reflected by the price of the product and, in the meantime, is independent of the nutritional components and the energy requirements. Given these considerations, the emotional value as the functional unit is strongly related to the economic value. Using the emotional value as the functional unit avoids supplementary considerations related to quality and nutritional facts. Quality aspects depend on the storage conditions, on time and on preparation mode, while the nutritional values of some nutrients depend on the choice of complimentary foods (Andersson et al. 1994).

2.3 Co-Product Allocation Procedures

The co-product allocation strongly influences the result of an LCA. The ISO 14044 standard presents a systematic way of dealing with the co-product allocation for food products. One of the strategies for the LCA of food products is the economic co-product allocation; however, this approach should always be used with care.

The most usual functional unit in the LCA of beef production studies, mass (1 kg), eliminates in the vast majority of the cases the co-product allocation problem.

The outstanding co-product allocation issues are solved according to the priorities in ISO 14044, taking into account that, in beef production, biological causality should be placed on the same level with physical causality (Schau and Fet, 2008).

As beef production is characterized by closely interlinked subsystems (Cederberg and Stadig 2003, Ceuterick et al. 1998), the co-production in LCA of beef is a common issue. For example, in the production of milk and beef "The two production schemes are closely interlinked; surplus calves and meat from culled dairy cows are an important base for beef production" (Cederberg and Stadig 2003, p. 350). When processes result in more than one economic output, ISO 14044 (2006) suggests three approaches:

- Allocation is avoided by separating multifunctional processes into sub-processes or through system expansion
- Allocation is performed according to physical relationships between the environmental burdens and the functions
- Impacts are allocated according to the relationships (i.e. economic) between environmental burdens and functions

Cederberg and Stadig (2003) performed an LCA study of milk and beef production systems based on the system expansion approach and compared the result to economic allocation. The system of combined milk and meat production was expanded by the alternative production of meat through suckling cows which deliver meat and calves for meat production, but no milk. By subtracting the result from the milk only production LCA from that of the combined milk and beef production LCA, the environmental impact of beef alone can be found. Cederberg and Stadig (2003) conclude that the most reliable results are obtained when system expansion is preferred over economic allocation.

The biological causality between the amount and quality of the feed and the output milk and meat, in addition to allocation based on economic value and mass, was used by Cederberg and Mattsson (2000). Another biological causality used to allocate between milk and meat (Eide, 2002) is the demand for fodder needed for lactation, body maintenance and recruiting of cows' calves. The use of biological causality is illustrated by a hypothetical example, as follows: based on food composition type A, a cow produces 5,000 litres of milk and 600 kg meat and emits 50 kg methane. If the milk production has to increase by one litre while keeping the meat production constant, this can be done by changing the food composition to food type B, which will increase the methane emissions by 0.005 kg. In this manner, the methane emissions can be allocated as follows: 0.005 kg methane per kg milk allocates 25 kg of methane to the milk (5000 X 0.005 kg = 25 kg), while the remaining 25 kg of methane are allocated to the meat (Schau and Fet, 2008).

Another strategy used to avoid the allocation issue is to subdivide the unit process; however, subdividing the unit requires more detailed information on the processes, on the expense of increased costs and/or data research. In light of the sub-divided unit, it can be argued that Cederberg and Mattsson (2000), by using a biological causality for fodder demand and the production of milk, calves and meat, actually sub-divide the unit process. On the other hand, Ekvall and Finnveden (2001) argue that in order to sub-divide a process, that process should be separated in space or time, which is not the case for milk and beef production in a cow. Based on this consideration, Ekvall and Finnveden (2001) conclude that the allocation problem is solved very rarely by subdividing.

Various LCA practitioners argue that the use of system expansion generates more reliable results than the ones obtained by using any other co-product allocation procedure. One of the downsides of system expansion is that the method is more complex, and needs more data from other systems. In addition, when the system expansion is applied without substituting the additional function, the functional unit encompasses more than intended. For example, in a beef production system that also produces milk, system expansion without substituting leads to a system with a function of delivering both milk and beef, which belongs to the product category of food, but not to milk or meat. A system expansion with subtracting of the additional function, also called "avoided burden approach", already applied by Thrane (2006) for LCA of fish products, solved this problem.

The ISO 14044 standard gives references to the handling of co-product allocation based on physical causality, but not on biological causality. Because food production usually includes biological processes, allocation according to biological causalities is quite appropriate. In the case of beef production, biological causality should be equal to physical causality, as long as the different products and functions "reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system" (ISO 14044, 2006). For example, the amount of greenhouse gas (GHG) methane emissions (output) can be reduced by changes in the fodder composition (input) for cows (Giger-Reverdin et al., 2003, Ward et al., 1993). The changes in the fodder composition are also important for the quantity and quality of milk and meat, as products delivered by the system (Berlin, 2002, Cederberg and Mattsson, 2000).

The most used approach in the LCA studies is economic co-product allocation, based on two motivations:

- The economic value of the product is the driving force of the producer (Ziegler and Hansson, 2003)
- Economic co-product allocation is often the easiest way to perform the allocation if economic data are easily obtained

Although ISO 14044 (2006) mentions the economic value as a basis for allocation, it also states that: "The inventory is based on material balances between input and output. Allocation procedure should therefore approximate as much as possible such fundamental input/output relationship and characteristics". Because most studies use mass or volume as a relevant measure of the system's performance, by choosing a functional unit related to mass or volume, the mass or volume should also be relevant for allocation. Economic value used as the basis for the allocation involves prices, which for food production systems are sensitive to subsidies (FAO Media Office 2003, Schrank 2003). Therefore, using an economic based allocation could lead to loss of information or double counting.

A good measure of the correct use of allocation is the following: using economic allocation when the functional unit is based on mass (volume) should give the same result as when using a functional unit based on economic value together with an allocation based on mass or volume.

2.4 Databases and Life Cycle Inventory

In addition to primary data, which is not always available, LCA practitioners often use secondary data from databases embedded in commercially available LCA software. The sources of inventory data used in LCA are clearly stated so as to understand uncertainties attached to the results. The sources of inventory are also linked to quality of interpretation and conclusions from LCA studies. Databases of food products – covering fish, crops, dairy, livestock, fruits and vegetables – are currently available.

The following presents the databases that have been identified as being potentially helpful during the completion of the current LCA study of beef production.

LCA Databases

- U.S. Life Cycle Inventory Database (http://www.nrel.gov/lci/). The database consists of categories such as:
  - Animal production
  - Crop production
  - Fabricated metal product manufacturing
  - Food manufacturing
  - Nonmetallic mineral product manufacturing
  - Oil and gas extraction
  - Petroleum and coal products manufacturing
  - Primary metal manufacturing
  - Transportation equipment manufacturing
  - Truck transportation

- Utilities
- Waste management
- Wood product manufacturing

- Chalmers Life Cycle Inventory Data (http://www.cpm.chalmers.se/CPMDatabase/). The database is organized in the following categories:
  - Processes excluding transports
  - Transports
  - Aggregated processes
- Economic Input-Output Life Cycle Assessment (EIO-LCA) Carnegie Mellon (http://www.eiolca.net/). The database is an on-line LCA model that will act as a tool to check some calculations during the LCA study with respect to greenhouse gas and conventional air pollutants emissions.
- Ecoinvent Centre (http://www.ecoinvent.ch/). The Ecoinvent Centre offers science-based, industrial, international life cycle assessment and life cycle management (LCM) data and services. Ecoinvent is available either through the purchase of the database itself, or through the purchase of the SimaPro LCA software.
- Pembina LCA Database (www.lcva.ca). Pembina's LCA database is a resource that can provide relevant and up-to-date data for the LCA.
- University of Washington, College of Engineering (http://faculty.washington.edu/cooperjs/Research/database%20projects.htm) LCA Database Projects. This website provides links to database such as:
  - University of Waterloo – Canadian Raw Materials Database
  - The European Union's European Reference Life Cycle Data System ELCD (including database categories such as end-of-life treatment, energy carriers and technologies, materials production, systems, and transport services)
  - Australian LCA Network – Australian and international LCA database information
  - Denmark LCA Food Database – Database information for industrial processing (slaughtering of cattle, livestock feed production, and fertilizer production)
- Environment Canada, National Inventory Report 1990-2006 – Greenhouse Gases Sources and Sinks in Canada (http://www.ec.gc.ca/pdb/ghg/inventory_report/2008_trends/trends_eng.cfm)
  - Electricity intensity tables
- IPCC Intergovernmental Panel on Climate Change (2006) – Guidelines for National Greenhouse Gas Inventories (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html)
  - Volume 2 – Energy
  - Volume 3 – Industrial Processes and Product Use
  - Volume 4 – Agriculture Forestry and Other Land Use
  - Volume 5 – Waste
- USEPA, Technology Transfer Network, Clearinghouse for Inventories & Emissions Factors (http://www.epa.gov/ttn/chief/ap42/) – Emissions Factors & AP 42
  - Materials and animal production emission factors

- Natural Resources Canada – Canadian Vehicle Survey 2005, Summary Report (http://oee.nrcan.gc.ca/Publications/statistics/cvs05/index.cfm?attr=0)
- Technology Early Action Measures – Sector Specific Protocol: GHG Protocol for Grid-Connected Renewable Energy Baselines in Canada
- Technology Early Action Measures – Emission Factor Database including the following categories:
  - Electricity production and transmission
  - Fuel combustion
  - Manufacturing and industry
  - Upstream emission factors (fuel)
  - Agriculture emission factors

The website below offers a more detailed list of life cycle databases that can be used as an alternative resource if any data gaps are recognized during the project: http://lca.jrc.ec.europa.eu/lcainfohub/databaseList.vm

Agriculture Databases

- Canfax (http://www.canfax.ca/Main.aspx). Provides information pertaining to Canada's cattle market information
- Statistics Canada (http://www.statcan.gc.ca/start-debut-eng.html). Provides Canadian statistical information pertaining to general agriculture, crops, farms and farm operators, land use, and livestock
- Government of Alberta – Agriculture and Rural Development – Fertilizer Guide (http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/agdex3894)
- Canadian Fertilizer Institute (http://www.cfi.ca/)
- University of Missouri, Columbia - Fuel Requirement Estimates for Selected Field Operations (http://www.todaystractors.com/articles/art1.html)
- Intervet and Texas Tech University – North American TBA Implant Database (http://www.depts.ttu.edu/afs/implantdb/dbhome/default.htm). Provides information on implants and drugs/growth stimulants
- Foragebeef.ca – Technical Information for the Canadian Forage Beef Industry (http://www.foragebeef.ca/app33/foragebeef/index_body.jsp). Provides a wide range of information in cows, calves, and forage

Based on the access to databases and collection of primary, site-specific and secondary, generic, raw data, a life cycle inventory (LCI) is produced. The LCI quantifies all the energy, raw materials requirements, atmospheric emissions, waterborne emissions, solid wastes and other releases for the entire life cycle of the product.

2.5 Environmental Impact Assessment

Life Cycle Impact Assessment (LCIA) methods connect the life cycle inventory to its potential environmental damages. The initial LCI results offer just an inventory of the environmental input-output data in the system; emissions are classified further into impact categories; the category indicator can be located at any place between the LCI-results and the category endpoint (Jolliet et al., 2003). Based on this format, two main schools of methods have been developed (Pre Consultants, 2008):

- Classical impact assessment methods (CML method: Guinée et al., 2002, EDIP method: Hauschild and Wenzel, 1997) which group LCI results in midpoint categories, according to common mechanisms (climate change-global warming) or commonly accepted grouping (ecotoxicity)
- Damage oriented methods such as Ecoindicator 99 (Goedkoop and Spriensma 2000) or EPS (http://eps.esa.chalmers.se/download.htm), which try to enhance relevance by modeling (sometimes with high uncertainties) the cause-effect chain up to the endpoint or damage

Figure 2.2 presents a general overview of the structure of an impact assessment method (Pre Consultants, 2008). The LCI results are characterized to produce a number of impact category indicators. The environmental relevance of each indicator is documented by describing the link to the endpoints.

Several impact assessment methods are available, based on different principles and measurements resulting in different sets of impact categories. These methods are enumerated below and also presented in Table 2.1 (lcinitiative.unep.fr):

- CML 2000
- Ecopoints 97
- Eco-Indicator 99
- EDIP97 & EDIP2003
- EPS 2000d
- (Dutch) Handbook on LCA
- IMPACT 2002+
- JEPIX - Japan Environmental Policy Priorities Index
- LIME
- Swiss Ecoscarcity Method (Ecopoints)
- The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)

A review of the available literature on LCA of beef production did not reveal a unitary approach regarding the life cycle impact method used to assess the environmental impacts based on the inventory data. Usually, the choice of environmental impact assessment method for each case study depends on the type of information required for further application as well as on the specific impacts associated with the product being studied, including beef. An accurate and detailed comparison of food products from different LCA studies can be done only if the same impact assessment methodology is used (Baumann and Tillman, 2004).

3.0 CASE STUDIES

Several case studies referenced in the literature and focusing directly on the LCA of beef production are presented below. The selection of the presented case studies was made based on their relevance and similarities with the current project.

3.1 Life Cycle Greenhouse Gas Emissions from Brazilian Beef Exported to Europe

Christel Cederberg, Daniel Meyer, Anna Flysjö, 2009. SIK Report No 792, The Swedish Institute for Food and Biotechnology, Gothenburg, Sweden, ISBN 978-91-7290-283-1

The goal of the study was to estimate the life cycle greenhouse gas (GHG) emissions and the use of energy and land from beef produced in Brazil and exported to Europe (Stockholm, Sweden) through LCA methodology. Increased knowledge of the environmental impact of beef production under tropical conditions where pastureland is the main resource was gained during this study. The livestock production systems under temperate climate conditions are significantly different from systems in the tropics, which are based on continuous grazing all year around. Since land use changes are of great importance for GHG emissions and habitat destruction caused by the livestock sector in South America (Steinfeld et al., 2006), a deeper analysis of deforestation related to Brazilian beef production was performed in the study.

Scope and Boundaries of the Study

The production system was divided into two phases:

- First phase describes the production system of Brazilian beef production, starting from cradle and ending-up as carcass weight equivalent (CWE) at the farm-gate, before transportation to the slaughterhouse. Figure 3.1 describes the first phase of the production system. The study addressed all the phases shown in Figure 3.1, including production of materials and energy used. GHG emissions from land-use transformation caused by the expansion of pasture into forestland were also included. Production for the year 2005 was studied.
- Second phase starts when the beef cattle are ready for slaughter. This phase includes the transportation from the farm-gate to a slaughterhouse, followed by slaughter of the cattle, beef processing and beef transport to its final consumption in Europe (Stockholm). The study ends up before the beef (one kg of bone-free meat) goes for consumption. Figure 3.2 describes the production system for the second phase of Brazilian beef ending up as one kg of bone-free meat exported to Europe.

In the analysis of transports, the use of energy and production of infrastructure (production of capital goods) are included.

The following processes were excluded from the study:

- Production of farm buildings and machinery, as the beef production is based on all-year grazing and thereby has a very small use of capital goods in production
- The production, use and emissions from medicines and pesticides
- The production of seed for renewing pastures

Functional Unit

Two functional units were used:

- Functional Unit No. 1 - one kg of Brazilian beef at the farm-gate, before transportation to the slaughterhouse, as carcass weight equivalent (CWE). The farm-gate includes all emissions until the livestock is ready to be delivered to slaughter.
- Functional Unit No. 2 - one kg of Brazilian beef exported to Europe for consumption (Stockholm, Sweden), as bone-free beef (BFB). Functional Unit No. 2 (bone-free beef) was calculated as: 1 kg carcass weight (meat with bone) = 0.70 kg bone-free beef.

Allocation

The studied beef production system generates meat, hides and intestines. The study allocates all environmental impacts to meat and none to the by-products of hides and intestines.

The allocation between beef and milk production was avoided by distributing all environmental impacts from the dairy cows to milk production and none of the impacts from the dairy cows to the meat production. In contrast, the environmental impacts from the rearing of the replacement heifers headed for milk production was only distributed to the meat production and nothing to the milk production.

Life Cycle Inventory

Information about the beef from separate states in Legal Amazon was taken from AliceWeb database information system (http://aliceweb.desenvolvimento.gov.br/) and from the Brazilian Institute of Geography and Statistics (IBGE, 2007).

Fertilizer application, mineral feed, and pasture renovation data was based on Ecoinvent database (Ecoinvent, 2003). Feed production data was based on a database of feed production in Sweden (Flysjö et al., 2008) and the Ecoinvent database (Ecoinvent, 2003).

Data for emissions from transports were taken from the Ecoinvent database (Ecoinvent, 2003).

Life Cycle Impact Assessment

The following environmental impact categories were analyzed:

- Climate change, as the main focus in the study is on GHG emissions from Brazilian beef
- Land use in Brazilian beef production, as land management and land transformation are major sources of GHG emissions in South America (Steinfeld et al., 2006; McAlpine et al., 2009)
- Impact on biodiversity caused by land transformation

Eutrophication and acidification were not considered, since these have not been recognized as major environmental impacts caused by livestock production in Brazil.

Results

The GHG emissions from primary production (not including emissions from land use changes) for the average Brazilian beef production in 2005 were estimated at approximately 28 kg CO_2 equivalents (eq) per kg CWE at the farm-gate. Methane from enteric fermentation represents approximately 76% of these emissions, and nitrous oxides approximately 22%. CO_2 emissions from the use of fossil fuels are of little significance to the result.

The overall life cycle of Brazilian beef, from primary production via slaughterhouse and transports to Europe (Stockholm), generates a GHG emission of about 41 kg CO_2 equivalents per kg BFB. Methane from enteric fermentation is the pre-dominant source and represents approximately 75% of total emissions.

Emissions of fossil CO_2, including transports of the beef to Europe (Stockholm), are less significant (around 2.5% of total emissions).

The energy use in the primary production is low, about 4 MJ per kg CWE at the farm-gate. The overall energy use for the whole life cycle of BFB exported to Europe is about 17 MJ per kg BFB. 80% of this energy is non-renewable fossil energy while the remaining 20% is renewable energy, consisting mostly of hydro power for electricity used in the slaughterhouses. The use of energy in the whole life cycle up to the end destination in Stockholm, where the bone-free beef is transported, can be divided up as 30% livestock production (farms), 35% transports, and 35% slaughterhouses.

Land used for beef production in Brazil in 2005 was calculated at approximately 175 m^2 per kg carcass weight X yr and approximately 250 m^2 per kg bone-free beef X yr for beef exported to Europe.

Conclusions

The GHG emissions in the primary production of Brazilian beef (not including land-use changes) are at least 30-40% higher than the current European production. Nitrous oxide emissions from the manure of the grazing cattle have a significant contribution to the overall GHG emissions of the beef. CO_2 emissions from land use transformation caused by deforestation in favor of pasture area are significant. CO_2 emissions due to overseas transports are insignificant.

High emissions of methane in the primary production of Brazilian beef are explained by high slaughter ages and long calving intervals (Lima et al, 2007), and also because the majority of beef is produced in cow-calf systems, not as by-products from milk production. Methane emissions can be reduced by improving livestock performance, such as shortening calving intervals, lowering slaughter age and improving pasture management. Poor pasture management is an important environmental hot-spot in Brazilian beef production. Pasture degradation can be prevented by maintenance fertilization and avoidance of high stocking rates, especially in dry periods (Boddey et al, 2004).

The use of energy in Brazilian beef production is very low, approximately a tenth of European production.

3.2 Evaluating Environmental Impacts of the Japanese Beef Cow–Calf System by the Life Cycle Assessment Method

Ogino, A., Orito, H., Shimada, K., Hirooka, H., 2007, Animal Science Journal 78, 424–432.

The Japanese beef production system is comprised of cow–calf production and fattening production. Ogino et al. (2007) performed an LCA study of the Japanese beef cow–calf system, with the following goals:

- To assess the environmental impacts of the beef cow–calf system
- To compare the results with those of the beef-fattening system
- To assess the results of the whole beef production system by combining the results of the beef cow–calf and beef-fattening systems
- To investigate the effects of two scenarios on reducing environmental impacts, by shortening calving intervals and, respectively, increasing the number of calves per cow

The System Boundary

The processes associated with the cow–calf life cycle, such as feed production, feed transport, animal management, the biological activity of the animal and the treatment of cattle waste were included in the system boundary. The system analyzed in this study is presented in Figure 3.3.

Functional Unit

The functional unit was defined as one marketed beef calf.

A growth curve for the cow was obtained from data for Japanese Black (Wagyu) cows, while the growth curve for the calves was assumed based on data for Japanese Black (Wagyu) steers and heifers from the same literature source (Agriculture, Forestry and Fisheries Research Council Secretariat, MAFF 2000). The growing curves were used to calculate the nutrient requirements and amounts of nitrogen and carbon excreted as manure. The cow diet was designed on the basis of nutrient requirements and the management manual for beef cow–calf production (Japan Livestock Industry Association, 1976). The calf diet was designed using mixed feed on the basis of nutrient requirements and the above-mentioned manual. The amount of nutrients required for a cow and her calves were calculated using the feeding standard (Agriculture, Forestry and Fisheries Research Council Secretariat, MAFF 2000) from respective weight and daily gain based on the growth curves.

Life Cycle Inventory

Data from the literature were used for specific activities for cow–calf production, while databases of the LCA software JEMAI-LCA (Japan Environmental Management Association for Industry 2000) and SimaPro (PRE Consultants 2003) were used for general activities such as production and combustion of fossil fuels and feed transport.

Life Cycle Impact Assessment

The contribution of the beef cow–calf system to the following environmental impact categories was examined: global warming, acidification, eutrophication and energy consumption. The global warming potential, an index for estimating the global warming contribution due to atmospheric emission of greenhouse gases, was computed according to CO_2 equivalent factors by IPCC (2001). The acidification potential was computed according to SO_2 equivalent factors (Heijungs et al., 1992). The eutrophication potential was computed according to the PO_4 equivalent factors derived from Heijungs et al. (1992). Normalization and weighting were not conducted in the study.

The following scenarios were used for the LCA analysis:

- Shortening calving intervals: calving intervals were defined as 14 months, followed by alternative scenarios which shortened calving intervals to 13 or 12 months. As a result, in the alternative scenarios, the cows culled after seven parturitions were 7 months younger as the calving intervals were 1 month shorter.
- Increasing the number of calves per cow: in the basic system the number of calves was defined as seven; in the alternative scenario cows were culled after eight or nine parturitions while maintaining calving intervals of 14 months. Consequently, in the case of eight and nine calves, the cows were culled at 127 and 141 months, respectively.

Results

The results showed that:

- The total contributions of one beef calf throughout its life cycle to global warming, acidification, eutrophication and energy consumption were 4550 kg of CO_2 equivalents, 40.1 kg of SO_2 equivalents, 7.0 kg of PO_4 equivalents and 16.1 GJ, respectively. The contribution of each process to the total environmental impact in each environmental impact category showed a similar tendency to the contribution of each process in each environmental category reported in the case of the beef-fattening system as a whole.
- Shortening calving intervals by 1 month reduced environmental impacts by 5.7–5.8% in all the environmental impact categories.
- Increasing the number of calves per cow reduced environmental impacts in all the environmental impact categories, although the effects were smaller compared to the scenario of shortening calving intervals.

3.3 Greenhouse Gas Emissions from Conventional, Agri-Environmental Scheme, and Organic Irish Suckler-Beef Units

Casey, J., W., and Holden, N., M., 2006a. Journal of Environmental Quality 35:231–239.

A life cycle assessment method was performed to estimate emissions of CO_2 equivalent per kilogram of live weight (LW) of beef (Bos taurus) leaving the farm gate per annum (kg CO_2/kg LW beef/yr) and per hectare (kg CO_2/ha/yr). Fifteen suckler-beef production units (five conventional, five in an Irish agri-environmental scheme, and five organic units) were evaluated for emissions per unit product and area, to assess whether moving toward more extensive methods of production could reduce GHG emissions per kilogram of live weight leaving the farm and per area used for production.

The System Boundary

The system boundary was defined from ''cradle-to-farm gate'', gate meaning up to the point of transportation from the beef-suckler unit. The GHG emissions associated with live weight production up to the point of transportation away from the suckler-beef unit were calculated. The system (Figure 3.4) included the physical limits of the beef units and the corresponding activities, as follows:

- The emissions associated with the individual ingredients of the concentrate feed production, transport, and processing
- Emissions associated with N fertilizer production, transportation, and application
- Emissions associated with livestock and related manure management
- Emissions associated with electricity used, and diesel fuel for agricultural operations (fertilizer and manure application, forage production)

The following emissions were excluded:

- Emissions associated with the production of medicines, insecticides, machines, buildings, and roads, due to lack of data (Cederberg and Mattsson, 2000)
- Direct N_2O emissions from cattle, as these are known to be negligible (Tiedje, 1988)
- CO_2 from enteric fermentation, as this is generally regarded as recycling from sustainably-produced plant matter and makes no net addition to the atmosphere (IPCC, 1993)

Geopolitical boundaries are not considered limits to the system.

Functional Unit

The functional unit defined for the study was the production of 1 kg of live weight during 1 year. By scaling emissions relative to a functional unit of live weight and scaling to a 1 year time frame, an accurate picture of both the emissions and the potential for emissions reduction (Casey and Holden, 2006b) is acquired.

Allocation

Based on the chosen functional unit, allocation to by-products was not necessary because the live weight of animals leaving the production unit are subject to the production of by-products after post-processing, which is outside the system boundary of the study.

Life Cycle Inventory

15 suckler-beef production units in the southern half of Ireland provided suitable quality data for specific activities for beef production.

Enteric methane emission was estimated using an IPCC methodology (IPCC, 1996a), unlike previous studies of Irish livestock systems (Casey and Holden, 2005a, 2005b), when enteric methane emissions were estimated using IPCC standard values. The calculation was based on required daily dry matter intake, metabolizable energy, and gross energy, determined using RUMNUT (RUMNUT, 2004), a nutrition software package used to estimate a diet based on surveyed livestock performance. RUMNUT is based on relationships defined by a range of protein systems and it uses the metabolizable protein system, revised from 1992 standards (Agricultural and Food Research Council AFRC, 1992).

Life Cycle Impact Assessment

The global warming potential (GWP) index was used to determine contribution to the greenhouse effect. The emissions are measured in terms of CO_2 as reference gas (IPCC, 1996b).

Results

The average emissions per kilogram of live weight beef were as follows:

- 13.0 kg CO_2/kg beef/yr from the conventional units
- 12.2 kg CO_2/kg beef/yr from the agri-environmental scheme units
- 11.1 kg CO_2/kg beef/yr from the organic units

The average emissions per unit area were as follows:

- 5,346 kg CO_2/ha/yr from the conventional units
- 4,372 kg CO_2/ha/yr from the agri-environmental scheme units
- 2,302 kg CO_2/ha/yr from the organic units

The results of the study indicated that moving from conventional suckler-beef production to an agri-environmental scheme unit production system would reduce GHG emissions in terms of both product and area. An even greater reduction in emissions could be achieved by organic suckler-beef production but at the cost of a large drop in kg of live weight production per hectare.

3.4 Quantification of GHG Emissions from Sucker-Beef Production In Ireland

Casey, J.W., Holden, N.M., 2006b, Agricultural Systems 90, 79–98.

LCA was used to quantify and analyze the GHG emissions from Irish suckler-beef production and to evaluate a number of alternative production management scenarios. The developed scenarios examined both beef-bred animals (Charolais, Simmental and Limousin) and dairy-bred animals (Holstein–Fresian).

In Ireland, beef production systems are predominantly grass-based. Weather permits 190–240 days of grazing. The most common system operated with 20 cows producing calves for replacements and beef consumption.

The System Boundary

The system boundary is defined by the GHG emissions associated with Irish beef production from ''cradle-to-farm gate'', up to the point of transportation of the animals from the beef-suckler unit. Transportation of the animals from the gate of the beef-suckler unit is not included in the study. Consequently, the system (Figure 3.4) included the physical limits of the beef unit and its activities:

- The emissions associated with the individual ingredients of the concentrate feed production, transport and processing
- Emissions associated with N fertilizer production, transportation and application
- Emissions associated with livestock and related manure management
- Emissions associated with electricity and diesel for agricultural operations (fertilizer and manure application, forage production)

The following emissions were excluded from the study:

- Emissions associated with the production of medicines, pesticides, machines, buildings and roads, due to lack of data (Cederberg and Mattsson, 2000)
- Direct N_2O emissions from cattle, as these are known to be negligible (Tiedje, 1988)
- CO_2 from enteric fermentation, as this is generally regarded as recycling from sustainably produced plant matter, and makes no net addition to the atmosphere (IPCC, 1993)

Geopolitical boundaries are not considered as limits to the system (in contrast to IPCC level 1 assessment, IPCC, 1996a,c).

Functional Unit

A mass or volume measure for the functional unit is appropriate for GHG emissions because it is applicable on a global scale (Haas et al., 2000). The functional unit was defined as the production of 1 kg of live weight (LW) over one year. By scaling total GHG emissions relative to a functional unit of live weight per year (kg CO_2/kg LW beef/yr), it was possible to estimate both the emissions and the potential for emissions reduction by adopting alternative management.

Allocation

Allocation of some of the GHG emissions to by-products was not necessary with the chosen functional unit because the live weight of animals leaving the production unit are subject to the production of by-products after post-processing, which is outside the system boundary of the study. Allocation into the system from dairy production was considered where relevant. The specific fraction was taken from an analysis by Casey and Holden (2005a) which indicated mass allocation of 96.6% to milk and 3.4% to meat based on the weight at sale of surplus calves, culled cows and 24 month male animals.

Life Cycle Inventory

National Farm Survey (Heavy et al., 1998; Burke and Roche, 1999, 2000, 2001; Connolly et al., 2002) data for the years 1997–2001 outlined the most common beef production system processes. Animal weight data used for calculations in the study were recorded from a random sample of greater than 1,500 animals worth of market data recorded at weekly livestock sales, and then crosschecked with Teagasc (Irish Agriculture and Food Development Authority) data (Drennen, 1999).

Life Cycle Impact Assessment

Global warming potential was used to determine the contribution of CO_2, CH_4 and N_2O to the greenhouse effect. The emissions are measured in terms of CO_2 as reference gas (IPCC, 1996b). The total greenhouse gas emissions were determined as kg CO_2 equivalents (Heijungs et al., 1992; Casey and Holden, 2005a). The impact is expressed as kg CO_2 (eq)/kg LW beef/yr.

Several scenarios for GHG emissions reduction were developed, examining using beef-bred animals with castrated males (Charolais, Simmental and Limousin) and dairy-bred animals (Holstein–Fresian). The system was then modified for a shorter life and a feedlot system with non-castrated males. The scenarios included the contribution from the source-cow unless the beef animal was supplied from the dairy sector, in which case a mass allocation of emissions from the newborn calf supplied by the dairy herd was used (Casey and Holden, 2005a). The assumed supplements, the feed rates and target production were calculated.

Results

The typical suckler-beef system was estimated to produce 11.26 kg CO_2/kg LW beef/yr. For beef-bred animals the cow contributed a large amount to the total emissions and had the greatest impact when attenuated. For dairy-bred beef production the allocation from the cow was much less. In terms of dietary supplementation for GHG emissions reduction, a broad range of supplement combinations were evaluated and showed no major reduction potential compared to, or within, the grass-dominated system.

3.5 Life Cycle Assessment (LCA) of Two Beef Production Systems

Chassot, A. Philipp, A., and Gaillard, G. 2005, Agroscope Liebefeld-Posieux Research Station ALP, PUB 2005/2840.

The objective of the study was to determine the environmental impacts of two contrasting beef production systems by LCA. An extensive beef production system of Limousine Simmental crossbred steers based on grass (EXT) was compared to an intensive beef production system of Simmental bulls (INT).

System Boundaries

The boundaries of the extensive, respectively intensive systems are presented in Figures 3.5 and 3.6.

Functional Unit

The functional unit of the system was defined as the production of 1 kg of beef carcass.

The characteristics of the beef production systems were as follows:

Extensive beef production system:

- The Limousine x Simmental crossbred steers had two grazing periods, the second one on an unfertilized mountain meadow, at low stocking rate. The winter ration was formed by low-quality hay and grass silage (1:1).
- The Limousine x Simmental crossbred steers were slaughtered at 20 months of age

Intensive beef production system:

- The Simmental bulls were continuously fed indoors with a ration composed of grass, maize silages (1:2), and concentrates (soybean meal and barley, 1,5:1)
- The Simmental bulls were slaughtered at 13 months of age

Life Cycle Inventory

The production data were based on experiments and the Swiss Agricultural Life Cycle Assessment (SALCA) database.

Life Cycle Impact Assessment

Various environmental impact categories were defined, as follows: depletion of non-renewable (fossil) energy resources, global warming potential, formation of ozone at ground level (summer smog), human toxicity, aquatic ecotoxicity, terrestrial ecotoxicity, total eutrophication, aquatic eutrophication, terrestrial eutrophication, and acidification.

The environmental impacts were quantified by using the software TEAM™ (Tools for Environmental Analysis and Management).

Figure 3.7 presents the results of the environmental impacts per kg of carcass of an extensive (EXT) beef production system compared to an intensive (INT) beef production system.

Results and Conclusions

- The environmental impacts of the extensive beef production system were similar or lower than those of the intensive beef production system
- The largest differences between the two systems were found in toxic effects on aquatic and terrestrial ecosystems
- The amount and type of fertilizers used to produce the feed were the main source of difference between the two systems

The extensive use of grasslands for beef production has the potential to reduce the environmental impacts per kg of carcass; especially if the animals reach desired slaughter maturity on the pasture (no intensive finishing period is required).

3.6 Environmental Impacts Of The Japanese Beef-Fattening System With Different Feeding Lengths As Evaluated By A Life-Cycle Assessment Method

Ogino, A., Kaku, K., Shimada, K., 2004. Journal of Animal Science 82, 2115–2122.

Ogino et al. (2004) evaluated the environmental impacts of a beef-fattening system using the LCA, investigated the effects of feeding length on the LCA results and discussed strategies to reduce them. The analyzed system is presented in Figure 3.8.

Functional Unit

The functional unit was defined as one animal, and the stages associated with the beef-fattening life cycle, such as feed (concentrate and roughage) production, feed transport, animal management, animal body (biological activity of cattle), and the treatment of cattle wastes, were included in the system boundary.

Scope and Boundaries of the System

The environmental impacts of a beef-fattening system were investigated, including the effects of feeding length on the environment. The system boundary started with the fattening stage, after purchasing of steer calves (8 months of age) and ended with the marketing of finished steers (26 to 28 months of age), before transportation to the slaughterhouse. A growth curve calculated from data on 367 Japanese Black (Wagyu) steers was used to calculate the amounts of N and C excreted into the manure, and a feeding system adopted in the experimental station located in the production region of the cattle was used for cattle diet. Environmental loads of transport of calves from the calf market and of finished steers to the carcass market were excluded. Finished compost was regarded as organic fertilizer and placed out of the system. The environmental loads associated with production of capital goods, such as cattle barn and front loader, were not taken into account.

Life Cycle Inventory

Data from the literature were used for specific activities for beef-fattening. For general activities, such as the production and combustion of fossil fuels and feed transport, the database of the LCA software JEMAI-LCA (JEMAI, 2000) was used.

Life Cycle Impact Assessment

The environmental effects of the beef-fattening system were examined through several environmental impact categories, such as: global warming, acidification, eutrophication, and energy consumption. The global warming potential, an index for estimating the global warming contribution due to atmospheric emission of greenhouse gases, was computed according to the CO_2 equivalent factors given by IPCC (2001). The acidification potential of the different trace gases was computed according to the SO_2 equivalent factors, derived from Heijungs et al. (1992). The eutrophication potential was computed according to the PO_4 equivalent factors derived from Heijungs et al. (1992). Normalization and weighting were not conducted in the study.

Results

The results suggested that:

- Enteric or gut CH_4 emissions of cattle were the major source in the impact category of global warming (2,851 kg of CO_2 equivalents), whereas NH_3 emissions from cattle waste were the major source in the impact categories of acidification (35.1 kg of SO_2 equivalents) and eutrophication (6.16 kg of PO_4 equivalents)
- In a previous study, Ogino et al. (2004) suggested for the reduction of the GHG environmental impact generated by the Japanese beef-fattening system are a strategy based on dietary control for enteric CH_4

emissions, adjustment of compost pile scales for greenhouse gas emissions from waste treatment, and utilization of biofiltration for NH_3 emissions from cattle barns and compost plants

- Feed production contributed significantly to all environmental impact categories
- A shorter feeding length resulted in lower environmental impacts in all the environmental impact categories, such as global warming and acidification, although there was a difference in effect of reducing environmental impacts among the categories

3.7 Greenhouse Gas Emissions from the Canadian Beef Industry

Vergé, X.P.C., Dyer, J.A., Desjardins, R.L., Worth D., 2008, Agricultural Systems 98: 126–134.

This study does not represent a complete LCA of the beef production system; however, it provides a very well documented estimate of the GHG emissions budget for the Canadian beef industry. A detailed description of the methodology can be found in a related study, addressing the GHG inventory of the Canadian dairy sector (Vergé et al., 2007). The methodology used for this study is particularly useful for setting up a specific working flow when dealing with inventory of emissions from the beef production. The main step of the study consisted of:

- Definition and quantification the beef crop complex (BCC)
- Quantification of feedlot population
- Quantification of nitrous oxide, methane, energy based CO_2 emissions
- Calculation of emission intensity indicators

Quantification and interpretation of results is a key point, referencing the significant share of the total agricultural GHG emissions coming from the beef production. The GHG emissions budget presented in the study is the best means of both projecting future GHG emissions and assessing relative trends in emissions from Canadian beef production. Soil carbon sequestration was not taken into account in this study.

Several conclusions were drawn, as follows:

- Beef cattle have their largest impact through their contribution of enteric methane
- Beef cattle were the source of 76% of the total enteric methane emissions in Canada
- Over a third of the total N_2O emitted from Canadian agriculture can be attributed to the beef industry
- The beef industry's share of fossil energy CO_2 emissions from agriculture is small mainly because of high reliance on forage crops, compared to non-ruminants and the grains and oilseeds farms
- The total emission intensity indicator for the Canadian beef industry is similar to the indicator recently developed for the Irish beef industry (Casey and Holden, 2006)

3.8 Summary of LCA Methodologies and Results

An overall review of the most up-to-date studies of LCA beef production shows that the system boundaries, the functional unit and allocation procedures are closely interlinked.

System boundaries: Beef as a product system is the result of closely interlinked nature and technosphere. System boundaries descriptions in the reviewed studies are usually described in a clear manner, with a diagram showing which parts of the life cycle are included in the analyses. The choice of system boundaries strongly influences the results; therefore, there is a need for a determined set of rules to delineate the system boundaries in such a manner that comparison of the environmental impacts between different beef products is possible. To date, such rules are not established.

A summary of the typical activities that were usually included in the reviewed LCA of beef production studies is presented below:

- The emissions associated with the individual ingredients of the concentrate feed production, transport, and processing (Casey and Holden, 2006a,b)
- The emissions associated with electricity used, and diesel fuel for agricultural operations (N fertilizer application, transportation, and application, manure application and related manure management, forage production) (Casey and Holden, 2006a,b)
- The stages associated with the beef-fattening life cycle: feed production, feed transport, animal management, biological activity of cattle, treatment of cattle wastes (Ogino et al., 2004, 2007)
- Use of energy and production of infrastructure (production of capital goods) in the analysis of transports (Cederberg et al., 2009)

The following activities were excluded from the reviewed LCA of beef production studies:

- Production of seed for renewing pastures (Cederberg et al., 2009);
- Production of farm buildings and machinery (Cederberg et al., 2009)
- Emissions associated with the production and use of medicines, pesticides, machines, buildings, and roads (Casey and Holden, 2006a,b)
- Land use changes (Cederberg et al., 2009)
- The production and use of complementary feed (in addition to pasture), including harvested fodder (Cederberg et al., 2009)
- CO_2 from enteric fermentation (Casey and Holden, 2006a,b)
- Direct N_2O emissions from cattle (Casey and Holden, 2006a,b)
- The finished compost regarded as organic fertilizer (Ogino et al., 2007)
- The environmental loads of transporting the calves to the calf market and of finished steers to the carcass market (Ogino et al., 2007)

The functional unit: The reviewed LCA beef studies use the mass as functional unit (1 kg of mass, live weight or carcass). Because the function of beef as food is more than just to fulfill the basic feeding needs (mass), the functional unit of beef product LCA could also be based on quality aspects and economic value. A quality corrected functional unit accounting for nutrient content of the food in addition to the mass is currently used only for milk products, an option that could also be considered for further LCA beef studies.

Co-product allocation: The co-product allocation method is directly related to the system boundaries and functional unit. The review of the literature showed that the choice of the functional unit can solve the co-product allocation problem. Mass is most often used as a basis for the allocation of beef product, while quality or economic value of the product (i.e. nutrient content) could be used in the future as a basis for the allocation.

The allocation issue can be avoided through system expansion. For the LCA of beef production case studies presented above, allocation to by-products was avoided by choosing as functional unit the production of 1 kg of live weight, because the live weight of animals leaving the farm is potentially generating by-products outside the boundaries of the system.

Life cycle inventory: A variety of international, regional, economic and academic databases as sources of data are available, several of them with special focus on food products, including livestock. As long as it is feasible within the constraints of the LCA study, primary data is always the best option compared to generic, secondary data.

Life cycle impact assessment: Environmental impacts especially relevant for beef and chosen for the reviewed case studies are as follows:

- Single impact categories, like energy or global warming potential
- More site-specific impact assessment, like eutrophication and acidification
- Direct ecosystem effects

Currently, for land use, a variety of assessment methods are used, however without a standard methodology.

There are no commonly accepted rules on how to define the system boundaries, the functional unit, and allocation procedures, making the comparison of different LCAs results difficult (Casey and Holden, 2006b). Also, geographical differences in the cattle production make comparison of LCA studies for beef production even more difficult. Despite the fact that a variety of LCA beef studies have been published by now, making it easier to check if the results of an LCA are of a reasonable magnitude or not, true validation of the LCA models will never be possible. Additionally, uncertainties in emission calculations reported for different practices within the system influence the LCA results. The quantification of the GHG emissions for several LCA of beef production studies are summarized below:

Study	*GHG emission*	*Comments*
Cederberg et al. (2009)	28 kg CO_2 (eq) / kg CWE	Estimated for the average Brazilian beef production in 2005 approximately at the farm-gate. The emissions are generated by primary production and do not include emissions from land use changes.

Study	*GHG emission*	*Comments*
Cederberg et al. (2009)	41 kg CO_2 (eq)/ kg BFB	Estimated for the entire life cycle of Brazilian beef, from primary production via slaughterhouse and transports to Europe (Stockholm).
Ogino et al. (2007)	4550 kg CO_2 (eq)	The total contributions of one beef calf throughout its life cycle to global warming.

Study	*GHG emission*	*Comments*
Casey and Holden (2006a)	13.0 kg CO_2 (eq)/kg LW beef/yr	The average emissions per kilogram of live weight beef from the conventional farms units. The system was based on the physical limits of the beef units, from crops, to livestock and manure management.
Casey and Holden (2006a)	12.2 kg CO_2 (eq)/kg LW beef/yr	The average emissions per kilogram of live weight beef from the agri-environmental farms units. The system was based on the physical limits of the beef units, from crops, to livestock and manure management.
Casey and Holden (2006a)	11.1 kg CO_2 (eq)/kg LW beef/yr	The average emissions per kilogram of live weight beef from the organic farms units. The system was based on the physical limits of the beef units, from crops, to livestock and manure management.
Casey and Holden (2006b)	11.26 kg CO_2 (eq)/kg LW beef/yr	For the typical suckler-beef production system.
Ogino et al. (2004)	32.3 kg CO_2 (eq)/kg	Beef gain during the fattening stage of the animal (based on a beef yield of 40%). The estimate did not account for whole system emissions (source cow is excluded).
Cederberg (2002)	17 kg CO_2 (eq)/kg (bone and fat free meat)	For animals supplied from a dairy herd. Most of the feed ingredients were grown on the farm therefore had no transport or processing. The functional unit encompassed the entire 576 days of animal life.
Subak (1999)	7.4 kg CO_2 (eq)/ kg/ (LW)/ yr	4396 kg CO_2 (eq) from a US feed lot system producing a 550 kg animal that is equivalent to 7.4 kg CO_2 (eq)/ kg/ (LW)/yr, excluding the cow phase.

In addition to the final results of the LCA of beef production studies, expressed as quantification of the GHG emissions, the review of specific LCA of beef literature also revealed the following:

- The enteric or gut CH_4 emission from livestock and N_2O emission from feed (crops) production are major contributors to global warming for beef production. Beef production in combination with milk production (surplus calves) can be carried out with fewer animals than in sole beef production systems, reducing the environmental burdens per product unit (Cederberg and Stadig, 2003).
- The increase in specialization of the dairy and the beef sectors make it difficult to reduce GHG emissions (Casey and Holden, 2006). The advantages of less intensive and combined systems are obvious for (sub)tropical animal production systems, where a combination of milk and beef production is very frequent and livestock needs to be seen in the context of larger livelihood systems (Cederberg et al., 2009, Sumberg, 2002).
- Organic farming reduces pesticide use but requires more land and leads to higher global warming impacts than non-organic systems in UK conditions (Williams et al., 2006).
- The environmental impacts of beef-fattening systems are dependent on the feeding length, feed production and type of feed, animal housing and manure storage (Ogino et al., 2002, 2004; Núñez et al., 2005, Williams et al., 2006; Nemecek, 2006). A shorter feeding length lowers the environmental impacts. The feeding stage is the most important factor for environmental impacts; the infrastructure is also relevant, especially for energy consumption and human toxicity (Erzinger et al., 2003; Núñez et al., 2005).

4.0 RECOMMENDATIONS

Based on the international leading experience acquired with the LCA of beef products, as described in the literature review and the Project Team's experience with greenhouse gas analysis, ISO environmental management standards, agricultural knowledge including the livestock industry, LCA expertise, and projects of comparable scale and complexity, the current LCA study of beef production industry in Alberta will address the following:

Goal and scope of the study

The goal and scope of the study is to quantify the GHG emissions generated during all stages of beef production, starting with production of cattle feed and ending with the production of beef at the door of the slaughterhouse. Two scenarios will be used: Yearling-fed system and, respectively, Calf-fed system. The environmental impacts associated with the life cycle of beef production for both scenarios will be presented and analyzed. Hot-spots in terms of carbon intensive stages will be identified. A sensitivity analysis will follow, looking for the best strategies for reduction of the carbon footprint at the identified hot-spots.

Boundaries of the system

Boundaries of the current study will describe the beef production system from "cradle-to-gate", where “gate” means the door of the slaughterhouse. The study will include processes associated with the cow-calf life cycle, such as production of cattle feed, feed transport, cattle feeding strategy, and livestock related activities (cattle management, storage of organic fertilizers, finishing, transport, litter). The biological activity of the animal and the treatment of cattle waste will also be included in the system boundary. The life cycle includes transportation from the finishing feedlot to local auction and slaughterhouse (meat packaging plant) and ends at the entrance door of the slaughterhouse. The activities associated with beef production will be summarized into an activity map. Further expansion of the system, to include the slaughterhouse, will be performed depending on the availability of already existent specific data. So far, a review of the specific LCA of beef production revealed that the majority of the studies end at the gate of the farm, in front of the slaughterhouse.

A recently published study (Cederberg et al., 2009) quantifying the greenhouse gas emissions and use of land and energy in Brazilian beef production, extended the boundary of the system beyond the gate of the farm to include the export of Brazilian beef to European markets. Data for energy use at the slaughterhouse was taken from a Swedish study on LCA of beef (Anonymous, 2002), where 2.4 MJ electricity and 2 MJ fossil fuel were used per kg of bone free meat. However, caution should be exercised when using data specific for systems that have a significantly different geographic and economic context compared to the system involved in the current study.

The functional unit

Despite the fact that consumption and trade of beef meat is often presented as carcass weight equivalents (meat with bone), and consumption data are given as meat including bones, the vast majority of LCA of beef production studies end in front of the slaughterhouse. As a result of this practice, the functional unit defined for the LCA studies is usually the production of 1 kg of live weight of beef leaving the farm gate. For the current study, the functional unit of 1 kg of live weight of beef leaving the farm gate has been selected. Depending on the reliability of the LCA literature data regarding processes at the slaughterhouse, the functional unit might be expanded to 1 kg of beef after the slaughterhouse, as carcass weight equivalent.

Life cycle inventory

The carbon life cycle assessment is based on a detailed quantitative life cycle inventory of the inputs and outputs quantified at the boundaries of the system. The database resources and references presented in Section 2.4 include public, academic and international resources and will be utilized by the Project Team to collect all relevant data for this project. The LCI will gather, as much as possible, specific raw data from the crop, feed and beef industries in Alberta, Canada and North America. Any data gaps identified at the time of the inventory, such as missing or incomplete data sources, will be completed through hypothesis and use of secondary data (usually generic or theoretical data available from specific literature and international LCA databases).

Life cycle impact assessment

Several LCIA methodologies are available for the assessment of the potential environmental impacts associated with the inventoried emissions. Previous LCA of food (pork and beef) production used the Impact 2002+ and Ecoindicator -99 as LCIA methodologies. Based on the results of the inventory, the assessment of the environmental impacts will be customized and the most appropriate LCIA method will be used.

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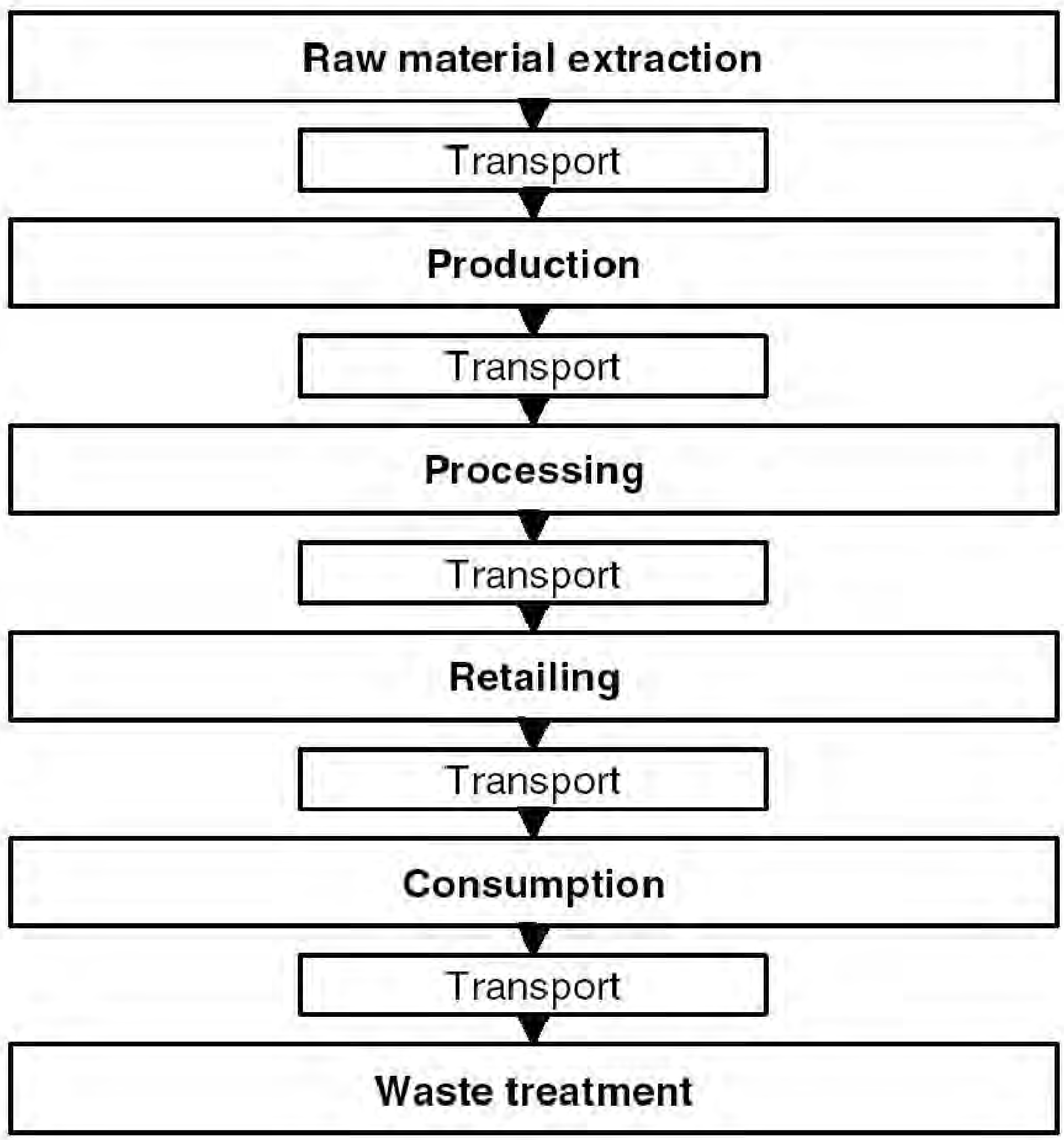
Glossary

Activity map	A depiction of the inputs and outputs of a system and how they are connected.
Allocation	Partitioning the input or output flows of a unit process to the product of interest.
By-products	An incidental product deriving from a manufacturing process or chemical reaction, and not the primary product or service being produced. A byproduct can be useful and marketable, or it can have negative ecological consequences.
Co-product	A product produced together with another product.
Functional unit	The unit of comparison that assures that the products being compared provide an equivalent level of function or service.
Life Cycle Impact assessment	The assessment of the environmental consequences of energy and natural resource consumption and waste releases associated with an actual or proposed action.
Impact categories	Classifications of human health and environmental effects caused by a product throughout its life cycle.
Life Cycle Analysis	A cradle-to-grave approach for assessing industrial systems that evaluates all stages of a product's life. It provides a comprehensive view of the environmental aspects of the product or process.
Life Cycle Inventory	The identification and quantification of energy, resource usage, and environmental emissions for a particular product, process, or activity.
Normalization	Normalization is a technique for changing impact indicator values with differing units into a common, unitless format by dividing the value(s) by a selected reference quantity. This process increases the comparability of data among various impact categories.
Weighting	The act of assigning subjective, value-based weighting factors to the different impact categories based on their perceived importance or relevance.
Technosphere	Part of the physical environment affected through building or modification by humans.



SOURCE: PRE CONSULTANTS. 2008. INTRODUCTION TO LCA WITH SIMAPRO 7. IN: INTRODUCTION TO LCA. PRE CONSULTANTS B.V., AMERSFOORT.

figure 2.1

GENERAL LIFE CYCLE OF PRODUCTS
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

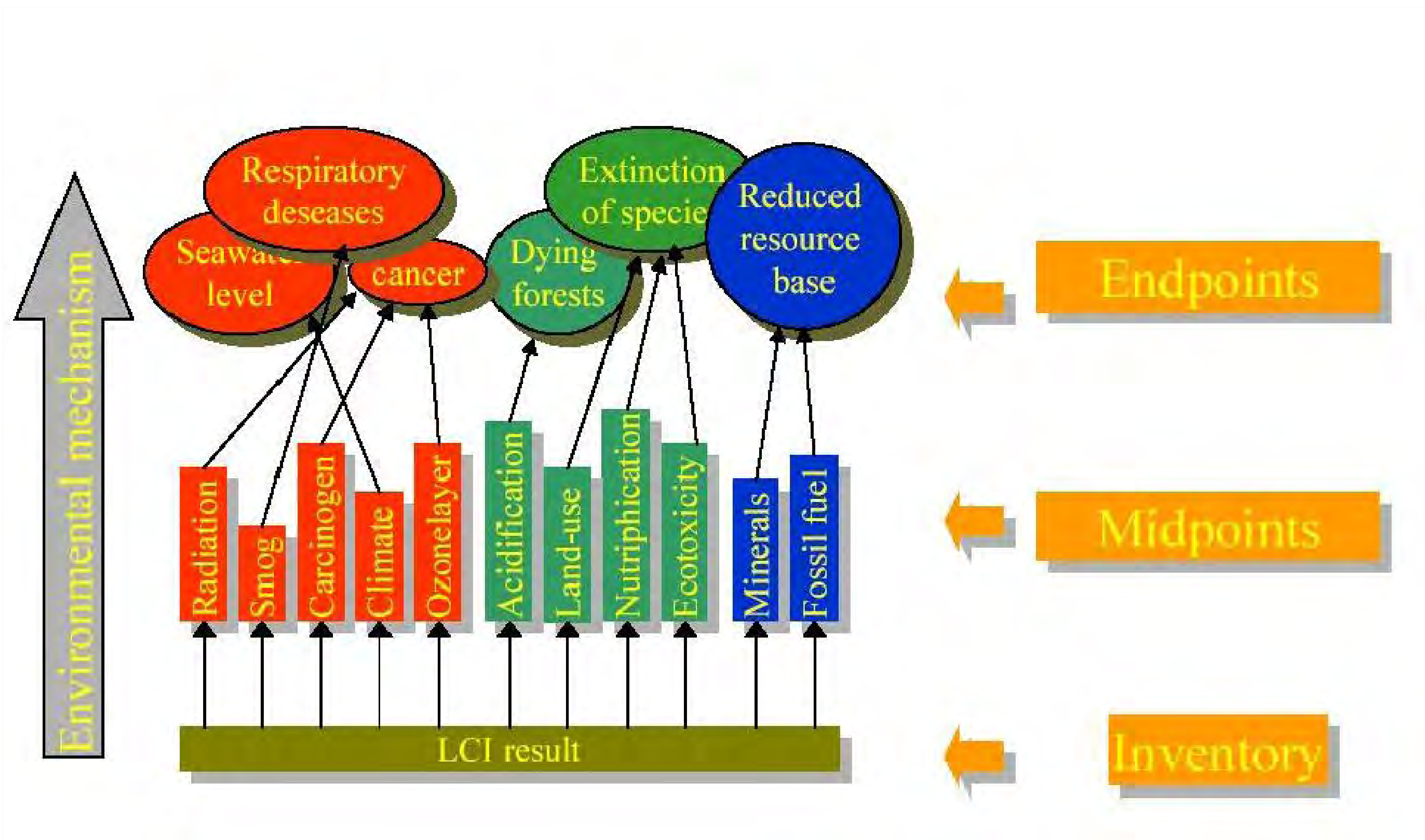
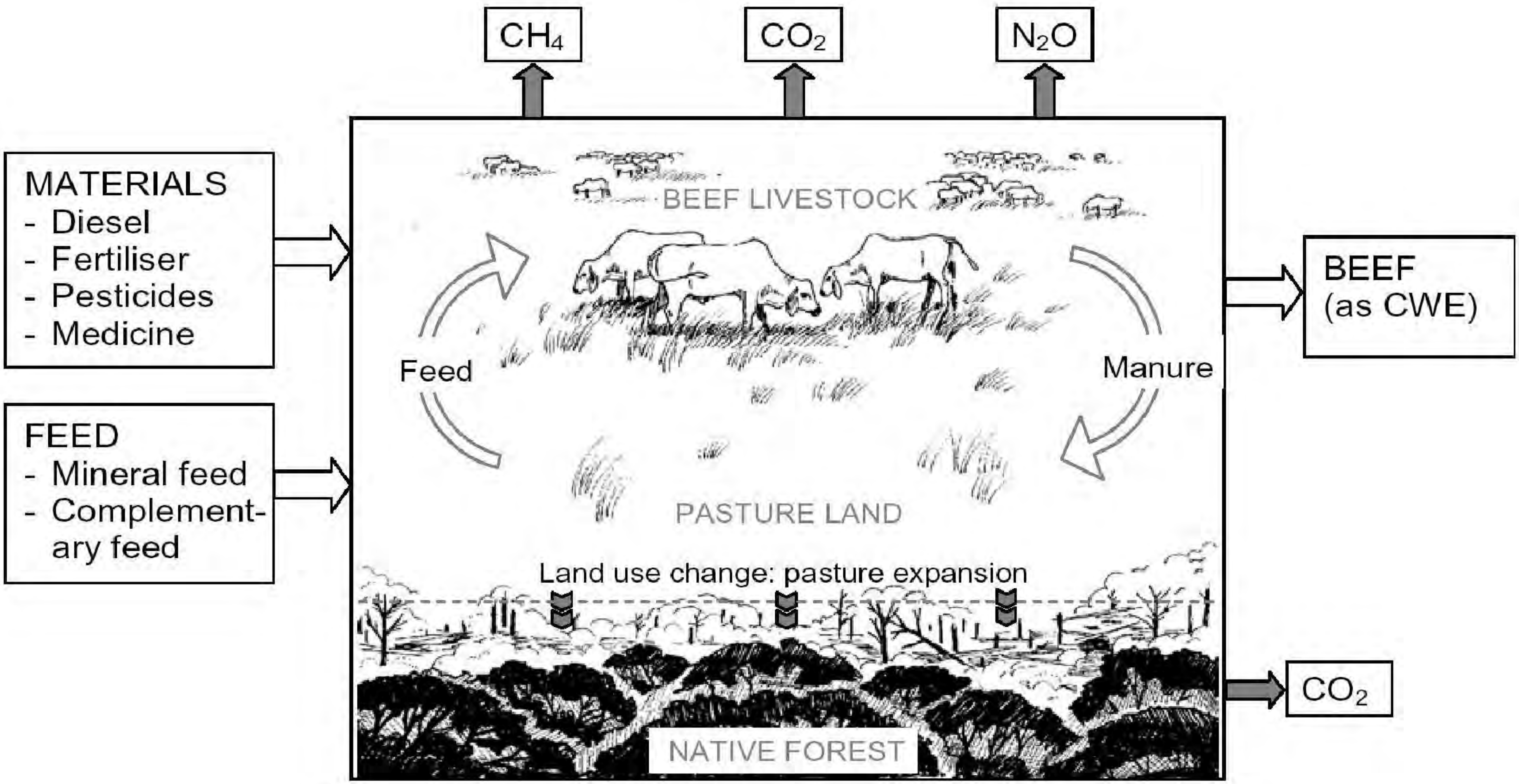


figure 2.2

GENERAL OVERVIEW OF THE STRUCTURE OF AN IMPACT ASSESSMENT METHOD
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: PRE CONSULTANTS. 2008. INTRODUCTION TO LCA WITH SIMAPRO 7. IN: INTRODUCTION TO LCA. PRE CONSULTANTS B.V., AMERSFOORT.



NOTE: CWE - CARCASS WEIGHT EQUIVALENT

figure 3.1

PRODUCTION SYSTEM OF THE FIRST PHASE OF BRAZILIAN BEEF PRODUCTION
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: CEDERBERG, C., MEYER, D., FLYSJÖ, A., JUNE 2009. LIFE CYCLE INVENTORY OF GREENHOUSE GAS EMISSIONS AND USE OF LAND AND ENERGY IN BRAZILIAN BEEF PRODUCTION, SIK REPORT NO 792.

figure 3.2

PRODUCTION SYSTEM OF THE SECOND PHASE OF BRAZILIAN BEEF PRODUCTION
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: CEDERBERG, C., MEYER, D., FLYSJÖ, A., JUNE 2009. LIFE CYCLE INVENTORY OF GREENHOUSE GAS EMISSIONS AND USE OF LAND AND ENERGY IN BRAZILIAN BEEF PRODUCTION, SIK REPORT NO 792.

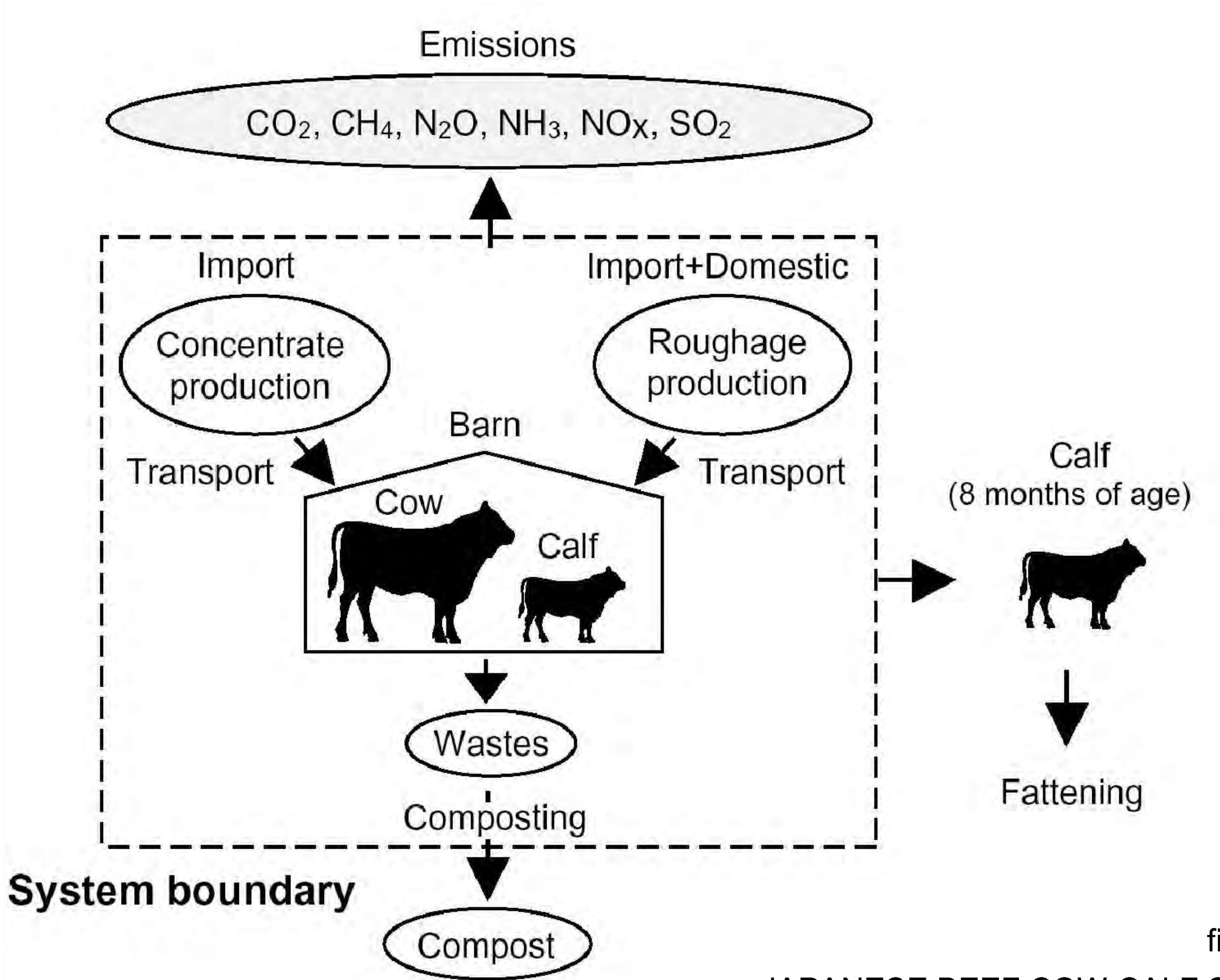


figure 3.3

JAPANESE BEEF COW-CALF SYSTEM
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: OGINO, A., ORITO, H., SHIMADA, K., HIROOKA, H., 2007. EVALUATING ENVIRONMENTAL IMPACTS OF THE JAPANESE BEEF COW-CALF SYSTEM BY THE LIFE CYCLE ASSESSMENT METHOD, ANIMAL SCI. J. 78, 424-432.

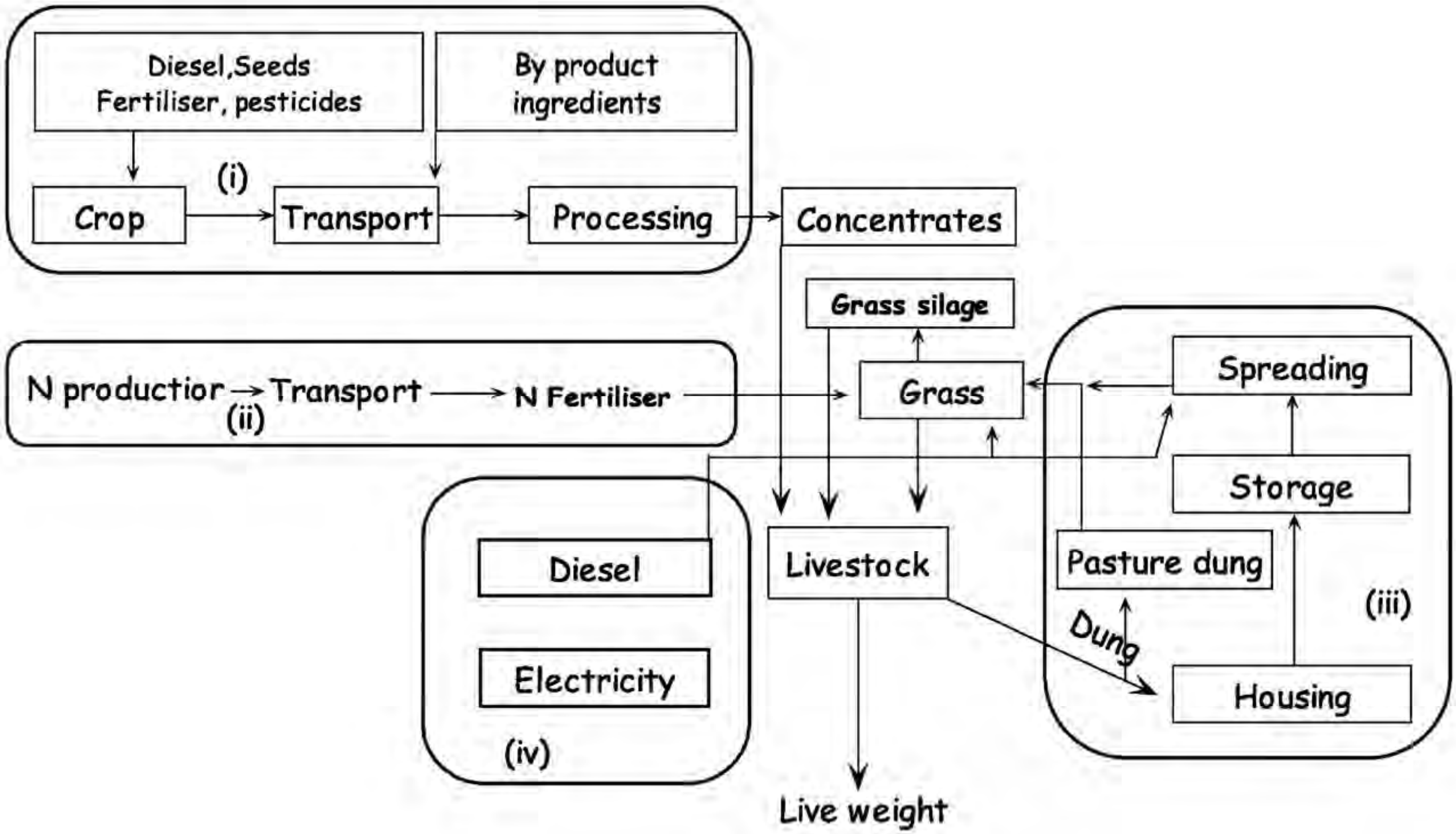
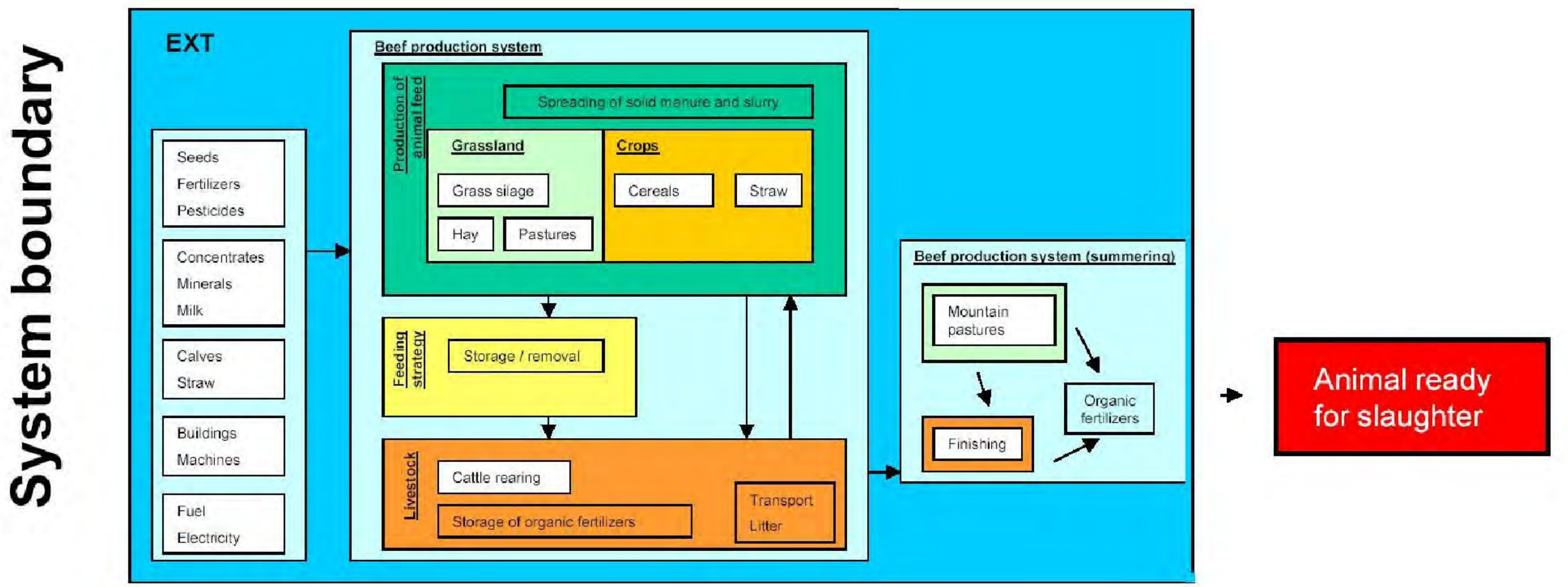


figure 3.4

FLOWCHART OF THE CRADLE TO FARM GATE BEEF PRODUCTION SYSTEM
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: CASEY, J., W., AND HOLDEN, N., M., 2006. GREENHOUSE GAS EMISSIONS FROM CONVENTIONAL, AGRI-ENVIRONMENTAL SCHEME, AND ORGANIC IRISH SUCKLER-BEEF UNITS, J. ENVIRON. QUAL. 35:231-239.

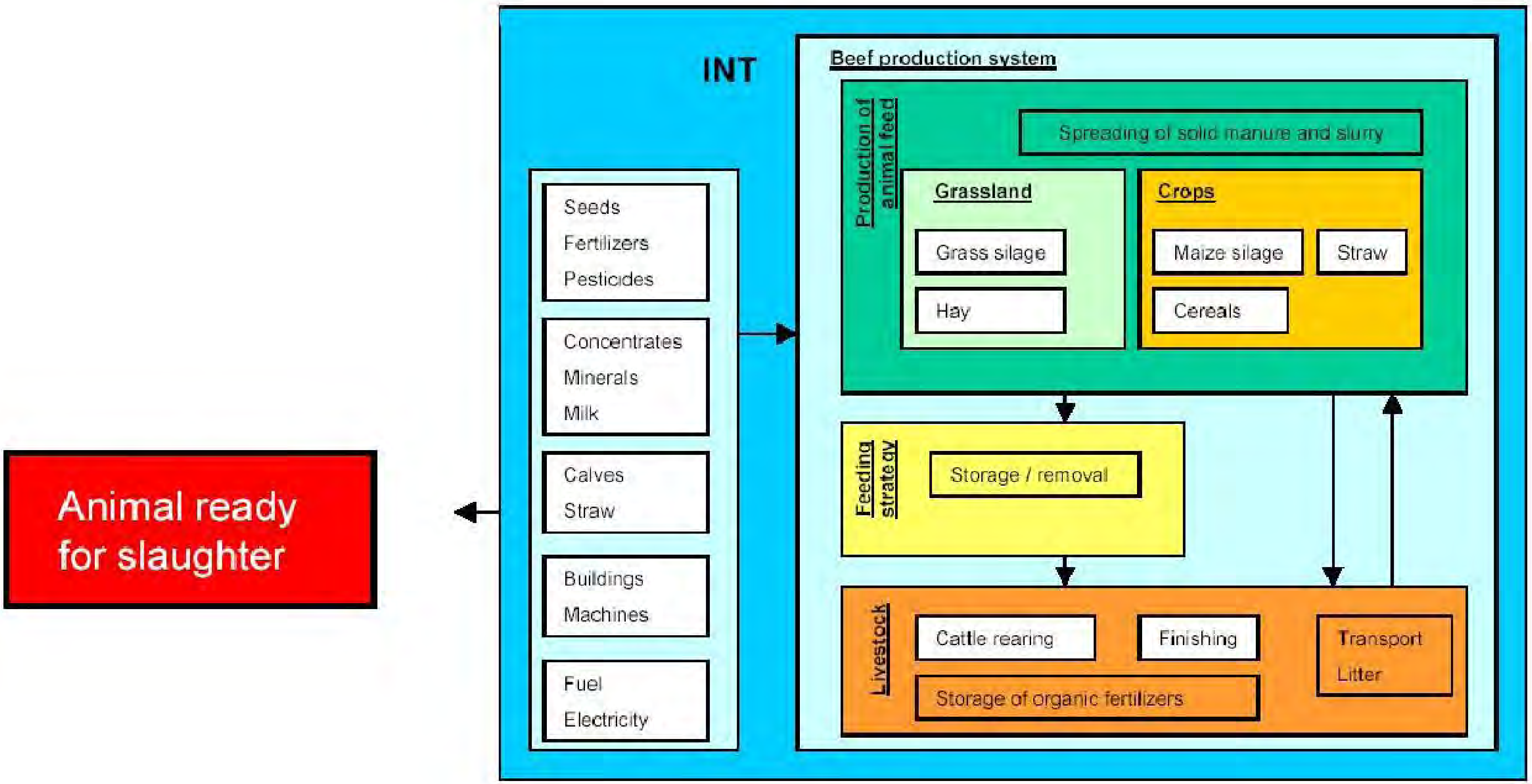


NOTE: EXT - EXTENSIVE FATTENING SYSTEM

figure 3.5

FLOWCHART OF AN EXTENSIVE FATTENING SYSTEM
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: CHASSOT, A. PHILIPP, A., GAILLARD, G., 2005. LIFE CYCLE ASSESSMENT (LCA) OF TWO BEEF PRODUCTION SYSTEMS, AGROSCOPE LIEBEFELD-POSIEUX RESEARCH STATION ALP, PUB 2005/2840*.

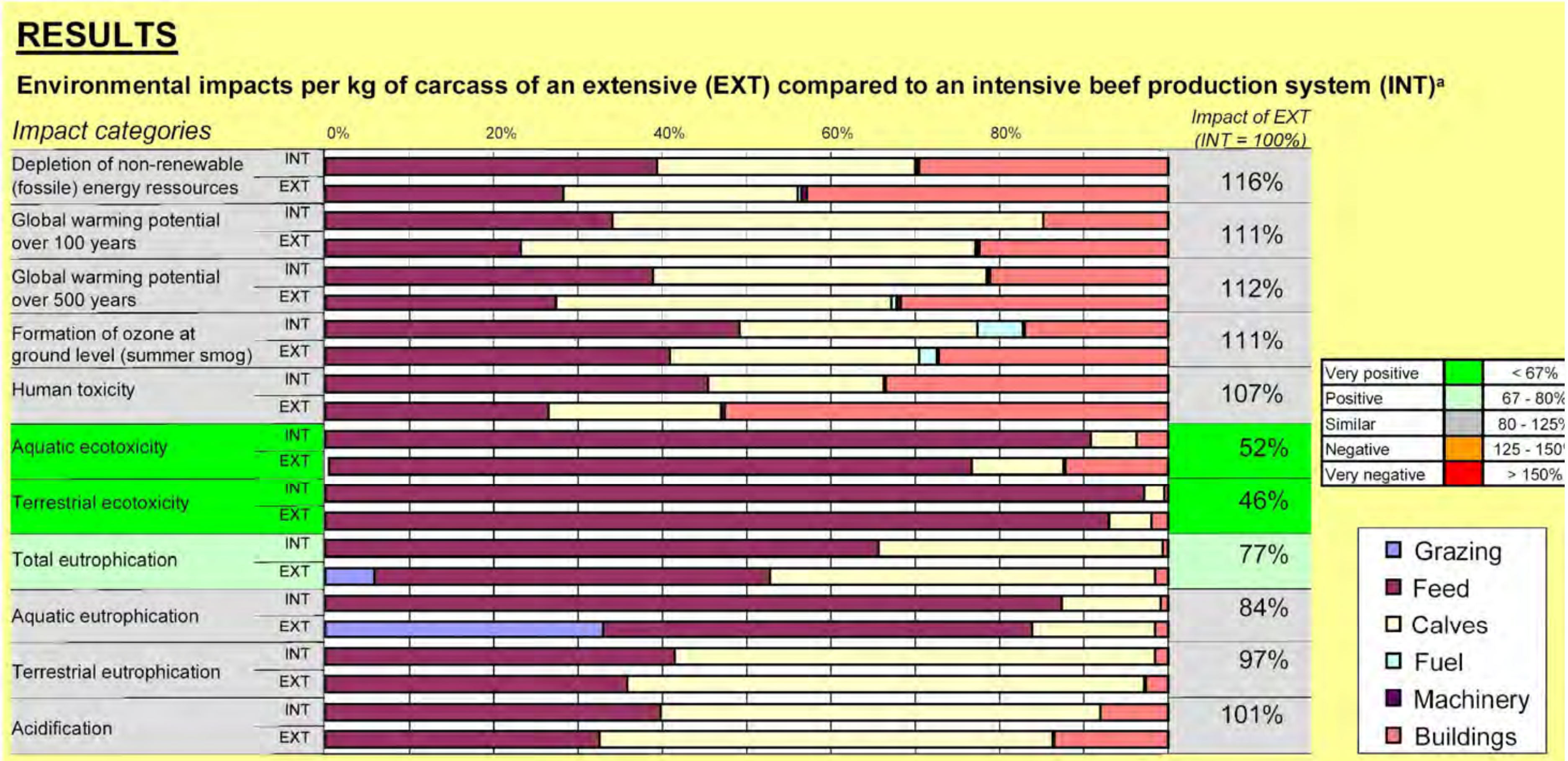


NOTE: INT - INTENSIVE FATTENING SYSTEM

figure 3.6

FLOWCHART OF AN INTENSIVE FATTENING SYSTEM
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: CHASSOT, A. PHILIPP, A., GAILLARD, G., 2005. LIFE CYCLE ASSESSMENT (LCA) OF TWO BEEF PRODUCTION SYSTEMS, AGROSCOPE LIEBEFELD-POSIEUX RESEARCH STATION ALP, PUB 2005/2840*.



NOTE: INT - INTENSIVE FATTENING SYSTEM
EXT - EXTENSIVE FATTENING SYSTEM

SOURCE: CHASSOT, A. PHILIPP, A., GAILLARD, G., 2005. LIFE CYCLE ASSESSMENT (LCA) OF TWO BEEF PRODUCTION SYSTEMS, AGROSCOPE LIEBEFELD-POSIEUX RESEARCH STATION ALP, PUB 2005/2840*.

figure 3.7

ENVIRONMENTAL IMPACTS PER KILOGRAM OF CARCASS
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

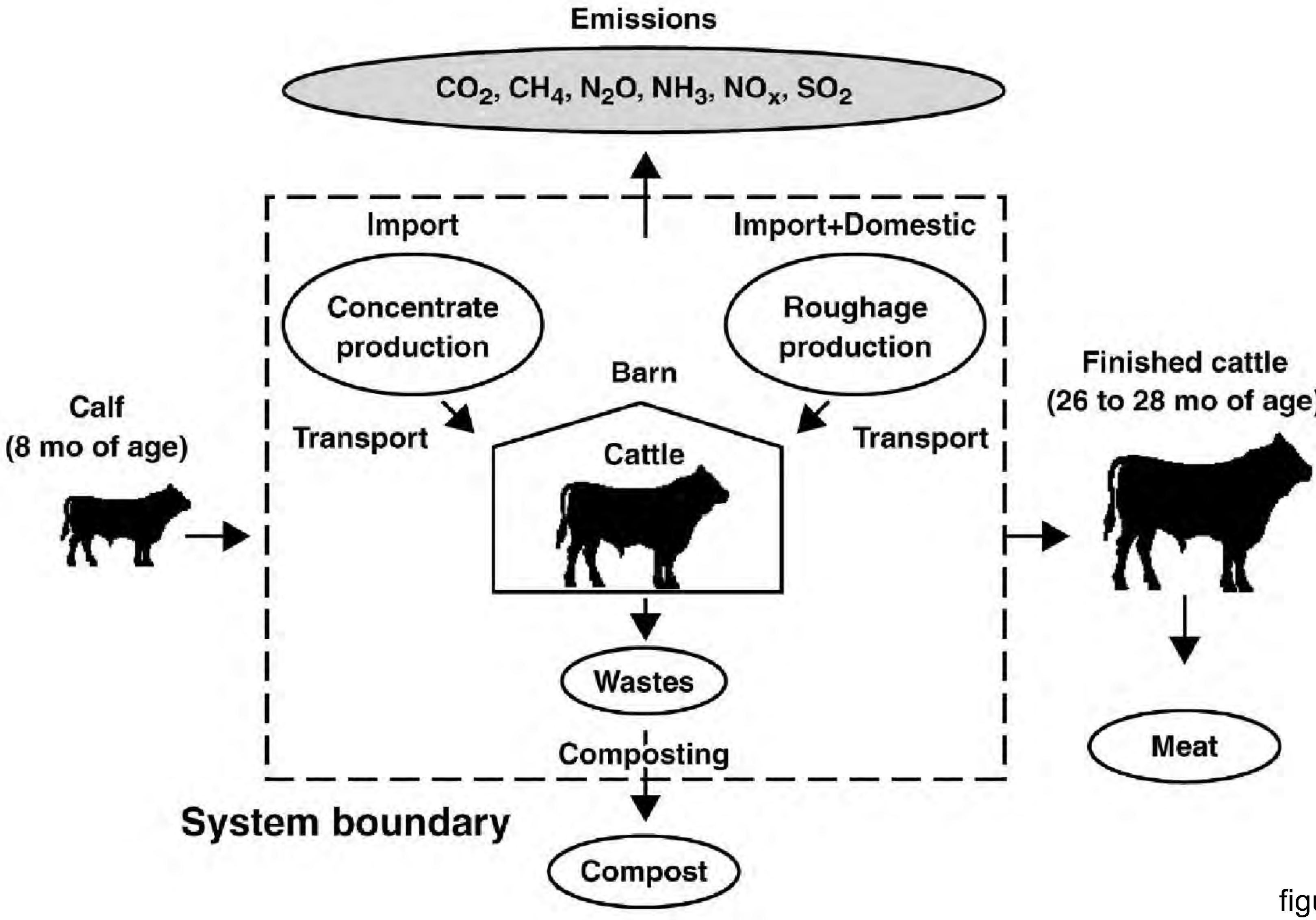


figure 3.8

JAPANESE BEEF-FATTENING SYSTEM
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
Edmonton, Alberta

SOURCE: OGINO, A., KAKU, K., SHIMADA, K., 2004. ENVIRONMENTAL IMPACTS OF THE JAPANESE BEEF FATTENING SYSTEM WITH DIFFERENT FEEDING LENGTHS AS EVALUATED BY A LIFE CYCLE ASSESSMENT METHOD. J. OF ANIMAL SCI. 82, 2115-2122.

TABLE 2.1

SUMMARY OF THE CURRENTLY AVAILABLE LCIA METHODS
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
AARD
Edmonton, Alberta

LCIA METHODOLOGY	Eco-indicator 99	EDIP97	EDIP2003	EPS 2000d	(Dutch) LCA Handbook
Method description	Damage approach, including Normalization and default weighting sets	Midpoint method with normalization	Midpoint method with normalization	Category indicators at damage level + weighting as WTP to avoid damage	Midpoint method with normalization
MIDPOINT CATEGORIES					
Releases					
Climate change	(DALYs/kg emission)	kg CO2-eq./kg emitted	kg CO2-eq./kg emitted	-	kg CO2-eq./kg emitted
Stratospheric ozone depletion	(DALYs/kg emission)	kg CFC-11-eq./kg emitted	kg CFC-11-eq./kg emitted	-	kg CFC-11-eq./kg emitted
Human toxicity, including workplace and indoor pollutants	(DALYs/kg emission)	m3 air/g emitted to air, water or soil; m3 water/g emitted to air, water or soil; m3 soil/g emitted to air, water or soil	person	-	kg 1,4-DCB-eq. emitted to air/kg emitted
Ionizing radiation	(DALYs/kg emission)	-	-	-	yr.kBq^{-1}; Sv.m^{3}.Bq^{-1}.yr^{-1}
Non-ionizing radiation	-	-	-	-	-
Accidents	-	-	-	-	-
Photo oxidant formation	(DALYs/kg emission)	kg ethylene-eq./kg emitted	m2 ecosystem*ppm*hours/g emitted; pers*ppm*hours/g emitted	-	kg ethylene-eq./kg emitted; kg formed ozone/kg emitted
Noise	(DALYs/Pa^2.s)		pers*sec	-	(Pa^2.s)
Acidification	(PDF/m3/yr)	kg SO2-eq. /kg emitted	m2 unprotected ecosystem/g emitted;	-	kg SO2-eq. in Switzerland/kg emitted; kg SO2-eq./kg emitted
Eutrophication	(DALYs/kg emission)	kg NO_3^--eq./kg emitted; kg N-eq/kg emitted; kg P-eq/kg emitted	m2 unprotected ecosystem/g emitted;	-	kg PO_4^{3-}-eq./kg emitted; kg NOx-eq. in Switzerland/kg emitted
Ecotoxicity (Fate, exposure and effects)	(PDF/m3/yr)/kg emission	m3 water/g emitted to air, water or soil; m3 soil/g emitted to air, water or soil	m3 water/g emitted to air, water or soil; m3 soil/g emitted to air, water or soil	-	kg 1,4-DCB-eq. emitted to fresh water, sea water or industrial soil/kg emitted
Resource use					
Land use & habitat losses	-	-	-	-	m2.yr
Energy extractions		-	-	-	-
Mineral extractions		-	-	-	-
Water resource use	-	-	-	-	-
Soil quality	-	-	-	-	-
Biotic resource use	-	-	-	-	-
DAMAGE ASSESSMENT CATEGORIES					
Human health					
Human health	(DALYs)	-	-	(years)	
Biotic and Abiotic natural environment					
Biotic natural environment	(PDF/m2/yr)/kg emission	-	-	Unitless	-
Abiotic natural environment	-	-	-	-	-
Abiotic and biotic natural resources					
Abiotic natural resources	-	-	-	kg / kg reserves	
Biotic natural resources		-	-	kg / kg reserves	
Abiotic and biotic man-made environment					
Abiotic man-made environment		-	-	-	-
Biotic man-made environment		-	-	-	-

TABLE 2.1

SUMMARY OF THE CURRENTLY AVAILABLE LCIA METHODS
LIFE CYCLE ASSESSMENT OF ALBERTA BEEF PRODUCTION
AARD
Edmonton, Alberta

LCIA METHODOLOGY	IMPACT 2002(+)	LIME	(SWISS) ECOSCARCITY	JEPIX	TRACI
Method description	Midpoint+damage including normalization	Midpoint+Damage assessment+Weighting; practitioner can choose the step of LCIA based on the aim of LCA.	Weighting method, based on environmental policy goals, to be used for midpoint categories and selected emissions/interventions	Weighting method, based on distance-to-target of environmental policy. Providing regionalized weighting factors based on specific environmental quality.	Midpoint method with normalization
MIDPOINT CATEGORIES					
Releases					
Climate change	kg CO2equ	M: kg CO2eq./kg emitted, D: DALYs/kg emitted, JY/kg emitted	CO2-eq / kg emission	CO2-eq / kg emission, weighting EIP/kg emission EIP=Environmental Impact Points	CO2-e / kg emission
Stratospheric ozone depletion	kg CFC-11 equ into air	M: kg CFC-11eq./kg emitted, D: DALYs/kg emitted, NPP/kg emitted, JY/kg emitted	CFC-11-eq / kg emission	CFC-11-eq / kg emission, weighing EIP/kg emission	CFC-11-e / kg emission
Human toxicity, including workplace and indoor pollutants	kg chloroethylene into air equ into air (cancer & non cancer) kg PM2.5equ into air (respiratory inorg.)	M: kg Benzene-eq. emitted to air/kg emitted, D: DALYs/kg emitted	g	kg 1,4-DCB-eq. emitted to air, fresh water, marine water, agricultural soil, industrial soil, weighting EIP/kg emission	Benzene-e/kg emissions (Cancer), toluene-e/kg emissions (NonCancer), DALYs/tonne emissions (Criteria)
Ionizing radiation	Bqeq carbon-14 into air	-	volume	-	-
Non-ionizing radiation	-	-		-	-
Accidents	-	-	-	-	-
Photo oxidant formation	kg ethylene equ into air	M: kg ethylene-eq./kg emitted, D: DALYs/kg emitted, NPP/kg emitted, JY/kg emitted	g NM-VOC	kg ethylene-eq./kg emitted, weighting EIP/kg	g - NOx-e / m / kg emission
Noise				EIP/km	
Acidification	kg SO2 equ into air	M: kg SO2-eq./kg emitted, D: NPP/kg emitted, JY/kg emitted	H+ moles-e / kg emission		H+ moles-e / kg emission
Eutrophication	kg PO43- equ into water	M: kg PO_4^{3-}-eq./kg emitted; D: JY/kg emitted	g N and g P	kg N (lakes, bays), kg P (lakes, bays), kg COD (lakes, bays), BOD kg (rivers)	N-e / kg emission
Ecotoxicity (Fate, exposure and effects)	kg triethylene glycol equ into water / soil	M: kg benzene-eq. emitted to water/kg emitted; D: EINES/kg emitted	g		2,4-D-e / kg emission
Resource use					
Land use & habitat losses	m2 organic arable crop	M: (occupation) m2.yr, (transformation) m2, D: (transformation) EINES/m2, dry-kg/m2, (occupation) dry-kg/m2/yr	volume and weight of controlled waste deposition (use of scarce space fit for specific waste depositions)	waste generated kg, waste landfilled kg	-
Energy extractions	MJ total	M: MJ total, D: JY/kg EINES/kg, dry-kg/kg	-	-	-
Mineral extractions	MJ surplus	M&D	-	-	-
Water resource use	MJ	-	-	-	-
Soil quality	-	-	-	-	-
Biotic resource use	-	D	-	-	-
DAMAGE ASSESSMENT CATEGORIES					
Human health					
Human health	(DALYs)	DALYs	-	-	DALYs/tonne emissions (Criteria)
Biotic and Abiotic natural environment					
Biotic natural environment	PDF-m2-year	EINES (Expected Increase in Number of Extinct Species)	-	-	-
Abiotic natural environment	Climate change kept as separate damage on life support system	-	-	-	-
Abiotic and biotic natural resources					
Abiotic natural resources		Loss of economic value (Japanese Yen)	MJ	-	-
Biotic natural resources		NPP (Net Primary Productivity) (dry kg)	-	-	-
Abiotic and biotic man-made environment					
Abiotic man-made environment	-	-	-	-	-
Biotic man-made environment	-	Loss of economic value (Japanese Yen) is adopted	-	-	-

APPENDIX B

BEEF PRODUCTION DATA FROM LCA MODEL

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Beef Production Data Worksheet

About This Worksheet

This worksheet contains data pertaining to the production of beef in Alberta necessary to calculate the life cycle impacts.

Index

** Uncertainty in data - highlighted in blue

Notes:
This spreadsheet can be updated based on new data to run different scenarios
All Alberta-specific and beef production data is contained in this tab.
The model will be updated based on any data updated in this tab of the model.

Description	Value	Units	Source

Alberta Beef Statistics

back to top

Alberta Cattle

Description	Value	Units	Source
15-May-01			
Total Cattle and Calves - Alberta	6,615,201	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Bulls, 1 year and over	111,379	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Total Cows	2,183,332	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Dairy Cows	84,044	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Beef Cows	2,099,288	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Total Heifers, 1 year and over	1,159,329	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Heifers for beef herd replacement	359,291	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Heifers for dairy herd replacement	38,485	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Heifers for slaughter or feeding	761,553	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Steers, 1 year and over	991,554	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm
Calves, under 1 year	2,169,607	number of head	Statistics Canada. Table 19 - Cattle and calves, by province, Census Agricultural Region (CAR) and Census Division (CD), May 15, 2001. Available at: http://www.statcan.gc.ca/pub/95f0301x/t/html/4064782-eng.htm

Alberta Cattle on Dairy Operations

Description	Value	Units	Source
1-Jan-01			
Bulls	1,800	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	90,000	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	0	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	35,000	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	0	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	7,800	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Steers	7,000	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Calves	60,500	number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

<u>1-Jul-01</u>		
Bulls	1,900 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	91,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	39,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	6,400 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Steers	5,200 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Calves	45,600 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
<u>1-Jan-02</u>		
Bulls	1,500 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	92,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	36,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	9,200 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Steers	6,300 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Calves	46,200 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
<u>1-Jul-02</u>		
Bulls	1,700 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	90,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	38,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	7,600 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Steers	4,500 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Calves	35,800 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.

Alberta Cattle on Beef Operations

<u>1-Jan-01</u>		
Bulls	96,200 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	1,995,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	275,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	552,200 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Steers	793,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Calves	1,915,600 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
<u>1-Jul-01</u>		
Bulls	112,100 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	2,060,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	370,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	713,500 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Steers	954,800 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Calves	2,100,500 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
<u>1-Jan-02</u>		
Bulls	96,500 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	1,959,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	0 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	250,000 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	600,900 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Steers	793,800 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
Calves	1,883,800 number of head	Statistics Canada. Cattle Statistics. 2002, vol. 1, no. 1. Catalogue no. 23-012-XIE.
<u>1-Jan-03</u>		
Bulls	94,600 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.
Milk Cows	0 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.
Beef Cows	1,915,000 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.
Milk Heifers	0 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - breeding	250,000 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.
Beef Heifers - slaughter	527,800 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.
Steers	695,100 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.
Calves	1,652,300 number of head	Statistics Canada. Cattle Statistics. 2004, vol. 3, no. 1. Catalogue no. 23-012-XIE.

Percent Breakdown of Animals on Beef Operations	*CALCULATION*	
1-Jan-01		
Bulls	98.2 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Milk Cows	0.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Cows	100.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Milk Heifers	0.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Heifers - breeding	100.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Heifers - slaughter	98.6 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Steers	99.1 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Calves	96.9 %	Calculated based on values above from Statistics Canada. 2002. Table 15
1-Jul-01		
Bulls	98.3 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Milk Cows	0.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Cows	100.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Milk Heifers	0.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Heifers - breeding	100.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Heifers - slaughter	99.1 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Steers	99.5 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Calves	97.9 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Average for 2001		
Bulls	98.2 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Milk Cows	0.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Cows	100.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Milk Heifers	0.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Heifers - breeding	100.0 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Beef Heifers - slaughter	98.9 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Steers	99.3 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Calves	97.4 %	Calculated based on values above from Statistics Canada. 2002. Table 15
Alberta Calf-Fed and Yearling-Fed Calf Breakdown		
Percent Calf-Fed Calves in Alberta	45 %	Comment from ARD during the Life Cycle Analysis of Beef Production in Alberta - Project Kick-Off Meeting. ARD, CRA, and Pembina. September 28, 2009.
Percent Yearling-Fed Calves in Alberta	55 %	Comment from ARD during the Life Cycle Analysis of Beef Production in Alberta - Project Kick-Off Meeting. ARD, CRA, and Pembina. September 28, 2009.
Alberta Steer and Heifer Breakdown	*CALCULATION*	
Percent steers in Alberta on May 15, 2001 compared to heifers	46 %	Calculated based on above (May 15, 2001 Census data)
Percent heifers in Alberta on May 15, 2001 compared to steers	54 %	Calculated based on above (May 15, 2001 Census data)
Alberta Beef Cow and Bull Breakdown		
Percent cows in Alberta on May 15, 2001 compared to bulls	95 %	Calculated based on above (May 15, 2001 Census data)
Percent bulls in Alberta on May 15, 2001 compared to cows	5 %	Calculated based on above (May 15, 2001 Census data)
Bull Replacement		
Culling/replacement rate for bulls (US)	25 %	Agricultural Alternatives. Beef Cow-Calf Operations. Available at: http://agalternatives.aers.psu.edu
Percent Cow and Bull Culls Directly to Slaughterhouse from Cow/Calf Operation		
	95 %	Assumed value
Alberta Auction Information		
Sales		
Through Local Auction Markets (1986/89 data)	70 %	Alberta Cow-Calf Audit, 1997/1998. Production Indicators and Management Practices Over the Last 10 years. Alberta Agriculture and Rural Development
Farmer to Farmer (1986/89 data)	12.3 %	Alberta Cow-Calf Audit, 1997/1998. Production Indicators and Management Practices Over the Last 10 years. Alberta Agriculture and Rural Development
Direct to Packer (1986/89 data)	9.6 %	Alberta Cow-Calf Audit, 1997/1998. Production Indicators and Management Practices Over the Last 10 years. Alberta Agriculture and Rural Development
Through Dealer (1986/89 data)	9.3 %	Alberta Cow-Calf Audit, 1997/1998. Production Indicators and Management Practices Over the Last 10 years. Alberta Agriculture and Rural Development
Direct to Feedlot (1986/89 data)	4.4 %	Alberta Cow-Calf Audit, 1997/1998. Production Indicators and Management Practices Over the Last 10 years. Alberta Agriculture and Rural Development
Time at Auction Facilities	24 - 48 hours	Discussion with Calgary Stockyard Ltd.
Assume 48 hours to be conservative		

Alberta Imports of Live Cattle

Purebred (2001) (for breeding) - international (includes dairy)	211	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003. Available at:http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd7799/$file/beef_live_cattle_five_year.pdf?OpenElement
Other Live Cattle (2001) (slaughter and feeder) - international (includes dairy)	129,133	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003. Available at:http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd7799/$file/beef_live_cattle_five_year.pdf?OpenElement
Purebred (2002) (for breeding) - international (includes dairy)	90	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003. Available at:http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd7799/$file/beef_live_cattle_five_year.pdf?OpenElement
Other Live Cattle (2002) (slaughter and feeder) - international (includes dairy)	8,794	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003. Available at:http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd7799/$file/beef_live_cattle_five_year.pdf?OpenElement

** International imports mainly feeders - assume all feeders unless more accurate data is obtained - assume all beef because fraction of beef to dairy is unknown

International Import Data - breakdown of type of animal not available

Interprovincial Movement of Cattle (Imports)

2007

To Alberta from British Columbia - Cattle	102,372	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from British Columbia - Calves	87,429	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Saskatchewan - Cattle	314,327	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Saskatchewan - Calves	278,683	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Manitoba - Cattle	160,655	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Manitoba - Calves	35,805	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.

2008

To Alberta from British Columbia - Cattle	96,285	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from British Columbia - Calves	85,048	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Saskatchewan - Cattle	317,216	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Saskatchewan - Calves	259,278	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Manitoba - Cattle	158,425	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Alberta from Manitoba - Calves	68,261	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.

** 2007-2008 data will be used for the interprovincial movement of cattle (imports) until 2001-2002 data is found. Assume the % of each animal type from Saskatchewan to Alberta in 2008 for all provinces as no further breakdown is available (included below under "Alberta Imports from Saskatchewan - 2008 and 2009)

2001-2002 data not available

Alberta Exports of Live Cattle

Alberta 2001 international exports	513,143	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Purebred (includes dairy animals)	110	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Other Cattle (includes dairy animals)	513,033	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Purebred Cattle - female (assume cows)	8	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Purebred Cattle - male (assume bulls)	46	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Steers for immediate slaughter	232,056	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Heifers for immediate slaughter	205,868	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Steers for feedlot	27,628	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Cows for immediate slaughter	17,443	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Bulls for immediate slaughter	13,970	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Male Calves for backgrounding (weight >200 and <320kg	2,786	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female Calves for backgrounding (weight >200 and <320kg)	298	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female calves for feedlot (>320kg)	8,445	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Bulls for breeding	1,788	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Cows for breeding	1,685	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Male calves >90kg and <200kg	117	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female calves >90kg and <200kg	126	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Male calves <90kg	18	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female calves <90kg	44	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Alberta 2002 international exports	511,878	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Purebred (includes dairy animals)	263	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Other Cattle (includes dairy animals)	511615	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Purebred Cattle - female (assume cows)	8	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Purebred Cattle - male (assume bulls)	0	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Steers for immediate slaughter	184,677	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Heifers for immediate slaughter	185,164	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Steers for feedlot	29,386	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Cows for immediate slaughter	37,795	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Bulls for immediate slaughter	16,478	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Male Calves for backgrounding (weight >200 and <320kg	18,433	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female Calves for backgrounding (weight >200 and <320kg)	14,018	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female calves for feedlot (>320kg)	9,661	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Bulls for breeding	1,831	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Cows for breeding	2,262	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Male calves >90kg and <200kg	5,468	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female calves >90kg and <200kg	4,988	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Male calves <90kg	11	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003
Female calves <90kg	0	number of head	Alberta Trade in Beef and Live Cattle. 1998-2002. Alberta Agriculture, Food and Rural Development, Nov. 2003

Interprovincial Movement of Cattle (Exports)

2007			
To British Columbia from Alberta - Cattle	15,080	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To British Columbia from Alberta - Calves	3,866	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Saskatchewan from Alberta - Cattle	51,805	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Saskatchewan from Alberta - Calves	23,744	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Manitoba from Alberta - Cattle	3,923	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Manitoba from Alberta - Calves	3,809	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Ontario from Alberta - Cattle	27,760	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Ontario from Alberta - Calves	26,091	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Quebec from Alberta - Cattle	15,568	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Quebec from Alberta - Calves	6,950	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To New Brunswick from Alberta - Cattle	2	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To New Brunswick from Alberta - Calves	1	number of head	Interprovincial Movement of Cattle and Calves, 2007. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.

2008			
To British Columbia from Alberta - Cattle	21,441	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To British Columbia from Alberta - Calves	1,477	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Saskatchewan from Alberta - Cattle	48,648	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Saskatchewan from Alberta - Calves	9,696	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Manitoba from Alberta - Cattle	5,932	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Manitoba from Alberta - Calves	1,567	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Ontario from Alberta - Cattle	29,267	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Ontario from Alberta - Calves	16,383	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Quebec from Alberta - Cattle	8,795	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To Quebec from Alberta - Calves	2,883	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To New Brunswick from Alberta - Cattle	1	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.
To New Brunswick from Alberta - Calves	0	number of head	Interprovincial Movement of Cattle and Calves, 2008. Emailed from Marni Donetz, Government of Manitoba, on December 16, 2009.

** 2007-2008 data will be used for the interprovincial movement of cattle (exports) until 2001-2002 data is found. Assume the % of each animal type from Saskatchewan to Alberta in 2008 for all provinces as no further breakdown is available (included below under "Alberta Imports from Saskatchewan - 2008 and 2009)

2001-2002 data not available

Alberta Imports from Saskatchewan - 2001 and 2002

2001

Feeder Steers	307,580	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	48	%	Calculated
Slaughter Steers	23,980	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	4	%	Calculated
Feeder Cows	3,750	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	1	%	Calculated

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Slaughter Cows	21,420	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	3	%	Calculated
Feeder Bulls	1,300	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	0	%	Calculated
Slaughter Bulls	1,110	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	0	%	Calculated
Feeder Heifers	259,080	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	41	%	Calculated
Slaughter Heifers	16,490	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	3	%	Calculated
Slaughter Calves	560	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	0	%	Calculated
<u>2002</u>			
Feeder Steers	211,310	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	42	%	Calculated
Slaughter Steers	35,720	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	7	%	Calculated
Feeder Cows	2,920	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	1	%	Calculated
Slaughter Cows	16,740	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	3	%	Calculated
Feeder Bulls	1,290	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	0	%	Calculated
Slaughter Bulls	940	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	0	%	Calculated
Feeder Heifers	205,590	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	41	%	Calculated
Slaughter Heifers	23,340	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	5	%	Calculated
Slaughter Calves	450	number of head	Cattle Marketings for the Year 2002, Government of Saskatchewan.
Percent of import	0	%	Calculated
Mature Cow Weight in Alberta	606	kg	Alberta Cow-Calf Audit, 1997/1998. Production Indicators and Management Practices Over the Last 10 years. Alberta Agriculture and Rural Development
Mature Bull Weight in Alberta	998	kg	Alberta Agriculture and Rural Development. Winter Feeding of Bulls. 2002. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/beef4881
Calf-Fed Weights			
Before backgrounding			
Heifer	500	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Heifer	227	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	500	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	227	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
After backgrounding			
Heifer	600	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Heifer	272	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	600	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	272	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Feedlot			
Heifer	1,350	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Heifer	612	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	1,450	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	658	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Yearling-Fed Weights			
Before backgrounding			
Heifer	600	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Heifer	272	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	600	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	272	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
After backgrounding (before backgrounding pasture)			
Heifer	750	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Heifer	340	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	750	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	340	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Feedlot			
Heifer	1,350	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Heifer	612	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	1,450	lbs	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Steer	658	kg	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Shrunk live weight of animal at time of sale (% reduction at slaughterhouse)	4	%	Cattlemen's Go To Feedlot Lingo. Dr. Greg Lardy, Beef Specialist, North Dakota State University. January 1999. Available at: http://www.ag.ndsu.edu/pubs/ansci/beef/as1161w.htm

Alberta Slaughtered Cattle and Calves (2001)

Total Cattle and Calves	2,342,002	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Steers	1,232,796	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Heifers	887,062	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Cows	217,408	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Bulls	4,180	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Calves	253	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf

Alberta Slaughtered Cattle and Calves (2002)

Total Cattle and Calves	2,367,910	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Steers	1,223,119	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Heifers	909,351	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Cows	231,917	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Bulls	3,207	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Calves	330	number of head	Alberta Agriculture Statistics Yearbook, 2008. Table 53. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf

Alberta Feedlot Capacity (2008)

Region 1 - Number of Lots	4	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 1 - Capacity	17,000	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 2 - Number of Lots	27	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 2 - Capacity	243,000	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 3 - Number of Lots	62	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 3 - Capacity	555,300	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 4 - Number of Lots	13	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 4 - Capacity	85,200	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 5 - Number of Lots	28	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 5 - Capacity	367,800	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 6 - Number of Lots	21	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 6 - Capacity	124,600	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 7 - Number of Lots	16	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 7 - Capacity	51,500	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 8 - Number of Lots	17	lots	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Region 8 - Capacity	120,000	number of head capacity	Canfax. 2008 Annual Report. Available at: www.canfax.ca

Alberta Packer (Slaughterhouse) Directory (January 2009)

Cargill Meat Solutions P.O. Box 3850, High River, AB T0L 1B0 Slaughter Type - Steers, Heifers, Cows Weekly Slaughter Capacity	20,000	number of head capacity / week	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Lacombe Research Centre 6000 C&E Trail, Lacombe, AB T4L 1W1 Slaughter Type - Steers, Heifers, Cows, Bulls Weekly Slaughter Capacity	25	number of head capacity / week	Canfax. 2008 Annual Report. Available at: www.canfax.ca
Canadian Premium Meats Inc. 3401 - 53 Ave., Lacombe, AB T4L 2L6 Slaughter Type - Cattle, Calves, Bison, Elk Weekly Slaughter Capacity	600	number of head capacity / week	Canfax. 2008 Annual Report. Available at: www.canfax.ca

Lakeside Packers Ltd. (a div. of Tyson)
Box 1868, Brooks, AB T0J 0J0
Slaughter Type - Steers, Heifers, Cows, Bulls

Weekly Slaughter Capacity	28,200	number of head capacity / week	Canfax. 2008 Annual Report. Available at: www.canfax.ca

Sunterra Meats Ltd.
4312-51 Street, Innisfail, AB T4G 1A3
Slaughter Type - Steers, Heifers, Cows, Bulls, Calves, Bison, Sheep

Weekly Slaughter Capacity	1,500	number of head capacity / week	Canfax. 2008 Annual Report. Available at: www.canfax.ca

XL Beef
5101 - 11 Street SE, Calgary, AB T2H 1M7
Slaughter Type - Steers, Heifers, Cows, Bulls

Weekly Slaughter Capacity	5,000	number of head capacity / week	Canfax. 2008 Annual Report. Available at: www.canfax.ca

Diet

back to top

Alberta Beef Generic Rations / Diets

See "Diets" tab for data regarding diets — Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.

Feed
Barley
Barley Silage
Alfalfa
Pasture

Supplement Ingredients
Lime (calcium)
Potassium Chloride (potassium)
Sodium Chloride (sodium)
Copper Sulphate (Copper)
Manganese Oxide (manganese)
Zinc Oxides (zinc)
Selinite (selenium)
Cobalt Carbonate (Cobalt)
EDDI (iodine)
Vitamin A Premix (vitamin A)
Vitamin D Premix (vitamin D)
Vitamin E Premix (vitamin E)
Rumnesin (monensin)
Dicalphos (calcium and phosphorus)
Potassium Chloride (magnesium)
Millrun Carrier

Dry Matter Intake for Cows/Bulls during Breeding or on Pasture	30	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake for Cows during Winter Feeding	25.2	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on April 1, 2010.
Dry Matter Intake for Cows during Calving	31.5	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on April 1, 2010.
Dry Matter Intake for Steers/Heifers on Pasture	20	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.

** note that these values can be variable depending on type of grass, level of growth, milk production, etc.

Dry Matter Intake - Backgrounding Calf-Fed	12.81	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Heifer Diet 3	9.64	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Heifer Diet 4	17.11	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Heifer Diet 5	19.72	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Heifer Diet 6	20.66	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Heifer Diet 7	21.12	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Steer Diet 3	10.07	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Steer Diet 4	21.77	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Steer Diet 5	22.13	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Steer Diet 6	22.97	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Calf-Fed Steer Diet 7	21.86	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Backgrounding Yearling-Fed	15.28	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Heifer Diet 1	11.27	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Heifer Diet 2	16.68	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Heifer Diet 3	16.18	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Heifer Diet 4	14.95	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Heifer Diet 5	21.75	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Heifer Diet 6	20.31	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Heifer Diet 7	22.33	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Steer Diet 1	12.18	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Steer Diet 2	17.51	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Steer Diet 3	21.59	lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Dry Matter Intake - Yearling-Fed Steer Diet 4	19.91 lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Steer Diet 5	22.49 lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Steer Diet 6	24.76 lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake - Yearling-Fed Steer Diet 7	24.76 lb dry matter/head/day	Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on January 18, 2010.
Dry Matter Intake for calves 0-3 months old	0.00 lb dry matter/head/day	Discussion with John Basarab
Dry Matter Intake for calves 0-3 months old	0.00 lb dry matter/head/day	Discussion with John Basarab
Dry Matter Intake for calves 3-4 months old	8.25 lb dry matter/head/day	Discussion with John Basarab
Dry Matter Intake for calves 3-4 months old	3.74 kg dry matter/head/day	Discussion with John Basarab
Feed		
Cows and Bulls - Winter Feeding and Calving		
Alfalfa - Hay	2.65 Mcal/kg	Assumed alfalfa hay based on diets. Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. Available at: http://www.nap.edu/openbook.php?record_id=9791&page=134
	11.10 MJ/kg	Calculated
Alfalfa - Hay, sun-cured, early bloom	2.65 Mcal/kg	Assumed alfalfa hay based on diets. Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. Available at: http://www.nap.edu/openbook.php?record_id=9791&page=134
	11.10 MJ/kg	Calculated
Alfalfa - Hay, sun-cured, mid-bloom	2.56 Mcal/kg	Assumed alfalfa hay based on diets. Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. Available at: http://www.nap.edu/openbook.php?record_id=9791&page=134
	10.72 MJ/kg	Calculated
Alfalfa - Hay, sun-cured, full bloom	2.43 Mcal/kg	Assumed alfalfa hay based on diets. Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. Available at: http://www.nap.edu/openbook.php?record_id=9791&page=134
	10.17 MJ/kg	Calculated
Alfalfa - Average	10.77 MJ/kg	Calculated
Cows and Bulls - Breeding and Pasture		
Wheat grass - crested fresh early bloom	2.6 Mcal/kg	Assumed wheat grass-dominated pasture due to lack of more explicit data. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. Available at: http://www.nap.edu/openbook.php?record_id=11654&page=1
	10.9 MJ/kg	Calculated
Wheat grass - crested fresh full bloom	2.4 Mcal/kg	Assumed wheat grass-dominated pasture due to lack of more explicit data. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. Available at: http://www.nap.edu/openbook.php?record_id=11654&page=1
	10.0 MJ/kg	Calculated
Alfalfa - fresh, full bloom	0 Mcal/kg	Assumed wheat grass-dominated pasture due to lack of more explicit data. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. Available at: http://www.nap.edu/openbook.php?record_id=11654&page=1
	0.00 MJ/kg	Calculated
Wheat grass - Average	10.5 MJ/kg	Calculated
Backgrounding, Calf-Fed, Yearling-Fed, Heifers, and Steers		
Barley grain	3.84 Mcal/kg	Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. Available at: http://www.nap.edu/openbook.php?record_id=9791&page=134
	16.08 MJ/kg	Calculated
Barley silage	2.65 Mcal/kg	Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. Available at: http://www.nap.edu/openbook.php?record_id=9791&page=134
	11.10 MJ/kg	Calculated
Digestible Energy (DE) of Diet		
Backgrounding - Yearling-Fed (Diet 1)	2.7588 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	11.55 MJ/kg	Calculated
Backgrounding - Calf-Fed (Diet 2)	2.91038 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	12.19 MJ/kg	Calculated
Calf-Fed Diet 3 (Heifers and Steers)	3.06302 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	12.82 MJ/kg	Calculated
Calf-Fed Diet 4 (Heifers and Steers)	3.2146 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	13.46 MJ/kg	Calculated
Calf-Fed Diet 5 (Heifers and Steers)	3.36618 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	14.09 MJ/kg	Calculated
Calf-Fed Diet 6 (Heifers and Steers)	3.51882 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	14.73 MJ/kg	Calculated
Calf-Fed Diet 7 (Heifers and Steers)	3.6704 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	15.37 MJ/kg	Calculated
Yearling-Fed Diet 1 (Heifers and Steers)	2.7588 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	11.55 MJ/kg	Calculated
Yearling-Fed Diet 2 (Heifers and Steers)	2.91038 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	12.19 MJ/kg	Calculated
Yearling-Fed Diet 3 (Heifers and Steers)	3.06302 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	12.82 MJ/kg	Calculated
Yearling-Fed Diet 4 (Heifers and Steers)	3.2146 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	13.46 MJ/kg	Calculated
Yearling-Fed Diet 5 (Heifers and Steers)	3.36618 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	14.09 MJ/kg	Calculated
Yearling-Fed Diet 6 (Heifers and Steers)	3.51882 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	14.73 MJ/kg	Calculated
Yearling-Fed Diet 7 (Heifers and Steers)	3.6704 Mcal/kg	Digestible energy content of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010
	15.37 MJ/kg	Calculated

Crude Protein (CP) of Diet			
Backgrounding - Yearling-Fed (Diet 1)	11.820	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Backgrounding - Calf-Fed (Diet 2)	11.892	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Calf-Fed Diet 3 (Heifers and Steers)	11.964	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Calf-Fed Diet 4 (Heifers and Steers)	12.305	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Calf-Fed Diet 5 (Heifers and Steers)	12.107	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Calf-Fed Diet 6 (Heifers and Steers)	12.179	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Calf-Fed Diet 7 (Heifers and Steers)	12.250	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Yearling-Fed Diet 1 (Heifers and Steers)	11.820	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Yearling-Fed Diet 2 (Heifers and Steers)	11.892	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Yearling-Fed Diet 3 (Heifers and Steers)	11.964	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Yearling-Fed Diet 4 (Heifers and Steers)	12.305	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Yearling-Fed Diet 5 (Heifers and Steers)	12.107	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Yearling-Fed Diet 6 (Heifers and Steers)	12.179	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Yearling-Fed Diet 7 (Heifers and Steers)	12.250	%	Protein Content (%) of diet from Feedlot Nutrition Newsletter. Dwight Karren. FeedlotNutrition@hotmail.com. Emailed on March 4, 2010.
Wheat grass - crested fresh early bloom (for cows, bulls, yearling-fed on pasture)	11.00	%	Assumed wheat grass-dominated pasture due to lack of more explicit data. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. Available at: http://www.nap.edu/openbook.php?record_id=11654&page=1
Wheat grass - crested fresh full bloom (for cows, bulls, yearling-fed on pasture)	10.00	%	Assumed wheat grass-dominated pasture due to lack of more explicit data. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. Available at: http://www.nap.edu/openbook.php?record_id=11654&page=1
Average	10.50	%	Calculated
Growth Promoters			
Dosage per calf (for calf-fed and yearling-fed calves)	36	mg	RALGRO Implant (Growth Hormone Implants). Available at: http://www.mindfully.org/Farm/2003/RALGRO-Implant-Advertising28dec03.htm
Alberta - Field crops, Yield on harvested area			
Barley (2009)	4,879	thousand tonnes	Statistics Canada, Field Crop Reporting Series, No. 7, October 2009. 10-year average
Barley (2009)	1,980	thousand ha	Statistics Canada, Field Crop Reporting Series, No. 7, October 2009. 10-year average
Barley (2009)	2,464	kg/ha	10-year average yield calculated using above
Barley (2009)	113	bushels/ha	Calculated based on above using conversion of 48 lbs/bushel (21.77 kg/bushel)
Alfalfa	3.35	tons/acre	AgricultureB2B.com. Alfalfa Crop Information Articles References Management Guides. Available at: http://www.agricultureb2b.com/biz/e/Crops/Field-Crops/Crop-Information/Alfalfa/
Alfalfa (1998)	7,510	kg/ha	AgricultureB2B.com. Alfalfa Crop Information Articles References Management Guides. Available at: http://www.agricultureb2b.com/biz/e/Crops/Field-Crops/Crop-Information/Alfalfa/
Alfalfa seed production per acre	459	lb/acre	http://www.nass.usda.gov/Statistics_by_State/Montana/Publications/crops/alfsdayp.htm
Barley Silage (2008)	1	ton/10 bushels	What is my cereal silage crop worth? - Frequently Asked Questions. Government of Alberta. Agriculture and Rural Development. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/faq8432?opendocument
Barley Silage (2008)	11	tons/ha	What is my cereal silage crop worth? - Frequently Asked Questions. Government of Alberta. Agriculture and Rural Development. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/faq8432?opendocument
Barley Silage (2008)	10,268	kg/ha	What is my cereal silage crop worth? - Frequently Asked Questions. Government of Alberta. Agriculture and Rural Development. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/faq8432?opendocument
Alberta - Average seeding rates			
Barley 2 row	111.18	kg/ha	Government of Alberta. ARD. Using 1,000 Kernel Weight for Calculating Seeding Rates and Harvest Losses. August 2007. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex81?opendocument#target
Barley 6 row	92.65	kg/ha	Government of Alberta. ARD. Using 1,000 Kernel Weight for Calculating Seeding Rates and Harvest Losses. August 2007. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex81?opendocument#target
Alfalfa	9.33	kg/ha	Government of Alberta. ARD. Using 1,000 Kernel Weight for Calculating Seeding Rates and Harvest Losses. August 2007. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex81?opendocument#target
Alberta - Tilling Practices (2006)			
No-Till	48	% of land	Alberta Agriculture Statistics Yearbook, 2008. Figure 37. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Reduced Till	28	% of land	Alberta Agriculture Statistics Yearbook, 2008. Figure 37. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Full Till	24	% of land	Alberta Agriculture Statistics Yearbook, 2008. Figure 37. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Alberta - Tilling Practices (2001)			
No-Till	28	% of land	Alberta Agriculture Statistics Yearbook, 2008. Figure 37. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Reduced Till	36	% of land	Alberta Agriculture Statistics Yearbook, 2008. Figure 37. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf
Full Till	37	% of land	Alberta Agriculture Statistics Yearbook, 2008. Figure 37. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12890/$FILE/table53.pdf

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Alberta			
Land used for beef production	21,000,000 acres		A Profile of Alberta's Beef Industry: Lessons for Saskatchewan. Laura Ramsay and Andrew Schmitz Working Paper # 6
Alberta - Irrigation Crop Land			
Irrigated crop land in Alberta (2001)	1,219,329 acres		Government of Alberta. Alberta Irrigation Information 2008. Available at:http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/irr7401/$FILE/AltaIrrigInfo2008web.pdf
Irrigated crop land in Alberta (2001)	493,444 ha		Government of Alberta. Alberta Irrigation Information 2008. Available at:http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/irr7401/$FILE/AltaIrrigInfo2008web.pdf
Total area seeded for crops in Alberta (2001)	24,247,000 acres		Government of Alberta. 2001 Annual Crop Review. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4192?opendocument#production
Total area seeded for crops in Alberta (2001)	9,812,397 ha		Government of Alberta. 2001 Annual Crop Review. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4192?opendocument#production
% of total crop land irrigated (2001)	5 %		Calculated
Repartition of Soil types for the area of the study in Alberta			
Black and grey zone area	25 %		Alberta Online Encyclopedia. Natural Regions of Alberta. Available at: http://www.abheritage.ca/abnature/map.htm
Brown and dark zone area	75 %		Alberta Online Encyclopedia. Natural Regions of Alberta. Available at: http://www.abheritage.ca/abnature/map.htm
<u>**Nutrient Composition of Manure**</u>			
	Elemental	Fertilizer equiv	Solid Cattle Manure http://www.ssca.ca/agronomics/pdfs/cattlemanure.pdf
	lb/ tonne	lb/ tonne	Solid Cattle Manure http://www.ssca.ca/agronomics/pdfs/cattlemanure.pdf
Nitrogen (N)	21.5	21.5	Solid Cattle Manure http://www.ssca.ca/agronomics/pdfs/cattlemanure.pdf
Phosphorus (P)	4	9.2	Solid Cattle Manure http://www.ssca.ca/agronomics/pdfs/cattlemanure.pdf
Potassium (K)	12	14.4	Solid Cattle Manure http://www.ssca.ca/agronomics/pdfs/cattlemanure.pdf
Sulphur (S)	1.55	1.55	Solid Cattle Manure http://www.ssca.ca/agronomics/pdfs/cattlemanure.pdf
Fertilizer Needs			
For alfalfa			
N - Crop Fertilizing Needs	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Manure Component	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Synthetic Component	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
K_2O - Crop Fertilizing Needs	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Manure Component	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Synthetic Component	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
S - Crop Fertilizing Needs	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Manure Component	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Synthetic Component	0 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
<u>Fertilizer Material Ratio</u>			
N - Urea	78 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
N - Anhydrous ammonia	22 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
P - Monoammonium phosphate	100 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
<u>Composition of Monoammonium Phosphate as Fertilizer</u>			
Monoammonium phosphate	100 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Monoammonium phosphate as P2O5	81 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Monoammonium phosphate as N	19 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
<u>Ammonia Liquid</u>			
Ammonia liquid	100 %		SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.

Anhydrous ammonia	36 %	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO_2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.

Barley		
N (SLA - from Pork LCA)	36.29 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
N (Alberta Fertilizer Guide)	31.75 kg nutrients/acre	Alberta Fertilizer Guide. Revised June 2004. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3894/$file/541-1.pdf?OpenElement
N (ARD - from Pork LCA)	31.75 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
P_2O_5 (SLA - from Pork LCA)	13.61 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
P_2O_5 (Alberta Fertilizer Guide)	13.61 kg nutrients/acre	Alberta Fertilizer Guide. Revised June 2004. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3894/$file/541-1.pdf?OpenElement
P_2O_5 (ARD - from Pork LCA)	13.61 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
K_2O (SLA - from Pork LCA)	6.80 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
K_2O (Alberta Fertilizer Guide)	0.00 kg nutrients/acre	Alberta Fertilizer Guide. Revised June 2004. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3894/$file/541-1.pdf?OpenElement
K_2O (ARD - from Pork LCA)	4.54 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
S (SLA - from Pork LCA)	5.44 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
S (Alberta Fertilizer Guide)	0.00 kg nutrients/acre	Alberta Fertilizer Guide. Revised June 2004. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3894/$file/541-1.pdf?OpenElement
S (ARD - from Pork LCA)	0.00 kg nutrients/acre	SNC-Lavalin Agro. A Life Cycle Analysis of Carbon Dioxide Equivalents (CO2e) of Alberta Barley, Wheat, Peas and Canola Meal Used in Pork Production, Slaughter and further Processing. March 31, 2009, rev. 2.
Alfalfa grass		
N (Alberta Fertilizer Guide)	0 kg nutrients/acre	Alberta Fertilizer Guide. Revised June 2004. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3894/$file/541-1.pdf?OpenElement
P_2O_5 (Alberta Fertilizer Guide)	15.20 kg nutrients/acre	Soil and Nutrient Management of Alfalfa. Revised July 2005. Available at:
K_2O (Alberta Fertilizer Guide)	0 kg nutrients/acre	Soil and Nutrient Management of Alfalfa. Revised July 2005. Available at:
S (Alberta Fertilizer Guide)	0 kg nutrients/acre	Alberta Fertilizer Guide. Revised June 2004. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3894/$file/541-1.pdf?OpenElement
Commercial Fertilizer Application Methods (2001)		
Broadcasting	27.5 %	Statistics Canada. Farm Environmental Management in Canada. Fertilizer and Pesticide Management in Canada, 2004, Vol. 1, No. 3. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004002/pdf/4193745-eng.pdf
Injected or knifed in	18.3 %	Statistics Canada. Farm Environmental Management in Canada. Fertilizer and Pesticide Management in Canada, 2004, Vol. 1, No. 3. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004002/pdf/4193745-eng.pdf
Post-plant Top/Side Dressing	41.4 %	Statistics Canada. Farm Environmental Management in Canada. Fertilizer and Pesticide Management in Canada, 2004, Vol. 1, No. 3. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004002/pdf/4193745-eng.pdf
Applied with Seed	1.0 %	Statistics Canada. Farm Environmental Management in Canada. Fertilizer and Pesticide Management in Canada, 2004, Vol. 1, No. 3. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004002/pdf/4193745-eng.pdf
Banded	10.2 %	Statistics Canada. Farm Environmental Management in Canada. Fertilizer and Pesticide Management in Canada, 2004, Vol. 1, No. 3. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004002/pdf/4193745-eng.pdf
Other	2.2 %	Statistics Canada. Farm Environmental Management in Canada. Fertilizer and Pesticide Management in Canada, 2004, Vol. 1, No. 3. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004002/pdf/4193745-eng.pdf
Pesticide Requirements Per Each Cultivated Hectare		
Barley	0.80 kg/ha	Alberta Environment. Pesticide Use in Alberta by Sector. (1998). Available at: www.environment.gov.ab.ca/info/library/7469.pdf
Barley Silage	0.80 kg/ha	Alberta Environment. Pesticide Use in Alberta by Sector. (1998). Available at: www.environment.gov.ab.ca/info/library/7469.pdf
Alfalfa Grass	0.80 kg/ha	Alberta Environment. Pesticide Use in Alberta by Sector. (1998). Available at: www.environment.gov.ab.ca/info/library/7469.pdf

Manure Generation and Management

back to top

Manure Generation		
Beef Cows	36.8 kg/day/635 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Bulls	42.1 kg/day/726 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Calves	11.8 kg/day/204 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Heifers	24.4 kg/day/421 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Steers	26.3 kg/day/454 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)

Nitrogen Generation from Manure

Beef Cows	0.216 kg/day/635 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Bulls	0.247 kg/day/726 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Calves	0.069 kg/day/204 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Heifers	0.143 kg/day/421 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Steers	0.154 kg/day/454 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)

Phosphorus Generation from Manure

Beef Cows	0.058 kg/day/635 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Bulls	0.067 kg/day/726 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Calves	0.019 kg/day/204 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Heifers	0.039 kg/day/421 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)
Steers	0.042 kg/day/454 kg animal	Statistics Canada. A Geographical Profile of Manure Production in Canada, 2001. Catalogue No. 21-601-MIE (Data sourced from American Society of Agriculture Engineers)

Manure Treatment (Beef Cattle) (Estimated from Graph) (2001)

Aeration	3 % farms	Statistics Canada. Farm Environmental Management in Canada. Manure Management in Canada, 2004, Vol. 1, No. 2. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004001/pdf/4193744-eng.pdf
Additives	0.5 % farms	Statistics Canada. Farm Environmental Management in Canada. Manure Management in Canada, 2004, Vol. 1, No. 2. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004001/pdf/4193744-eng.pdf
Filtration Marsh	0.25 % farms	Statistics Canada. Farm Environmental Management in Canada. Manure Management in Canada, 2004, Vol. 1, No. 2. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004001/pdf/4193744-eng.pdf
Composting	38 % farms	Statistics Canada. Farm Environmental Management in Canada. Manure Management in Canada, 2004, Vol. 1, No. 2. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004001/pdf/4193744-eng.pdf
Drying	16 % farms	Statistics Canada. Farm Environmental Management in Canada. Manure Management in Canada, 2004, Vol. 1, No. 2. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004001/pdf/4193744-eng.pdf
Other Treatments	5 % farms	Statistics Canada. Farm Environmental Management in Canada. Manure Management in Canada, 2004, Vol. 1, No. 2. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004001/pdf/4193744-eng.pdf
None	37 % farms	Statistics Canada. Farm Environmental Management in Canada. Manure Management in Canada, 2004, Vol. 1, No. 2. Available at: http://www.statcan.gc.ca/pub/21-021-m/2004001/pdf/4193744-eng.pdf

Manure Storage

Unmanaged (left on pasture range and paddock)	48 %	Methane to markets. Country profile for animal waste management. Canada. Table 2. November 2006. Available at: http://www.methanetomarkets.org/m2m2009/documents/ag_cap_canada.pdf
Stored on farms as solid	47 %	Methane to markets. Country profile for animal waste management. Canada. Table 2. November 2006. Available at: http://www.methanetomarkets.org/m2m2009/documents/ag_cap_canada.pdf
Stored on farms as liquid	1 %	Methane to markets. Country profile for animal waste management. Canada. Table 2. November 2006. Available at: http://www.methanetomarkets.org/m2m2009/documents/ag_cap_canada.pdf
N emission reductions from manure using Ionophores in the Diet	4 % N reduction	Tedeschi, Luis Orlindo et. al. Potential Environmental Benefits of Ionophores in Ruminant Diets. Journal of Environmental Quality. 32:1591-1602 (2003).

Garbage Generation and Management

back to top

Garbage Generation

Physical Feed Wastage		
Feed Storage Loss Goal	5 %	Alberta Agriculture and Food. Agri-Facts. Feed Waste Management. Agdex 420/54-1. Revised August 2006. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex4734/$file/420_54-1.pdf?OpenElement
Feed Wastage Goal	5 %	Alberta Agriculture and Food. Agri-Facts. Feed Waste Management. Agdex 420/54-1. Revised August 2006. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex4734/$file/420_54-1.pdf?OpenElement
Physical Garbage (Silage Plastic Covers and Bailer Twine)	** Other quantities of garbage generated in the Alberta beef industry not available	

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Expected Agricultural Polyethylene to be Marketed in 2008 in Alberta		
(agricultural sheet materials like silage bags and bale wrap)	9.5 - 11 million lbs	Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf
Agricultural films LLDPE#4 - Linear Low Density Polyethylene		http://www.gov.mb.ca/conservation/pollutionprevention/plastic_bags.html
Minimum	9.5 million lbs	Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf
Maximum	11 million lbs	Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf
Average	10.25 million lbs	Calculated
	4,649 tonnes	Calculated
Expected Agricultural Polypropylene to be Marketed in 2008 in Alberta		
(agricultural twine and cord)	6.5 - 8.7 million lbs	Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf
Minimum	6.5 million lbs	Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf
Maximum	8.7 million lbs	Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf
Average	7.6 million lbs	Calculated
	3,447 tonnes	Calculated

Alberta Farm Cash Receipts from 2004-2008 used to predict the percentage of agricultural plastics in Alberta used in beef production.
Assumed that all cattle and calves cash receipts from the beef industry.

Total Cattle and Calves - Alberta Farm Cash Receipts		
2004	2,571,540 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2005	3,022,320 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2006	2,941,140 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2007	3,026,908 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2008	2,969,753 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
Total Alberta Farm Cash Receipts		
2004	6,570,681 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2005	6,734,259 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2006	6,799,573 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2007	7,757,154 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
2008	8,984,221 $ Thousands	Government of Alberta. Agriculture and Rural Development. Alberta Farm Cash Receipts by Detailed Type ($ Thousands), 2004-2008. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4807
Percent of Cattle and Calves Farm Receipts of the Total Farm Cash Receipts for Crops and Livestock		
2004	39.1 %	Calculated based on above.
2005	44.9 %	Calculated based on above.
2006	43.3 %	Calculated based on above.
2007	39.0 %	Calculated based on above.
2008	33.1 %	Calculated based on above.
Average	39.9 %	Calculated based on above.
Assumed amount of polyethylene used in the beef production industry in Alberta		
	1,854 tonnes	Calculated based on above.
Assumed amount of polypropylene used in the beef production industry in Alberta		
	1,374 tonnes	Calculated based on above.

Garbage Management

Most Common Forms of Plastics Management

Garbage Burned in Burning Barrels or on Burn Piles On Farms in Alberta (most common)		Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf
Garbage Buried		Alberta Plastics Recycling Association. Volume 4. Spring 2008. Available at: http://www.recycleyourplastic.ca/pdf/apra_news_spr08.pdf

** Many landfills will not accept agricultural plastics because of the handling challenges and potential risks the material poses to equipment

Estimated % of plastic in Alberta beef production - burned	75 %	Estimated based on Alberta Plastics Recycling Association articles.
Estimated % of plastic in Alberta beef production - buried	25 %	Estimated based on Alberta Plastics Recycling Association articles.
Recycling initiatives in the works		Alberta Plastics Recycling Association. Volume 5. Spring 2009. Available at: http://www.recycleyourplastic.ca/pdf/APRANews_Spr09.pdf

Mortalities and Disposal

back to top

Mortalities

Beef Cattle - Cows and Bulls - average weight 650 kg	1 %	Government of Alberta. Agriculture and Rural Development. Livestock Mortality Management (Disposal). Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex6081
Cow/Calf - Calves (newborn) - average weight 40 kg	3 %	Government of Alberta. Agriculture and Rural Development. Livestock Mortality Management (Disposal). Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex6081
Cow/Calf - Calves (pre-weaning) - average weight 150 kg	2 %	Government of Alberta. Agriculture and Rural Development. Livestock Mortality Management (Disposal). Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex6081
Cow/Calf - Calves (replacements) - average weight 350 kg	1 %	Government of Alberta. Agriculture and Rural Development. Livestock Mortality Management (Disposal). Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex6081
Feedlot - Backgrounders - average weight 300 kg	2 %	Government of Alberta. Agriculture and Rural Development. Livestock Mortality Management (Disposal). Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex6081
Feedlot - Feeders - average weight 425 kg	1 %	Government of Alberta. Agriculture and Rural Development. Livestock Mortality Management (Disposal). Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex6081

Mortality Disposal

Current Estimated Ratios for Disposal			
Cow-Calf Operations			
On-Farm Disposal		90 %	Discussion with Alberta Agriculture and Rural Development. No other information available for mortality disposal.
Rendering		10 %	
Feedlot Operations			
Rendering		90 %	Discussion with Alberta Agriculture and Rural Development. No other information available for mortality disposal.
Other Methods (assume on-farm disposal)		10 %	
Methods of Mortality Disposal	Incineration Burial Composting On-Farm Rendering		Saskatchewan Ministry of Agriculture. Fact Sheet. Managing Livestock Mortalities. Available at: http://www.agriculture.gov.sk.ca/mortalities
Most Prominent Methods of Mortality Disposal in Alberta	On-Farm Rendering		Discussions with people in the cattle industry in Alberta (John Kolk, Bryan Walton, Dave Moss, John Basarab)

Operation and Maintenance on Beef Farms

back to top

On-Site Usage of Energy (Gasoline, Diesel, Natural Gas, Electricity, Liquid Petroleum Gas)

Alberta Energy Consumption - Cattle Farms (per year)

Gasoline (trucks and auto, farm machine, non-farm)	5,512.1 TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Percent of total energy used	22.9 %	Calculated
Diesel (trucks and auto, farm machine, non-farm)	13,924.8 TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Percent of total energy used	57.9 %	Calculated
Natural Gas (heat and light, non-farm)	2,108.9 TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Percent of total energy used	8.8 %	Calculated
Electricity (heat and light, other uses, non-farm)	2,371.4 TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Percent of total energy used	9.9 %	Calculated
LPG (heat and light, other uses, non-farm) (assume propane)	124.4 TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Percent of total energy used	0.5 %	Calculated
Total energy usage	24,041.6 TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Energy used for trucks and auto	4,729	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Energy used for heat and light	1,770	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Energy used for other uses	376	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Energy used for farm machinery	13,217	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Energy used for non-farm	3,728	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Total energy usage	24,041	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult

** Assumed that energy used for trucks and auto and non-farm usage does not pertain to energy used on beef farms in Alberta as farm machinery and personal usage of vehicles has been included in the farm machinery section and the other uses section.
** The trucks and auto portion has been removed from the gasoline and diesel usage based on the fraction of each to the total gas and diesel usage, and then the non-farm usage has been removed from all sources of energy proportionate to the total usage.

Gasoline (trucks and auto, farm machine, non-farm)	3,333	TJ	Calculated based on source above
Diesel (trucks and auto, farm machine, non-farm)	8,361	TJ	Calculated based on source above
Natural Gas (heat and light, non-farm)	1,782	TJ	Calculated based on source above
Electricity (heat and light, other uses, non-farm)	2,004	TJ	Calculated based on source above
LPG (heat and light, other uses, non-farm) (assume propane)	105	TJ	Calculated based on source above
Total energy usage	15,585	TJ	Calculated based on source above

** Capped the total gasoline used on Alberta beef farms to 15% of the total volume of diesel used based on John Kolk's (ACFA) expert opinion that gasoline usage on beef farms in Alberta is only 10-15% of the total diesel usage.

Diesel (trucks and auto, farm machine, non-farm)	8,361	TJ	
	211,096	tonnes	
Gasoline (trucks and auto, farm machine, non-farm)	31,664	tonnes	Based on assumption above
	1,422	TJ	Based on assumption above
Gasoline (farm machine)	1,422	TJ	Based on assumption above
	1,422,364,675	MJ	Calculated
Diesel (farm machine)	8,361	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
	8,360,951,007	MJ	Calculated
Natural Gas (heat and light)	1,782	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
	1,781,893,132	MJ	Calculated
Electricity (heat and light, other uses)	2,004	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
Amount of electricity	556,580,494	kWh	Calculated
LPG (heat and light, other uses) (assume propane)	105	TJ	Khakbazan, Mohammad. Descriptive Analysis of On-Farm Energy Use in Canada. A Report to Natural Resources Canada. Prepared for The Canadian Agricultural Energy End Use Data and Analysis Centre. February 2000. Available at: http://www.usask.ca/agricult
	105,110,487	MJ	Calculated
Energy content of propane	24,100	MJ/m^3	Energy Density of Propane. Average value taken. Available at: http://hypertextbook.com/facts/2002/EricLeung.shtml
Amount of propane	4,361	m^3	Calculated
Gasoline Factors			
Density of gasoline	0.73722	kg/L	Simetric. Specific Gravity of Liquids. Available at: http://www.simetric.co.uk/si_liquids.htm
Volume of crude oil barrel	159	L/barrel	The Quiet Road. Carbon dioxide emissions per barrel of crude. Available at: http://numero57.net/?p=255
Gasoline (44.1%) production from 1 barrel crude oil	70.12	L/barrel	The Quiet Road. Carbon dioxide emissions per barrel of crude. Available at: http://numero57.net/?p=255
Energy content of gasoline	44.92	MJ/kg	Energy Density of Gasoline. Average value taken. Available at: http://hypertextbook.com/facts/2003/ArthurGolnik.shtml
Diesel Factors			
Density of diesel	0.885	kg/L	Simetric. Specific Gravity of Liquids. Available at: http://www.simetric.co.uk/si_liquids.htm
Volume of crude oil barrel	159	L/barrel	The Quiet Road. Carbon dioxide emissions per barrel of crude. Available at: http://numero57.net/?p=255
Diesel fuel (20.8%) production from 1 barrel crude oil	33.07	L/barrel	The Quiet Road. Carbon dioxide emissions per barrel of crude. Available at: http://numero57.net/?p=255
Energy content of diesel	35.05	MJ/L	Energy Density of Diesel. Average value taken. Available at: http://hypertextbook.com/facts/2006/TatyanaNektalova.shtml
Natural Gas Factors			
Gas at standard conditions	38.04	ft^3/Nm^3	Answers.com. Available at: http://wiki.answers.com/Q/What_does_this_mean_Nm3
Density of natural gas	0.71122	kg/m^3	Simetric. Specific Gravity of Liquids. Available at: http://www.simetric.co.uk/si_liquids.htm
Estimated transport distance to natural gas processing	1000	km	Assumed value
Estimated transport distance to consumer	1000	km	Assumed value
Energy content of natural gas	37.63	MJ/m^3	Energy Density of Natural Gas. Average value taken. Available at: http://hypertextbook.com/facts/2004/JessicaYan.shtml

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Operation and Maintenance - Farm Components

Number of barns for beef production in Alberta		units	Unknown Data
Amount of damage steel removed per year per farm		kg	Unknown Data
Amount of damaged wood removed per year per farm		kg	Unknown Data
Amount of concrete removed per year per farm		kg	Unknown Data
Gravel required per farm per year		kg	Unknown Data

Bedding
back to top

Quantity of Bedding (Cow-Calf Operations)	0.2	tonnes/cow/yr	From conversation with Dale Kaliel with Agriprofit$; aggregate data, 5 year average for cow-calf operations
Amount of Straw Bedding Material Used	95	%	From conversation with Dale Kaliel with Agriprofit$.
Amount of Wood Chip Bedding Material Used	5	%	From conversation with Dale Kaliel with Agriprofit$.
Assumed 100% straw bedding used			
Quantity of Bedding (Feedlot) (assuming 240 days)	0.42	kg/head/day	From Meeting with ARD and Steering Committee on November 30, 2009.

Water Consumption
back to top

Feeders - 250 kg (summer days above 25^{o}C x 2)	15	L/head/day	Alberta Agriculture and Food. Agri-Facts. Farm Water Supply Requirements. Agdex 716 (C01). Revised April 2009. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1349
Feeders - 400 kg (summer days above 25^{o}C x 2)	26	L/head/day	Alberta Agriculture and Food. Agri-Facts. Farm Water Supply Requirements. Agdex 716 (C01). Revised April 2009. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1349
Feeders - 550 kg (summer days above 25^{o}C x 2)	38	L/head/day	Alberta Agriculture and Food. Agri-Facts. Farm Water Supply Requirements. Agdex 716 (C01). Revised April 2009. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1349
Cows with Calves - 600 kg (summer days above 25^{o}C x 1.5)	45	L/head/day	Alberta Agriculture and Food. Agri-Facts. Farm Water Supply Requirements. Agdex 716 (C01). Revised April 2009. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1349
Dry Cows - 600 kg (summer days above 25^{o}C x 1.5)	38	L/head/day	Alberta Agriculture and Food. Agri-Facts. Farm Water Supply Requirements. Agdex 716 (C01). Revised April 2009. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1349
Calves - 120 kg (summer days above 25^{o}C x 1.5)	8	L/head/day	Alberta Agriculture and Food. Agri-Facts. Farm Water Supply Requirements. Agdex 716 (C01). Revised April 2009. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1349

** Note that the water consumption data is not used in the calculations as the total amount of energy used on beef farms in Alberta is known; therefore, the energy required to supply water has been accounted for.

Transportation
back to top

Cereal and Grain - Train and Truck Transportation

Farm to Primary Elevator - average truck weight	8	tonnes	The Canadian Encyclopedia. Grain Handling and Marketing. Available at: http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0003364
Primary Elevator to Elsewhere	91	tonnes	The Canadian Encyclopedia. Grain Handling and Marketing. Available at: http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0003364
(average train boxcar and hopper car weight)			
Grain Hauling - Average Load Weight	43	tonnes	Grain Hauling 2008. Document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
Average Distance Traveled from Farm (to primary elevators)	20	km	The Canadian Encyclopedia. Grain Handling and Marketing. Available at: http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0003364
Average Distance Traveled from Primary Elevators to Port	1400	km	The Canadian Encyclopedia. Grain Handling and Marketing. Available at: http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0003364
Feed transportation	100	km	Assumed value

Forage - Hay and Straw - Truck Transportation

Hay - Estimated Load Weight (max allowable)	25	tonnes	Microsoft Word document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
	30 - 35	bales	Microsoft Word document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009

BEEF PRODUCTION DATA FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Average Weight of Hay Bale	540 - 725 kg	Microsoft Word document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
Average Weight of Hay Bale	1200 - 1600 lbs	Microsoft Word document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
Straw - Estimated Load Weight	16 tonnes	Microsoft Word document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
	30 - 35 bales	Microsoft Word document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
Average Weight of Straw Bale	450 kg	Microsoft Word document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
Forage transportation	10 km	Alberta Agriculture and Rural Development, Comments from Steering Committee on the Beef LCA Draft Final Report Submitted to CRA, March 30, 2010
Mineral Transportation	100 km	Assumed value
Growth Promotant Transportation	100 km	Assumed value
Vitamin Transportation		
Vitamin A	Manufactured in Switzerland	Conversation with DSM Nutritional Products Canada Inc., High River, Alberta (403-652-7272)
Vitamin D	Manufactured in France	
Vitamin E	Manufactured in NE USA	
Average vitamin transportation distance for Vitamin E	2500 km	Assumed (from North America)
Average vitamin transportation distance for vitamin overseas	5500 km	Transoceanic freight ship, assumed
Average vitamin transportation distance for vitamin overseas	4000 km	land, railroad
Average vitamin transportation distance for vitamin overseas	500 km	land, road
Nitrogen-Based Fertilizer Transportation	240 km	Estimated based on Agriculture and Agri-Food Canada Chapter II - The Structure of the Canadian Fertilizer Industry - Fertilizer Pricing in Cana
Phosphate-Based Fertilizer Transportation	550 km	Estimated based on Agriculture and Agri-Food Canada Chapter II - The Structure of the Canadian Fertilizer Industry - Fertilizer Pricing in Canada. Assumed all phosphate fertilizer from Saskatchewan.
Pesticide Transportation	100 km	Assumed
Manure Transportation	7 km	The Economics of Manure vs. Chemical Fertilizer, for ARD Use. Emailed from Emmanuel Laate to Stephen Ball on November 20, 2009. Value chosen by ARD during February 22, 2010 presentation.
Materials Transportation	50 km	Assumed
Bedding Transportation	10 km	Assumed
Animals - Truck Transportation		
Average Distance Traveled - From Feedlot to Auction	100 km (one way estimate)	Based on Alberta feedlot locations and capacity and Alberta auction locations (actual distance confidential)
Average Distance Traveled - From Auction to Slaughterhouse	200 km (estimate)	Based on Alberta auction locations and the 2 main Alberta slaughterhouse locations
Average Distance (Long Haul)	1106.5 +/- 329 km	Transport Benchmark Study. K. Schwartzkopf-Genswein et. al. Agriculture and Agri-Food Canada. AFAC Transport Conference. January 29, 2009. Calgary, AB. Available at: http://livestocktransport.ca/conference/presentations/KSG.pdf
Assumed Distance (Short Haul) (winter to summer pasture; into separate pen; from dairy)	70 km	From Meeting with ARD and Steering Committee on November 30, 2009. Herd-specific, uncertainty in value.
Distance - Cows from pasture to feedlot (internal)		
- Internal	181 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	610 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Cows to slaughterhouse		
- Internal	238 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	950 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Bulls from pasture to feedlot		
- Internal	199 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	600 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Bulls to slaughterhouse		
- Internal	247 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	473 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Calf-Fed from cow/calf operations to backgrounding feedlot		
- Internal	222 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	552 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Calf-Fed from feedlot to slaughter (heifer)		
- Internal	312 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	659 km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Calf-Fed from feedlot to slaughter (steer)		

- Internal	309	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	686	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010

Distance - Yearling-Fed from cow/calf operations to backgrounding feedlot			
- Internal	279	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	635	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Yearling-Fed from feedlot to slaughter (heifer)			
- Internal	312	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	659	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Yearling-Fed from feedlot to slaughter (steer)			
- Internal	309	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
- Out of province	686	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Distance - Heifer Replacements for Breeding	258	km	Calculated from the 2006 transportation information provided by Pat Mergen from LIS to Matthew Murphy from CRA on January 5, 2010
Feedlot Cattle Sold Directly to Packers in Western Canada	95	%	Statistics Canada. The North American Beef Market: Competition Keeps It Lean. Available at: http://www.statcan.gc.ca/kits-trousses/agric/edu04_0104a-eng.htm
(no additional auction)			
Max Allowable Travel Time to Slaughter with No Food or Water	52	hrs	TheBeefSite.com. Transport to Slaughterhouse on Welfare Agenda. November 2, 2009. Available at: http://www.thebeefsite.com/news/28882/transport-to-slaughterhouse-on-welfare-agenda
** Assumed value	48	hrs	
Livestock Hauling - Most Common Trailer Used	64000	lb tri-axle possum belly trailer	Livestock Hauling 2008. Document provided by Alberta Agriculture and Rural Development in an email from Emmanuel Laate to Stephen Ball on November 20, 2009
Average Number of Animals Per Truck	46.7	number of head	Transport Benchmark Study. K. Schwartzkopf-Genswein et. al. Agriculture and Agri-Food Canada. AFAC Transport Conference. January 29, 2009. Calgary, AB. Available at: http://livestocktransport.ca/conference/presentations/KSG.pdf
Average Calves Per Truck	104.3	number of head	Transport Benchmark Study. K. Schwartzkopf-Genswein et. al. Agriculture and Agri-Food Canada. AFAC Transport Conference. January 29, 2009. Calgary, AB. Available at: http://livestocktransport.ca/conference/presentations/KSG.pdf
Average Feeders Per Truck	69	number of head	Transport Benchmark Study. K. Schwartzkopf-Genswein et. al. Agriculture and Agri-Food Canada. AFAC Transport Conference. January 29, 2009. Calgary, AB. Available at: http://livestocktransport.ca/conference/presentations/KSG.pdf
Average Fed Cattle Per Truck	42.3	number of head	Transport Benchmark Study. K. Schwartzkopf-Genswein et. al. Agriculture and Agri-Food Canada. AFAC Transport Conference. January 29, 2009. Calgary, AB. Available at: http://livestocktransport.ca/conference/presentations/KSG.pdf
Average Weight of Cattle in Truck	1387.2	lbs	Transport Benchmark Study. K. Schwartzkopf-Genswein et. al. Agriculture and Agri-Food Canada. AFAC Transport Conference. January 29, 2009. Calgary, AB. Available at: http://livestocktransport.ca/conference/presentations/KSG.pdf
Average Weight of Cattle in Truck	629.2	kg	Transport Benchmark Study. K. Schwartzkopf-Genswein et. al. Agriculture and Agri-Food Canada. AFAC Transport Conference. January 29, 2009. Calgary, AB. Available at: http://livestocktransport.ca/conference/presentations/KSG.pdf
Transport Mortalities	100	km	Assumed

Dairy Cows

back to top

Percentage of Dairy Cows Entering the Beef System	5	%	Conversation with Paulin van Biert based upon impressions from dealing with the dairy industry
National Average Culling Rate of Dairy Cows	23	%	Government of Canada. Culling Rate and Replacement Rate in Dairy Herds (Canada) (2002 data). Available at: http://www.dairyinfo.gc.ca/pdf/publication_2008.pdf
Transportation of Dairy Cow Culls	directly to slaughter rather than feedlot		Conversation with Paulin van Biert based upon impressions from dealing with the dairy industry

END OF WORKSHEET

APPENDIX C

EMISSIONS FACTOR DATA FROM LCA MODEL

Emission Factor Data Worksheet

Index

Construction	AF1	Construct bunkers	Ecoinvent	building, hall
	AF2	Construct fences and gates		data gap
	AF3	Construct livestock shelters	Ecoinvent	tied housing system, cattle, construction
	AF4	Construct manure storage	Ecoinvent	slurry tanker, production
	AF5	Construct feed storage	Ecoinvent	shed
	AF6	Construct machinery	Ecoinvent	building, hall
	AF7	Construct watering facilities	Ecoinvent	water supply network
	AP1	Construct fences and gates	Ecoinvent	
	AP2	Construct watering facilities	Ecoinvent	water supply network
	AP3	Construct irrigation systems	Ecoinvent	pump station
Forage and cereal sub-activities	B1	Produce seed (barley, barley silage, alfalfa)	Ecoinvent	barley, grains IP, at farm, at farm; clover seed IP, at farm
	B6	Transport seed to processing center	Ecoinvent	seed barley, clover IP, at regional storehouse, CH
	B10	Process seed	Ecoinvent	
	B12	Store seed after being processed	Ecoinvent	
	B13	Transport seed to regional storehouse	Ecoinvent	
	B14	Store seed in the regional storehouse	Ecoinvent	data gap
	B2	Produce fertilizer	Ecoinvent	Urea, as N, urea, as N, at regional storehouse chemicals_organics RER Ammonia, liquid, at regional storehouse chemicals_inorganics RER;
	B7	Transport fertilizer	Ecoinvent	transport, lorry >16t, fleet average, RER
	B3	Produce pesticide/herbicide	Ecoinvent	pesticide unspecified, at regional storehouse, CH
	B8	Transport pesticide/herbicide	Ecoinvent	transport, lorry >16t, fleet average, RER
	B4	Transport manure	Ecoinvent	transport, lorry >32t, EURO4, RER
	B9	Apply manure	Ecoinvent	Solid manure loading and spreading, by hydraulic loader and spreader_CH
	B11	Incorporate manure	Ecoinvent	Tillage, cultivating, chiseling
	B5	Irrigate crop	Ecoinvent	Irrigating_CH
Energy generation activities	E1	Produce crude	Ecoinvent	proxy of crude oil, at production onshore, RME, see calculations
	E4	Transport crude	Ecoinvent	crude oil, production NO, at long distance transport
	E7a	Refine crude into diesel	Ecoinvent	proxy of diesel, at refinery, RER, see calculations
	E9a	Transport diesel	Ecoinvent	diesel, at regional storage oil_fuels(deliver to end user)_RER
	E7b	Refine crude into coloured diesel	Ecoinvent	proxy of diesel, at refinery, RER, see calculations
	E9b	Transport coloured diesel	Ecoinvent	diesel, at regional storage oil_fuels(deliver to end user)_RER
	E2	Produce natural gas	Ecoinvent (NREL)	proxy of natural gas, unprocessed, at extraction, RNA, see calculations
	E5	Transport natural gas		transport, natural gas, pipeline, long distance, RER
	E8	Process natural gas	Ecoinvent (NREL)	proxy of natural gas, at production, RNA, see calculations
	E10	Combust natural gas	Ecoinvent	proxy of natural gas, burned in industrial furnace >100kW, RER, see calculations
	E3	Generate electricity	Ecoinvent (NREL)	proxy of electricity, low voltage, at grid, US, see calculations
	E6	Transmit electricity		Included in E3 above.
O&M activities	R1	Produce materials for replacement components	Ecoinvent	tied housing system, cattle, operation, CH
	R4	Manufacture replacement components		
	R7	Transport replacement components		
	R10	Install replacement components		
	R2	Remove damaged/worn components	Ecoinvent	Remove damaged steel: disposal, building, reinforcement steel, to recycling waste management_recycling_CH
	R5a	Transport steel to recycle center	Ecoinvent	transport, lorry >32t, EURO4, RER
	R8a	Recycle steel components	Ecoinvent	disposal, building, reinforcement steel, to recycling
	R5b	Transport wood to recycle center	Ecoinvent	disposal, building, waste wood, untreated, to final disposal
	R8b	Recycle wood components		No recycling. Wood is considered waste. See R2
	R5c	Transport concrete for reuse as aggregate	Ecoinvent	transport, lorry >32t, EURO4, RER
	R3	Extract gravel materials	Ecoinvent	mining, gravel / sand+ gravel, crushed, at mine (2 processes)
	R6	Transport gravel materials	Ecoinvent	transport, lorry >32t, EURO4, RER
	R9	Grade access roads	data gap	

Cereal activities	CC1	Plant cover crop or green manure	Ecoinvent	not applicable for Alberta agricultural practices	
	CC2	Cultivate soil	combination of different processes, adjusted as proxy based on fuel	For adjustment or processes based on fuel consumption see appropriate tabs : Cereal activity	
		no till	Ecoinvent	years	spring tine harrow
		reduced till	Ecoinvent	year	chiseling
			Ecoinvent	years	spring tine harrow
		full till	Ecoinvent	year	chiseling
			Ecoinvent	times per year	chiseling
			Ecoinvent	two years	cultivator
	CC3	Apply fertilizer (includes manure)	combination of different processes, adjusted as proxy based on fuel	For adjustment or processes based on fuel consumption see appropriate tabs : Cereal activity	
		Broadcasting	Ecoinvent	Alberta practice - sprayer	Ecoinvent proxy - tillage, rotary cultivator
		Injected or knifed in	Ecoinvent	Alberta practice - anhydrous applicator	harrow
		Post-plant Top/Side	Ecoinvent	previous processes	
		Banded	Ecoinvent	When seeding. Should not require additional fuel consumption. Assumption.	
		Applied with Seed	Ecoinvent	When seeding. Should not require additional fuel consumption. Assumption.	
		Other	Ecoinvent		
	CC4	Plant crop	Ecoinvent	Alberta practice - air drill, once per year	Ecoinvent proxy- planting
	CC5	Irrigate crop CC	Ecoinvent	Irrigating, CH	
	CC6	Apply chemical treatment	Ecoinvent	crop	protection products, by field sprayer
	CC7	Apply mechanical treatment	Ecoinvent	per year	weeder
	CC8	Harvest crop (grain and straw)	Ecoinvent	Alberta practice -combine (small grain), once per year	Ecoinvent proxy- combine harvesting
	CC9	Transport harvested crop (grain)	Ecoinvent		

Forage activities	FC1	Cultivate soil (not annually)	Ecoinvent	see above, cultivate soil, CC2
	FC2	Apply fertilizer	Ecoinvent	see above, apply fertilizer, CC3
	FC3	Plant crop (not annually)	Ecoinvent	see above, planting, CC4
	FC4	Irrigate crops	Ecoinvent	Irrigating, CH
	FC5	Apply chemical treatment	Ecoinvent	see above, apply chemical treatment, CC6
	FC6	Harvest crop (multiple times per year)	Ecoinvent	see above, harvesting, CC8
	FC7	Transport harvested crop (feed)	Ecoinvent	transport
	FC8	Treat harvested crop (feed)		no treatment necessary

Feedlot and pasture activities	FL1	Deposit manure		emissions covered under biological activity of cattle
	FL2	Collect manure		Included in total energy used on beef farms
	FL7	Transfer manure	Ecoinvent	Included in total energy used on beef farms
	FL12	Store manure	Ecoinvent	slurry store and processing_CH
	FL24	Dispose of manure (not on crops fed to beef)	Ecoinvent	Transport of manure off site+ spreading. Spreading is not accounted for, as the manure leaves the beef production system.
	FL3	Collect garbage		Included in total energy used on beef farms.
	FL8	Store garbage		No emissions associated with this activity
	FL13	Transport garbage	Ecoinvent	transport, Lorry >32 t
	FL25	Dispose of garbage		burned , combustion
	FL4	Collect mortalities (on-site)		Included in total energy used on beef farms
	FL9	Store mortalities		No emissions involved in this activity
	FL14	Transport mortalities	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL26	Dispose of mortalities		Rendering. Emissions from rendering are cut-off.
	FL5	Produce bedding material	Ecoinvent	straw, from straw areas_CH
	FL10	Transport bedding	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL15	Store bedding		No emissions involved in this activity
	FL27	Bed livestock		Included in total energy used on beef farms
	FL6	Store feed	Ecoinvent	Included in total energy used on beef farms
	FL11	Store feed		
	FL16	Transport feed		Feedmill consumptions (source Pork LCA)
	FL28	Feed livestock		Included in total energy used on beef farms
	F17	Produce mineral	Ecoinvent	Sodium phosphate, RER
	FL29	Transport mineral	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL18	Produce trace mineral		minerals required have not been included in the analysis)
	FL30	Transport trace mineral	Ecoinvent	Not applicable - see FL 18
	FL19	Produce cobalt (iodized)		Cobalt Iodized Salt Block - considered within the sodium chloride production
	FL31	Transport cobalt (iodized)	Ecoinvent	Cobalt Iodized Salt Block - considered within the sodium chloride production
	FL20	Produce millrun carrier		waste product from the wheat processing industry.
	FL32	Transport millrun carrier	Ecoinvent	transport, lorry >16t, fleet average, RER
	FL21	Produce vitamin		data gap
	FL33	Transport vitamin	Ecoinvent	transport distance Calgary, AB- New York-Paris (estimated from Google Earth)
	FL22	Produce growth promotant		data gap
	FL34	Transport growth promotant	Ecoinvent	Transport, van <3.5t
	FL23	Produce vaccination/antibiotic		data gap
	FL 35	Transport vaccination/antibiotic		data gap
	FL39	Production of plastic	Ecoinvent	polypropylene, granulate, at plant, RER, polyethylene, LLDPE, granulate, at plant
	FL36	Supply water to livestock		Included in total energy used on beef farms

Parameter	Category	Subcategory	LCIA unit	eq factors	eq units	Mean Value Process	Unit process	Emissions / unit	Source
AF1	**Construct bunkers**								
back to top	**building, hall**	Includes a combination of the wooden building hall (30%) and the steel building hall (70%) to represent the estimated current Swiss share.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	8.19E+01	kg/kg	8.19E+01	Ecoinvent V2, building, hall
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	5.07E+01	kg/kg	5.07E+01	Ecoinvent V2, building, hall
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	8.20E-06	kg/kg	8.20E-06	Ecoinvent V2, building, hall
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.42E+02	kg/kg	1.42E+02	Ecoinvent V2, building, hall
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	4.02E-02	kg/kg	6.32E-02	Ecoinvent V2, building, hall
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	9.65E-02	kg/kg	1.52E-01	Ecoinvent V2, building, hall
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	9.63E-09	kg/kg	1.51E-08	Ecoinvent V2, building, hall
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.07E+00	kg/kg	1.68E+00	Ecoinvent V2, building, hall
Chloroform	air	high population density	kg	30	kg CO2-Eq	8.62E-08	kg/kg	2.59E-06	Ecoinvent V2, building, hall
Chloroform	air	low population density	kg	30	kg CO2-Eq	9.03E-09	kg/kg	2.71E-07	Ecoinvent V2, building, hall
Chloroform	air	unspecified	kg	30	kg CO2-Eq	6.13E-14	kg/kg	1.84E-12	Ecoinvent V2, building, hall
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.93E-03	kg/kg	5.75E-01	Ecoinvent V2, building, hall
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	9.35E-04	kg/kg	2.79E-01	Ecoinvent V2, building, hall
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	7.81E-11	kg/kg	2.33E-08	Ecoinvent V2, building, hall
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.25E-03	kg/kg	6.71E-01	Ecoinvent V2, building, hall
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.73E-09	kg/kg	2.47E-06	Ecoinvent V2, building, hall
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	4.59E-08	kg/kg	6.56E-05	Ecoinvent V2, building, hall
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.41E-05	kg/kg	6.31E-02	Ecoinvent V2, building, hall
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	6.76E-10	kg/kg	4.15E-06	Ecoinvent V2, building, hall
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, building, hall
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	3.20E-08	kg/kg	3.97E-06	Ecoinvent V2, building, hall
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, building, hall
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	8.23E-07	kg/kg	8.23E-03	Ecoinvent V2, building, hall
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, building, hall
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	4.74E-08	kg/kg	5.78E-04	Ecoinvent V2, building, hall
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	5.93E-05	kg/kg	7.24E-01	Ecoinvent V2, building, hall
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	8.65E-04	kg/kg	2.16E-02	Ecoinvent V2, building, hall
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.08E-03	kg/kg	2.69E-02	Ecoinvent V2, building, hall
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	4.04E-04	kg/kg	1.01E-02	Ecoinvent V2, building, hall
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.66E-13	kg/kg	8.31E-13	Ecoinvent V2, building, hall
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	8.47E-07	kg/kg	1.60E-03	Ecoinvent V2, building, hall

Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	7.99E-13	kg/kg	5.71E-09	Ecoinvent V2, building, hall
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.14E-06	kg/kg	8.16E-03	Ecoinvent V2, building, hall
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	6.38E-06	kg/kg	1.15E-02	Ecoinvent V2, building, hall
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.13E-06	kg/kg	5.67E-03	Ecoinvent V2, building, hall
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, building, hall
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.09E-08	kg/kg	1.81E-07	Ecoinvent V2, building, hall
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.67E-08	kg/kg	2.32E-07	Ecoinvent V2, building, hall
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	2.70E-09	kg/kg	2.94E-05	Ecoinvent V2, building, hall
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.90E-09	kg/kg	3.17E-05	Ecoinvent V2, building, hall
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.10E-13	kg/kg	1.20E-09	Ecoinvent V2, building, hall
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	4.92E-12	kg/kg	1.03E-09	Ecoinvent V2, building, hall
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.94E-01	kg/kg	4.86E+00	Ecoinvent V2, building, hall
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.94E-01	kg/kg	9.86E+00	Ecoinvent V2, building, hall
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.30E-10	kg/kg	3.25E-09	Ecoinvent V2, building, hall
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	8.26E-03	kg/kg	2.06E-01	Ecoinvent V2, building, hall
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.24E-06	kg/kg	3.14E-03	Ecoinvent V2, building, hall
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	4.94E-11	kg/kg	6.92E-08	Ecoinvent V2, building, hall
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.65E-09	kg/kg	1.22E-05	Ecoinvent V2, building, hall
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	5.34E-04	kg/kg	3.94E+00	Ecoinvent V2, building, hall
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	7.98E-12	kg/kg	3.79E-08	Ecoinvent V2, building, hall
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.56E-09	kg/kg	2.32E-05	Ecoinvent V2, building, hall
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, building, hall
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	6.00E-08	kg/kg	1.37E-03	Ecoinvent V2, building, hall
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	5.47E-06	kg/kg	1.25E-01	Ecoinvent V2, building, hall
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.69E-09	kg/kg	3.50E-08	Ecoinvent V2, building, hall
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.88E-08	kg/kg	6.34E-07	Ecoinvent V2, building, hall
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.50E-03	kg/kg	3.50E-03	Ecoinvent V2, building, hall
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, building, hall
								2.97E+02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	3.76E-03	kg/kg	7.06E-03	Ecoinvent V2, building, hall
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	9.47E-03	kg/kg	1.78E-02	Ecoinvent V2, building, hall
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	6.14E-01	kg/kg	1.15E+00	Ecoinvent V2, building, hall
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.21E-03	kg/kg	1.95E-03	Ecoinvent V2, building, hall
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.92E-03	kg/kg	2.57E-03	Ecoinvent V2, building, hall
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.82E-01	kg/kg	2.48E-01	Ecoinvent V2, building, hall
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	8.27E-05	kg/kg	1.32E-04	Ecoinvent V2, building, hall
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	6.74E-04	kg/kg	1.08E-03	Ecoinvent V2, building, hall
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.37E-03	kg/kg	3.79E-03	Ecoinvent V2, building, hall
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.14E-05	kg/kg	2.14E-05	Ecoinvent V2, building, hall
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	9.09E-04	kg/kg	1.71E-03	Ecoinvent V2, building, hall
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.10E-04	kg/kg	3.95E-04	Ecoinvent V2, building, hall
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.19E-01	kg/kg	8.32E-02	Ecoinvent V2, building, hall
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.53E-01	kg/kg	1.07E-01	Ecoinvent V2, building, hall
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	7.32E-01	kg/kg	5.12E-01	Ecoinvent V2, building, hall
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.27E-01	kg/kg	1.27E-01	Ecoinvent V2, building, hall
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.55E-01	kg/kg	3.55E-01	Ecoinvent V2, building, hall
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.14E-01	kg/kg	1.14E-01	Ecoinvent V2, building, hall
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.87E-05	kg/kg	5.40E-05	Ecoinvent V2, building, hall
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.85E-11	kg/kg	1.20E-11	Ecoinvent V2, building, hall
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, building, hall
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.18E-11	kg/kg	2.07E-11	Ecoinvent V2, building, hall
								2.74E+00	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.46E-05	kg/kg	1.06E-04	Ecoinvent V2, building, hall
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.25E-06	kg/kg	3.84E-06	Ecoinvent V2, building, hall
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.42E-06	kg/kg	4.33E-06	Ecoinvent V2, building, hall
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.68E-07	kg/kg	5.14E-07	Ecoinvent V2, building, hall
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	9.53E-05	kg/kg	2.92E-04	Ecoinvent V2, building, hall
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.82E-05	kg/kg	1.17E-04	Ecoinvent V2, building, hall
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.64E-01	kg/kg	5.81E-03	Ecoinvent V2, building, hall
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.32E-03	kg/kg	1.61E-04	Ecoinvent V2, building, hall
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.87E-01	kg/kg	6.31E-03	Ecoinvent V2, building, hall
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.88E-03	kg/kg	1.73E-04	Ecoinvent V2, building, hall
Phosphate	water	river	kg	1	kg PO4-Eq	1.42E-04	kg/kg	1.42E-04	Ecoinvent V2, building, hall
Phosphorus	water	river	kg	3.06	kg PO4-Eq	4.20E-04	kg/kg	1.28E-03	Ecoinvent V2, building, hall
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.52E-05	kg/kg	4.66E-05	Ecoinvent V2, building, hall
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	
								1.45E-02	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.42E+01	kg/kg	1.41E+02	Ecoinvent V2, building, hall
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	4.09E+01	kg/kg	7.82E+02	Ecoinvent V2, building, hall
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	4.12E-01	Nm3/kg	1.64E+01	Ecoinvent V2, building, hall
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.48E+01	Nm3/kg	9.48E+02	Ecoinvent V2, building, hall
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.51E+01	kg/kg	1.61E+03	Ecoinvent V2, building, hall
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.07E-02	kg/kg	1.06E-01	Ecoinvent V2, building, hall
								3.49E+03	
AF2	**Construct fences and gates**								
back to top									
AF3	**Construct livestock shelters**								Ecoinvent V2, tied housing system, cattle, construction, CH
back to top	**tied housing system, cattle, construction**	The inventory takes into account the use of construction materials and building machines for construction, repair and replacement including waste disposal and the transportation of the materials to the building site. Not taken into account were direct emission of the construction, disposal of production waste and the use of resources during utilization phase.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	3.54E+03	kg/kg	3.54E+03	Ecoinvent V2, tied housing system, cattle, construction, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.72E+03	kg/kg	1.72E+03	Ecoinvent V2, tied housing system, cattle, construction, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.98E-04	kg/kg	3.98E-04	Ecoinvent V2, tied housing system, cattle, construction, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	8.79E+03	kg/kg	8.79E+03	Ecoinvent V2, tied housing system, cattle, construction, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.24E+00	kg/kg	3.51E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	8.43E+00	kg/kg	1.32E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	4.67E-07	kg/kg	7.34E-07	Ecoinvent V2, tied housing system, cattle, construction, CH

Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	4.56E+01	kg/kg	7.17E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.90E-06	kg/kg	5.71E-05	Ecoinvent V2, tied housing system, cattle, construction, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.12E-07	kg/kg	3.35E-06	Ecoinvent V2, tied housing system, cattle, construction, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	5.96E-13	kg/kg	1.79E-11	Ecoinvent V2, tied housing system, cattle, construction, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.48E-01	kg/kg	4.42E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	3.88E-02	kg/kg	1.16E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.79E-09	kg/kg	1.13E-06	Ecoinvent V2, tied housing system, cattle, construction, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.83E-01	kg/kg	5.45E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	8.37E-08	kg/kg	1.20E-04	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.64E-06	kg/kg	2.34E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.17E-03	kg/kg	3.10E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.30E-08	kg/kg	2.02E-04	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.48E-06	kg/kg	1.84E-04	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.99E-05	kg/kg	2.99E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.31E-06	kg/kg	2.82E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	6.11E-04	kg/kg	7.46E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	4.42E-02	kg/kg	1.10E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.82E-02	kg/kg	9.56E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.97E-02	kg/kg	4.93E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.61E-12	kg/kg	8.07E-12	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.28E-05	kg/kg	6.20E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.78E-11	kg/kg	2.70E-07	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	5.29E-05	kg/kg	3.78E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	3.21E-05	kg/kg	5.81E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.24E-04	kg/kg	2.24E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.38E-06	kg/kg	2.07E-05	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.31E-07	kg/kg	2.88E-06	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.91E-07	kg/kg	2.09E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.12E-07	kg/kg	1.22E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.07E-12	kg/kg	1.17E-08	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.38E-10	kg/kg	5.00E-08	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.52E+00	kg/kg	8.81E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.85E+01	kg/kg	4.62E+02	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	6.31E-09	kg/kg	1.58E-07	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	2.02E-01	kg/kg	5.04E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	3.87E-05	kg/kg	5.42E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	4.80E-10	kg/kg	6.72E-07	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	7.62E-08	kg/kg	5.63E-04	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	5.50E-03	kg/kg	4.07E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.86E-10	kg/kg	1.84E-06	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	7.57E-08	kg/kg	1.12E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	7.23E-06	kg/kg	1.65E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	2.35E-04	kg/kg	5.36E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	8.30E-07	kg/kg	1.08E-05	Ecoinvent V2, tied housing system, cattle, construction, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	6.04E-07	kg/kg	7.85E-06	Ecoinvent V2, tied housing system, cattle, construction, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.57E-01	kg/kg	1.57E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
								1.49E+04	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.95E-01	kg/kg	3.66E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.78E-02	kg/kg	1.09E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.09E+00	kg/kg	3.93E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.31E-01	kg/kg	1.15E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.02E-01	kg/kg	8.97E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	8.61E-01	kg/kg	7.58E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	5.30E-03	kg/kg	8.48E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	2.31E-02	kg/kg	3.70E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	8.25E-02	kg/kg	1.32E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.09E-03	kg/kg	3.94E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	3.60E-02	kg/kg	6.78E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.12E-02	kg/kg	2.11E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	5.04E+00	kg/kg	3.53E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	5.94E+00	kg/kg	4.16E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.83E+01	kg/kg	1.98E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	4.89E+00	kg/kg	4.89E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.63E+01	kg/kg	1.63E+01	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	4.93E+00	kg/kg	4.93E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.19E-03	kg/kg	2.24E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	9.01E-10	kg/kg	5.86E-10	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.47E-09	kg/kg	9.56E-10	Ecoinvent V2, tied housing system, cattle, construction, CH
								5.92E+01	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.48E-03	kg/kg	4.54E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	5.18E-05	kg/kg	1.58E-04	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	5.29E-05	kg/kg	1.62E-04	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.74E-06	kg/kg	5.32E-06	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.36E-03	kg/kg	1.03E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.40E-03	kg/kg	4.29E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	9.38E+00	kg/kg	2.06E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.14E-01	kg/kg	4.71E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.07E+01	kg/kg	2.35E-01	Ecoinvent V2, tied housing system, cattle, construction, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.27E-01	kg/kg	5.00E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphate	water	river	kg	1	kg PO4-Eq	4.04E-03	kg/kg	4.04E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	8.83E-03	kg/kg	2.70E-02	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	4.43E-04	kg/kg	1.35E-03	Ecoinvent V2, tied housing system, cattle, construction, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
								5.03E-01	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	6.04E+02	kg/kg	5.98E+03	Ecoinvent V2, tied housing system, cattle, construction, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.88E+03	kg/kg	3.60E+04	Ecoinvent V2, tied housing system, cattle, construction, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.04E+01	Nm3/kg	8.13E+02	Ecoinvent V2, tied housing system, cattle, construction, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	8.71E+02	Nm3/kg	3.34E+04	Ecoinvent V2, tied housing system, cattle, construction, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.37E+03	kg/kg	6.28E+04	Ecoinvent V2, tied housing system, cattle, construction, CH

Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	3.51E-01	kg/kg	3.48E+00	Ecoinvent V2, tied housing system, cattle, construction, CH
								1.39E+05	
AF4	**Construct manure storage**								Ecoinvent V2, slurry tanker, production, CH
back to top	**slurry tanker, production**	The inventory takes into account the use of resources and the amount of emissions during the production, the maintenance and repair and the disposal of agricultural slurry tankers. Not taken into account were the impacts caused by fuel consumption during operation-time of the trailing machinery. No data was available about buildings needed for manufacture and maintenance of the machinery. The routes needed for transport from manufacturer place to the farm and from here to disposal place of the waste, are balanced in the utilized transport modules.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.24E+00	kg/kg	1.24E+00	Ecoinvent V2, slurry tanker, production, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.04E-01	kg/kg	6.04E-01	Ecoinvent V2, slurry tanker, production, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	6.80E-08	kg/kg	6.80E-08	Ecoinvent V2, slurry tanker, production, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.25E+00	kg/kg	1.25E+00	Ecoinvent V2, slurry tanker, production, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	6.16E-04	kg/kg	9.68E-04	Ecoinvent V2, slurry tanker, production, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.25E-03	kg/kg	1.96E-03	Ecoinvent V2, slurry tanker, production, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	7.98E-11	kg/kg	1.25E-10	Ecoinvent V2, slurry tanker, production, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	3.31E-02	kg/kg	5.20E-02	Ecoinvent V2, slurry tanker, production, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	9.00E-10	kg/kg	2.70E-08	Ecoinvent V2, slurry tanker, production, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	8.07E-11	kg/kg	2.42E-09	Ecoinvent V2, slurry tanker, production, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	4.30E-16	kg/kg	1.29E-14	Ecoinvent V2, slurry tanker, production, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.65E-05	kg/kg	7.90E-03	Ecoinvent V2, slurry tanker, production, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.43E-05	kg/kg	4.26E-03	Ecoinvent V2, slurry tanker, production, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	6.47E-13	kg/kg	1.93E-10	Ecoinvent V2, slurry tanker, production, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.53E-05	kg/kg	4.57E-03	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.58E-11	kg/kg	2.26E-08	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.12E-09	kg/kg	1.61E-06	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.60E-07	kg/kg	2.28E-04	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	5.34E-12	kg/kg	3.27E-08	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	7.27E-10	kg/kg	9.02E-08	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.18E-08	kg/kg	2.18E-04	Ecoinvent V2, slurry tanker, production, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	3.86E-10	kg/kg	4.70E-06	Ecoinvent V2, slurry tanker, production, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.62E-08	kg/kg	1.98E-04	Ecoinvent V2, slurry tanker, production, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.95E-06	kg/kg	4.87E-05	Ecoinvent V2, slurry tanker, production, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.09E-05	kg/kg	2.74E-04	Ecoinvent V2, slurry tanker, production, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	7.50E-06	kg/kg	1.87E-04	Ecoinvent V2, slurry tanker, production, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.16E-15	kg/kg	5.82E-15	Ecoinvent V2, slurry tanker, production, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.17E-08	kg/kg	2.21E-05	Ecoinvent V2, slurry tanker, production, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	5.73E-15	kg/kg	4.09E-11	Ecoinvent V2, slurry tanker, production, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.22E-08	kg/kg	8.74E-05	Ecoinvent V2, slurry tanker, production, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	3.07E-10	kg/kg	5.56E-07	Ecoinvent V2, slurry tanker, production, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	4.44E-08	kg/kg	8.04E-05	Ecoinvent V2, slurry tanker, production, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	4.18E-11	kg/kg	3.64E-10	Ecoinvent V2, slurry tanker, production, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.39E-10	kg/kg	2.08E-09	Ecoinvent V2, slurry tanker, production, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	2.04E-11	kg/kg	2.22E-07	Ecoinvent V2, slurry tanker, production, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.89E-11	kg/kg	4.24E-07	Ecoinvent V2, slurry tanker, production, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	7.74E-16	kg/kg	8.44E-12	Ecoinvent V2, slurry tanker, production, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	4.49E-14	kg/kg	9.43E-12	Ecoinvent V2, slurry tanker, production, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.97E-04	kg/kg	9.93E-03	Ecoinvent V2, slurry tanker, production, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	8.16E-03	kg/kg	2.04E-01	Ecoinvent V2, slurry tanker, production, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.08E-12	kg/kg	2.70E-11	Ecoinvent V2, slurry tanker, production, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	3.16E-05	kg/kg	7.90E-04	Ecoinvent V2, slurry tanker, production, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	4.24E-09	kg/kg	5.94E-06	Ecoinvent V2, slurry tanker, production, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.46E-13	kg/kg	4.85E-10	Ecoinvent V2, slurry tanker, production, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.74E-11	kg/kg	2.76E-07	Ecoinvent V2, slurry tanker, production, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.46E-07	kg/kg	1.08E-03	Ecoinvent V2, slurry tanker, production, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	7.29E-14	kg/kg	3.46E-10	Ecoinvent V2, slurry tanker, production, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.43E-11	kg/kg	2.11E-07	Ecoinvent V2, slurry tanker, production, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	7.41E-11	kg/kg	1.69E-06	Ecoinvent V2, slurry tanker, production, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.07E-07	kg/kg	2.44E-03	Ecoinvent V2, slurry tanker, production, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	6.50E-13	kg/kg	8.45E-12	Ecoinvent V2, slurry tanker, production, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.36E-10	kg/kg	5.67E-09	Ecoinvent V2, slurry tanker, production, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	4.09E-05	kg/kg	4.09E-05	Ecoinvent V2, slurry tanker, production, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
								3.39E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	6.67E-06	kg/kg	1.25E-05	Ecoinvent V2, slurry tanker, production, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.64E-05	kg/kg	3.09E-05	Ecoinvent V2, slurry tanker, production, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.57E-04	kg/kg	2.95E-04	Ecoinvent V2, slurry tanker, production, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	9.35E-05	kg/kg	8.23E-05	Ecoinvent V2, slurry tanker, production, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.87E-05	kg/kg	2.52E-05	Ecoinvent V2, slurry tanker, production, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.17E-05	kg/kg	4.55E-05	Ecoinvent V2, slurry tanker, production, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.00E-06	kg/kg	4.80E-06	Ecoinvent V2, slurry tanker, production, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	6.79E-06	kg/kg	1.09E-05	Ecoinvent V2, slurry tanker, production, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.05E-05	kg/kg	1.69E-05	Ecoinvent V2, slurry tanker, production, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.09E-09	kg/kg	5.81E-09	Ecoinvent V2, slurry tanker, production, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.46E-05	kg/kg	4.63E-05	Ecoinvent V2, slurry tanker, production, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.04E-05	kg/kg	1.96E-05	Ecoinvent V2, slurry tanker, production, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.21E-03	kg/kg	8.46E-04	Ecoinvent V2, slurry tanker, production, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.50E-03	kg/kg	1.75E-03	Ecoinvent V2, slurry tanker, production, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.79E-03	kg/kg	1.95E-03	Ecoinvent V2, slurry tanker, production, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.08E-03	kg/kg	2.08E-03	Ecoinvent V2, slurry tanker, production, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.91E-03	kg/kg	3.91E-03	Ecoinvent V2, slurry tanker, production, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.53E-03	kg/kg	1.53E-03	Ecoinvent V2, slurry tanker, production, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.10E-06	kg/kg	2.06E-06	Ecoinvent V2, slurry tanker, production, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.46E-13	kg/kg	9.48E-14	Ecoinvent V2, slurry tanker, production, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	7.23E-13	kg/kg	4.70E-13	Ecoinvent V2, slurry tanker, production, CH
								1.27E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.86E-07	kg/kg	5.68E-07	Ecoinvent V2, slurry tanker, production, CH

Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.71E-08	kg/kg	1.44E-07	Ecoinvent V2, slurry tanker, production, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	3.64E-08	kg/kg	1.11E-07	Ecoinvent V2, slurry tanker, production, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	4.71E-11	kg/kg	1.44E-10	Ecoinvent V2, slurry tanker, production, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.80E-07	kg/kg	5.52E-07	Ecoinvent V2, slurry tanker, production, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.62E-07	kg/kg	1.11E-06	Ecoinvent V2, slurry tanker, production, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.20E-03	kg/kg	4.83E-05	Ecoinvent V2, slurry tanker, production, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.49E-04	kg/kg	3.27E-06	Ecoinvent V2, slurry tanker, production, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.26E-03	kg/kg	4.97E-05	Ecoinvent V2, slurry tanker, production, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.50E-04	kg/kg	3.30E-06	Ecoinvent V2, slurry tanker, production, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.94E-06	kg/kg	1.94E-06	Ecoinvent V2, slurry tanker, production, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.47E-06	kg/kg	4.49E-06	Ecoinvent V2, slurry tanker, production, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.37E-08	kg/kg	4.18E-08	Ecoinvent V2, slurry tanker, production, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, slurry tanker, production, CH
								1.14E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.82E-01	kg/kg	1.80E+00	Ecoinvent V2, slurry tanker, production, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.15E+00	kg/kg	2.19E+01	Ecoinvent V2, slurry tanker, production, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.11E-02	Nm3/kg	4.41E-01	Ecoinvent V2, slurry tanker, production, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.59E-01	Nm3/kg	9.91E+00	Ecoinvent V2, slurry tanker, production, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.08E-01	kg/kg	1.41E+01	Ecoinvent V2, slurry tanker, production, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.58E-05	kg/kg	4.53E-04	Ecoinvent V2, slurry tanker, production, CH
								4.81E+01	
AF5	**Construct feed storage**								Ecoinvent V2, shed, CH
back to top	**shed**	The inventory takes into account the use of construction materials and building machines for construction, repair and replacement including waste disposal and the transportation of the materials to the building site. Not taken into account were direct emission of the construction, disposal of production waste and the use of resources during utilization phase.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.23E+01	kg/kg	2.23E+01	Ecoinvent V2, shed, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.08E+01	kg/kg	2.08E+01	Ecoinvent V2, shed, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	5.56E-06	kg/kg	5.56E-06	Ecoinvent V2, shed, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.65E+02	kg/kg	1.65E+02	Ecoinvent V2, shed, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.57E-02	kg/kg	2.46E-02	Ecoinvent V2, shed, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.28E-01	kg/kg	3.58E-01	Ecoinvent V2, shed, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	6.53E-09	kg/kg	1.03E-08	Ecoinvent V2, shed, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	4.07E-01	kg/kg	6.40E-01	Ecoinvent V2, shed, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.88E-08	kg/kg	8.63E-07	Ecoinvent V2, shed, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	7.19E-10	kg/kg	2.16E-08	Ecoinvent V2, shed, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	8.71E-16	kg/kg	2.61E-14	Ecoinvent V2, shed, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	3.04E-03	kg/kg	9.06E-01	Ecoinvent V2, shed, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	6.68E-04	kg/kg	1.99E-01	Ecoinvent V2, shed, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.29E-11	kg/kg	1.58E-08	Ecoinvent V2, shed, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.07E-03	kg/kg	3.19E-01	Ecoinvent V2, shed, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.18E-09	kg/kg	1.68E-06	Ecoinvent V2, shed, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.90E-08	kg/kg	4.15E-05	Ecoinvent V2, shed, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.15E-05	kg/kg	5.94E-02	Ecoinvent V2, shed, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	4.58E-10	kg/kg	2.80E-06	Ecoinvent V2, shed, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.25E-08	kg/kg	2.80E-06	Ecoinvent V2, shed, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	5.52E-07	kg/kg	5.52E-03	Ecoinvent V2, shed, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	3.21E-08	kg/kg	3.91E-04	Ecoinvent V2, shed, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.78E-06	kg/kg	2.17E-02	Ecoinvent V2, shed, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	6.71E-04	kg/kg	1.68E-02	Ecoinvent V2, shed, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	9.48E-04	kg/kg	2.37E-02	Ecoinvent V2, shed, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.69E-04	kg/kg	6.73E-03	Ecoinvent V2, shed, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.36E-15	kg/kg	1.18E-14	Ecoinvent V2, shed, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	2.82E-07	kg/kg	5.32E-04	Ecoinvent V2, shed, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	7.23E-13	kg/kg	5.16E-09	Ecoinvent V2, shed, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	8.67E-07	kg/kg	6.19E-03	Ecoinvent V2, shed, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	4.48E-08	kg/kg	8.10E-05	Ecoinvent V2, shed, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.12E-06	kg/kg	2.02E-03	Ecoinvent V2, shed, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.90E-09	kg/kg	1.66E-08	Ecoinvent V2, shed, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.13E-09	kg/kg	1.85E-08	Ecoinvent V2, shed, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.76E-09	kg/kg	1.92E-05	Ecoinvent V2, shed, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	9.56E-10	kg/kg	1.04E-05	Ecoinvent V2, shed, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.57E-15	kg/kg	1.71E-11	Ecoinvent V2, shed, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	3.35E-12	kg/kg	7.03E-10	Ecoinvent V2, shed, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	2.13E-02	kg/kg	5.32E-01	Ecoinvent V2, shed, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.36E-01	kg/kg	5.89E+00	Ecoinvent V2, shed, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	8.82E-11	kg/kg	2.20E-09	Ecoinvent V2, shed, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	5.66E-03	kg/kg	1.42E-01	Ecoinvent V2, shed, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	4.98E-07	kg/kg	6.97E-04	Ecoinvent V2, shed, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	7.02E-13	kg/kg	9.82E-10	Ecoinvent V2, shed, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.16E-09	kg/kg	8.57E-06	Ecoinvent V2, shed, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.60E-05	kg/kg	1.18E-01	Ecoinvent V2, shed, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	5.44E-12	kg/kg	2.58E-08	Ecoinvent V2, shed, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.07E-09	kg/kg	1.58E-05	Ecoinvent V2, shed, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.34E-07	kg/kg	5.34E-03	Ecoinvent V2, shed, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	3.67E-06	kg/kg	8.38E-02	Ecoinvent V2, shed, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	7.71E-11	kg/kg	1.00E-09	Ecoinvent V2, shed, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.88E-09	kg/kg	5.05E-08	Ecoinvent V2, shed, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.47E-03	kg/kg	2.47E-03	Ecoinvent V2, shed, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
								2.17E+02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.79E-03	kg/kg	3.37E-03	Ecoinvent V2, shed, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.07E-04	kg/kg	9.53E-04	Ecoinvent V2, shed, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.02E-02	kg/kg	1.92E-02	Ecoinvent V2, shed, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	4.81E-04	kg/kg	4.23E-04	Ecoinvent V2, shed, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.14E-03	kg/kg	1.00E-03	Ecoinvent V2, shed, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.58E-03	kg/kg	2.27E-03	Ecoinvent V2, shed, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.96E-05	kg/kg	3.14E-05	Ecoinvent V2, shed, CH

Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	2.65E-04	kg/kg	4.24E-04	Ecoinvent V2, shed, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.50E-04	kg/kg	2.40E-04	Ecoinvent V2, shed, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.49E-04	kg/kg	2.80E-04	Ecoinvent V2, shed, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.69E-04	kg/kg	5.06E-04	Ecoinvent V2, shed, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	7.86E-05	kg/kg	1.48E-04	Ecoinvent V2, shed, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	6.11E-02	kg/kg	4.27E-02	Ecoinvent V2, shed, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	7.20E-02	kg/kg	5.04E-02	Ecoinvent V2, shed, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	5.18E-01	kg/kg	3.62E-01	Ecoinvent V2, shed, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	4.74E-02	kg/kg	4.74E-02	Ecoinvent V2, shed, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.66E-01	kg/kg	1.66E-01	Ecoinvent V2, shed, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	7.14E-02	kg/kg	7.14E-02	Ecoinvent V2, shed, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	8.15E-06	kg/kg	1.53E-05	Ecoinvent V2, shed, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.25E-11	kg/kg	8.13E-12	Ecoinvent V2, shed, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.24E-11	kg/kg	1.46E-11	Ecoinvent V2, shed, CH
								7.70E-01	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.42E-05	kg/kg	4.36E-05	Ecoinvent V2, shed, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.84E-07	kg/kg	1.18E-06	Ecoinvent V2, shed, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	9.46E-07	kg/kg	2.89E-06	Ecoinvent V2, shed, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	5.16E-09	kg/kg	1.58E-08	Ecoinvent V2, shed, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	7.66E-06	kg/kg	2.34E-05	Ecoinvent V2, shed, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.20E-05	kg/kg	6.73E-05	Ecoinvent V2, shed, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.46E-01	kg/kg	3.21E-03	Ecoinvent V2, shed, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.56E-03	kg/kg	3.43E-05	Ecoinvent V2, shed, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.92E-01	kg/kg	4.22E-03	Ecoinvent V2, shed, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.67E-03	kg/kg	3.68E-05	Ecoinvent V2, shed, CH
Phosphate	water	river	kg	1	kg PO4-Eq	6.90E-05	kg/kg	6.90E-05	Ecoinvent V2, shed, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	7.05E-05	kg/kg	2.16E-04	Ecoinvent V2, shed, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	3.78E-06	kg/kg	1.16E-05	Ecoinvent V2, shed, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, shed, CH
								7.94E-03	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	7.18E+00	kg/kg	7.10E+01	Ecoinvent V2, shed, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.99E+01	kg/kg	3.80E+02	Ecoinvent V2, shed, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.49E-01	Nm3/kg	9.89E+00	Ecoinvent V2, shed, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	7.89E+00	Nm3/kg	3.02E+02	Ecoinvent V2, shed, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.09E+01	kg/kg	9.55E+02	Ecoinvent V2, shed, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	9.36E-03	kg/kg	9.26E-02	Ecoinvent V2, shed, CH
								1.72E+03	
AF6	**Construct machinery storage**	see building, hall, AF1							
back to top									
AF7	**Construct watering facilities**	Ecoinvent V2, water supply network, CH							Ecoinvent V2, water supply network, CH
	water supply network	Materials, transports, disposal for the infrastructure. Estimation for building process.							
back to top		No land use for construction work.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	8.84E+03	kg/km	8.84E+03	Ecoinvent V2, water supply network, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	9.19E+03	kg/km	9.19E+03	Ecoinvent V2, water supply network, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	6.92E-04	kg/km	6.92E-04	Ecoinvent V2, water supply network, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	2.34E+04	kg/km	2.34E+04	Ecoinvent V2, water supply network, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	5.73E+00	kg/km	9.00E+00	Ecoinvent V2, water supply network, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.12E+01	kg/km	3.33E+01	Ecoinvent V2, water supply network, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	8.13E-07	kg/km	1.28E-06	Ecoinvent V2, water supply network, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	5.18E+02	kg/km	8.14E+02	Ecoinvent V2, water supply network, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.73E-03	kg/km	5.20E-02	Ecoinvent V2, water supply network, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.16E-07	kg/km	1.25E-05	Ecoinvent V2, water supply network, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	2.42E-12	kg/km	7.25E-11	Ecoinvent V2, water supply network, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	3.19E-01	kg/km	9.51E+01	Ecoinvent V2, water supply network, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.32E-01	kg/km	3.94E+01	Ecoinvent V2, water supply network, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	6.59E-09	kg/km	1.96E-06	Ecoinvent V2, water supply network, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	3.28E-01	kg/km	9.77E+01	Ecoinvent V2, water supply network, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	4.16E-04	kg/km	5.95E-01	Ecoinvent V2, water supply network, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.03E-06	kg/km	7.19E-03	Ecoinvent V2, water supply network, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.79E-03	kg/km	2.56E+00	Ecoinvent V2, water supply network, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	5.43E-08	kg/km	3.33E-04	Ecoinvent V2, water supply network, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	6.17E-06	kg/km	7.65E-04	Ecoinvent V2, water supply network, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	8.73E-05	kg/km	8.73E-01	Ecoinvent V2, water supply network, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	3.89E-06	kg/km	4.75E-02	Ecoinvent V2, water supply network, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.79E-04	kg/km	2.18E+00	Ecoinvent V2, water supply network, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.84E-01	kg/km	4.60E+00	Ecoinvent V2, water supply network, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.15E-01	kg/km	2.87E+00	Ecoinvent V2, water supply network, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	9.17E-02	kg/km	2.29E+00	Ecoinvent V2, water supply network, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	6.55E-12	kg/km	3.27E-11	Ecoinvent V2, water supply network, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	8.69E-05	kg/km	1.64E-01	Ecoinvent V2, water supply network, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	7.12E-10	kg/km	5.08E-06	Ecoinvent V2, water supply network, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.34E-04	kg/km	9.58E-01	Ecoinvent V2, water supply network, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	5.90E-03	kg/km	1.07E+01	Ecoinvent V2, water supply network, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.50E-04	kg/km	6.33E-01	Ecoinvent V2, water supply network, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	9.83E-05	kg/km	8.55E-04	Ecoinvent V2, water supply network, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.23E-06	kg/km	1.07E-05	Ecoinvent V2, water supply network, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.37E-04	kg/km	1.49E+00	Ecoinvent V2, water supply network, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.03E-07	kg/km	3.30E-03	Ecoinvent V2, water supply network, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	4.35E-12	kg/km	4.75E-08	Ecoinvent V2, water supply network, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.18E-06	kg/km	2.48E-04	Ecoinvent V2, water supply network, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.93E+01	kg/km	4.82E+02	Ecoinvent V2, water supply network, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.09E+02	kg/km	2.72E+03	Ecoinvent V2, water supply network, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.10E-08	kg/km	2.75E-07	Ecoinvent V2, water supply network, CH

Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	4.97E-01	kg/km	1.24E+01	Ecoinvent V2, water supply network, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.26E-04	kg/km	3.16E-01	Ecoinvent V2, water supply network, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.95E-09	kg/km	2.73E-06	Ecoinvent V2, water supply network, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.17E-07	kg/km	2.35E-03	Ecoinvent V2, water supply network, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.61E-03	kg/km	1.19E+01	Ecoinvent V2, water supply network, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.92E-06	kg/km	9.12E-03	Ecoinvent V2, water supply network, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	3.77E-04	kg/km	5.57E+00	Ecoinvent V2, water supply network, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	6.48E-07	kg/km	1.48E-02	Ecoinvent V2, water supply network, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.05E-03	kg/km	2.39E+01	Ecoinvent V2, water supply network, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	6.29E-09	kg/km	8.17E-08	Ecoinvent V2, water supply network, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.25E-06	kg/km	2.92E-05	Ecoinvent V2, water supply network, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	6.19E-01	kg/km	6.19E-01	Ecoinvent V2, water supply network, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
								4.58E+04	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.56E-01	kg/km	2.94E-01	Ecoinvent V2, water supply network, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	2.06E-01	kg/km	3.87E-01	Ecoinvent V2, water supply network, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.82E+00	kg/km	3.41E+00	Ecoinvent V2, water supply network, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.01E-01	kg/km	1.77E-01	Ecoinvent V2, water supply network, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.92E-01	kg/km	4.33E-01	Ecoinvent V2, water supply network, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	9.57E-01	kg/km	8.43E-01	Ecoinvent V2, water supply network, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	7.73E-03	kg/km	1.24E-02	Ecoinvent V2, water supply network, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.06E-01	kg/km	1.69E-01	Ecoinvent V2, water supply network, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.21E-01	kg/km	3.54E-01	Ecoinvent V2, water supply network, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.89E-04	kg/km	7.31E-04	Ecoinvent V2, water supply network, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	3.48E-01	kg/km	6.55E-01	Ecoinvent V2, water supply network, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.68E-01	kg/km	3.16E-01	Ecoinvent V2, water supply network, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.20E+01	kg/km	8.37E+00	Ecoinvent V2, water supply network, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	3.60E+01	kg/km	2.52E+01	Ecoinvent V2, water supply network, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.15E+02	kg/km	8.04E+01	Ecoinvent V2, water supply network, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.50E+01	kg/km	1.50E+01	Ecoinvent V2, water supply network, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	5.20E+01	kg/km	5.20E+01	Ecoinvent V2, water supply network, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	2.75E+01	kg/km	2.75E+01	Ecoinvent V2, water supply network, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.77E-02	kg/km	3.33E-02	Ecoinvent V2, water supply network, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.48E-09	kg/km	9.64E-10	Ecoinvent V2, water supply network, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	6.13E-09	kg/km	3.98E-09	Ecoinvent V2, water supply network, CH
								2.16E+02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	8.11E-04	kg/km	2.48E-03	Ecoinvent V2, water supply network, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	7.36E-04	kg/km	2.25E-03	Ecoinvent V2, water supply network, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.65E-04	kg/km	5.04E-04	Ecoinvent V2, water supply network, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	5.10E-07	kg/km	1.56E-06	Ecoinvent V2, water supply network, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.33E-03	kg/km	7.14E-03	Ecoinvent V2, water supply network, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	5.46E-03	kg/km	1.67E-02	Ecoinvent V2, water supply network, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.94E+01	kg/km	8.66E-01	Ecoinvent V2, water supply network, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.28E+00	kg/km	5.02E-02	Ecoinvent V2, water supply network, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	4.97E+01	kg/km	1.09E+00	Ecoinvent V2, water supply network, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.29E+00	kg/km	5.04E-02	Ecoinvent V2, water supply network, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.04E-02	kg/km	1.04E-02	Ecoinvent V2, water supply network, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.08E-01	kg/km	3.30E-01	Ecoinvent V2, water supply network, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	6.23E-05	kg/km	1.91E-04	Ecoinvent V2, water supply network, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/km	0.00E+00	Ecoinvent V2, water supply network, CH
								2.43E+00	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.85E+03	kg/km	2.82E+04	Ecoinvent V2, water supply network, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.71E+04	kg/km	3.27E+05	Ecoinvent V2, water supply network, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.64E+02	Nm3/km	6.51E+03	Ecoinvent V2, water supply network, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.55E+03	Nm3/km	9.75E+04	Ecoinvent V2, water supply network, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	4.20E+03	kg/km	1.92E+05	Ecoinvent V2, water supply network, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	3.21E-01	kg/km	3.18E+00	Ecoinvent V2, water supply network, CH
								6.51E+05	
AP1	**Construct fences and gates**								
back to top									
AP2	**Construct watering facilities**	see AF7							
back to top									
AP3	**Construct irrigation systems**	Ecoinvent V2, pump station, CH							
back to top	**pump station**	Materials, transports, disposal for the infrastructure. Estimation for land use. No data for construction work.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.59E+04	kg/unit	1.59E+04	Ecoinvent V2, pump station, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.49E+04	kg/unit	1.49E+04	Ecoinvent V2, pump station, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.79E-03	kg/unit	1.79E-03	Ecoinvent V2, pump station, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.23E+05	kg/unit	1.23E+05	Ecoinvent V2, pump station, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	6.99E+00	kg/unit	1.10E+01	Ecoinvent V2, pump station, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.91E+01	kg/unit	4.57E+01	Ecoinvent V2, pump station, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.10E-06	kg/unit	3.30E-06	Ecoinvent V2, pump station, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	6.77E+02	kg/unit	1.06E+03	Ecoinvent V2, pump station, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.30E-05	kg/unit	3.89E-04	Ecoinvent V2, pump station, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	3.38E-07	kg/unit	1.01E-05	Ecoinvent V2, pump station, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.00E-13	kg/unit	3.01E-12	Ecoinvent V2, pump station, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	5.25E-01	kg/unit	1.56E+02	Ecoinvent V2, pump station, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.60E-01	kg/unit	7.75E+01	Ecoinvent V2, pump station, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.70E-08	kg/unit	5.08E-06	Ecoinvent V2, pump station, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	5.37E-01	kg/unit	1.60E+02	Ecoinvent V2, pump station, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	4.05E-07	kg/unit	5.79E-04	Ecoinvent V2, pump station, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.58E-05	kg/unit	2.26E-02	Ecoinvent V2, pump station, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.68E-02	kg/unit	2.41E+01	Ecoinvent V2, pump station, CH

Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.44E-07	kg/unit	8.83E-04	Ecoinvent V2, pump station, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.28E-05	kg/unit	1.59E-03	Ecoinvent V2, pump station, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.99E-04	kg/unit	2.99E+00	Ecoinvent V2, pump station, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.02E-05	kg/unit	1.25E-01	Ecoinvent V2, pump station, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.05E-03	kg/unit	1.28E+01	Ecoinvent V2, pump station, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.79E-02	kg/unit	4.47E-01	Ecoinvent V2, pump station, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	2.52E-01	kg/unit	6.30E+00	Ecoinvent V2, pump station, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.58E-01	kg/unit	3.95E+00	Ecoinvent V2, pump station, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.72E-13	kg/unit	1.36E-12	Ecoinvent V2, pump station, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.69E-04	kg/unit	3.20E-01	Ecoinvent V2, pump station, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.36E-10	kg/unit	2.40E-06	Ecoinvent V2, pump station, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	4.82E-04	kg/unit	3.44E+00	Ecoinvent V2, pump station, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.25E-05	kg/unit	2.26E-02	Ecoinvent V2, pump station, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	6.70E-04	kg/unit	1.21E+00	Ecoinvent V2, pump station, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	8.01E-05	kg/unit	6.97E-04	Ecoinvent V2, pump station, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.00E-06	kg/unit	8.71E-06	Ecoinvent V2, pump station, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	5.74E-07	kg/unit	6.25E-03	Ecoinvent V2, pump station, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	5.75E-07	kg/unit	6.27E-03	Ecoinvent V2, pump station, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.81E-13	kg/unit	1.97E-09	Ecoinvent V2, pump station, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.15E-09	kg/unit	2.42E-07	Ecoinvent V2, pump station, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	8.14E+00	kg/unit	2.04E+02	Ecoinvent V2, pump station, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.14E+02	kg/unit	5.36E+03	Ecoinvent V2, pump station, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.84E-08	kg/unit	7.10E-07	Ecoinvent V2, pump station, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.42E+00	kg/unit	3.56E+01	Ecoinvent V2, pump station, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	8.01E-05	kg/unit	1.12E-01	Ecoinvent V2, pump station, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	8.07E-11	kg/unit	1.13E-07	Ecoinvent V2, pump station, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	6.59E-07	kg/unit	4.87E-03	Ecoinvent V2, pump station, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	9.41E-03	kg/unit	6.95E+01	Ecoinvent V2, pump station, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.87E-09	kg/unit	8.88E-06	Ecoinvent V2, pump station, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	3.66E-07	kg/unit	5.42E-03	Ecoinvent V2, pump station, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.27E-06	kg/unit	2.90E-02	Ecoinvent V2, pump station, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	2.15E-03	kg/unit	4.89E+01	Ecoinvent V2, pump station, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.38E-08	kg/unit	3.10E-07	Ecoinvent V2, pump station, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.83E-06	kg/unit	2.38E-05	Ecoinvent V2, pump station, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.13E+00	kg/unit	1.13E+00	Ecoinvent V2, pump station, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
								1.61E+05	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	2.67E-01	kg/unit	5.02E-01	Ecoinvent V2, pump station, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	2.81E-01	kg/unit	5.27E-01	Ecoinvent V2, pump station, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	7.96E+00	kg/unit	1.50E+01	Ecoinvent V2, pump station, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	6.08E-01	kg/unit	5.35E-01	Ecoinvent V2, pump station, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	7.03E-01	kg/unit	6.18E-01	Ecoinvent V2, pump station, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.91E+00	kg/unit	1.68E+00	Ecoinvent V2, pump station, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	2.39E-02	kg/unit	3.82E-02	Ecoinvent V2, pump station, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.57E-01	kg/unit	2.52E-01	Ecoinvent V2, pump station, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.43E-01	kg/unit	3.89E-01	Ecoinvent V2, pump station, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.34E-04	kg/unit	4.40E-04	Ecoinvent V2, pump station, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	4.13E-01	kg/unit	7.77E-01	Ecoinvent V2, pump station, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.83E-01	kg/unit	3.44E-01	Ecoinvent V2, pump station, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.93E+01	kg/unit	1.35E+01	Ecoinvent V2, pump station, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	6.08E+01	kg/unit	4.26E+01	Ecoinvent V2, pump station, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	3.10E+02	kg/unit	2.17E+02	Ecoinvent V2, pump station, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.54E+01	kg/unit	2.54E+01	Ecoinvent V2, pump station, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.56E+02	kg/unit	1.56E+02	Ecoinvent V2, pump station, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	6.90E+01	kg/unit	6.90E+01	Ecoinvent V2, pump station, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.93E-02	kg/unit	3.62E-02	Ecoinvent V2, pump station, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.94E-09	kg/unit	2.56E-09	Ecoinvent V2, pump station, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.27E-08	kg/unit	8.28E-09	Ecoinvent V2, pump station, CH
								5.44E+02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.86E-03	kg/unit	5.68E-03	Ecoinvent V2, pump station, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	8.19E-04	kg/unit	2.51E-03	Ecoinvent V2, pump station, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	5.15E-04	kg/unit	1.58E-03	Ecoinvent V2, pump station, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	3.00E-06	kg/unit	9.17E-06	Ecoinvent V2, pump station, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	4.07E-03	kg/unit	1.25E-02	Ecoinvent V2, pump station, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.16E-02	kg/unit	3.56E-02	Ecoinvent V2, pump station, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	6.97E+01	kg/unit	1.53E+00	Ecoinvent V2, pump station, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.34E+00	kg/unit	7.35E-02	Ecoinvent V2, pump station, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	7.68E+01	kg/unit	1.69E+00	Ecoinvent V2, pump station, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.34E+00	kg/unit	7.34E-02	Ecoinvent V2, pump station, CH
Phosphate	water	river	kg	1	kg PO4-Eq	3.74E-02	kg/unit	3.74E-02	Ecoinvent V2, pump station, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	3.09E-02	kg/unit	9.45E-02	Ecoinvent V2, pump station, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	9.58E-05	kg/unit	2.93E-04	Ecoinvent V2, pump station, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/unit	0.00E+00	Ecoinvent V2, pump station, CH
								3.56E+00	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.41E+03	kg/unit	4.36E+04	Ecoinvent V2, pump station, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.55E+04	kg/unit	4.86E+05	Ecoinvent V2, pump station, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.84E+02	Nm3/unit	1.13E+04	Ecoinvent V2, pump station, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	4.80E+03	Nm3/init	1.84E+05	Ecoinvent V2, pump station, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.14E+04	kg/unit	5.20E+05	Ecoinvent V2, pump station, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	7.68E-01	kg/unit	7.61E+00	Ecoinvent V2, pump station, CH
								1.24E+06	
B1	**Produce Seed**								
	Barley	The inventory includes the processes of soil cultivation, sowing, weed control, fertilization, pest and pathogen control, harvest and grain drying. Machine infrastructure and a shed for machine sheltering is included. Inputs of fertilizers, pesticides and seed as well as grain transports to the regional processing center (10km) are considered. The direct emissions on the field are also included.							Ecoinvent V2, barley grains IP, at farm, CH

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	5.72E-02	kg/kg	5.72E-02	Ecoinvent V2, barley grains IP, at farm, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	7.52E-02	kg/kg	7.52E-02	Ecoinvent V2, barley grains IP, at farm, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.70E-08	kg/kg	3.70E-08	Ecoinvent V2, barley grains IP, at farm, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.31E-02	kg/kg	1.31E-02	Ecoinvent V2, barley grains IP, at farm, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.04E-05	kg/kg	3.21E-05	Ecoinvent V2, barley grains IP, at farm, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.46E-04	kg/kg	2.29E-04	Ecoinvent V2, barley grains IP, at farm, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	4.35E-11	kg/kg	6.83E-11	Ecoinvent V2, barley grains IP, at farm, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.84E-04	kg/kg	2.89E-04	Ecoinvent V2, barley grains IP, at farm, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	7.04E-11	kg/kg	2.11E-09	Ecoinvent V2, barley grains IP, at farm, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	6.02E-13	kg/kg	1.81E-11	Ecoinvent V2, barley grains IP, at farm, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.05E-18	kg/kg	3.16E-17	Ecoinvent V2, barley grains IP, at farm, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.85E-04	kg/kg	5.51E-02	Ecoinvent V2, barley grains IP, at farm, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	5.76E-04	kg/kg	1.72E-01	Ecoinvent V2, barley grains IP, at farm, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.53E-13	kg/kg	1.05E-10	Ecoinvent V2, barley grains IP, at farm, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	4.22E-07	kg/kg	1.26E-04	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	7.43E-12	kg/kg	1.06E-08	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.06E-11	kg/kg	2.94E-08	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.11E-08	kg/kg	1.59E-05	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.21E-12	kg/kg	1.97E-08	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.66E-11	kg/kg	2.06E-09	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	3.87E-10	kg/kg	3.87E-06	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.21E-10	kg/kg	2.70E-06	Ecoinvent V2, barley grains IP, at farm, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	4.63E-09	kg/kg	5.65E-05	Ecoinvent V2, barley grains IP, at farm, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	3.37E-08	kg/kg	8.43E-07	Ecoinvent V2, barley grains IP, at farm, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	6.42E-07	kg/kg	1.60E-05	Ecoinvent V2, barley grains IP, at farm, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.05E-07	kg/kg	5.12E-06	Ecoinvent V2, barley grains IP, at farm, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.86E-18	kg/kg	1.43E-17	Ecoinvent V2, barley grains IP, at farm, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	8.55E-10	kg/kg	1.62E-06	Ecoinvent V2, barley grains IP, at farm, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.85E-15	kg/kg	2.75E-11	Ecoinvent V2, barley grains IP, at farm, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.25E-09	kg/kg	8.89E-06	Ecoinvent V2, barley grains IP, at farm, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.12E-10	kg/kg	2.02E-07	Ecoinvent V2, barley grains IP, at farm, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.04E-09	kg/kg	5.51E-06	Ecoinvent V2, barley grains IP, at farm, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.92E-12	kg/kg	2.54E-11	Ecoinvent V2, barley grains IP, at farm, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.78E-12	kg/kg	1.55E-11	Ecoinvent V2, barley grains IP, at farm, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.54E-11	kg/kg	1.68E-07	Ecoinvent V2, barley grains IP, at farm, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.96E-12	kg/kg	3.23E-08	Ecoinvent V2, barley grains IP, at farm, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.90E-18	kg/kg	2.07E-14	Ecoinvent V2, barley grains IP, at farm, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.11E-14	kg/kg	4.44E-12	Ecoinvent V2, barley grains IP, at farm, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.10E-05	kg/kg	2.75E-04	Ecoinvent V2, barley grains IP, at farm, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.20E-04	kg/kg	5.50E-03	Ecoinvent V2, barley grains IP, at farm, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	5.88E-13	kg/kg	1.47E-11	Ecoinvent V2, barley grains IP, at farm, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	4.13E-07	kg/kg	1.03E-05	Ecoinvent V2, barley grains IP, at farm, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.01E-10	kg/kg	1.42E-07	Ecoinvent V2, barley grains IP, at farm, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	8.49E-16	kg/kg	1.19E-12	Ecoinvent V2, barley grains IP, at farm, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	8.53E-13	kg/kg	6.31E-09	Ecoinvent V2, barley grains IP, at farm, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	4.17E-08	kg/kg	3.08E-04	Ecoinvent V2, barley grains IP, at farm, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.43E-14	kg/kg	1.63E-10	Ecoinvent V2, barley grains IP, at farm, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	6.72E-12	kg/kg	9.95E-08	Ecoinvent V2, barley grains IP, at farm, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	6.73E-12	kg/kg	1.53E-07	Ecoinvent V2, barley grains IP, at farm, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	2.73E-09	kg/kg	6.23E-05	Ecoinvent V2, barley grains IP, at farm, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	6.27E-14	kg/kg	8.15E-13	Ecoinvent V2, barley grains IP, at farm, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.25E-12	kg/kg	4.23E-11	Ecoinvent V2, barley grains IP, at farm, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.03E-05	kg/kg	2.03E-05	Ecoinvent V2, barley grains IP, at farm, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
								3.79E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	7.81E-05	kg/kg	1.47E-04	Ecoinvent V2, barley grains IP, at farm, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.29E-03	kg/kg	2.42E-03	Ecoinvent V2, barley grains IP, at farm, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.92E-06	kg/kg	3.61E-06	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.08E-06	kg/kg	9.47E-07	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	9.46E-07	kg/kg	8.33E-07	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.12E-07	kg/kg	4.50E-07	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	4.16E-07	kg/kg	6.66E-07	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	6.16E-07	kg/kg	9.86E-07	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.61E-07	kg/kg	2.58E-07	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.77E-09	kg/kg	5.20E-09	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	4.92E-07	kg/kg	9.24E-07	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	4.91E-08	kg/kg	9.24E-08	Ecoinvent V2, barley grains IP, at farm, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.64E-04	kg/kg	1.15E-04	Ecoinvent V2, barley grains IP, at farm, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	9.33E-04	kg/kg	6.53E-04	Ecoinvent V2, barley grains IP, at farm, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	7.54E-05	kg/kg	5.28E-05	Ecoinvent V2, barley grains IP, at farm, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.20E-04	kg/kg	2.20E-04	Ecoinvent V2, barley grains IP, at farm, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.70E-04	kg/kg	1.70E-04	Ecoinvent V2, barley grains IP, at farm, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	9.99E-06	kg/kg	9.99E-06	Ecoinvent V2, barley grains IP, at farm, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	5.07E-09	kg/kg	9.52E-09	Ecoinvent V2, barley grains IP, at farm, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	8.76E-14	kg/kg	5.69E-14	Ecoinvent V2, barley grains IP, at farm, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.65E-14	kg/kg	1.07E-14	Ecoinvent V2, barley grains IP, at farm, CH
								3.80E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.93E-09	kg/kg	8.95E-09	Ecoinvent V2, barley grains IP, at farm, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.43E-10	kg/kg	7.43E-10	Ecoinvent V2, barley grains IP, at farm, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	6.69E-10	kg/kg	2.05E-09	Ecoinvent V2, barley grains IP, at farm, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.32E-11	kg/kg	4.03E-11	Ecoinvent V2, barley grains IP, at farm, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	6.02E-09	kg/kg	1.84E-08	Ecoinvent V2, barley grains IP, at farm, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	4.04E-08	kg/kg	1.24E-07	Ecoinvent V2, barley grains IP, at farm, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.62E-04	kg/kg	5.77E-06	Ecoinvent V2, barley grains IP, at farm, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.54E-07	kg/kg	1.66E-08	Ecoinvent V2, barley grains IP, at farm, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.65E-04	kg/kg	5.83E-06	Ecoinvent V2, barley grains IP, at farm, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.61E-07	kg/kg	1.67E-08	Ecoinvent V2, barley grains IP, at farm, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.23E-04	kg/kg	1.23E-04	Ecoinvent V2, barley grains IP, at farm, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.66E-05	kg/kg	5.07E-05	Ecoinvent V2, barley grains IP, at farm, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.86E-10	kg/kg	5.68E-10	Ecoinvent V2, barley grains IP, at farm, CH

Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley grains IP, at farm, CH
								1.86E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	5.73E-03	kg/kg	5.67E-02	Ecoinvent V2, barley grains IP, at farm, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	8.59E-03	kg/kg	1.64E-01	Ecoinvent V2, barley grains IP, at farm, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	8.40E-05	Nm3/kg	3.34E-03	Ecoinvent V2, barley grains IP, at farm, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.86E-02	Nm3/kg	7.14E-01	Ecoinvent V2, barley grains IP, at farm, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.08E-02	kg/kg	1.41E+00	Ecoinvent V2, barley grains IP, at farm, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.10E-06	kg/kg	1.09E-05	Ecoinvent V2, barley grains IP, at farm, CH
								2.35E+00	

B6, B10, B12, B13

	Barley	The seed produced at the farm is transported to the processing centre, treated (pre-cleaning, cleaning, eventually drying, chemical dressing (for integrated production) and bag filling), stored and afterwards transported to the regional storage centre. No data on wastewater production were available.							Ecoinvent V2, barley seed IP, at regional storehouse, CH
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	6.16E-02	kg/kg	6.16E-02	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	8.05E-02	kg/kg	8.05E-02	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	4.05E-08	kg/kg	4.05E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	3.46E-02	kg/kg	3.46E-02	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.26E-05	kg/kg	3.55E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.52E-04	kg/kg	2.38E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	4.75E-11	kg/kg	7.47E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.63E-04	kg/kg	4.14E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	8.76E-11	kg/kg	2.63E-09	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	9.63E-13	kg/kg	2.89E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.16E-18	kg/kg	3.47E-17	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.85E-04	kg/kg	5.51E-02	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	5.76E-04	kg/kg	1.72E-01	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.86E-13	kg/kg	1.15E-10	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	8.55E-07	kg/kg	2.55E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	8.14E-12	kg/kg	1.16E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.67E-11	kg/kg	5.25E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	6.37E-08	kg/kg	9.11E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.50E-12	kg/kg	2.14E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.55E-11	kg/kg	3.16E-09	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	7.05E-10	kg/kg	7.05E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.42E-10	kg/kg	2.95E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	8.24E-09	kg/kg	1.01E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	4.88E-08	kg/kg	1.22E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	7.86E-07	kg/kg	1.96E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.83E-07	kg/kg	7.08E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.13E-18	kg/kg	1.57E-17	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	9.02E-10	kg/kg	1.70E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	4.72E-15	kg/kg	3.37E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.60E-09	kg/kg	1.14E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.24E-10	kg/kg	2.25E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.25E-09	kg/kg	5.88E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	5.09E-12	kg/kg	4.43E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.85E-12	kg/kg	2.48E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.62E-11	kg/kg	1.76E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.11E-12	kg/kg	3.39E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.08E-18	kg/kg	2.27E-14	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.32E-14	kg/kg	4.86E-12	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.32E-05	kg/kg	3.31E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.63E-04	kg/kg	6.57E-03	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	6.43E-13	kg/kg	1.61E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	7.45E-07	kg/kg	1.86E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.19E-10	kg/kg	1.67E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	9.32E-16	kg/kg	1.30E-12	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.31E-12	kg/kg	9.69E-09	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	7.42E-08	kg/kg	5.48E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.76E-14	kg/kg	1.79E-10	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	7.37E-12	kg/kg	1.09E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	8.95E-12	kg/kg	2.04E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.20E-09	kg/kg	9.58E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	7.86E-14	kg/kg	1.02E-12	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	5.20E-12	kg/kg	6.76E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.08E-05	kg/kg	2.08E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
								4.12E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	7.82E-05	kg/kg	1.47E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.29E-03	kg/kg	2.42E-03	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.89E-06	kg/kg	5.43E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.14E-06	kg/kg	1.01E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.18E-06	kg/kg	1.03E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	6.57E-07	kg/kg	5.78E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	4.20E-07	kg/kg	6.72E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	6.79E-07	kg/kg	1.09E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.85E-07	kg/kg	4.56E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.90E-09	kg/kg	5.46E-09	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	5.29E-07	kg/kg	9.95E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	5.78E-08	kg/kg	1.09E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.70E-04	kg/kg	1.19E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	9.51E-04	kg/kg	6.66E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.82E-04	kg/kg	1.98E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.31E-04	kg/kg	2.31E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.14E-04	kg/kg	2.14E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.42E-05	kg/kg	1.42E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH

Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	5.95E-09	kg/kg	1.12E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	9.56E-14	kg/kg	6.21E-14	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.54E-14	kg/kg	1.65E-14	Ecoinvent V2, barley seed IP, at regional storehouse, CH
								4.02E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.95E-09	kg/kg	1.21E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.07E-10	kg/kg	9.40E-10	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.19E-09	kg/kg	3.64E-09	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.34E-11	kg/kg	7.17E-11	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	9.38E-09	kg/kg	2.87E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	4.94E-08	kg/kg	1.51E-07	Ecoinvent V2, barley seed IP, at regional storehouse, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.20E-04	kg/kg	7.05E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	9.21E-07	kg/kg	2.03E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.24E-04	kg/kg	7.13E-06	Ecoinvent V2, barley seed IP, at regional storehouse, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	9.30E-07	kg/kg	2.05E-08	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.23E-04	kg/kg	1.23E-04	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.66E-05	kg/kg	5.07E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.42E-10	kg/kg	7.40E-10	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
								1.88E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	7.39E-03	kg/kg	7.32E-02	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.07E-02	kg/kg	2.04E-01	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.05E-04	Nm3/kg	4.17E-03	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.01E-02	Nm3/kg	7.71E-01	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.89E-02	kg/kg	1.78E+00	Ecoinvent V2, barley seed IP, at regional storehouse, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.38E-06	kg/kg	1.37E-05	Ecoinvent V2, barley seed IP, at regional storehouse, CH
								2.83E+00	
	Alfalfa grass	The seed produced at the farm is transported to the processing centre, treated (pre-cleaning, cleaning, eventually drying, chemical dressing (for integrated production) and bag filling), stored and afterwards transported to the regional storage centre. No data on wastewater production were available.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	0.43066	kg/kg	4.31E-01	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	0.56138	kg/kg	5.61E-01	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.0304E-07	kg/kg	3.03E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	0.20354	kg/kg	2.04E-01	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	0.00019687	kg/kg	3.09E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	0.0011769	kg/kg	1.85E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	3.5596E-10	kg/kg	5.59E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	0.0016561	kg/kg	2.60E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	6.9185E-10	kg/kg	2.08E-08	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	8.284E-12	kg/kg	2.49E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	9.1337E-18	kg/kg	2.74E-16	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	0.000014514	kg/kg	4.33E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	0.0073099	kg/kg	2.18E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	2.8861E-12	kg/kg	8.60E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	8.7416E-06	kg/kg	2.60E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	6.1239E-11	kg/kg	8.76E-08	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.2237E-10	kg/kg	4.61E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	3.4794E-07	kg/kg	4.98E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.6256E-11	kg/kg	1.61E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.2571E-10	kg/kg	2.80E-08	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	6.2085E-09	kg/kg	6.21E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.8151E-09	kg/kg	2.21E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	4.004E-08	kg/kg	4.88E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	3.3303E-07	kg/kg	8.33E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	7.7832E-06	kg/kg	1.95E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.4992E-06	kg/kg	6.25E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.4758E-17	kg/kg	1.24E-16	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.9657E-09	kg/kg	7.50E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.3537E-14	kg/kg	1.68E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.1276E-08	kg/kg	8.05E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	9.4024E-10	kg/kg	1.70E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.4998E-08	kg/kg	2.71E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	3.1399E-11	kg/kg	2.73E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.4517E-11	kg/kg	2.13E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	6.8991E-11	kg/kg	7.52E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.3595E-11	kg/kg	1.48E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.6461E-17	kg/kg	1.79E-13	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.7423E-13	kg/kg	3.66E-11	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	0.00014872	kg/kg	3.72E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	0.0017803	kg/kg	4.45E-02	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	4.8103E-12	kg/kg	1.20E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	0.000012175	kg/kg	3.04E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.4415E-09	kg/kg	2.02E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	7.3605E-15	kg/kg	1.03E-11	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.1606E-11	kg/kg	8.58E-08	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	3.6036E-07	kg/kg	2.66E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.8285E-13	kg/kg	1.34E-09	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	5.5437E-11	kg/kg	8.20E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	5.55E-11	kg/kg	1.27E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	3.7183E-08	kg/kg	8.48E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	5.8306E-13	kg/kg	7.58E-12	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.4767E-11	kg/kg	5.82E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	0.00026835	kg/kg	2.68E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
								3.44E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	3.3977E-06	kg/kg	6.39E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	6.3152E-06	kg/kg	1.19E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	0.000019013	kg/kg	3.57E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	9.2519E-06	kg/kg	8.14E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	0.00001006	kg/kg	8.85E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH

Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	4.9746E-06	kg/kg	4.38E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	0.000010979	kg/kg	1.76E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	8.4191E-06	kg/kg	1.35E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.4057E-06	kg/kg	2.25E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.6869E-09	kg/kg	5.05E-09	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	0.000054683	kg/kg	1.03E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.1719E-06	kg/kg	2.20E-06	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	0.00055579	kg/kg	3.89E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	0.0078766	kg/kg	5.51E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	0.0017051	kg/kg	1.19E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	0.0027763	kg/kg	2.78E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	0.0014512	kg/kg	1.45E-03	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	0.000087455	kg/kg	8.75E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	4.0284E-08	kg/kg	7.57E-08	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfuric acid	air	high population density	kg	0.65	kg SO2-Eq	1.1615E-09	kg/kg	7.55E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.2446E-13	kg/kg	1.46E-13	Ecoinvent V2, clover seed IP, at regional storehouse, CH
								1.16E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.7699E-08	kg/kg	8.48E-08	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.208E-09	kg/kg	6.76E-09	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.0477E-08	kg/kg	3.21E-08	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.1378E-10	kg/kg	3.48E-10	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	7.0817E-08	kg/kg	2.17E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.2257E-07	kg/kg	9.87E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	0.0021282	kg/kg	4.68E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.1276E-06	kg/kg	1.35E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	0.0021544	kg/kg	4.74E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.1894E-06	kg/kg	1.36E-07	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphate	water	river	kg	1	kg PO4-Eq	0.00074534	kg/kg	7.45E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	0.00025472	kg/kg	7.79E-04	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.5699E-09	kg/kg	4.80E-09	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
								1.62E-03	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	0.063903	kg/kg	6.33E-01	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	0.08034	kg/kg	1.53E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	0.00078635	Nm3/kg	3.13E-02	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	0.095384	Nm3/kg	3.65E+00	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	0.26983	kg/kg	1.24E+01	Ecoinvent V2, clover seed IP, at regional storehouse, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	9.5208E-06	kg/kg	9.43E-05	Ecoinvent V2, clover seed IP, at regional storehouse, CH
								1.82E+01	

B14	**Store seed in the regional storehouse**	data gap	

back to top

B2	**Produce Fertilizer**	

back to top

Urea, as N — The unit process inventory takes into account the production of urea from ammonia and carbon dioxide. Transports of the intermediate products were included as well as the transport of the fertilizer product from the factory to the regional storehouse. Production and waste treatment of catalysts, coating and packaging of the final fertilizer products were not included. CO2-consumption (733 kg CO2/ton of urea) during production of urea was not included, since CO2 arises as a by-product during the production of ammonia. Infrastructure was included by means of a proxy — Ecoinvent V2, urea, as N, at regional storehouse, RER

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.64E+00	kg/kg	2.64E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	3.60E-01	kg/kg	3.60E-01	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.11E-06	kg/kg	1.11E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	9.17E-02	kg/kg	9.17E-02	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.18E-03	kg/kg	4.99E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	3.70E-04	kg/kg	5.81E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.30E-09	kg/kg	2.04E-09	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	9.42E-04	kg/kg	1.48E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.83E-09	kg/kg	5.48E-08	Ecoinvent V2, urea, as N, at regional storehouse, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	6.77E-12	kg/kg	2.03E-10	Ecoinvent V2, urea, as N, at regional storehouse, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	9.24E-18	kg/kg	2.77E-16	Ecoinvent V2, urea, as N, at regional storehouse, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.89E-05	kg/kg	8.62E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	5.83E-06	kg/kg	1.74E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.05E-11	kg/kg	3.14E-09	Ecoinvent V2, urea, as N, at regional storehouse, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	5.51E-06	kg/kg	1.64E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.23E-10	kg/kg	3.19E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.27E-10	kg/kg	3.25E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	7.11E-08	kg/kg	1.02E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	9.66E-11	kg/kg	5.92E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.84E-10	kg/kg	3.52E-08	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	3.92E-09	kg/kg	3.92E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	6.67E-09	kg/kg	8.13E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	4.06E-08	kg/kg	4.96E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.12E-07	kg/kg	5.29E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.12E-05	kg/kg	2.81E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	4.28E-06	kg/kg	1.07E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.51E-17	kg/kg	1.25E-16	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	6.05E-08	kg/kg	1.14E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.73E-15	kg/kg	1.24E-11	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.04E-08	kg/kg	7.43E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	3.28E-09	kg/kg	5.95E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.10E-07	kg/kg	3.80E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	6.87E-11	kg/kg	5.98E-10	Ecoinvent V2, urea, as N, at regional storehouse, RER

Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.00E-11	kg/kg	1.74E-10	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	7.83E-10	kg/kg	8.53E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.07E-10	kg/kg	2.25E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.67E-17	kg/kg	1.82E-13	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	6.34E-13	kg/kg	1.33E-10	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	8.80E-04	kg/kg	2.20E-02	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	7.02E-03	kg/kg	1.75E-01	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.76E-11	kg/kg	4.39E-10	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	3.98E-06	kg/kg	9.94E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.07E-09	kg/kg	1.50E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	7.45E-15	kg/kg	1.04E-11	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.46E-11	kg/kg	1.08E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	3.66E-07	kg/kg	2.70E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.03E-12	kg/kg	4.89E-09	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.02E-10	kg/kg	2.98E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.27E-10	kg/kg	2.91E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.80E-08	kg/kg	1.09E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.70E-12	kg/kg	2.21E-11	Ecoinvent V2, urea, as N, at regional storehouse, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.66E-11	kg/kg	4.76E-10	Ecoinvent V2, urea, as N, at regional storehouse, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.80E-05	kg/kg	3.80E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
								3.31E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	3.48E-03	kg/kg	6.55E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	2.76E-06	kg/kg	5.20E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.90E-05	kg/kg	5.46E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.92E-05	kg/kg	1.69E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.22E-05	kg/kg	1.95E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	6.34E-06	kg/kg	5.58E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.67E-06	kg/kg	2.67E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.86E-06	kg/kg	7.78E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.53E-06	kg/kg	2.45E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	9.86E-10	kg/kg	1.85E-09	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.91E-05	kg/kg	5.47E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.42E-07	kg/kg	4.55E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.20E-03	kg/kg	1.54E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.01E-03	kg/kg	7.07E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	7.19E-04	kg/kg	5.04E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	4.80E-04	kg/kg	4.80E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.46E-03	kg/kg	3.46E-03	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	6.17E-05	kg/kg	6.17E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.27E-08	kg/kg	4.26E-08	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.64E-12	kg/kg	1.72E-12	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.82E-13	kg/kg	1.83E-13	Ecoinvent V2, urea, as N, at regional storehouse, RER
								1.35E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.88E-08	kg/kg	1.19E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.29E-09	kg/kg	3.96E-09	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	7.48E-09	kg/kg	2.29E-08	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.15E-10	kg/kg	3.53E-10	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.28E-07	kg/kg	3.92E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	7.07E-07	kg/kg	2.16E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.42E-03	kg/kg	7.53E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.27E-06	kg/kg	9.40E-08	Ecoinvent V2, urea, as N, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.46E-03	kg/kg	7.60E-05	Ecoinvent V2, urea, as N, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.33E-06	kg/kg	9.52E-08	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphate	water	river	kg	1	kg PO4-Eq	1.94E-06	kg/kg	1.94E-06	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.09E-07	kg/kg	3.35E-07	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.42E-09	kg/kg	4.34E-09	Ecoinvent V2, urea, as N, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
								1.57E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.32E-01	kg/kg	1.31E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	9.74E-02	kg/kg	1.86E+00	Ecoinvent V2, urea, as N, at regional storehouse, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	9.51E-04	Nm3/kg	3.79E-02	Ecoinvent V2, urea, as N, at regional storehouse, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.19E+00	Nm3/kg	4.55E+01	Ecoinvent V2, urea, as N, at regional storehouse, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.00E-01	kg/kg	1.37E+01	Ecoinvent V2, urea, as N, at regional storehouse, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.24E-05	kg/kg	2.22E-04	Ecoinvent V2, urea, as N, at regional storehouse, RER
								6.24E+01	

Ammonia, liquid :rage of numbers for steam reforming (85%) and partial oxidation of heavy fuel oil (15%) — Ecoinvent V2, ammonia, liquid, at regional storehouse, RER

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.78E+00	kg/kg	1.78E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.64E-01	kg/kg	1.64E-01	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.29E-07	kg/kg	3.29E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	4.05E-02	kg/kg	4.05E-02	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.02E-04	kg/kg	3.18E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.38E-04	kg/kg	3.74E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	3.86E-10	kg/kg	6.07E-10	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	4.12E-04	kg/kg	6.47E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	5.42E-10	kg/kg	1.63E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.14E-12	kg/kg	6.41E-11	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	2.79E-18	kg/kg	8.37E-17	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.56E-05	kg/kg	7.63E-03	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.72E-06	kg/kg	8.12E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.13E-12	kg/kg	9.34E-10	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.05E-06	kg/kg	6.11E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	6.58E-11	kg/kg	9.40E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	7.39E-11	kg/kg	1.06E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	3.31E-08	kg/kg	4.74E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.85E-11	kg/kg	1.75E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	9.19E-11	kg/kg	1.14E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.28E-09	kg/kg	1.28E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.97E-09	kg/kg	2.40E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER

Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.25E-08	kg/kg	1.52E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	7.52E-08	kg/kg	1.88E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	6.38E-06	kg/kg	1.59E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.39E-06	kg/kg	3.46E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	7.57E-18	kg/kg	3.78E-17	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.20E-08	kg/kg	6.04E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	7.16E-16	kg/kg	5.11E-12	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.16E-08	kg/kg	8.25E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	9.73E-10	kg/kg	1.76E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.10E-07	kg/kg	2.00E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.07E-11	kg/kg	1.80E-10	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	6.33E-12	kg/kg	5.51E-11	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	5.08E-10	kg/kg	5.54E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.10E-10	kg/kg	1.20E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	5.03E-18	kg/kg	5.48E-14	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.87E-13	kg/kg	3.93E-11	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	5.30E-05	kg/kg	1.32E-03	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.86E-03	kg/kg	9.64E-02	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	5.22E-12	kg/kg	1.31E-10	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.83E-06	kg/kg	4.58E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	4.72E-10	kg/kg	6.61E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.25E-15	kg/kg	3.15E-12	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	4.73E-12	kg/kg	3.49E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.12E-07	kg/kg	8.30E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.04E-13	kg/kg	1.44E-09	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	5.95E-11	kg/kg	8.81E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.82E-11	kg/kg	8.71E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.54E-08	kg/kg	3.51E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	5.09E-13	kg/kg	6.61E-12	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.16E-11	kg/kg	1.50E-10	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.54E-05	kg/kg	1.54E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
								2.10E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	8.79E-07	kg/kg	1.65E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.68E-06	kg/kg	3.15E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.06E-05	kg/kg	1.99E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.94E-05	kg/kg	1.71E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	7.23E-06	kg/kg	6.37E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.19E-06	kg/kg	1.92E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.86E-06	kg/kg	2.98E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.58E-06	kg/kg	2.52E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	5.00E-07	kg/kg	7.99E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.10E-07	kg/kg	3.95E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.53E-05	kg/kg	2.88E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.05E-07	kg/kg	1.97E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.45E-03	kg/kg	1.02E-03	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	6.37E-04	kg/kg	4.46E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	3.34E-04	kg/kg	2.34E-04	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.21E-03	kg/kg	2.21E-03	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.14E-03	kg/kg	2.14E-03	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	2.49E-05	kg/kg	2.49E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.01E-08	kg/kg	1.90E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	7.79E-13	kg/kg	5.06E-13	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	9.12E-14	kg/kg	5.93E-14	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
								6.16E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.27E-08	kg/kg	3.90E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	5.34E-10	kg/kg	1.63E-09	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.43E-09	kg/kg	7.43E-09	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	3.56E-11	kg/kg	1.09E-10	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	4.17E-08	kg/kg	1.28E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	6.35E-07	kg/kg	1.94E-06	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.88E-03	kg/kg	8.53E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.98E-06	kg/kg	4.35E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.90E-03	kg/kg	8.58E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.00E-06	kg/kg	4.40E-08	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphate	water	river	kg	1	kg PO4-Eq	6.07E-07	kg/kg	6.07E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	7.35E-08	kg/kg	2.25E-07	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	7.04E-10	kg/kg	2.15E-09	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
								1.74E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.24E-02	kg/kg	4.20E-01	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	3.39E-02	kg/kg	6.47E-01	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	3.31E-04	Nm3/kg	1.32E-02	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	6.34E-01	Nm3/kg	2.43E+01	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.35E-01	kg/kg	1.53E+01	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	8.87E-06	kg/kg	8.78E-05	Ecoinvent V2, ammonia, liquid, at regional storehouse, RER
								4.07E+01	
	Monoammonium phosphate, as P2O5	The unit process inventory takes into account the production of monoammonium phosphate from ammonia and phosphoric acid. Transports of raw materials and intermediate products to the fertilizer plant as well as the transport of the fertilizer product from the factory to the regional department store were included. Production and waste treatment of catalysts, coating and packaging of the final fertilizer products were not included. Infrastructure was included by means of a proxy							Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
[back to top](#)									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	7.54E-01	kg/kg	7.54E-01	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.17E-01	kg/kg	6.17E-01	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	8.94E-07	kg/kg	8.94E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.53E-01	kg/kg	1.53E-01	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.86E-04	kg/kg	2.93E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	8.80E-04	kg/kg	1.38E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.05E-09	kg/kg	1.65E-09	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.02E-03	kg/kg	1.60E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.50E-09	kg/kg	4.51E-08	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER

Chloroform	air	low population density	kg	30	kg CO2-Eq	6.66E-12	kg/kg	2.00E-10	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	7.99E-18	kg/kg	2.40E-16	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	9.22E-06	kg/kg	2.75E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	8.24E-06	kg/kg	2.45E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	8.51E-12	kg/kg	2.54E-09	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	8.13E-06	kg/kg	2.42E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.80E-10	kg/kg	2.57E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.42E-10	kg/kg	3.45E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.33E-07	kg/kg	3.33E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	7.80E-11	kg/kg	4.78E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.98E-10	kg/kg	3.70E-08	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	4.20E-09	kg/kg	4.20E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	5.38E-09	kg/kg	6.56E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	3.51E-08	kg/kg	4.28E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.69E-07	kg/kg	6.73E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	5.66E-05	kg/kg	1.41E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	4.45E-06	kg/kg	1.11E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.16E-17	kg/kg	1.08E-16	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.04E-08	kg/kg	1.97E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	4.25E-15	kg/kg	3.03E-11	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	6.18E-09	kg/kg	4.41E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.69E-09	kg/kg	4.86E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.83E-08	kg/kg	6.94E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	5.66E-11	kg/kg	4.92E-10	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.97E-11	kg/kg	1.71E-10	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	2.02E-10	kg/kg	2.20E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.58E-11	kg/kg	3.90E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.44E-17	kg/kg	1.57E-13	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	5.12E-13	kg/kg	1.08E-10	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	7.67E-05	kg/kg	1.92E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.15E-03	kg/kg	5.37E-02	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.42E-11	kg/kg	3.55E-10	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	9.73E-06	kg/kg	2.43E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	3.83E-09	kg/kg	5.36E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	6.44E-15	kg/kg	9.01E-12	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.53E-11	kg/kg	1.13E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	3.16E-07	kg/kg	2.33E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	8.32E-13	kg/kg	3.95E-09	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.63E-10	kg/kg	2.41E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.07E-10	kg/kg	2.44E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.92E-08	kg/kg	1.12E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.43E-12	kg/kg	1.86E-11	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.60E-11	kg/kg	4.68E-10	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.50E-03	kg/kg	2.50E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
								1.60E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	4.63E-06	kg/kg	8.71E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.27E-05	kg/kg	2.39E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.75E-05	kg/kg	5.18E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.41E-05	kg/kg	3.00E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.35E-05	kg/kg	2.07E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	6.61E-06	kg/kg	5.82E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.27E-06	kg/kg	2.03E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	8.47E-05	kg/kg	1.36E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.30E-06	kg/kg	2.08E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.38E-09	kg/kg	2.59E-09	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	5.20E-06	kg/kg	9.77E-06	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.26E-07	kg/kg	4.25E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.03E-03	kg/kg	1.42E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.28E-03	kg/kg	8.98E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.47E-03	kg/kg	1.03E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	3.24E-02	kg/kg	3.24E-02	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.29E-03	kg/kg	2.29E-03	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	6.01E-05	kg/kg	6.01E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.08E-08	kg/kg	3.91E-08	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.13E-12	kg/kg	1.38E-12	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.96E-13	kg/kg	1.92E-13	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
								3.84E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	9.09E-08	kg/kg	2.78E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.24E-09	kg/kg	3.81E-09	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	7.99E-09	kg/kg	2.44E-08	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	9.93E-11	kg/kg	3.04E-10	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.72E-07	kg/kg	5.27E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.51E-07	kg/kg	7.69E-07	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.78E-03	kg/kg	3.91E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.71E-06	kg/kg	8.17E-08	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.80E-03	kg/kg	3.95E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.76E-06	kg/kg	8.27E-08	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphate	water	river	kg	1	kg PO4-Eq	5.48E-05	kg/kg	5.48E-05	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	3.48E-05	kg/kg	1.06E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.28E-09	kg/kg	3.93E-09	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
								2.42E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.37E-01	kg/kg	1.35E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.30E-01	kg/kg	2.48E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.26E-03	Nm3/kg	5.03E-02	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.13E-01	Nm3/kg	8.16E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.60E-01	kg/kg	7.34E+00	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.32E-05	kg/kg	1.31E-04	Ecoinvent V2, monoammonium phosphate, as P2O5, at regional storehouse, RER
								1.94E+01	

Monoammonium phosphate, as N — The unit process inventory takes into account the production of monoammonium phosphate from ammonia and phosphoric acid. Transports of raw materials and intermediate products to the fertilizer plant as well as the transport of the fertilizer product from the factory to the regional department store were included. Production and waste treatment of catalysts, coating and packaging of the final fertilizer products were not included. Infrastructure was included by means of a proxy — Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.14E+00	kg/kg	2.14E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	3.52E-01	kg/kg	3.52E-01	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.71E-06	kg/kg	1.71E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.59E-01	kg/kg	1.59E-01	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.70E-04	kg/kg	4.24E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	4.21E-04	kg/kg	6.62E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.01E-09	kg/kg	3.16E-09	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.31E-03	kg/kg	2.05E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.76E-09	kg/kg	8.27E-08	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	7.69E-12	kg/kg	2.31E-10	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.43E-17	kg/kg	4.30E-16	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.78E-05	kg/kg	8.30E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	6.13E-06	kg/kg	1.83E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.63E-11	kg/kg	4.85E-09	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	7.04E-06	kg/kg	2.10E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.44E-10	kg/kg	4.91E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.02E-10	kg/kg	2.88E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.14E-07	kg/kg	3.05E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.50E-10	kg/kg	9.17E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.45E-10	kg/kg	3.04E-08	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	3.48E-09	kg/kg	3.48E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.03E-08	kg/kg	1.26E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	6.15E-08	kg/kg	7.50E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	3.01E-07	kg/kg	7.52E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.05E-05	kg/kg	2.64E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.68E-06	kg/kg	9.20E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.88E-17	kg/kg	1.94E-16	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	4.76E-08	kg/kg	9.00E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.90E-15	kg/kg	2.79E-11	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.14E-08	kg/kg	8.15E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	5.07E-09	kg/kg	9.17E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.65E-07	kg/kg	2.99E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.03E-10	kg/kg	8.99E-10	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.28E-11	kg/kg	1.98E-10	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	8.96E-10	kg/kg	9.76E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.63E-10	kg/kg	1.78E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.58E-17	kg/kg	2.81E-13	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	9.78E-13	kg/kg	2.05E-10	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	9.16E-05	kg/kg	2.29E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	5.81E-03	kg/kg	1.45E-01	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.71E-11	kg/kg	6.78E-10	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	9.15E-06	kg/kg	2.29E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.45E-09	kg/kg	2.03E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.15E-14	kg/kg	1.62E-11	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.26E-11	kg/kg	9.32E-08	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	5.53E-07	kg/kg	4.09E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.59E-12	kg/kg	7.54E-09	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	3.11E-10	kg/kg	4.60E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.85E-10	kg/kg	4.23E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.13E-08	kg/kg	9.41E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.50E-12	kg/kg	3.25E-11	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.15E-11	kg/kg	5.40E-10	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.59E-05	kg/kg	3.59E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
								2.82E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.20E-03	kg/kg	2.26E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	7.12E-06	kg/kg	1.34E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	4.01E-05	kg/kg	7.55E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.07E-05	kg/kg	1.82E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.00E-05	kg/kg	1.76E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	9.39E-06	kg/kg	8.26E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.70E-06	kg/kg	2.72E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.34E-06	kg/kg	6.94E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.27E-06	kg/kg	3.64E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.60E-09	kg/kg	3.02E-09	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.31E-05	kg/kg	4.34E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.88E-07	kg/kg	5.41E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.91E-03	kg/kg	1.34E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.51E-03	kg/kg	1.06E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.30E-03	kg/kg	9.07E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	5.10E-04	kg/kg	5.10E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.84E-03	kg/kg	3.84E-03	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	8.56E-05	kg/kg	8.56E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.82E-08	kg/kg	5.30E-08	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	4.08E-12	kg/kg	2.66E-12	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.43E-13	kg/kg	1.58E-13	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
								1.02E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	4.14E-08	kg/kg	1.27E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.48E-09	kg/kg	4.53E-09	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	6.61E-09	kg/kg	2.02E-08	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.74E-10	kg/kg	5.32E-10	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.22E-07	kg/kg	3.74E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	6.73E-07	kg/kg	2.06E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER

BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.59E-03	kg/kg	7.89E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.47E-06	kg/kg	1.20E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.62E-03	kg/kg	7.97E-05	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.55E-06	kg/kg	1.22E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphate	water	river	kg	1	kg PO4-Eq	2.97E-06	kg/kg	2.97E-06	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.33E-07	kg/kg	4.07E-07	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.90E-09	kg/kg	5.81E-09	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
								1.65E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.14E-01	kg/kg	1.13E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	9.64E-02	kg/kg	1.84E+00	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	9.43E-04	Nm3/kg	3.75E-02	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	9.41E-01	Nm3/kg	3.60E+01	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.23E-01	kg/kg	1.48E+01	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.79E-05	kg/kg	2.76E-04	Ecoinvent V2, monoammonium phosphate, as N, at regional storehouse, RER
								5.38E+01	

Ammonium sulphate, as N

The unit process inventory takes into account the use of energy resources cited in Kongshaug (1998), needed for the production of ammonium sulphate as by-product during the manufacture of nylon (caprolactam). These values must be considered as uncertain, because the system boundaries were not clearly defined by Kongshaug. Infrastructure was included by means of a proxy module.

Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.12E+00	kg/kg	2.12E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.81E-01	kg/kg	2.81E-01	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.54E-06	kg/kg	1.54E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.43E-01	kg/kg	1.43E-01	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.99E-04	kg/kg	6.26E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.76E-04	kg/kg	4.33E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.81E-09	kg/kg	2.85E-09	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.28E-03	kg/kg	2.01E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.50E-09	kg/kg	7.49E-08	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	7.16E-12	kg/kg	2.15E-10	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.29E-17	kg/kg	3.88E-16	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.99E-05	kg/kg	5.93E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	4.67E-06	kg/kg	1.39E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.47E-11	kg/kg	4.38E-09	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	6.27E-06	kg/kg	1.87E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.11E-10	kg/kg	4.44E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.94E-10	kg/kg	2.77E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.40E-07	kg/kg	2.00E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.35E-10	kg/kg	8.28E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.34E-10	kg/kg	2.90E-08	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	3.35E-09	kg/kg	3.35E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	9.31E-09	kg/kg	1.14E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	5.73E-08	kg/kg	6.99E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.60E-07	kg/kg	6.50E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	5.23E-06	kg/kg	1.31E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.50E-06	kg/kg	8.76E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.50E-17	kg/kg	1.75E-16	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.86E-08	kg/kg	7.30E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.74E-15	kg/kg	1.96E-11	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	6.37E-09	kg/kg	4.55E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	4.58E-09	kg/kg	8.29E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.34E-07	kg/kg	2.43E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	9.41E-11	kg/kg	8.18E-10	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.12E-11	kg/kg	1.84E-10	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.46E-10	kg/kg	3.77E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.32E-10	kg/kg	1.44E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.33E-17	kg/kg	2.54E-13	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	8.84E-13	kg/kg	1.86E-10	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.37E-04	kg/kg	3.41E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	5.13E-03	kg/kg	1.28E-01	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.45E-11	kg/kg	6.12E-10	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	6.98E-06	kg/kg	1.75E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.25E-09	kg/kg	1.75E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.04E-14	kg/kg	1.46E-11	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.20E-11	kg/kg	8.90E-08	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	5.16E-07	kg/kg	3.81E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.43E-12	kg/kg	6.81E-09	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.81E-10	kg/kg	4.16E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.69E-10	kg/kg	3.85E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	3.73E-08	kg/kg	8.51E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.27E-12	kg/kg	2.95E-11	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.87E-11	kg/kg	5.03E-10	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.19E-05	kg/kg	3.19E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
								2.69E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	2.15E-06	kg/kg	4.03E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	2.75E-06	kg/kg	5.17E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	3.72E-05	kg/kg	7.00E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	8.55E-05	kg/kg	7.52E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.84E-05	kg/kg	1.62E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	8.62E-06	kg/kg	7.58E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.20E-06	kg/kg	5.13E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.06E-06	kg/kg	6.49E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.11E-06	kg/kg	3.38E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.35E-09	kg/kg	2.54E-09	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.88E-05	kg/kg	3.53E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.80E-07	kg/kg	5.27E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.82E-03	kg/kg	1.28E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER

Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	7.84E-04	kg/kg	5.49E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.23E-03	kg/kg	8.64E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	3.14E-03	kg/kg	3.14E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.24E-03	kg/kg	2.24E-03	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	8.31E-05	kg/kg	8.31E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.75E-08	kg/kg	5.16E-08	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.69E-12	kg/kg	2.40E-12	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.32E-13	kg/kg	1.51E-13	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
								8.38E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.52E-07	kg/kg	4.66E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.44E-09	kg/kg	4.40E-09	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	6.35E-09	kg/kg	1.94E-08	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.62E-10	kg/kg	4.97E-10	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.15E-07	kg/kg	3.52E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	4.25E-07	kg/kg	1.30E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.96E-03	kg/kg	4.32E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.24E-06	kg/kg	1.15E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.99E-03	kg/kg	4.37E-05	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.30E-06	kg/kg	1.17E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphate	water	river	kg	1	kg PO4-Eq	2.68E-06	kg/kg	2.68E-06	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.04E-07	kg/kg	3.19E-07	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.59E-09	kg/kg	4.88E-09	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
								9.23E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.09E-01	kg/kg	1.08E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.77E-01	kg/kg	3.38E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.72E-03	Nm3/kg	6.86E-02	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	7.60E-01	Nm3/kg	2.91E+01	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.79E-01	kg/kg	8.22E+00	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.43E-05	kg/kg	2.41E-04	Ecoinvent V2, ammonium sulphate, as N, at regional storehouse, RER
								4.18E+01	

B7	**Transport fertilizer**	See Transport Lorry > 16 t	
back to top			

B3	**Produce pesticide/ herbicide**								Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
back to top	**pesticide unspecified, at regional storehouse**	Fuel and energy consumption for the production process of the pesticide. Infrastructure requirements and transports to the regional storage are included. Waste generation is also considered.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	4.43E+00	kg/kg	4.43E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.05E+00	kg/kg	2.05E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	9.18E-07	kg/kg	9.18E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.42E-01	kg/kg	1.42E-01	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	6.29E-04	kg/kg	9.89E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.40E-03	kg/kg	2.19E-03	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.08E-09	kg/kg	1.69E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.50E-03	kg/kg	2.36E-03	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.45E-09	kg/kg	7.34E-08	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.87E-11	kg/kg	1.46E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	7.14E-18	kg/kg	2.14E-16	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	8.51E-05	kg/kg	2.53E-02	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	3.66E-05	kg/kg	1.09E-02	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	8.74E-12	kg/kg	2.61E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	3.47E-05	kg/kg	1.03E-02	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.46E-10	kg/kg	2.09E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.36E-09	kg/kg	3.37E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	9.17E-08	kg/kg	1.31E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	5.90E-11	kg/kg	3.62E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.30E-09	kg/kg	2.86E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	4.34E-08	kg/kg	4.34E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	4.13E-09	kg/kg	5.03E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	3.40E-08	kg/kg	4.15E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	5.15E-07	kg/kg	1.29E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.76E-05	kg/kg	9.40E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.11E-05	kg/kg	7.78E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.94E-17	kg/kg	9.68E-17	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	6.54E-08	kg/kg	1.24E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	7.83E-15	kg/kg	5.59E-11	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	8.20E-08	kg/kg	5.85E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.17E-09	kg/kg	3.92E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.46E-07	kg/kg	4.45E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.50E-10	kg/kg	1.31E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.44E-10	kg/kg	1.25E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.77E-10	kg/kg	1.93E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.66E-10	kg/kg	2.90E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.29E-17	kg/kg	1.40E-13	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	4.16E-13	kg/kg	8.74E-11	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.04E-04	kg/kg	7.60E-03	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.50E-02	kg/kg	3.74E-01	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.46E-11	kg/kg	3.64E-10	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	3.98E-06	kg/kg	9.94E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	3.69E-09	kg/kg	5.17E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	5.75E-15	kg/kg	8.06E-12	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.18E-10	kg/kg	8.75E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	3.06E-07	kg/kg	2.26E-03	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	6.76E-13	kg/kg	3.21E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.32E-10	kg/kg	1.96E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.06E-10	kg/kg	4.69E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH

Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.09E-07	kg/kg	9.33E-03	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.44E-12	kg/kg	3.17E-11	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.63E-10	kg/kg	3.42E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.03E-04	kg/kg	2.03E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
								7.08E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.15E-05	kg/kg	2.16E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.46E-05	kg/kg	2.75E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	5.32E-05	kg/kg	1.00E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	6.77E-05	kg/kg	5.96E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.45E-04	kg/kg	1.28E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.84E-06	kg/kg	5.14E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	4.81E-06	kg/kg	7.70E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	3.22E-05	kg/kg	5.15E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.40E-06	kg/kg	2.24E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.06E-09	kg/kg	3.87E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	3.56E-05	kg/kg	6.70E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	7.15E-07	kg/kg	1.34E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	5.80E-03	kg/kg	4.06E-03	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	5.44E-03	kg/kg	3.81E-03	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.17E-03	kg/kg	8.18E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.70E-02	kg/kg	1.70E-02	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.34E-02	kg/kg	1.34E-02	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	8.94E-05	kg/kg	8.94E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	5.22E-08	kg/kg	9.82E-08	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.61E-12	kg/kg	1.05E-12	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.29E-12	kg/kg	1.49E-12	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
								3.96E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	5.00E-07	kg/kg	1.53E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	6.08E-09	kg/kg	1.86E-08	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	7.76E-08	kg/kg	2.38E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	9.82E-11	kg/kg	3.00E-10	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	7.72E-07	kg/kg	2.36E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.20E-06	kg/kg	9.79E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.15E-02	kg/kg	4.74E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.20E-06	kg/kg	1.58E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.17E-02	kg/kg	4.77E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.30E-06	kg/kg	1.61E-07	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphate	water	river	kg	1	kg PO4-Eq	2.30E-05	kg/kg	2.30E-05	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	5.44E-07	kg/kg	1.67E-06	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	3.18E-09	kg/kg	9.73E-09	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
								9.90E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	8.95E-01	kg/kg	8.86E+00	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	6.09E-01	kg/kg	1.16E+01	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	5.94E-03	Nm3/kg	2.36E-01	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.54E+00	Nm3/kg	5.90E+01	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.16E+00	kg/kg	9.91E+01	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.06E-05	kg/kg	2.04E-04	Ecoinvent V2, pesticide unspecified, at regional storehouse, CH
								1.79E+02	
B8	**Transport pesticide/ herbicide**	See Transport, lorry> 16t							
back to top									
B4	**Transport manure**	See transport, lorry >32t, EURO4							
back to top									
B9	**Apply Manure**	see Cereal Activities, Cereal and Forage Activities							
	Solid manure loading and spreading	The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the manure loading and spreading. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. The amount of spread material is not taken into account. Not included are dust other than from combustion and							Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	5.86E-04	kg/kg	5.86E-04	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.98E-03	kg/kg	1.98E-03	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.85E-11	kg/kg	3.85E-11	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	4.36E-04	kg/kg	4.36E-04	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.63E-07	kg/kg	4.13E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	3.84E-06	kg/kg	6.03E-06	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	4.53E-14	kg/kg	7.11E-14	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	9.43E-06	kg/kg	1.48E-05	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	3.17E-13	kg/kg	9.52E-12	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.19E-14	kg/kg	3.58E-13	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	2.93E-20	kg/kg	8.80E-19	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.15E-08	kg/kg	3.44E-06	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	7.08E-08	kg/kg	2.11E-05	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.67E-16	kg/kg	1.09E-13	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	5.98E-09	kg/kg	1.78E-06	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	7.61E-15	kg/kg	1.09E-11	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.84E-13	kg/kg	5.49E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.04E-10	kg/kg	1.49E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.75E-15	kg/kg	1.69E-11	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.65E-13	kg/kg	3.28E-11	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH

Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	7.40E-12	kg/kg	7.40E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.96E-13	kg/kg	2.39E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	6.65E-11	kg/kg	8.12E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.22E-09	kg/kg	3.04E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	4.87E-09	kg/kg	1.22E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.90E-09	kg/kg	7.24E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	7.95E-20	kg/kg	3.98E-19	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.66E-12	kg/kg	6.91E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.74E-16	kg/kg	1.24E-12	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	3.08E-11	kg/kg	2.20E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.59E-13	kg/kg	2.87E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.41E-11	kg/kg	2.55E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.63E-14	kg/kg	1.42E-13	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.53E-14	kg/kg	3.07E-13	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	9.83E-15	kg/kg	1.07E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.32E-14	kg/kg	1.44E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	5.29E-20	kg/kg	5.76E-16	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.16E-17	kg/kg	4.54E-15	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	2.21E-07	kg/kg	5.52E-06	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	4.42E-06	kg/kg	1.10E-04	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	6.12E-16	kg/kg	1.53E-14	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	7.03E-09	kg/kg	1.76E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.72E-12	kg/kg	2.41E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.36E-17	kg/kg	3.31E-14	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.36E-14	kg/kg	1.01E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	5.99E-10	kg/kg	4.43E-06	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.51E-17	kg/kg	1.67E-13	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	6.89E-15	kg/kg	1.02E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.25E-13	kg/kg	2.86E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.03E-11	kg/kg	9.19E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.69E-16	kg/kg	3.50E-15	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	6.45E-14	kg/kg	8.39E-13	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.18E-08	kg/kg	2.18E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
								3.18E-03	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	3.59E-09	kg/kg	6.75E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.74E-08	kg/kg	3.26E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	4.51E-08	kg/kg	8.47E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.47E-08	kg/kg	2.17E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.20E-08	kg/kg	1.05E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.60E-08	kg/kg	1.41E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	8.72E-10	kg/kg	1.40E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	2.81E-09	kg/kg	4.49E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	4.24E-09	kg/kg	6.78E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	6.99E-11	kg/kg	1.31E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	6.95E-09	kg/kg	1.31E-08	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.88E-09	kg/kg	5.41E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	5.61E-07	kg/kg	3.93E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.57E-05	kg/kg	1.80E-05	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.19E-06	kg/kg	8.30E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.11E-06	kg/kg	1.11E-06	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.06E-06	kg/kg	3.06E-06	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	4.65E-07	kg/kg	4.65E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.03E-10	kg/kg	5.69E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	7.52E-17	kg/kg	4.89E-17	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.63E-16	kg/kg	1.71E-16	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
								2.41E-05	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	6.60E-11	kg/kg	2.02E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.31E-11	kg/kg	4.01E-11	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.25E-11	kg/kg	3.81E-11	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.90E-13	kg/kg	5.81E-13	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	7.10E-11	kg/kg	2.17E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	8.27E-10	kg/kg	2.53E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	5.54E-06	kg/kg	1.22E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.16E-08	kg/kg	9.16E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	5.63E-06	kg/kg	1.24E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.19E-08	kg/kg	9.22E-10	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.10E-09	kg/kg	1.10E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	6.76E-10	kg/kg	2.07E-09	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	7.01E-12	kg/kg	2.14E-11	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
								2.54E-07	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	7.42E-05	kg/kg	7.35E-04	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	3.31E-04	kg/kg	6.33E-03	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	3.23E-06	Nm3/kg	1.28E-04	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.24E-04	Nm3/kg	4.73E-03	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	7.34E-04	kg/kg	3.36E-02	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.52E-08	kg/kg	2.50E-07	Ecoinvent V2, solid manure loading and spreading, by hydraulic loader and spreader, CH
								4.55E-02	
B11	**Incorporate Manure**	see Cereal Activities, Cereal and Forage Activities	proxy of Tillage, cultivating, chiseling						
								1.03E+03	
B5	**Irrigate Crop**								

back to top

Irrigating The inventory takes into account electricity and diesel fuel consumption, the amount of agricultural machinery, of the shed and the further infrastructure like pump or water hose, etc., which has to be attributed to the irrigation. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. The amount of water irrigated is taken into account. Not included are dust other than from combustion and noise.

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.14E+02	kg/ha	1.14E+02	Irrigating
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.06E+02	kg/ha	1.06E+02	Irrigating
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	4.38E-06	kg/ha	4.38E-06	Irrigating
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	5.03E+01	kg/ha	5.03E+01	Irrigating
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.22E-01	kg/ha	5.05E-01	Irrigating
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.16E-01	kg/ha	1.82E-01	Irrigating
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	5.14E-09	kg/ha	8.08E-09	Irrigating
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.03E+00	kg/ha	1.61E+00	Irrigating
Chloroform	air	high population density	kg	30	kg CO2-Eq	4.14E-07	kg/ha	1.24E-05	Irrigating
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.17E-08	kg/ha	3.51E-07	Irrigating
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.38E-15	kg/ha	4.14E-14	Irrigating
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.38E-03	kg/ha	7.08E-01	Irrigating
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.94E-03	kg/ha	8.77E-01	Irrigating
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	4.17E-11	kg/ha	1.24E-08	Irrigating
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	5.68E-03	kg/ha	1.69E+00	Irrigating
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.88E-09	kg/ha	2.69E-06	Irrigating
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.34E-07	kg/ha	7.63E-04	Irrigating
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	7.64E-06	kg/ha	1.09E-02	Irrigating
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.17E-10	kg/ha	1.33E-06	Irrigating
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Irrigating
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.86E-07	kg/ha	3.55E-05	Irrigating
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Irrigating
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.06E-05	kg/ha	1.06E-01	Irrigating
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Irrigating
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.20E-08	kg/ha	2.69E-04	Irrigating
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.30E-06	kg/ha	2.80E-02	Irrigating
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.38E-03	kg/ha	5.95E-02	Irrigating
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.79E-03	kg/ha	9.48E-02	Irrigating
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.34E-03	kg/ha	5.86E-02	Irrigating
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.74E-15	kg/ha	1.87E-14	Irrigating
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	9.79E-07	kg/ha	1.85E-03	Irrigating
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.05E-12	kg/ha	2.18E-08	Irrigating
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	7.34E-07	kg/ha	5.24E-03	Irrigating
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	3.35E-08	kg/ha	6.07E-05	Irrigating
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	4.71E-06	kg/ha	8.53E-03	Irrigating
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Irrigating
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.01E-07	kg/ha	8.75E-07	Irrigating
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.46E-08	kg/ha	3.01E-07	Irrigating
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	2.52E-09	kg/ha	2.75E-05	Irrigating
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.56E-09	kg/ha	2.79E-05	Irrigating
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.49E-15	kg/ha	2.71E-11	Irrigating
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	5.34E-12	kg/ha	1.12E-09	Irrigating
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.51E-01	kg/ha	8.78E+00	Irrigating
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	4.94E-01	kg/ha	1.24E+01	Irrigating
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	6.95E-11	kg/ha	1.74E-09	Irrigating
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	7.22E-04	kg/ha	1.80E-02	Irrigating
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.31E-07	kg/ha	3.23E-04	Irrigating
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.11E-12	kg/ha	1.56E-09	Irrigating
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.47E-08	kg/ha	1.09E-04	Irrigating
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.07E-05	kg/ha	1.53E-01	Irrigating
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	8.67E-12	kg/ha	4.12E-08	Irrigating
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.70E-09	kg/ha	2.52E-05	Irrigating
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Irrigating
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.23E-08	kg/ha	7.35E-04	Irrigating
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.67E-05	kg/ha	1.06E+00	Irrigating
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.97E-10	kg/ha	2.55E-09	Irrigating
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	6.32E-08	kg/ha	8.22E-07	Irrigating
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	9.83E-03	kg/ha	9.83E-03	Irrigating
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Irrigating
								2.99E+02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	6.13E-04	kg/ha	1.15E-03	Irrigating
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.16E-03	kg/ha	2.19E-03	Irrigating
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	7.53E-03	kg/ha	1.42E-02	Irrigating
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	4.00E-03	kg/ha	3.52E-03	Irrigating
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.63E-03	kg/ha	4.07E-03	Irrigating
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.85E-03	kg/ha	1.63E-03	Irrigating
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.33E-04	kg/ha	2.12E-04	Irrigating
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.35E-03	kg/ha	2.16E-03	Irrigating
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	3.75E-04	kg/ha	6.00E-04	Irrigating
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.40E-05	kg/ha	2.64E-05	Irrigating
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.04E-03	kg/ha	1.95E-03	Irrigating
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	3.42E-04	kg/ha	6.43E-04	Irrigating
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.68E-01	kg/ha	1.18E-01	Irrigating
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	3.80E-01	kg/ha	2.66E-01	Irrigating
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.59E-01	kg/ha	1.11E-01	Irrigating
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.05E-01	kg/ha	2.05E-01	Irrigating
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.36E-01	kg/ha	3.36E-01	Irrigating
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	5.11E-02	kg/ha	5.11E-02	Irrigating
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.45E-05	kg/ha	6.49E-05	Irrigating
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	5.93E-12	kg/ha	3.85E-12	Irrigating
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Irrigating
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.85E-10	kg/ha	1.85E-10	Irrigating
								1.12E+00	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.76E-05	kg/ha	5.40E-05	Irrigating
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.35E-06	kg/ha	7.21E-06	Irrigating

Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.73E-05	kg/ha	5.30E-05	Irrigating
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	6.52E-09	kg/ha	1.99E-08	Irrigating
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	5.44E-05	kg/ha	1.67E-04	Irrigating
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.57E-05	kg/ha	7.85E-05	Irrigating
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.59E-01	kg/ha	3.49E-03	Irrigating
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.54E-03	kg/ha	9.98E-05	Irrigating
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.71E-01	kg/ha	3.76E-03	Irrigating
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.56E-03	kg/ha	1.00E-04	Irrigating
Phosphate	water	river	kg	1	kg PO4-Eq	9.25E-05	kg/ha	9.25E-05	Irrigating
Phosphorus	water	river	kg	3.06	kg PO4-Eq	6.68E-05	kg/ha	2.05E-04	Irrigating
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	6.88E-07	kg/ha	2.11E-06	Irrigating
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Irrigating
								8.11E-03	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.12E+01	kg/ha	4.08E+02	Irrigating
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	6.28E+01	kg/ha	1.20E+03	Irrigating
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	5.94E-01	Nm3/ha	2.36E+01	Irrigating
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	3.65E+01	Nm3/ha	1.40E+03	Irrigating
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	4.02E+01	kg/ha	1.84E+03	Irrigating
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.89E-02	kg/ha	4.84E-01	Irrigating
								4.87E+03	
E1	**Produce crude**								
back to top	crude oil, at production onshore								
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.41E-02	kg / kg	2.41E-02	crude oil, at production onshore, RME
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.69E-02	kg / kg	6.69E-02	crude oil, at production onshore, RME
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	4.92E-10	kg / kg	4.92E-10	crude oil, at production onshore, RME
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	3.49E-03	kg / kg	3.49E-03	crude oil, at production onshore, RME
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.03E-06	kg / kg	4.76E-06	crude oil, at production onshore, RME
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.64E-04	kg / kg	4.15E-04	crude oil, at production onshore, RME
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	5.78E-13	kg / kg	9.08E-13	crude oil, at production onshore, RME
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	4.67E-05	kg / kg	7.35E-05	crude oil, at production onshore, RME
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.10E-12	kg / kg	6.31E-11	crude oil, at production onshore, RME
Chloroform	air	low population density	kg	30	kg CO2-Eq	6.58E-14	kg / kg	1.98E-12	crude oil, at production onshore, RME
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.27E-20	kg / kg	3.80E-19	crude oil, at production onshore, RME
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	7.34E-07	kg / kg	2.19E-04	crude oil, at production onshore, RME
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.29E-06	kg / kg	6.82E-04	crude oil, at production onshore, RME
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	4.69E-15	kg / kg	1.40E-12	crude oil, at production onshore, RME
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.25E-07	kg / kg	3.72E-05	crude oil, at production onshore, RME
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	7.99E-14	kg / kg	1.14E-10	crude oil, at production onshore, RME
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.40E-12	kg / kg	4.87E-09	crude oil, at production onshore, RME
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	5.04E-10	kg / kg	7.20E-07	crude oil, at production onshore, RME
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.56E-14	kg / kg	1.57E-10	crude oil, at production onshore, RME
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg / kg	0.00E+00	crude oil, at production onshore, RME
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	4.39E-12	kg / kg	5.44E-10	crude oil, at production onshore, RME
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg / kg	0.00E+00	crude oil, at production onshore, RME
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	5.89E-11	kg / kg	5.89E-07	crude oil, at production onshore, RME
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg / kg	0.00E+00	crude oil, at production onshore, RME
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.87E-12	kg / kg	2.28E-08	crude oil, at production onshore, RME
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	4.85E-11	kg / kg	5.92E-07	crude oil, at production onshore, RME
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	3.48E-09	kg / kg	8.71E-08	crude oil, at production onshore, RME
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.01E-07	kg / kg	2.53E-06	crude oil, at production onshore, RME
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	6.60E-08	kg / kg	1.65E-06	crude oil, at production onshore, RME
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.43E-20	kg / kg	1.72E-19	crude oil, at production onshore, RME
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.94E-11	kg / kg	7.45E-08	crude oil, at production onshore, RME
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.63E-17	kg / kg	1.16E-13	crude oil, at production onshore, RME
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	5.88E-08	kg / kg	4.20E-04	crude oil, at production onshore, RME
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.60E-12	kg / kg	2.90E-09	crude oil, at production onshore, RME
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.69E-10	kg / kg	3.06E-07	crude oil, at production onshore, RME
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg / kg	0.00E+00	crude oil, at production onshore, RME
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.99E-13	kg / kg	2.60E-12	crude oil, at production onshore, RME
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.95E-13	kg / kg	1.70E-12	crude oil, at production onshore, RME
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.37E-13	kg / kg	1.49E-09	crude oil, at production onshore, RME
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.78E-13	kg / kg	1.94E-09	crude oil, at production onshore, RME
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.28E-20	kg / kg	2.49E-16	crude oil, at production onshore, RME
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.27E-16	kg / kg	4.77E-14	crude oil, at production onshore, RME
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	2.82E-06	kg / kg	7.04E-05	crude oil, at production onshore, RME
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	8.16E-04	kg / kg	2.04E-02	crude oil, at production onshore, RME
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	7.81E-15	kg / kg	1.95E-13	crude oil, at production onshore, RME
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.55E-07	kg / kg	3.87E-06	crude oil, at production onshore, RME
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	8.89E-11	kg / kg	1.25E-07	crude oil, at production onshore, RME
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.02E-17	kg / kg	1.43E-14	crude oil, at production onshore, RME
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	2.26E-13	kg / kg	1.67E-09	crude oil, at production onshore, RME
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	4.37E-10	kg / kg	3.23E-06	crude oil, at production onshore, RME
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.69E-16	kg / kg	1.75E-12	crude oil, at production onshore, RME
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	7.23E-14	kg / kg	1.07E-09	crude oil, at production onshore, RME
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg / kg	0.00E+00	crude oil, at production onshore, RME
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.05E-13	kg / kg	6.94E-09	crude oil, at production onshore, RME
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	7.49E-10	kg / kg	1.71E-05	crude oil, at production onshore, RME
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	3.52E-15	kg / kg	4.58E-14	crude oil, at production onshore, RME
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.56E-13	kg / kg	4.63E-12	crude oil, at production onshore, RME
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.37E-06	kg / kg	2.37E-06	crude oil, at production onshore, RME
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg / kg	0.00E+00	crude oil, at production onshore, RME
Total Carbon Dioxide Equivalents	**air**		kg	**1**	kg CO2-Eq	**2.13E-01**	**kg/kg**	2.13E-01	**See values below from Pembina**
								2.13E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.45E-07	kg/kg	2.73E-07	crude oil, at production onshore, RME
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	8.78E-08	kg/kg	1.65E-07	crude oil, at production onshore, RME
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.26E-07	kg/kg	4.24E-07	crude oil, at production onshore, RME
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	4.11E-07	kg/kg	3.62E-07	crude oil, at production onshore, RME
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	3.43E-07	kg/kg	3.02E-07	crude oil, at production onshore, RME
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	8.77E-08	kg/kg	7.72E-08	crude oil, at production onshore, RME

Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.86E-08	kg/kg	6.18E-08	crude oil, at production onshore, RME
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	7.42E-08	kg/kg	1.19E-07	crude oil, at production onshore, RME
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.62E-08	kg/kg	2.59E-08	crude oil, at production onshore, RME
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.16E-11	kg/kg	2.17E-11	crude oil, at production onshore, RME
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	3.85E-08	kg/kg	7.25E-08	crude oil, at production onshore, RME
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.30E-08	kg/kg	2.44E-08	crude oil, at production onshore, RME
Hydrogen Sulfide	**air**		kg	1.88	kg SO2-Eq	**3.83E-05**	**kg/kg**	7.21E-05	**See values below from Pembina**
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.11E-05	kg/kg	2.18E-05	crude oil, at production onshore, RME
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	6.95E-04	kg/kg	4.86E-04	crude oil, at production onshore, RME
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.75E-05	kg/kg	1.92E-05	crude oil, at production onshore, RME
Nitrogen oxides	**air**		kg	0.7	kg SO2-Eq	**1.04E-04**	**kg/kg**	7.27E-05	**See values below from Pembina**
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.15E-04	kg/kg	1.15E-04	crude oil, at production onshore, RME
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	8.41E-05	kg/kg	8.41E-05	crude oil, at production onshore, RME
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	2.47E-06	kg/kg	2.47E-06	crude oil, at production onshore, RME
Sulfur dioxide	**air**		kg	1	kg SO2-Eq	**3.72E-04**	**kg/kg**	3.72E-04	**See values below from Pembina**
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.32E-09	kg/kg	2.49E-09	crude oil, at production onshore, RME
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	6.99E-16	kg/kg	4.55E-16	crude oil, at production onshore, RME
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	crude oil, at production onshore, RME
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	4.36E-15	kg/kg	2.83E-15	crude oil, at production onshore, RME
								5.18E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	6.45E-10	kg/kg	1.98E-09	crude oil, at production onshore, RME
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	5.99E-11	kg/kg	1.83E-10	crude oil, at production onshore, RME
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.13E-10	kg/kg	3.46E-10	crude oil, at production onshore, RME
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.53E-13	kg/kg	4.67E-13	crude oil, at production onshore, RME
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.68E-09	kg/kg	5.15E-09	crude oil, at production onshore, RME
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.18E-07	kg/kg	6.68E-07	crude oil, at production onshore, RME
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.43E-04	kg/kg	5.35E-06	crude oil, at production onshore, RME
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.99E-07	kg/kg	6.59E-09	crude oil, at production onshore, RME
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.66E-04	kg/kg	5.86E-06	crude oil, at production onshore, RME
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.05E-07	kg/kg	6.72E-09	crude oil, at production onshore, RME
Phosphate	water	river	kg	1	kg PO4-Eq	1.14E-08	kg/kg	1.14E-08	crude oil, at production onshore, RME
Phosphorus	water	river	kg	3.06	kg PO4-Eq	9.92E-09	kg/kg	3.04E-08	crude oil, at production onshore, RME
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.03E-10	kg/kg	6.21E-10	crude oil, at production onshore, RME
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	crude oil, at production onshore, RME
								1.19E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.02E-03	kg/kg	2.00E-02	crude oil, at production onshore, RME
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.26E-03	kg/kg	4.32E-02	crude oil, at production onshore, RME
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.20E-05	Nm3/ha	8.77E-04	crude oil, at production onshore, RME
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.67E-02	Nm3/ha	6.41E-01	crude oil, at production onshore, RME
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.02E+00	kg/kg	4.66E+01	crude oil, at production onshore, RME
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	3.30E-08	kg/kg	3.27E-07	crude oil, at production onshore, RME
								4.73E+01	

					Produce Crude Oil - Pembina Institute				
					For light and medium crude oil		(Canada average)		
		These emissions replace Ecoinvent emissions below	**CO2eq**		**29.47**	Air		kg/bbl	
			NOx		**14.36**	Air		g/bbl	
			CO		22.59	Air		g/bbl	
			SO2		**51.44**	Air		g/bbl	
			H2S		**5.30**	Air		g/bbl	
			1	bbl	=	1.59E+02	L		
				Density of crude oil	=	8.70E+02	kg/m3		The Engineering Toolbox. Available at: http://www.engineeringtoolbox.com/liquids-densities-d_743.html

E4	Transport crude		1000000 lkm			Transport crude - Pembina Institute			
back to top									
			CO		5.23E-02			kg/1000000 lkm	Pembina Institute
			CO2		9.03E+00			kg/1000000 lkm	Pembina Institute
			NOx		2.43E-01			kg/1000000 lkm	Pembina Institute
			PM		1.71E-02			kg/1000000 lkm	Pembina Institute
			SO2		1.60E-02			kg/1000000 lkm	Pembina Institute
			CO2 Equivalents		9.02E+00			kg CO2 Eq./100000lkm	
	crude oil, production , at long distance transport	Transportation of crude oil from exploration site to refinery in Europe. Includes transport service requirements and emissions from oil handling and evaporation.							
		Ecoinvent V2, crude oil, production NO, at long distance transport							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.62E-03	kg/kg	2.62E-03	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.15E-02	kg/kg	6.15E-02	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	4.16E-10	kg/kg	4.16E-10	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.53E-03	kg/kg	1.53E-03	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	8.79E-07	kg/kg	1.38E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.61E-04	kg/kg	2.53E-04	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	4.89E-13	kg/kg	7.68E-13	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.20E-05	kg/kg	3.45E-05	Ecoinvent V2, crude oil, production NO, at long distance transport
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.59E-12	kg/kg	4.77E-11	Ecoinvent V2, crude oil, production NO, at long distance transport
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.04E-14	kg/kg	1.21E-12	Ecoinvent V2, crude oil, production NO, at long distance transport
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.43E-20	kg/kg	4.28E-19	Ecoinvent V2, crude oil, production NO, at long distance transport
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.95E-07	kg/kg	1.47E-04	Ecoinvent V2, crude oil, production NO, at long distance transport
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	9.20E-07	kg/kg	2.74E-04	Ecoinvent V2, crude oil, production NO, at long distance transport
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.96E-15	kg/kg	1.18E-12	Ecoinvent V2, crude oil, production NO, at long distance transport
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	4.87E-08	kg/kg	1.45E-05	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	8.30E-14	kg/kg	1.19E-10	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.03E-12	kg/kg	2.90E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.20E-10	kg/kg	3.14E-07	Ecoinvent V2, crude oil, production NO, at long distance transport

Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.07E-14	kg/kg	1.88E-10	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.60E-12	kg/kg	3.23E-10	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	3.52E-11	kg/kg	3.52E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.18E-12	kg/kg	2.66E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	7.23E-11	kg/kg	8.83E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	4.63E-09	kg/kg	1.16E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	7.75E-07	kg/kg	1.94E-05	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.91E-08	kg/kg	9.76E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.87E-20	kg/kg	1.93E-19	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	7.55E-10	kg/kg	1.43E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	8.49E-18	kg/kg	6.06E-14	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.67E-10	kg/kg	1.19E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.38E-12	kg/kg	2.50E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.07E-10	kg/kg	1.93E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	4.17E-13	kg/kg	3.63E-12	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.20E-13	kg/kg	1.04E-12	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.36E-13	kg/kg	1.48E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	9.69E-14	kg/kg	1.06E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.57E-20	kg/kg	2.80E-16	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.36E-16	kg/kg	4.96E-14	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.72E-06	kg/kg	9.30E-05	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.35E-04	kg/kg	5.86E-03	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	6.60E-15	kg/kg	1.65E-13	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.13E-07	kg/kg	2.82E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	9.46E-11	kg/kg	1.32E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.15E-17	kg/kg	1.61E-14	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.34E-13	kg/kg	9.89E-10	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.51E-10	kg/kg	4.81E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.83E-16	kg/kg	1.82E-12	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	7.51E-14	kg/kg	1.11E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.00E-13	kg/kg	4.56E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.44E-10	kg/kg	1.01E-05	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.29E-15	kg/kg	2.97E-14	Ecoinvent V2, crude oil, production NO, at long distance transport
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.18E-13	kg/kg	2.84E-12	Ecoinvent V2, crude oil, production NO, at long distance transport
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	5.65E-07	kg/kg	5.65E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
								7.24E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	2.21E-07	kg/kg	4.15E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.53E-07	kg/kg	1.04E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.26E-07	kg/kg	2.37E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.96E-08	kg/kg	3.49E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.78E-07	kg/kg	2.45E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	4.29E-08	kg/kg	3.78E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	2.00E-09	kg/kg	3.19E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	5.23E-08	kg/kg	8.37E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.09E-08	kg/kg	1.74E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.17E-11	kg/kg	2.20E-11	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.19E-08	kg/kg	4.13E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	6.57E-09	kg/kg	1.23E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.74E-06	kg/kg	2.62E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	3.41E-04	kg/kg	2.39E-04	Ecoinvent V2, crude oil, production NO, at long distance transport
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	7.18E-06	kg/kg	5.02E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	8.88E-06	kg/kg	8.88E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.32E-04	kg/kg	1.32E-04	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.21E-06	kg/kg	1.21E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	6.65E-10	kg/kg	1.25E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	8.39E-16	kg/kg	5.45E-16	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.58E-15	kg/kg	1.68E-15	Ecoinvent V2, crude oil, production NO, at long distance transport
								3.91E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.38E-10	kg/kg	1.03E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.06E-11	kg/kg	9.36E-11	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	6.74E-11	kg/kg	2.06E-10	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.29E-12	kg/kg	3.95E-12	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	9.84E-10	kg/kg	3.01E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	7.24E-09	kg/kg	2.22E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.29E-04	kg/kg	7.23E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.33E-07	kg/kg	2.92E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.29E-04	kg/kg	7.24E-06	Ecoinvent V2, crude oil, production NO, at long distance transport
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.43E-07	kg/kg	3.14E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphate	water	river	kg	1	kg PO4-Eq	8.07E-09	kg/kg	8.07E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphorus	water	river	kg	3.06	kg PO4-Eq	8.18E-09	kg/kg	2.50E-08	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	3.33E-10	kg/kg	1.02E-09	Ecoinvent V2, crude oil, production NO, at long distance transport
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, crude oil, production NO, at long distance transport
								1.45E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.20E-03	kg/kg	1.18E-02	Ecoinvent V2, crude oil, production NO, at long distance transport
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.27E-03	kg/kg	2.42E-02	Ecoinvent V2, crude oil, production NO, at long distance transport
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.24E-05	Nm3/kg	4.94E-04	Ecoinvent V2, crude oil, production NO, at long distance transport
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.98E-02	Nm3/kg	7.57E-01	Ecoinvent V2, crude oil, production NO, at long distance transport
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.01E+00	kg/kg	4.60E+01	Ecoinvent V2, crude oil, production NO, at long distance transport
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.68E-08	kg/kg	4.63E-07	Ecoinvent V2, crude oil, production NO, at long distance transport
								4.68E+01	

E7a	Refine crude into diesel				Refine Crude Oil - Pembina Institute (kg/L crude refined)		
back to top					(specific for Alberta)		
	These emissions replace Ecoinvent emissions below	CO		2.85E-04	Air	kg/l	Pembina Institute
		CO2		7.08E-02	Air	kg/l	Pembina Institute
		NOx		6.75E-05	Air	kg/l	Pembina Institute
		SO2		2.32E-04	Air	kg/l	Pembina Institute
		Sulphuric Acid		2.96E-08	Air	kg/l	Pembina Institute
		Density of crude oil	=	8.70E+02	kg/m3		
							Average value from: http://www.simetric.co.uk/si_liquids.htm

back to top

Diesel, at refinery

Description of all flows of materials and energy due to the throughput of 1kg crude oil in the refinery. The multi-output-process 'crude oil, in refinery' delivers the co-products petrol, unleaded, bitumen, diesel, light fuel oil, heavy fuel oil, kerosene, naphtha, propane/ butane, refinery gas, secondary sulphur and electricity. The impacts of processing are allocated to the different products.

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.27E-01	kg/kg	2.27E-01	Ecoinvent V2, diesel, at refinery, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.92E-01	kg/kg	1.92E-01	Ecoinvent V2, diesel, at refinery, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.36E-08	kg/kg	1.36E-08	Ecoinvent V2, diesel, at refinery, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.66E-02	kg/kg	1.66E-02	Ecoinvent V2, diesel, at refinery, RER
Carbon Dioxide	**air**			1	kg CO2-Eq	**8.14E-02**	**kg/kg**	8.14E-02	**See values above from Pembina**
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	5.36E-05	kg/kg	8.42E-05	Ecoinvent V2, diesel, at refinery, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	3.88E-04	kg/kg	6.10E-04	Ecoinvent V2, diesel, at refinery, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.60E-11	kg/kg	2.51E-11	Ecoinvent V2, diesel, at refinery, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.37E-04	kg/kg	3.72E-04	Ecoinvent V2, diesel, at refinery, RER
Carbon Monoxide	**air**			1.5714	kg CO2-Eq	**3.27E-04**	**kg/kg**	5.14E-04	**See values above from Pembina**
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.38E-11	kg/kg	7.14E-10	Ecoinvent V2, diesel, at refinery, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	8.61E-13	kg/kg	2.58E-11	Ecoinvent V2, diesel, at refinery, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	9.87E-20	kg/kg	2.96E-18	Ecoinvent V2, diesel, at refinery, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	3.05E-06	kg/kg	9.08E-04	Ecoinvent V2, diesel, at refinery, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	3.95E-06	kg/kg	1.18E-03	Ecoinvent V2, diesel, at refinery, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.30E-13	kg/kg	3.86E-11	Ecoinvent V2, diesel, at refinery, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.01E-06	kg/kg	3.00E-04	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	6.09E-13	kg/kg	8.71E-10	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	4.52E-11	kg/kg	6.46E-08	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.56E-09	kg/kg	3.67E-06	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.41E-13	kg/kg	8.67E-10	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	5.87E-11	kg/kg	7.27E-09	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at refinery, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	7.81E-10	kg/kg	7.81E-06	Ecoinvent V2, diesel, at refinery, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at refinery, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.12E-11	kg/kg	1.36E-07	Ecoinvent V2, diesel, at refinery, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	3.91E-10	kg/kg	4.78E-06	Ecoinvent V2, diesel, at refinery, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.38E-08	kg/kg	5.94E-07	Ecoinvent V2, diesel, at refinery, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.24E-06	kg/kg	3.09E-05	Ecoinvent V2, diesel, at refinery, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	8.85E-07	kg/kg	2.21E-05	Ecoinvent V2, diesel, at refinery, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.68E-19	kg/kg	1.34E-18	Ecoinvent V2, diesel, at refinery, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	5.74E-10	kg/kg	1.09E-06	Ecoinvent V2, diesel, at refinery, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.53E-16	kg/kg	1.09E-12	Ecoinvent V2, diesel, at refinery, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	3.79E-08	kg/kg	2.71E-04	Ecoinvent V2, diesel, at refinery, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.05E-11	kg/kg	1.90E-08	Ecoinvent V2, diesel, at refinery, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.21E-09	kg/kg	4.00E-06	Ecoinvent V2, diesel, at refinery, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at refinery, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.30E-12	kg/kg	2.00E-11	Ecoinvent V2, diesel, at refinery, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.55E-12	kg/kg	2.22E-11	Ecoinvent V2, diesel, at refinery, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.19E-12	kg/kg	1.29E-08	Ecoinvent V2, diesel, at refinery, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	4.85E-12	kg/kg	5.28E-08	Ecoinvent V2, diesel, at refinery, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.78E-19	kg/kg	1.94E-15	Ecoinvent V2, diesel, at refinery, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.73E-15	kg/kg	3.64E-13	Ecoinvent V2, diesel, at refinery, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	6.90E-05	kg/kg	1.73E-03	Ecoinvent V2, diesel, at refinery, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.77E-03	kg/kg	4.43E-02	Ecoinvent V2, diesel, at refinery, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.16E-13	kg/kg	5.40E-12	Ecoinvent V2, diesel, at refinery, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	7.37E-07	kg/kg	1.84E-05	Ecoinvent V2, diesel, at refinery, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	5.29E-10	kg/kg	7.41E-07	Ecoinvent V2, diesel, at refinery, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	7.95E-17	kg/kg	1.11E-13	Ecoinvent V2, diesel, at refinery, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.02E-12	kg/kg	2.23E-08	Ecoinvent V2, diesel, at refinery, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	3.52E-09	kg/kg	2.60E-05	Ecoinvent V2, diesel, at refinery, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.81E-15	kg/kg	1.34E-11	Ecoinvent V2, diesel, at refinery, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	5.51E-13	kg/kg	8.16E-09	Ecoinvent V2, diesel, at refinery, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at refinery, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.72E-12	kg/kg	8.48E-08	Ecoinvent V2, diesel, at refinery, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.01E-08	kg/kg	2.31E-04	Ecoinvent V2, diesel, at refinery, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	4.17E-14	kg/kg	5.42E-13	Ecoinvent V2, diesel, at refinery, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.65E-12	kg/kg	6.05E-11	Ecoinvent V2, diesel, at refinery, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.41E-05	kg/kg	1.41E-05	Ecoinvent V2, diesel, at refinery, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at refinery, RER
								1.31E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	7.60E-07	kg/kg	1.43E-06	Ecoinvent V2, diesel, at refinery, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	3.45E-06	kg/kg	6.49E-06	Ecoinvent V2, diesel, at refinery, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.56E-06	kg/kg	2.93E-06	Ecoinvent V2, diesel, at refinery, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.13E-06	kg/kg	1.87E-06	Ecoinvent V2, diesel, at refinery, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.95E-06	kg/kg	4.36E-06	Ecoinvent V2, diesel, at refinery, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	4.32E-07	kg/kg	3.80E-07	Ecoinvent V2, diesel, at refinery, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.99E-07	kg/kg	3.18E-07	Ecoinvent V2, diesel, at refinery, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.02E-06	kg/kg	1.64E-06	Ecoinvent V2, diesel, at refinery, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	8.56E-08	kg/kg	1.37E-07	Ecoinvent V2, diesel, at refinery, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	6.73E-11	kg/kg	1.26E-10	Ecoinvent V2, diesel, at refinery, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.85E-07	kg/kg	5.36E-07	Ecoinvent V2, diesel, at refinery, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	7.45E-08	kg/kg	1.40E-07	Ecoinvent V2, diesel, at refinery, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.99E-04	kg/kg	2.09E-04	Ecoinvent V2, diesel, at refinery, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.24E-03	kg/kg	8.70E-04	Ecoinvent V2, diesel, at refinery, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.11E-04	kg/kg	7.79E-05	Ecoinvent V2, diesel, at refinery, RER
Nitrogen oxides	**air**		kg	0.7	**kg SO2-Eq**	**7.76E-05**	**kg/kg**	5.43E-05	**See values above from Pembina**

Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.06E-03	kg/kg	1.06E-03	Ecoinvent V2, diesel, at refinery, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.15E-03	kg/kg	3.15E-03	Ecoinvent V2, diesel, at refinery, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.25E-05	kg/kg	1.25E-05	Ecoinvent V2, diesel, at refinery, RER
Sulfur dioxide	**air**		kg	1	**kg SO2-Eq**	**2.67E-04**	**kg/kg**	2.67E-04	**See values above from Pembina**
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	7.21E-09	kg/kg	1.35E-08	Ecoinvent V2, diesel, at refinery, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.86E-15	kg/kg	2.51E-15	Ecoinvent V2, diesel, at refinery, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	5.82E-14	kg/kg	3.78E-14	Ecoinvent V2, diesel, at refinery, RER
Sulfuric acid	**air**		kg	0.65	**kg SO2-Eq**	**3.40E-08**	**kg/kg**	2.21E-08	**See values above from Pembina**
								3.41E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	6.05E-09	kg/kg	1.85E-08	Ecoinvent V2, diesel, at refinery, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.69E-10	kg/kg	1.13E-09	Ecoinvent V2, diesel, at refinery, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.50E-09	kg/kg	4.60E-09	Ecoinvent V2, diesel, at refinery, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.90E-12	kg/kg	5.80E-12	Ecoinvent V2, diesel, at refinery, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.21E-08	kg/kg	6.77E-08	Ecoinvent V2, diesel, at refinery, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.64E-06	kg/kg	5.01E-06	Ecoinvent V2, diesel, at refinery, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.29E-02	kg/kg	2.84E-04	Ecoinvent V2, diesel, at refinery, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.47E-06	kg/kg	3.23E-08	Ecoinvent V2, diesel, at refinery, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.30E-02	kg/kg	2.85E-04	Ecoinvent V2, diesel, at refinery, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.51E-06	kg/kg	3.32E-08	Ecoinvent V2, diesel, at refinery, RER
Phosphate	water	river	kg	1	kg PO4-Eq	6.19E-08	kg/kg	6.19E-08	Ecoinvent V2, diesel, at refinery, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.65E-07	kg/kg	5.05E-07	Ecoinvent V2, diesel, at refinery, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.27E-09	kg/kg	3.89E-09	Ecoinvent V2, diesel, at refinery, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at refinery, RER
								2.89E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.70E-02	kg/kg	2.68E-01	Ecoinvent V2, diesel, at refinery, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.09E-02	kg/kg	3.99E-01	Ecoinvent V2, diesel, at refinery, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.04E-04	Nm3/kg	8.11E-03	Ecoinvent V2, diesel, at refinery, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	5.54E-02	Nm3/kg	2.12E+00	Ecoinvent V2, diesel, at refinery, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.10E+00	kg/kg	5.06E+01	Ecoinvent V2, diesel, at refinery, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.43E-07	kg/kg	2.40E-06	Ecoinvent V2, diesel, at refinery, RER
								5.34E+01	
E9a	**Transport diesel diesel, at regional storage (transport to end user)**	Transportation of product from the refinery to the end user. Operation of storage tanks and petrol stations. Emissions from evaporation and treatment of effluents. Excluding emissions from car-washing at petrol stations.							Ecoinvent V2, diesel, at regional storage, RER
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.32E-01	kg/kg	2.32E-01	Ecoinvent V2, diesel, at regional storage, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.05E-01	kg/kg	2.05E-01	Ecoinvent V2, diesel, at regional storage, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.46E-08	kg/kg	1.46E-08	Ecoinvent V2, diesel, at regional storage, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	2.29E-02	kg/kg	2.29E-02	Ecoinvent V2, diesel, at regional storage, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	5.49E-05	kg/kg	8.62E-05	Ecoinvent V2, diesel, at regional storage, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	3.96E-04	kg/kg	6.23E-04	Ecoinvent V2, diesel, at regional storage, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.71E-11	kg/kg	2.69E-11	Ecoinvent V2, diesel, at regional storage, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.82E-04	kg/kg	4.43E-04	Ecoinvent V2, diesel, at regional storage, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.90E-11	kg/kg	8.70E-10	Ecoinvent V2, diesel, at regional storage, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.04E-12	kg/kg	3.11E-11	Ecoinvent V2, diesel, at regional storage, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.40E-19	kg/kg	1.02E-17	Ecoinvent V2, diesel, at regional storage, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	3.17E-06	kg/kg	9.46E-04	Ecoinvent V2, diesel, at regional storage, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	4.30E-06	kg/kg	1.28E-03	Ecoinvent V2, diesel, at regional storage, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.39E-13	kg/kg	4.13E-11	Ecoinvent V2, diesel, at regional storage, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.30E-06	kg/kg	3.88E-04	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	8.32E-13	kg/kg	1.19E-09	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.29E-11	kg/kg	7.56E-08	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.13E-08	kg/kg	1.62E-05	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.18E-13	kg/kg	1.34E-09	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	6.83E-11	kg/kg	8.47E-09	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	9.14E-10	kg/kg	9.14E-06	Ecoinvent V2, diesel, at regional storage, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.67E-11	kg/kg	2.04E-07	Ecoinvent V2, diesel, at regional storage, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	7.54E-10	kg/kg	9.20E-06	Ecoinvent V2, diesel, at regional storage, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	3.06E-08	kg/kg	7.65E-07	Ecoinvent V2, diesel, at regional storage, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.53E-06	kg/kg	3.82E-05	Ecoinvent V2, diesel, at regional storage, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.03E-06	kg/kg	2.57E-05	Ecoinvent V2, diesel, at regional storage, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	9.22E-19	kg/kg	4.61E-18	Ecoinvent V2, diesel, at regional storage, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	6.39E-10	kg/kg	1.21E-06	Ecoinvent V2, diesel, at regional storage, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.06E-16	kg/kg	2.19E-12	Ecoinvent V2, diesel, at regional storage, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	3.81E-08	kg/kg	2.72E-04	Ecoinvent V2, diesel, at regional storage, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	3.65E-11	kg/kg	6.61E-08	Ecoinvent V2, diesel, at regional storage, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.51E-09	kg/kg	4.55E-06	Ecoinvent V2, diesel, at regional storage, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.64E-12	kg/kg	2.29E-11	Ecoinvent V2, diesel, at regional storage, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.07E-12	kg/kg	2.67E-11	Ecoinvent V2, diesel, at regional storage, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.51E-12	kg/kg	1.64E-08	Ecoinvent V2, diesel, at regional storage, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	5.07E-12	kg/kg	5.53E-08	Ecoinvent V2, diesel, at regional storage, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.13E-19	kg/kg	6.68E-15	Ecoinvent V2, diesel, at regional storage, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.37E-15	kg/kg	4.97E-13	Ecoinvent V2, diesel, at regional storage, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	7.04E-05	kg/kg	1.76E-03	Ecoinvent V2, diesel, at regional storage, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.81E-03	kg/kg	4.51E-02	Ecoinvent V2, diesel, at regional storage, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.31E-13	kg/kg	5.78E-12	Ecoinvent V2, diesel, at regional storage, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.13E-06	kg/kg	2.82E-05	Ecoinvent V2, diesel, at regional storage, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	5.65E-10	kg/kg	7.91E-07	Ecoinvent V2, diesel, at regional storage, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.74E-16	kg/kg	3.84E-13	Ecoinvent V2, diesel, at regional storage, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.51E-12	kg/kg	2.60E-08	Ecoinvent V2, diesel, at regional storage, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.79E-09	kg/kg	5.02E-05	Ecoinvent V2, diesel, at regional storage, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.84E-15	kg/kg	1.83E-11	Ecoinvent V2, diesel, at regional storage, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	7.53E-13	kg/kg	1.11E-08	Ecoinvent V2, diesel, at regional storage, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	4.59E-12	kg/kg	1.05E-07	Ecoinvent V2, diesel, at regional storage, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.18E-08	kg/kg	2.69E-04	Ecoinvent V2, diesel, at regional storage, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	5.98E-14	kg/kg	7.77E-13	Ecoinvent V2, diesel, at regional storage, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	5.61E-12	kg/kg	7.29E-11	Ecoinvent V2, diesel, at regional storage, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.62E-05	kg/kg	1.62E-05	Ecoinvent V2, diesel, at regional storage, RER

Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
								5.12E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	7.94E-07	kg/kg	1.49E-06	Ecoinvent V2, diesel, at regional storage, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	3.90E-06	kg/kg	7.32E-06	Ecoinvent V2, diesel, at regional storage, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	4.01E-06	kg/kg	7.53E-06	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.17E-06	kg/kg	1.91E-06	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	5.74E-06	kg/kg	5.05E-06	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.50E-06	kg/kg	1.32E-06	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	2.01E-07	kg/kg	3.21E-07	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.19E-06	kg/kg	1.90E-06	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.07E-07	kg/kg	1.71E-07	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.32E-10	kg/kg	2.48E-10	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	3.30E-07	kg/kg	6.21E-07	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	8.57E-08	kg/kg	1.61E-07	Ecoinvent V2, diesel, at regional storage, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.06E-04	kg/kg	2.14E-04	Ecoinvent V2, diesel, at regional storage, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.30E-03	kg/kg	9.12E-04	Ecoinvent V2, diesel, at regional storage, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.69E-04	kg/kg	1.18E-04	Ecoinvent V2, diesel, at regional storage, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.07E-03	kg/kg	1.07E-03	Ecoinvent V2, diesel, at regional storage, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.25E-03	kg/kg	3.25E-03	Ecoinvent V2, diesel, at regional storage, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.49E-05	kg/kg	1.49E-05	Ecoinvent V2, diesel, at regional storage, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	8.31E-09	kg/kg	1.56E-08	Ecoinvent V2, diesel, at regional storage, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	5.96E-15	kg/kg	3.87E-15	Ecoinvent V2, diesel, at regional storage, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	6.78E-14	kg/kg	4.41E-14	Ecoinvent V2, diesel, at regional storage, RER
								5.60E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	7.14E-09	kg/kg	2.19E-08	Ecoinvent V2, diesel, at regional storage, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.26E-10	kg/kg	1.30E-09	Ecoinvent V2, diesel, at regional storage, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.76E-09	kg/kg	5.38E-09	Ecoinvent V2, diesel, at regional storage, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.93E-12	kg/kg	8.97E-12	Ecoinvent V2, diesel, at regional storage, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.60E-08	kg/kg	7.96E-08	Ecoinvent V2, diesel, at regional storage, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.64E-06	kg/kg	5.03E-06	Ecoinvent V2, diesel, at regional storage, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.29E-02	kg/kg	2.84E-04	Ecoinvent V2, diesel, at regional storage, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.70E-06	kg/kg	3.75E-08	Ecoinvent V2, diesel, at regional storage, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.30E-02	kg/kg	2.86E-04	Ecoinvent V2, diesel, at regional storage, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.74E-06	kg/kg	3.84E-08	Ecoinvent V2, diesel, at regional storage, RER
Phosphate	water	river	kg	1	kg PO4-Eq	1.25E-07	kg/kg	1.25E-07	Ecoinvent V2, diesel, at regional storage, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.69E-07	kg/kg	5.16E-07	Ecoinvent V2, diesel, at regional storage, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.34E-09	kg/kg	4.11E-09	Ecoinvent V2, diesel, at regional storage, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, diesel, at regional storage, RER
								5.76E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	3.15E-02	kg/kg	3.12E-01	Ecoinvent V2, diesel, at regional storage, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.43E-02	kg/kg	4.64E-01	Ecoinvent V2, diesel, at regional storage, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.37E-04	Nm3/kg	9.43E-03	Ecoinvent V2, diesel, at regional storage, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	5.69E-02	Nm3/kg	2.18E+00	Ecoinvent V2, diesel, at regional storage, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.11E+00	kg/kg	5.08E+01	Ecoinvent V2, diesel, at regional storage, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	3.43E-07	kg/kg	3.40E-06	Ecoinvent V2, diesel, at regional storage, RER
								5.37E+01	

E7b	**Refine crude into coloured diesel**	see Refine crude into Diesel E7a	Assumed combustion/production/ delivery of coloured diesel same as regular diesel

back to top

E9b	**Transport coloured diesel**	see Transport Diesel E9a	Assumed combustion/production/ delivery of coloured diesel same as regular diesel

back to top

E7c	**Refine crude into gasoline**	petrol, unleaded, at refinery RER	Refine Crude Oil - Pembina Institute (kg/L crude refined) **(specific for Alberta)**

back to top

These emissions replace Ecoinvent emissions below

CO	4.11E-04	Air	kg/l	Pembina Institute
CO2	1.02E-01	Air	kg/l	Pembina Institute
NOx	9.75E-05	Air	kg/l	Pembina Institute
SO2	3.35E-04	Air	kg/l	Pembina Institute
Sulphuric Acid	4.28E-08	Air	kg/l	Pembina Institute

Density of crude oil = 8.70E+02 kg/m3

back to top

Description of all flows of materials and energy due to the throughput of 1kg crude oil in the refinery. The multi-output-process 'crude oil, in refinery' delivers the co-products petrol, unleaded, bitumen, diesel, light fuel oil, heavy fuel oil, kerosene, naphtha, propane/ butane, refinery gas, secondary sulphur and electricity. The impacts of processing are allocated to the different products.

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	3.97E-01	kg/kg	3.97E-01	petrol, unleaded, at refinery, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.09E-01	kg/kg	2.09E-01	petrol, unleaded, at refinery, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	2.37E-07	kg/kg	2.37E-07	petrol, unleaded, at refinery, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.81E-02	kg/kg	1.81E-02	petrol, unleaded, at refinery, RER
Carbon Dioxide	**air**			1	kg CO2-Eq	**1.18E-01**	**kg/kg**	1.18E-01	**See values above from Pembina**
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.19E-04	kg/kg	1.87E-04	petrol, unleaded, at refinery, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	4.00E-04	kg/kg	6.28E-04	petrol, unleaded, at refinery, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.79E-10	kg/kg	4.38E-10	petrol, unleaded, at refinery, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.53E-04	kg/kg	3.98E-04	petrol, unleaded, at refinery, RER
Carbon Monoxide	**air**			1.5714	kg CO2-Eq	**4.73E-04**	**kg/kg**	7.43E-04	**See values above from Pembina**
Chloroform	air	high population density	kg	30	kg CO2-Eq	5.77E-11	kg/kg	1.73E-09	petrol, unleaded, at refinery, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.12E-12	kg/kg	3.35E-11	petrol, unleaded, at refinery, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	2.10E-19	kg/kg	6.30E-18	petrol, unleaded, at refinery, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.19E-06	kg/kg	1.25E-03	petrol, unleaded, at refinery, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	4.25E-06	kg/kg	1.27E-03	petrol, unleaded, at refinery, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	2.26E-12	kg/kg	6.74E-10	petrol, unleaded, at refinery, RER

Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.24E-06	kg/kg	3.70E-04	petrol, unleaded, at refinery, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.35E-12	kg/kg	3.36E-09	petrol, unleaded, at refinery, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.76E-11	kg/kg	8.24E-08	petrol, unleaded, at refinery, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	3.61E-09	kg/kg	5.17E-06	petrol, unleaded, at refinery, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	8.65E-13	kg/kg	5.30E-09	petrol, unleaded, at refinery, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	7.48E-11	kg/kg	9.27E-09	petrol, unleaded, at refinery, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	9.96E-10	kg/kg	9.96E-06	petrol, unleaded, at refinery, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	6.15E-11	kg/kg	7.50E-07	petrol, unleaded, at refinery, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	7.61E-10	kg/kg	9.28E-06	petrol, unleaded, at refinery, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.82E-07	kg/kg	4.54E-06	petrol, unleaded, at refinery, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.53E-06	kg/kg	3.82E-05	petrol, unleaded, at refinery, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.13E-06	kg/kg	2.82E-05	petrol, unleaded, at refinery, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	5.70E-19	kg/kg	2.85E-18	petrol, unleaded, at refinery, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	9.14E-10	kg/kg	1.73E-06	petrol, unleaded, at refinery, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.00E-16	kg/kg	1.43E-12	petrol, unleaded, at refinery, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	3.86E-08	kg/kg	2.76E-04	petrol, unleaded, at refinery, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	3.62E-11	kg/kg	6.55E-08	petrol, unleaded, at refinery, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.51E-09	kg/kg	6.36E-06	petrol, unleaded, at refinery, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	3.03E-12	kg/kg	2.64E-11	petrol, unleaded, at refinery, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.31E-12	kg/kg	2.88E-11	petrol, unleaded, at refinery, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.23E-12	kg/kg	3.52E-08	petrol, unleaded, at refinery, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	6.05E-12	kg/kg	6.60E-08	petrol, unleaded, at refinery, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	3.79E-19	kg/kg	4.13E-15	petrol, unleaded, at refinery, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	6.68E-15	kg/kg	1.40E-12	petrol, unleaded, at refinery, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.70E-04	kg/kg	4.26E-03	petrol, unleaded, at refinery, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.87E-03	kg/kg	4.68E-02	petrol, unleaded, at refinery, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	3.77E-12	kg/kg	9.42E-11	petrol, unleaded, at refinery, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	6.95E-07	kg/kg	1.74E-05	petrol, unleaded, at refinery, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	8.93E-10	kg/kg	1.25E-06	petrol, unleaded, at refinery, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.69E-16	kg/kg	2.37E-13	petrol, unleaded, at refinery, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.85E-12	kg/kg	2.84E-08	petrol, unleaded, at refinery, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.85E-09	kg/kg	5.06E-05	petrol, unleaded, at refinery, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.08E-14	kg/kg	5.15E-11	petrol, unleaded, at refinery, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.12E-12	kg/kg	3.14E-08	petrol, unleaded, at refinery, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	5.51E-12	kg/kg	1.26E-07	petrol, unleaded, at refinery, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.29E-08	kg/kg	2.95E-04	petrol, unleaded, at refinery, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	6.38E-14	kg/kg	8.29E-13	petrol, unleaded, at refinery, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	6.04E-12	kg/kg	7.86E-11	petrol, unleaded, at refinery, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.58E-05	kg/kg	1.58E-05	petrol, unleaded, at refinery, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
								1.73E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	8.06E-07	kg/kg	1.52E-06	petrol, unleaded, at refinery, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	3.59E-06	kg/kg	6.76E-06	petrol, unleaded, at refinery, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.97E-06	kg/kg	3.71E-06	petrol, unleaded, at refinery, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.68E-06	kg/kg	3.23E-06	petrol, unleaded, at refinery, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	6.20E-06	kg/kg	5.46E-06	petrol, unleaded, at refinery, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	4.95E-07	kg/kg	4.36E-07	petrol, unleaded, at refinery, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.36E-07	kg/kg	5.38E-07	petrol, unleaded, at refinery, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.30E-06	kg/kg	2.07E-06	petrol, unleaded, at refinery, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.02E-07	kg/kg	1.63E-07	petrol, unleaded, at refinery, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.41E-10	kg/kg	2.66E-10	petrol, unleaded, at refinery, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	4.47E-07	kg/kg	8.41E-07	petrol, unleaded, at refinery, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	8.12E-08	kg/kg	1.53E-07	petrol, unleaded, at refinery, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	5.30E-04	kg/kg	3.71E-04	petrol, unleaded, at refinery, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.29E-03	kg/kg	9.04E-04	petrol, unleaded, at refinery, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.23E-04	kg/kg	8.63E-05	petrol, unleaded, at refinery, RER
Nitrogen oxides	**air**		kg	0.7	**kg SO2-Eq**	**1.12E-04**	**kg/kg**	7.85E-05	**See values above from Pembina**
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.82E-03	kg/kg	1.82E-03	petrol, unleaded, at refinery, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.76E-03	kg/kg	3.76E-03	petrol, unleaded, at refinery, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.35E-05	kg/kg	1.35E-05	petrol, unleaded, at refinery, RER
Sulfur dioxide	**air**		kg	1	**kg SO2-Eq**	**3.86E-04**	**kg/kg**	3.86E-04	**See values above from Pembina**
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	7.74E-09	kg/kg	1.45E-08	petrol, unleaded, at refinery, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.36E-14	kg/kg	1.54E-14	petrol, unleaded, at refinery, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	7.42E-14	kg/kg	4.83E-14	petrol, unleaded, at refinery, RER
Sulfuric acid	**air**		kg	0.65	**kg SO2-Eq**	**4.92E-08**	**kg/kg**	3.20E-08	**See values above from Pembina**
								4.89E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	7.68E-09	kg/kg	2.35E-08	petrol, unleaded, at refinery, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.11E-10	kg/kg	1.26E-09	petrol, unleaded, at refinery, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.92E-09	kg/kg	5.87E-09	petrol, unleaded, at refinery, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.95E-12	kg/kg	9.04E-12	petrol, unleaded, at refinery, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.83E-08	kg/kg	8.66E-08	petrol, unleaded, at refinery, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.67E-06	kg/kg	5.10E-06	petrol, unleaded, at refinery, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.31E-02	kg/kg	2.88E-04	petrol, unleaded, at refinery, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.20E-06	kg/kg	7.04E-08	petrol, unleaded, at refinery, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.32E-02	kg/kg	2.90E-04	petrol, unleaded, at refinery, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.09E-06	kg/kg	1.34E-07	petrol, unleaded, at refinery, RER
Phosphate	water	river	kg	1	kg PO4-Eq	8.39E-08	kg/kg	8.39E-08	petrol, unleaded, at refinery, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.71E-07	kg/kg	5.25E-07	petrol, unleaded, at refinery, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	9.31E-08	kg/kg	2.85E-07	petrol, unleaded, at refinery, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	petrol, unleaded, at refinery, RER
								5.85E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	3.45E-02	kg/kg	3.42E-01	petrol, unleaded, at refinery, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.58E-02	kg/kg	4.93E-01	petrol, unleaded, at refinery, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.48E-04	Nm3/kg	9.86E-03	petrol, unleaded, at refinery, RER

Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	7.17E-02	Nm3/kg	2.74E+00	petrol, unleaded, at refinery, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.14E+00	kg/kg	5.23E+01	petrol, unleaded, at refinery, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.22E-06	kg/kg	4.18E-05	petrol, unleaded, at refinery, RER
								5.59E+01	petrol, unleaded, at refinery, RER
E9c	**Transport gasoline**	petrol, unleaded, at regional storage RER							
back to top		Transportation of product from the refinery to the end user. Operation of storage tanks and petrol stations. Emissions from evaporation and treatment of effluents. Excluding emissions from car-washing at petrol stations.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	4.03E-01	kg/kg	4.03E-01	petrol, unleaded, at regional storage RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.22E-01	kg/kg	2.22E-01	petrol, unleaded, at regional storage RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	2.38E-07	kg/kg	2.38E-07	petrol, unleaded, at regional storage RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	2.44E-02	kg/kg	2.44E-02	petrol, unleaded, at regional storage RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.20E-04	kg/kg	1.89E-04	petrol, unleaded, at regional storage RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	4.08E-04	kg/kg	6.41E-04	petrol, unleaded, at regional storage RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.80E-10	kg/kg	4.40E-10	petrol, unleaded, at regional storage RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.99E-04	kg/kg	4.69E-04	petrol, unleaded, at regional storage RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	6.30E-11	kg/kg	1.89E-09	petrol, unleaded, at regional storage RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.30E-12	kg/kg	3.90E-11	petrol, unleaded, at regional storage RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	4.78E-19	kg/kg	1.43E-17	petrol, unleaded, at regional storage RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.32E-06	kg/kg	1.29E-03	petrol, unleaded, at regional storage RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	4.61E-06	kg/kg	1.37E-03	petrol, unleaded, at regional storage RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	2.27E-12	kg/kg	6.76E-10	petrol, unleaded, at regional storage RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.54E-06	kg/kg	4.58E-04	petrol, unleaded, at regional storage RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.57E-12	kg/kg	3.68E-09	petrol, unleaded, at regional storage RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	6.53E-11	kg/kg	9.34E-08	petrol, unleaded, at regional storage RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.24E-08	kg/kg	1.77E-05	petrol, unleaded, at regional storage RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	9.42E-13	kg/kg	5.78E-09	petrol, unleaded, at regional storage RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	8.45E-11	kg/kg	1.05E-08	petrol, unleaded, at regional storage RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.13E-09	kg/kg	1.13E-05	petrol, unleaded, at regional storage RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	6.70E-11	kg/kg	8.18E-07	petrol, unleaded, at regional storage RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.15E-09	kg/kg	1.40E-05	petrol, unleaded, at regional storage RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.89E-07	kg/kg	4.72E-06	petrol, unleaded, at regional storage RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.82E-06	kg/kg	4.54E-05	petrol, unleaded, at regional storage RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.27E-06	kg/kg	3.18E-05	petrol, unleaded, at regional storage RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.30E-18	kg/kg	6.48E-18	petrol, unleaded, at regional storage RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	9.79E-10	kg/kg	1.85E-06	petrol, unleaded, at regional storage RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.54E-16	kg/kg	2.53E-12	petrol, unleaded, at regional storage RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	3.87E-08	kg/kg	2.77E-04	petrol, unleaded, at regional storage RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	6.49E-11	kg/kg	1.18E-07	petrol, unleaded, at regional storage RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.82E-09	kg/kg	6.91E-06	petrol, unleaded, at regional storage RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	3.38E-12	kg/kg	2.94E-11	petrol, unleaded, at regional storage RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.85E-12	kg/kg	3.35E-11	petrol, unleaded, at regional storage RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.55E-12	kg/kg	3.87E-08	petrol, unleaded, at regional storage RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	6.28E-12	kg/kg	6.84E-08	petrol, unleaded, at regional storage RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	8.61E-19	kg/kg	9.39E-15	petrol, unleaded, at regional storage RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	7.31E-15	kg/kg	1.54E-12	petrol, unleaded, at regional storage RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.72E-04	kg/kg	4.30E-03	petrol, unleaded, at regional storage RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.91E-03	kg/kg	4.77E-02	petrol, unleaded, at regional storage RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	3.78E-12	kg/kg	9.46E-11	petrol, unleaded, at regional storage RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.09E-06	kg/kg	2.72E-05	petrol, unleaded, at regional storage RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	9.30E-10	kg/kg	1.30E-06	petrol, unleaded, at regional storage RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.85E-16	kg/kg	5.39E-13	petrol, unleaded, at regional storage RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	4.34E-12	kg/kg	3.21E-08	petrol, unleaded, at regional storage RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.03E-08	kg/kg	7.64E-05	petrol, unleaded, at regional storage RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.19E-14	kg/kg	5.64E-11	petrol, unleaded, at regional storage RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.33E-12	kg/kg	3.44E-08	petrol, unleaded, at regional storage RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	6.41E-12	kg/kg	1.46E-07	petrol, unleaded, at regional storage RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.46E-08	kg/kg	3.33E-04	petrol, unleaded, at regional storage RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	8.30E-14	kg/kg	1.08E-12	petrol, unleaded, at regional storage RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	7.02E-12	kg/kg	9.13E-11	petrol, unleaded, at regional storage RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.80E-05	kg/kg	1.80E-05	petrol, unleaded, at regional storage RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
								7.06E-01	petrol, unleaded, at regional storage RER
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	8.42E-07	kg/kg	1.58E-06	petrol, unleaded, at regional storage RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	4.04E-06	kg/kg	7.60E-06	petrol, unleaded, at regional storage RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	4.68E-06	kg/kg	8.80E-06	petrol, unleaded, at regional storage RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.72E-06	kg/kg	3.28E-06	petrol, unleaded, at regional storage RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	6.99E-06	kg/kg	6.15E-06	petrol, unleaded, at regional storage RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.68E-06	kg/kg	1.48E-06	petrol, unleaded, at regional storage RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.39E-07	kg/kg	5.42E-07	petrol, unleaded, at regional storage RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.46E-06	kg/kg	2.34E-06	petrol, unleaded, at regional storage RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.24E-07	kg/kg	1.99E-07	petrol, unleaded, at regional storage RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.11E-10	kg/kg	3.96E-10	petrol, unleaded, at regional storage RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	4.93E-07	kg/kg	9.27E-07	petrol, unleaded, at regional storage RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	9.26E-08	kg/kg	1.74E-07	petrol, unleaded, at regional storage RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	5.37E-04	kg/kg	3.76E-04	petrol, unleaded, at regional storage RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.35E-03	kg/kg	9.46E-04	petrol, unleaded, at regional storage RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.81E-04	kg/kg	1.27E-04	petrol, unleaded, at regional storage RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.83E-03	kg/kg	1.83E-03	petrol, unleaded, at regional storage RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.86E-03	kg/kg	3.86E-03	petrol, unleaded, at regional storage RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.59E-05	kg/kg	1.59E-05	petrol, unleaded, at regional storage RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	8.86E-09	kg/kg	1.67E-08	petrol, unleaded, at regional storage RER

Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.57E-14	kg/kg	1.67E-14	petrol, unleaded, at regional storage RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	8.38E-14	kg/kg	5.45E-14	petrol, unleaded, at regional storage RER
								7.19E-03	petrol, unleaded, at regional storage RER
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	8.78E-09	kg/kg	2.69E-08	petrol, unleaded, at regional storage RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.69E-10	kg/kg	1.44E-09	petrol, unleaded, at regional storage RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.17E-09	kg/kg	6.65E-09	petrol, unleaded, at regional storage RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	4.06E-12	kg/kg	1.24E-11	petrol, unleaded, at regional storage RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.23E-08	kg/kg	9.87E-08	petrol, unleaded, at regional storage RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.67E-06	kg/kg	5.12E-06	petrol, unleaded, at regional storage RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.31E-02	kg/kg	2.89E-04	petrol, unleaded, at regional storage RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.44E-06	kg/kg	7.57E-08	petrol, unleaded, at regional storage RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.32E-02	kg/kg	2.91E-04	petrol, unleaded, at regional storage RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.33E-06	kg/kg	1.39E-07	petrol, unleaded, at regional storage RER
Phosphate	water	river	kg	1	kg PO4-Eq	1.47E-07	kg/kg	1.47E-07	petrol, unleaded, at regional storage RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.75E-07	kg/kg	5.36E-07	petrol, unleaded, at regional storage RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	9.32E-08	kg/kg	2.85E-07	petrol, unleaded, at regional storage RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	petrol, unleaded, at regional storage RER
								5.87E-04	petrol, unleaded, at regional storage RER
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	3.89E-02	kg/kg	3.85E-01	petrol, unleaded, at regional storage RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.92E-02	kg/kg	5.58E-01	petrol, unleaded, at regional storage RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.81E-04	Nm3/kg	1.12E-02	petrol, unleaded, at regional storage RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	7.32E-02	Nm3/kg	2.80E+00	petrol, unleaded, at regional storage RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.15E+00	kg/kg	5.25E+01	petrol, unleaded, at regional storage RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.32E-06	kg/kg	4.28E-05	petrol, unleaded, at regional storage RER
								5.63E+01	petrol, unleaded, at regional storage RER

E12a and E12b Combust Diesel in Agricultural Equipment - Off-Road Mobile Sources and Machinery (Agriculture - Diesel)

back to top

Carbon Dioxide	air	kg/TJ	7.41E+04	kg/kg	2.93E+00	Intergovernmental Panel on Climate Change (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Chapter 3: Mobile Combustion. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
Methane	air	kg/TJ	4.15E+00	kg/kg	4.11E-03	Intergovernmental Panel on Climate Change (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Chapter 3: Mobile Combustion. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
Dinitrogen Monoxide	air	kg/TJ	2.86E+01	kg/kg	3.38E-01	Intergovernmental Panel on Climate Change (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Chapter 3: Mobile Combustion. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
					3.28E+00	

E12c Combust Gasoline in Agricultural Equipment - Off-Road Mobile Sources and Machinery (Agriculture - Gasoline)

Carbon Dioxide	air	kg/TJ	6.93E+04	kg/kg	3.11E+00	Intergovernmental Panel on Climate Change (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Chapter 3: Mobile Combustion. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
Methane	air	kg/TJ	1.80E+02	kg/kg	2.02E-01	Intergovernmental Panel on Climate Change (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Chapter 3: Mobile Combustion. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
Dinitrogen Monoxide	air	kg/TJ	4.00E-01	kg/kg	5.35E-03	Intergovernmental Panel on Climate Change (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Chapter 3: Mobile Combustion. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
					3.32E+00	

Assumed combustion/production/ delivery of coloured diesel same as regular diesel

E2, E5, E8, E10 Natural Gas Production, Processing, Distribution/ Deliver / Combust

back to top

	Natural Gas End-Use Combustion Efficiency				
	Furnace Efficiency	8.25E-01			Selected from options below
	Low efficiency (residential)	6.00E-01			NRCan (2005). Heating with Gas. Accessed online June 2008 at http://oee.nrcan.gc.ca/publications/infosource/pub/home/Heating_With_Gas_Contents.cfm?text=N&printview=N
	Standard efficiency (residential)	8.00E-01			NRCan (2005). Heating with Gas. Accessed online June 2008 at http://oee.nrcan.gc.ca/publications/infosource/pub/home/Heating_With_Gas_Contents.cfm?text=N&printview=N
	High efficiency (residential)	9.25E-01			NRCan (2005). Heating with Gas. Accessed online June 2008 at http://oee.nrcan.gc.ca/publications/infosource/pub/home/Heating_With_Gas_Contents.cfm?text=N&printview=N
	Standard efficiency (commercial)	6.45E-01			Government of Alberta. Utilities Consumer Advocate. Natural Gas Furnaces. Available at: http://www.ucahelps.gov.ab.ca/141.html
	Mid efficiency (commercial)	8.25E-01			Government of Alberta. Utilities Consumer Advocate. Natural Gas Furnaces. Available at: http://www.ucahelps.gov.ab.ca/141.html
	Condensing efficiency (commercial)	9.35E-01			Government of Alberta. Utilities Consumer Advocate. Natural Gas Furnaces. Available at: http://www.ucahelps.gov.ab.ca/141.html
	Natural Gas Combustion				
These emissions replace Ecoinvent emissions below	**Carbon Dioxide**	**1.92E+06**	air	**kg/10^6 m^3**	Environmental Protection Agency. 1998. AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources 1.4 Natural Gas Combustion, http://www.epa.gov/ttn/chief/ap42/ch01/index.html.
	Carbon Monoxide - Uncontrolled Residential Furnace	**6.40E+02**	air	**kg/10^6 m^3**	Environmental Protection Agency. 1998. AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources 1.4 Natural Gas Combustion, http://www.epa.gov/ttn/chief/ap42/ch01/index.html.
	Dinitrogen Monoxide - Uncontrolled Furnace	**3.52E+01**	air	**kg/10^6 m^3**	Environmental Protection Agency. 1998. AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources 1.4 Natural Gas Combustion, http://www.epa.gov/ttn/chief/ap42/ch01/index.html.
	Methane	**3.68E+01**	air	**kg/10^6 m^3**	Environmental Protection Agency. 1998. AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources 1.4 Natural Gas Combustion, http://www.epa.gov/ttn/chief/ap42/ch01/index.html.
	Nitrogen Oxides- Uncontrolled Residential Furnace	**1.50E+03**	air	**kg/10^6 m^3**	Environmental Protection Agency. 1998. AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources 1.4 Natural Gas Combustion, http://www.epa.gov/ttn/chief/ap42/ch01/index.html.
	Sulphur Dioxide	**9.60E+00**	air	**kg/10^6 m^3**	Environmental Protection Agency. 1998. AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources 1.4 Natural Gas Combustion, http://www.epa.gov/ttn/chief/ap42/ch01/index.html.
	Natural Gas Production, Processing, and Distribution				
**** Values inserted into the production of natural gas as they are combined values and could not be separated.**	**Carbon Dioxide**	**2.06E+02**	air	**g / m^3**	Canadian Association of Petroleum Producers. 2005. A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory, http://www.capp.ca/library/publications/climateChange/Pages/default.aspx.

These emissions replace Ecoinvent emissions below	**Methane**	**8.50E+00**	air	**g / m³**	Canadian Association of Petroleum Producers. 2005. A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory, http://www.capp.ca/library/publications/climateChange/Pages/default.aspx.
(doesn't include natural gas transmission by pipeline)	**Nitrogen Oxides**	**9.79E-03**	air	**g / m³**	Canadian Association of Petroleum Producers. 2005. A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory, http://www.capp.ca/library/publications/climateChange/Pages/default.aspx.
	Natural Gas Production (Canada - 2000)	2.18E+11		m³/year	Canadian Association of Petroleum Producers. 2005. A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory, http://www.capp.ca/library/publications/climateChange/Pages/default.aspx.
	Emissions - Upstream NG (Produce, Process, Transport) CO2	4.49E+04		kt/year	Canadian Association of Petroleum Producers. 2005. A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory, http://www.capp.ca/library/publications/climateChange/Pages/default.aspx.
	Emissions - Upstream NG (Produce, Process, Transport) CH4	1.85E+03		kt/year	Canadian Association of Petroleum Producers. 2005. A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory, http://www.capp.ca/library/publications/climateChange/Pages/default.aspx.
	Emissions - Upstream NG (Produce, Process, Transport) NOx	2.13E+00		kt/year	Canadian Association of Petroleum Producers. 2005. A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory, http://www.capp.ca/library/publications/climateChange/Pages/default.aspx.

E2 **Produce natural gas**

back to top

The dataset includes data for natural gas extracted from onshore and offshore wells. Furthermore, the dataset includes data for natural gas co-extracted with crude oil as well as for wells that produce only natural gas.

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.08E-03	kg/m3	1.08E-03	natural gas, unprocessed, at extraction, RNA
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.71E-02	kg/m3	1.71E-02	natural gas, unprocessed, at extraction, RNA
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	4.89E-11	kg/m3	4.89E-11	natural gas, unprocessed, at extraction, RNA
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	3.53E-03	kg/m3	3.53E-03	natural gas, unprocessed, at extraction, RNA
Carbon dioxide	**air**		**kg**	**1**	**kg CO2-Eq**	**2.06E-01**	**kg/m3**	**2.06E-01**	**See calculations above for producing, processing and distributing natural gas**
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.37E-07	kg/m3	3.72E-07	natural gas, unprocessed, at extraction, RNA
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.27E-06	kg/m3	3.57E-06	natural gas, unprocessed, at extraction, RNA
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	5.74E-14	kg/m3	9.02E-14	natural gas, unprocessed, at extraction, RNA
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	6.46E-06	kg/m3	1.01E-05	natural gas, unprocessed, at extraction, RNA
Chloroform	air	high population density	kg	30	kg CO2-Eq	6.45E-12	kg/m3	1.93E-10	natural gas, unprocessed, at extraction, RNA
Chloroform	air	low population density	kg	30	kg CO2-Eq	3.27E-10	kg/m3	9.82E-09	natural gas, unprocessed, at extraction, RNA
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.08E-16	kg/m3	9.25E-15	natural gas, unprocessed, at extraction, RNA
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	9.51E-08	kg/m3	2.83E-05	natural gas, unprocessed, at extraction, RNA
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	5.42E-07	kg/m3	1.61E-04	natural gas, unprocessed, at extraction, RNA
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	4.65E-16	kg/m3	1.39E-13	natural gas, unprocessed, at extraction, RNA
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	7.44E-08	kg/m3	2.22E-05	natural gas, unprocessed, at extraction, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.35E-14	kg/m3	3.36E-11	natural gas, unprocessed, at extraction, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.11E-11	kg/m3	4.44E-08	natural gas, unprocessed, at extraction, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	5.25E-11	kg/m3	7.51E-08	natural gas, unprocessed, at extraction, RNA
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.68E-15	kg/m3	1.03E-11	natural gas, unprocessed, at extraction, RNA
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	4.01E-12	kg/m3	4.97E-10	natural gas, unprocessed, at extraction, RNA
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	4.40E-10	kg/m3	4.40E-06	natural gas, unprocessed, at extraction, RNA
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.15E-13	kg/m3	2.62E-09	natural gas, unprocessed, at extraction, RNA
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	6.44E-11	kg/m3	7.86E-07	natural gas, unprocessed, at extraction, RNA
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.62E-09	kg/m3	4.06E-08	natural gas, unprocessed, at extraction, RNA
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	2.21E-07	kg/m3	5.52E-06	natural gas, unprocessed, at extraction, RNA
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.07E-07	kg/m3	2.68E-06	natural gas, unprocessed, at extraction, RNA
Methane	**air**		**kg**	**25**	**kg CO2-Eq**	**8.50E-03**	**kg/m3**	**2.12E-01**	**See calculations above for producing, processing and distributing natural gas**
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	8.35E-16	kg/m3	4.18E-15	natural gas, unprocessed, at extraction, RNA
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	2.08E-12	kg/m3	3.93E-09	natural gas, unprocessed, at extraction, RNA
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.40E-17	kg/m3	1.71E-13	natural gas, unprocessed, at extraction, RNA
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.42E-11	kg/m3	1.01E-07	natural gas, unprocessed, at extraction, RNA
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	3.61E-13	kg/m3	6.53E-10	natural gas, unprocessed, at extraction, RNA
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.82E-11	kg/m3	3.29E-08	natural gas, unprocessed, at extraction, RNA
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.08E-13	kg/m3	1.81E-12	natural gas, unprocessed, at extraction, RNA
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	9.69E-10	kg/m3	8.43E-09	natural gas, unprocessed, at extraction, RNA
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	4.13E-14	kg/m3	4.50E-10	natural gas, unprocessed, at extraction, RNA
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	7.80E-15	kg/m3	8.50E-11	natural gas, unprocessed, at extraction, RNA
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	5.55E-16	kg/m3	6.05E-12	natural gas, unprocessed, at extraction, RNA
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	6.68E-17	kg/m3	1.40E-14	natural gas, unprocessed, at extraction, RNA
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.05E-07	kg/m3	2.63E-06	natural gas, unprocessed, at extraction, RNA
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.24E-05	kg/m3	5.59E-04	natural gas, unprocessed, at extraction, RNA
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	7.76E-16	kg/m3	1.94E-14	natural gas, unprocessed, at extraction, RNA
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	9.10E-03	kg/m3	2.28E-01	natural gas, unprocessed, at extraction, RNA
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	5.33E-12	kg/m3	7.46E-09	natural gas, unprocessed, at extraction, RNA
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.48E-13	kg/m3	3.48E-10	natural gas, unprocessed, at extraction, RNA
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	2.07E-13	kg/m3	1.53E-09	natural gas, unprocessed, at extraction, RNA
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	5.80E-10	kg/m3	4.29E-06	natural gas, unprocessed, at extraction, RNA
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.09E-16	kg/m3	5.16E-13	natural gas, unprocessed, at extraction, RNA
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.13E-14	kg/m3	3.15E-10	natural gas, unprocessed, at extraction, RNA
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.88E-09	kg/m3	8.85E-05	natural gas, unprocessed, at extraction, RNA
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.39E-10	kg/m3	3.17E-06	natural gas, unprocessed, at extraction, RNA
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.72E-15	kg/m3	3.54E-14	natural gas, unprocessed, at extraction, RNA
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.77E-09	kg/m3	2.30E-08	natural gas, unprocessed, at extraction, RNA
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.65E-06	kg/m3	1.65E-06	natural gas, unprocessed, at extraction, RNA
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
								4.19E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	2.13E-08	kg/m3	4.00E-08	natural gas, unprocessed, at extraction, RNA
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	6.05E-08	kg/m3	1.14E-07	natural gas, unprocessed, at extraction, RNA
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	7.78E-07	kg/m3	1.46E-06	natural gas, unprocessed, at extraction, RNA
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.08E-08	kg/m3	1.83E-08	natural gas, unprocessed, at extraction, RNA
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.10E-06	kg/m3	3.61E-06	natural gas, unprocessed, at extraction, RNA
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.59E-08	kg/m3	1.40E-08	natural gas, unprocessed, at extraction, RNA
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.03E-09	kg/m3	1.65E-09	natural gas, unprocessed, at extraction, RNA

Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	5.18E-07	kg/m3	8.28E-07	natural gas, unprocessed, at extraction, RNA
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	3.40E-09	kg/m3	5.44E-09	natural gas, unprocessed, at extraction, RNA
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.36E-11	kg/m3	2.56E-11	natural gas, unprocessed, at extraction, RNA
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.82E-09	kg/m3	3.42E-09	natural gas, unprocessed, at extraction, RNA
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.77E-09	kg/m3	3.33E-09	natural gas, unprocessed, at extraction, RNA
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.10E-06	kg/m3	2.17E-06	natural gas, unprocessed, at extraction, RNA
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.93E-05	kg/m3	2.05E-05	natural gas, unprocessed, at extraction, RNA
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.12E-05	kg/m3	7.84E-06	natural gas, unprocessed, at extraction, RNA
Nitrogen oxides	**air**		**kg**	**0.7**	**kg SO2-Eq**	**9.79E-06**	**kg/m3**	**6.85E-06**	**See calculations above for producing, processing and distributing natural gas**
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	6.74E-06	kg/m3	6.74E-06	natural gas, unprocessed, at extraction, RNA
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	8.24E-05	kg/m3	8.24E-05	natural gas, unprocessed, at extraction, RNA
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	4.86E-04	kg/m3	4.86E-04	natural gas, unprocessed, at extraction, RNA
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	6.03E-11	kg/m3	1.13E-10	natural gas, unprocessed, at extraction, RNA
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	4.58E-17	kg/m3	2.98E-17	natural gas, unprocessed, at extraction, RNA
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.90E-15	kg/m3	2.54E-15	natural gas, unprocessed, at extraction, RNA
								5.88E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	9.97E-10	kg/m3	3.05E-09	natural gas, unprocessed, at extraction, RNA
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.61E-11	kg/m3	4.92E-11	natural gas, unprocessed, at extraction, RNA
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.48E-10	kg/m3	7.59E-10	natural gas, unprocessed, at extraction, RNA
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.82E-13	kg/m3	5.56E-13	natural gas, unprocessed, at extraction, RNA
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	4.16E-09	kg/m3	1.27E-08	natural gas, unprocessed, at extraction, RNA
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	6.02E-10	kg/m3	1.84E-09	natural gas, unprocessed, at extraction, RNA
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	4.66E-06	kg/m3	1.03E-07	natural gas, unprocessed, at extraction, RNA
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.67E-04	kg/m3	1.25E-05	natural gas, unprocessed, at extraction, RNA
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	4.75E-06	kg/m3	1.05E-07	natural gas, unprocessed, at extraction, RNA
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	9.38E-04	kg/m3	2.06E-05	natural gas, unprocessed, at extraction, RNA
Phosphate	water	river	kg	1	kg PO4-Eq	1.52E-09	kg/m3	1.52E-09	natural gas, unprocessed, at extraction, RNA
Phosphorus	water	river	kg	3.06	kg PO4-Eq	3.56E-10	kg/m3	1.09E-09	natural gas, unprocessed, at extraction, RNA
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.41E-12	kg/m3	4.33E-12	natural gas, unprocessed, at extraction, RNA
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/m3	0.00E+00	natural gas, unprocessed, at extraction, RNA
								3.33E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.05E-03	kg/m3	1.04E-02	natural gas, unprocessed, at extraction, RNA
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	9.13E-03	kg/m3	1.74E-01	natural gas, unprocessed, at extraction, RNA
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	5.99E-05	Nm3/m3	2.38E-03	natural gas, unprocessed, at extraction, RNA
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.03E+00	Nm3/m3	3.93E+01	natural gas, unprocessed, at extraction, RNA
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	4.08E-04	kg/m3	1.87E-02	natural gas, unprocessed, at extraction, RNA
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	7.79E-09	kg/m3	7.71E-08	natural gas, unprocessed, at extraction, RNA
								3.96E+01	
E5	**Transport natural**								transport, natural gas, pipeline, long distance, RER
back to top		This dataset describes the energy consumption and the emissions linked to the transport of 1 tkm average natural gas in Europe.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	4.83E-02	kg/tkm	4.83E-02	transport, natural gas, pipeline, long distance, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.18E-03	kg/tkm	2.18E-03	transport, natural gas, pipeline, long distance, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	5.77E-11	kg/tkm	5.77E-11	transport, natural gas, pipeline, long distance, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.75E-03	kg/tkm	1.75E-03	transport, natural gas, pipeline, long distance, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.44E-05	kg/tkm	5.40E-05	transport, natural gas, pipeline, long distance, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	4.78E-06	kg/tkm	7.51E-06	transport, natural gas, pipeline, long distance, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	6.78E-14	kg/tkm	1.07E-13	transport, natural gas, pipeline, long distance, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.82E-05	kg/tkm	4.43E-05	transport, natural gas, pipeline, long distance, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.64E-13	kg/tkm	7.91E-12	transport, natural gas, pipeline, long distance, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	8.39E-15	kg/tkm	2.52E-13	transport, natural gas, pipeline, long distance, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	7.64E-21	kg/tkm	2.29E-19	transport, natural gas, pipeline, long distance, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	8.57E-07	kg/tkm	2.55E-04	transport, natural gas, pipeline, long distance, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.39E-08	kg/tkm	7.14E-06	transport, natural gas, pipeline, long distance, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.50E-16	kg/tkm	1.64E-13	transport, natural gas, pipeline, long distance, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	3.98E-08	kg/tkm	1.18E-05	transport, natural gas, pipeline, long distance, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.24E-14	kg/tkm	1.78E-11	transport, natural gas, pipeline, long distance, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.91E-13	kg/tkm	5.59E-10	transport, natural gas, pipeline, long distance, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.16E-10	kg/tkm	3.08E-07	transport, natural gas, pipeline, long distance, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	4.43E-15	kg/tkm	2.71E-11	transport, natural gas, pipeline, long distance, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	4.63E-13	kg/tkm	5.75E-11	transport, natural gas, pipeline, long distance, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	6.76E-12	kg/tkm	6.76E-08	transport, natural gas, pipeline, long distance, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	3.17E-13	kg/tkm	3.86E-09	transport, natural gas, pipeline, long distance, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.43E-11	kg/tkm	2.97E-07	transport, natural gas, pipeline, long distance, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.01E-09	kg/tkm	5.03E-08	transport, natural gas, pipeline, long distance, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	2.71E-08	kg/tkm	6.78E-07	transport, natural gas, pipeline, long distance, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	7.13E-09	kg/tkm	1.78E-07	transport, natural gas, pipeline, long distance, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.07E-20	kg/tkm	1.04E-19	transport, natural gas, pipeline, long distance, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	2.35E-08	kg/tkm	4.44E-05	transport, natural gas, pipeline, long distance, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	4.27E-18	kg/tkm	3.05E-14	transport, natural gas, pipeline, long distance, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.64E-11	kg/tkm	1.17E-07	transport, natural gas, pipeline, long distance, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.86E-13	kg/tkm	5.18E-10	transport, natural gas, pipeline, long distance, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	7.31E-08	kg/tkm	1.32E-04	transport, natural gas, pipeline, long distance, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.70E-14	kg/tkm	1.48E-13	transport, natural gas, pipeline, long distance, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.48E-14	kg/tkm	2.16E-13	transport, natural gas, pipeline, long distance, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.83E-14	kg/tkm	2.00E-10	transport, natural gas, pipeline, long distance, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	4.31E-12	kg/tkm	4.70E-08	transport, natural gas, pipeline, long distance, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.38E-20	kg/tkm	1.50E-16	transport, natural gas, pipeline, long distance, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	3.54E-17	kg/tkm	7.43E-15	transport, natural gas, pipeline, long distance, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	4.24E-06	kg/tkm	1.06E-04	transport, natural gas, pipeline, long distance, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.33E-04	kg/tkm	8.33E-03	transport, natural gas, pipeline, long distance, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	9.17E-16	kg/tkm	2.29E-14	transport, natural gas, pipeline, long distance, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	4.85E-08	kg/tkm	1.21E-06	transport, natural gas, pipeline, long distance, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.76E-11	kg/tkm	3.86E-08	transport, natural gas, pipeline, long distance, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	6.16E-18	kg/tkm	8.62E-15	transport, natural gas, pipeline, long distance, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	2.38E-14	kg/tkm	1.76E-10	transport, natural gas, pipeline, long distance, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.19E-10	kg/tkm	1.62E-06	transport, natural gas, pipeline, long distance, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	5.74E-17	kg/tkm	2.73E-13	transport, natural gas, pipeline, long distance, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.13E-14	kg/tkm	1.67E-10	transport, natural gas, pipeline, long distance, RER

Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.99E-14	kg/tkm	9.10E-10	transport, natural gas, pipeline, long distance, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	8.93E-11	kg/tkm	2.04E-06	transport, natural gas, pipeline, long distance, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	4.48E-16	kg/tkm	5.83E-15	transport, natural gas, pipeline, long distance, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.53E-14	kg/tkm	5.89E-13	transport, natural gas, pipeline, long distance, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.67E-06	kg/tkm	1.67E-06	transport, natural gas, pipeline, long distance, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
								6.13E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	6.91E-09	kg/tkm	1.30E-08	transport, natural gas, pipeline, long distance, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.54E-08	kg/tkm	2.89E-08	transport, natural gas, pipeline, long distance, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	8.71E-08	kg/tkm	1.64E-07	transport, natural gas, pipeline, long distance, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.42E-08	kg/tkm	1.25E-08	transport, natural gas, pipeline, long distance, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	3.40E-08	kg/tkm	2.99E-08	transport, natural gas, pipeline, long distance, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	4.70E-08	kg/tkm	4.14E-08	transport, natural gas, pipeline, long distance, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	5.31E-10	kg/tkm	8.50E-10	transport, natural gas, pipeline, long distance, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	7.60E-09	kg/tkm	1.22E-08	transport, natural gas, pipeline, long distance, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	9.04E-09	kg/tkm	1.45E-08	transport, natural gas, pipeline, long distance, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.01E-12	kg/tkm	5.66E-12	transport, natural gas, pipeline, long distance, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	6.15E-07	kg/tkm	1.16E-06	transport, natural gas, pipeline, long distance, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	7.75E-09	kg/tkm	1.46E-08	transport, natural gas, pipeline, long distance, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.65E-04	kg/tkm	1.15E-04	transport, natural gas, pipeline, long distance, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	7.31E-06	kg/tkm	5.12E-06	transport, natural gas, pipeline, long distance, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.29E-05	kg/tkm	9.00E-06	transport, natural gas, pipeline, long distance, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.57E-06	kg/tkm	1.57E-06	transport, natural gas, pipeline, long distance, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.03E-05	kg/tkm	2.03E-05	transport, natural gas, pipeline, long distance, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.40E-06	kg/tkm	1.40E-06	transport, natural gas, pipeline, long distance, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	8.15E-10	kg/tkm	1.53E-09	transport, natural gas, pipeline, long distance, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.21E-16	kg/tkm	7.86E-17	transport, natural gas, pipeline, long distance, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	4.60E-16	kg/tkm	2.99E-16	transport, natural gas, pipeline, long distance, RER
								1.54E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.51E-10	kg/tkm	4.61E-10	transport, natural gas, pipeline, long distance, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.41E-11	kg/tkm	1.04E-10	transport, natural gas, pipeline, long distance, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.23E-11	kg/tkm	3.76E-11	transport, natural gas, pipeline, long distance, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	3.81E-13	kg/tkm	1.17E-12	transport, natural gas, pipeline, long distance, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.78E-10	kg/tkm	8.50E-10	transport, natural gas, pipeline, long distance, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	6.27E-09	kg/tkm	1.92E-08	transport, natural gas, pipeline, long distance, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	4.86E-06	kg/tkm	1.07E-07	transport, natural gas, pipeline, long distance, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.99E-07	kg/tkm	4.38E-09	transport, natural gas, pipeline, long distance, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	5.19E-06	kg/tkm	1.14E-07	transport, natural gas, pipeline, long distance, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.99E-07	kg/tkm	4.38E-09	transport, natural gas, pipeline, long distance, RER
Phosphate	water	river	kg	1	kg PO4-Eq	5.49E-09	kg/tkm	5.49E-09	transport, natural gas, pipeline, long distance, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.16E-09	kg/tkm	3.56E-09	transport, natural gas, pipeline, long distance, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	7.55E-12	kg/tkm	2.31E-11	transport, natural gas, pipeline, long distance, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/tkm	0.00E+00	transport, natural gas, pipeline, long distance, RER
								2.60E-07	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.03E-04	kg/tkm	2.00E-03	transport, natural gas, pipeline, long distance, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	8.27E-04	kg/tkm	1.58E-02	transport, natural gas, pipeline, long distance, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	8.00E-06	Nm3/tkm	3.18E-04	transport, natural gas, pipeline, long distance, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.46E-02	Nm3/tkm	9.40E-01	transport, natural gas, pipeline, long distance, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	4.60E-04	kg/tkm	2.11E-02	transport, natural gas, pipeline, long distance, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.21E-07	kg/tkm	2.19E-06	transport, natural gas, pipeline, long distance, RER
								9.79E-01	

E8	**Process natural gas**								
back to top	The dataset describes the processing of natural gas including sweetening.								
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.72E-03	kg/Nm3	1.72E-03	Ecoinvent V2, natural gas, at production, RNA
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.72E-02	kg/Nm3	2.72E-02	Ecoinvent V2, natural gas, at production, RNA
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	7.76E-11	kg/Nm3	7.76E-11	Ecoinvent V2, natural gas, at production, RNA
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	5.61E-03	kg/Nm3	5.61E-03	Ecoinvent V2, natural gas, at production, RNA
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.76E-07	kg/Nm3	5.91E-07	Ecoinvent V2, natural gas, at production, RNA
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	3.60E-06	kg/Nm3	5.66E-06	Ecoinvent V2, natural gas, at production, RNA
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	9.11E-14	kg/Nm3	1.43E-13	Ecoinvent V2, natural gas, at production, RNA
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.02E-05	kg/Nm3	1.61E-05	Ecoinvent V2, natural gas, at production, RNA
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.02E-11	kg/Nm3	3.07E-10	Ecoinvent V2, natural gas, at production, RNA
Chloroform	air	low population density	kg	30	kg CO2-Eq	5.20E-10	kg/Nm3	1.56E-08	Ecoinvent V2, natural gas, at production, RNA
Chloroform	air	unspecified	kg	30	kg CO2-Eq	4.89E-16	kg/Nm3	1.47E-14	Ecoinvent V2, natural gas, at production, RNA
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.51E-07	kg/Nm3	4.50E-05	Ecoinvent V2, natural gas, at production, RNA
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	8.60E-07	kg/Nm3	2.56E-04	Ecoinvent V2, natural gas, at production, RNA
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	7.39E-16	kg/Nm3	2.20E-13	Ecoinvent V2, natural gas, at production, RNA
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.18E-07	kg/Nm3	3.52E-05	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.73E-14	kg/Nm3	5.33E-11	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	4.93E-11	kg/Nm3	7.05E-08	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	8.34E-11	kg/Nm3	1.19E-07	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.66E-15	kg/Nm3	1.63E-11	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	6.36E-12	kg/Nm3	7.89E-10	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	6.99E-10	kg/Nm3	6.99E-06	Ecoinvent V2, natural gas, at production, RNA
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	3.41E-13	kg/Nm3	4.16E-09	Ecoinvent V2, natural gas, at production, RNA
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.02E-10	kg/Nm3	1.25E-06	Ecoinvent V2, natural gas, at production, RNA
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.58E-09	kg/Nm3	6.45E-08	Ecoinvent V2, natural gas, at production, RNA
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.50E-07	kg/Nm3	8.76E-06	Ecoinvent V2, natural gas, at production, RNA
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.70E-07	kg/Nm3	4.25E-06	Ecoinvent V2, natural gas, at production, RNA
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.33E-15	kg/Nm3	6.63E-15	Ecoinvent V2, natural gas, at production, RNA
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.30E-12	kg/Nm3	6.23E-09	Ecoinvent V2, natural gas, at production, RNA
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.81E-17	kg/Nm3	2.72E-13	Ecoinvent V2, natural gas, at production, RNA
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	2.25E-11	kg/Nm3	1.61E-07	Ecoinvent V2, natural gas, at production, RNA
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	5.73E-13	kg/Nm3	1.04E-09	Ecoinvent V2, natural gas, at production, RNA
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.88E-11	kg/Nm3	5.22E-08	Ecoinvent V2, natural gas, at production, RNA
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	3.31E-13	kg/Nm3	2.88E-12	Ecoinvent V2, natural gas, at production, RNA
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.54E-09	kg/Nm3	1.34E-08	Ecoinvent V2, natural gas, at production, RNA

Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	6.56E-14	kg/Nm3	7.15E-10	Ecoinvent V2, natural gas, at production, RNA
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.24E-14	kg/Nm3	1.35E-10	Ecoinvent V2, natural gas, at production, RNA
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	8.82E-16	kg/Nm3	9.61E-12	Ecoinvent V2, natural gas, at production, RNA
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.06E-16	kg/Nm3	2.23E-14	Ecoinvent V2, natural gas, at production, RNA
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.67E-07	kg/Nm3	4.18E-06	Ecoinvent V2, natural gas, at production, RNA
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.55E-05	kg/Nm3	8.88E-04	Ecoinvent V2, natural gas, at production, RNA
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.23E-15	kg/Nm3	3.08E-14	Ecoinvent V2, natural gas, at production, RNA
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.10E-02	kg/Nm3	2.75E-01	Ecoinvent V2, natural gas, at production, RNA
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	8.46E-12	kg/Nm3	1.18E-08	Ecoinvent V2, natural gas, at production, RNA
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.94E-13	kg/Nm3	5.52E-10	Ecoinvent V2, natural gas, at production, RNA
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.28E-13	kg/Nm3	2.42E-09	Ecoinvent V2, natural gas, at production, RNA
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	9.21E-10	kg/Nm3	6.81E-06	Ecoinvent V2, natural gas, at production, RNA
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.72E-16	kg/Nm3	8.18E-13	Ecoinvent V2, natural gas, at production, RNA
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	3.38E-14	kg/Nm3	5.00E-10	Ecoinvent V2, natural gas, at production, RNA
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	6.16E-09	kg/Nm3	1.40E-04	Ecoinvent V2, natural gas, at production, RNA
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	2.21E-10	kg/Nm3	5.03E-06	Ecoinvent V2, natural gas, at production, RNA
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	4.32E-15	kg/Nm3	5.62E-14	Ecoinvent V2, natural gas, at production, RNA
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.81E-09	kg/Nm3	3.65E-08	Ecoinvent V2, natural gas, at production, RNA
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.62E-06	kg/Nm3	2.62E-06	Ecoinvent V2, natural gas, at production, RNA
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
								5.22E-04	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	3.38E-08	kg/Nm3	6.35E-08	Ecoinvent V2, natural gas, at production, RNA
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	9.61E-08	kg/Nm3	1.81E-07	Ecoinvent V2, natural gas, at production, RNA
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.24E-06	kg/Nm3	2.32E-06	Ecoinvent V2, natural gas, at production, RNA
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.31E-08	kg/Nm3	2.91E-08	Ecoinvent V2, natural gas, at production, RNA
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	6.51E-06	kg/Nm3	5.73E-06	Ecoinvent V2, natural gas, at production, RNA
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.53E-08	kg/Nm3	2.22E-08	Ecoinvent V2, natural gas, at production, RNA
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.63E-09	kg/Nm3	2.61E-09	Ecoinvent V2, natural gas, at production, RNA
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	8.22E-07	kg/Nm3	1.32E-06	Ecoinvent V2, natural gas, at production, RNA
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	5.39E-09	kg/Nm3	8.63E-09	Ecoinvent V2, natural gas, at production, RNA
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.16E-11	kg/Nm3	4.07E-11	Ecoinvent V2, natural gas, at production, RNA
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.89E-09	kg/Nm3	5.44E-09	Ecoinvent V2, natural gas, at production, RNA
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.81E-09	kg/Nm3	5.29E-09	Ecoinvent V2, natural gas, at production, RNA
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	4.93E-06	kg/Nm3	3.45E-06	Ecoinvent V2, natural gas, at production, RNA
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	4.66E-05	kg/Nm3	3.26E-05	Ecoinvent V2, natural gas, at production, RNA
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.78E-05	kg/Nm3	1.24E-05	Ecoinvent V2, natural gas, at production, RNA
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.07E-05	kg/Nm3	1.07E-05	Ecoinvent V2, natural gas, at production, RNA
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.31E-04	kg/Nm3	1.31E-04	Ecoinvent V2, natural gas, at production, RNA
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.89E-02	kg/Nm3	1.89E-02	Ecoinvent V2, natural gas, at production, RNA
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	9.57E-11	kg/Nm3	1.80E-10	Ecoinvent V2, natural gas, at production, RNA
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	7.27E-17	kg/Nm3	4.73E-17	Ecoinvent V2, natural gas, at production, RNA
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	6.19E-15	kg/Nm3	4.03E-15	Ecoinvent V2, natural gas, at production, RNA
								1.91E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.58E-09	kg/Nm3	4.84E-09	Ecoinvent V2, natural gas, at production, RNA
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.55E-11	kg/Nm3	7.82E-11	Ecoinvent V2, natural gas, at production, RNA
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	3.94E-10	kg/Nm3	1.20E-09	Ecoinvent V2, natural gas, at production, RNA
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.88E-13	kg/Nm3	8.83E-13	Ecoinvent V2, natural gas, at production, RNA
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	6.61E-09	kg/Nm3	2.02E-08	Ecoinvent V2, natural gas, at production, RNA
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	9.55E-10	kg/Nm3	2.92E-09	Ecoinvent V2, natural gas, at production, RNA
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	7.40E-06	kg/Nm3	1.63E-07	Ecoinvent V2, natural gas, at production, RNA
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.96E-04	kg/Nm3	1.31E-05	Ecoinvent V2, natural gas, at production, RNA
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	7.54E-06	kg/Nm3	1.66E-07	Ecoinvent V2, natural gas, at production, RNA
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	9.86E-04	kg/Nm3	2.17E-05	Ecoinvent V2, natural gas, at production, RNA
Phosphate	water	river	kg	1	kg PO4-Eq	2.41E-09	kg/Nm3	2.41E-09	Ecoinvent V2, natural gas, at production, RNA
Phosphorus	water	river	kg	3.06	kg PO4-Eq	5.65E-10	kg/Nm3	1.73E-09	Ecoinvent V2, natural gas, at production, RNA
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.24E-12	kg/Nm3	6.87E-12	Ecoinvent V2, natural gas, at production, RNA
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq			0.00E+00	Ecoinvent V2, natural gas, at production, RNA
								3.52E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.67E-03	kg/Nm3	1.66E-02	Ecoinvent V2, natural gas, at production, RNA
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.45E-02	kg/Nm3	2.77E-01	Ecoinvent V2, natural gas, at production, RNA
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	9.51E-05	Nm3/Nm3	3.78E-03	Ecoinvent V2, natural gas, at production, RNA
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.08E+00	Nm3/Nm3	4.14E+01	Ecoinvent V2, natural gas, at production, RNA
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	6.47E-04	kg/Nm3	2.96E-02	Ecoinvent V2, natural gas, at production, RNA
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.24E-08	kg/Nm3	1.22E-07	Ecoinvent V2, natural gas, at production, RNA
								4.17E+01	

E10 **Transport and distribution of natural gas** The dataset describes approximately the transport and distribution of natural gas.

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	6.72E-05	kg/MJ	6.72E-05	Ecoinvent V2, natural gas, at consumer, RNA
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	7.46E-04	kg/MJ	7.46E-04	Ecoinvent V2, natural gas, at consumer, RNA
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.79E-12	kg/MJ	3.79E-12	Ecoinvent V2, natural gas, at consumer, RNA
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	5.03E-03	kg/MJ	5.03E-03	Ecoinvent V2, natural gas, at consumer, RNA
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.54E-08	kg/MJ	2.41E-08	Ecoinvent V2, natural gas, at consumer, RNA
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.31E-07	kg/MJ	2.06E-07	Ecoinvent V2, natural gas, at consumer, RNA
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	4.45E-15	kg/MJ	6.99E-15	Ecoinvent V2, natural gas, at consumer, RNA
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	6.83E-06	kg/MJ	1.07E-05	Ecoinvent V2, natural gas, at consumer, RNA
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.81E-13	kg/MJ	8.44E-12	Ecoinvent V2, natural gas, at consumer, RNA
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.39E-11	kg/MJ	4.18E-10	Ecoinvent V2, natural gas, at consumer, RNA
Chloroform	air	unspecified	kg	30	kg CO2-Eq	5.47E-15	kg/MJ	1.64E-13	Ecoinvent V2, natural gas, at consumer, RNA
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.34E-09	kg/MJ	1.29E-06	Ecoinvent V2, natural gas, at consumer, RNA
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.33E-08	kg/MJ	6.95E-06	Ecoinvent V2, natural gas, at consumer, RNA
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.61E-17	kg/MJ	1.08E-14	Ecoinvent V2, natural gas, at consumer, RNA
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.03E-07	kg/MJ	3.06E-05	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.36E-15	kg/MJ	1.95E-12	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.33E-12	kg/MJ	1.90E-09	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	9.70E-12	kg/MJ	1.39E-08	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.05E-16	kg/MJ	1.26E-12	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.82E-13	kg/MJ	2.26E-11	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.89E-11	kg/MJ	1.89E-07	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA

Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.86E-14	kg/MJ	2.27E-10	Ecoinvent V2, natural gas, at consumer, RNA
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	3.09E-12	kg/MJ	3.77E-08	Ecoinvent V2, natural gas, at consumer, RNA
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.30E-10	kg/MJ	3.26E-09	Ecoinvent V2, natural gas, at consumer, RNA
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	9.59E-09	kg/MJ	2.40E-07	Ecoinvent V2, natural gas, at consumer, RNA
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	4.72E-09	kg/MJ	1.18E-07	Ecoinvent V2, natural gas, at consumer, RNA
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.48E-14	kg/MJ	7.42E-14	Ecoinvent V2, natural gas, at consumer, RNA
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.10E-13	kg/MJ	5.85E-10	Ecoinvent V2, natural gas, at consumer, RNA
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.16E-18	kg/MJ	8.27E-15	Ecoinvent V2, natural gas, at consumer, RNA
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.02E-12	kg/MJ	7.30E-09	Ecoinvent V2, natural gas, at consumer, RNA
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.39E-14	kg/MJ	4.33E-11	Ecoinvent V2, natural gas, at consumer, RNA
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.63E-12	kg/MJ	2.94E-09	Ecoinvent V2, natural gas, at consumer, RNA
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	9.25E-15	kg/MJ	8.04E-14	Ecoinvent V2, natural gas, at consumer, RNA
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	4.12E-11	kg/MJ	3.59E-10	Ecoinvent V2, natural gas, at consumer, RNA
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	2.25E-15	kg/MJ	2.45E-11	Ecoinvent V2, natural gas, at consumer, RNA
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.11E-15	kg/MJ	1.21E-11	Ecoinvent V2, natural gas, at consumer, RNA
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	9.86E-15	kg/MJ	1.08E-10	Ecoinvent V2, natural gas, at consumer, RNA
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	3.88E-18	kg/MJ	8.14E-16	Ecoinvent V2, natural gas, at consumer, RNA
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.32E-08	kg/MJ	3.30E-07	Ecoinvent V2, natural gas, at consumer, RNA
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.13E-06	kg/MJ	2.82E-05	Ecoinvent V2, natural gas, at consumer, RNA
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	6.02E-17	kg/MJ	1.50E-15	Ecoinvent V2, natural gas, at consumer, RNA
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	3.23E-04	kg/MJ	8.07E-03	Ecoinvent V2, natural gas, at consumer, RNA
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.10E-12	kg/MJ	1.54E-09	Ecoinvent V2, natural gas, at consumer, RNA
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	4.41E-12	kg/MJ	6.17E-09	Ecoinvent V2, natural gas, at consumer, RNA
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	9.38E-15	kg/MJ	6.93E-11	Ecoinvent V2, natural gas, at consumer, RNA
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.78E-11	kg/MJ	2.05E-07	Ecoinvent V2, natural gas, at consumer, RNA
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	6.30E-18	kg/MJ	2.99E-14	Ecoinvent V2, natural gas, at consumer, RNA
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.23E-15	kg/MJ	1.83E-11	Ecoinvent V2, natural gas, at consumer, RNA
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.65E-10	kg/MJ	3.76E-06	Ecoinvent V2, natural gas, at consumer, RNA
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	7.76E-12	kg/MJ	1.77E-07	Ecoinvent V2, natural gas, at consumer, RNA
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.28E-16	kg/MJ	1.66E-15	Ecoinvent V2, natural gas, at consumer, RNA
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	7.53E-11	kg/MJ	9.79E-10	Ecoinvent V2, natural gas, at consumer, RNA
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.25E-07	kg/MJ	1.25E-07	Ecoinvent V2, natural gas, at consumer, RNA
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA
								5.43E-05	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.04E-09	kg/MJ	1.95E-09	Ecoinvent V2, natural gas, at consumer, RNA
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	3.03E-09	kg/MJ	5.70E-09	Ecoinvent V2, natural gas, at consumer, RNA
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	3.75E-08	kg/MJ	7.04E-08	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.29E-09	kg/MJ	1.14E-09	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.75E-07	kg/MJ	1.54E-07	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.16E-07	kg/MJ	1.90E-07	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	5.86E-11	kg/MJ	9.38E-11	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	2.22E-08	kg/MJ	3.55E-08	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.63E-08	kg/MJ	4.21E-08	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	6.70E-13	kg/MJ	1.26E-12	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	6.14E-10	kg/MJ	1.15E-09	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	3.13E-10	kg/MJ	5.88E-10	Ecoinvent V2, natural gas, at consumer, RNA
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.49E-07	kg/MJ	1.04E-07	Ecoinvent V2, natural gas, at consumer, RNA
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.31E-06	kg/MJ	9.17E-07	Ecoinvent V2, natural gas, at consumer, RNA
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	7.69E-06	kg/MJ	5.38E-06	Ecoinvent V2, natural gas, at consumer, RNA
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	3.15E-07	kg/MJ	3.15E-07	Ecoinvent V2, natural gas, at consumer, RNA
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.60E-06	kg/MJ	3.60E-06	Ecoinvent V2, natural gas, at consumer, RNA
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	5.47E-04	kg/MJ	5.47E-04	Ecoinvent V2, natural gas, at consumer, RNA
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.76E-11	kg/MJ	5.18E-11	Ecoinvent V2, natural gas, at consumer, RNA
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	5.61E-18	kg/MJ	3.65E-18	Ecoinvent V2, natural gas, at consumer, RNA
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.77E-16	kg/MJ	1.15E-16	Ecoinvent V2, natural gas, at consumer, RNA
								5.51E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	4.63E-11	kg/MJ	1.42E-10	Ecoinvent V2, natural gas, at consumer, RNA
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.73E-12	kg/MJ	5.28E-12	Ecoinvent V2, natural gas, at consumer, RNA
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.09E-11	kg/MJ	3.32E-11	Ecoinvent V2, natural gas, at consumer, RNA
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	8.72E-15	kg/MJ	2.67E-14	Ecoinvent V2, natural gas, at consumer, RNA
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.82E-10	kg/MJ	5.58E-10	Ecoinvent V2, natural gas, at consumer, RNA
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	4.26E-11	kg/MJ	1.30E-10	Ecoinvent V2, natural gas, at consumer, RNA
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.21E-07	kg/MJ	7.07E-09	Ecoinvent V2, natural gas, at consumer, RNA
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.60E-05	kg/MJ	3.52E-07	Ecoinvent V2, natural gas, at consumer, RNA
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.31E-07	kg/MJ	7.28E-09	Ecoinvent V2, natural gas, at consumer, RNA
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.64E-05	kg/MJ	5.81E-07	Ecoinvent V2, natural gas, at consumer, RNA
Phosphate	water	river	kg	1	kg PO4-Eq	2.37E-10	kg/MJ	2.37E-10	Ecoinvent V2, natural gas, at consumer, RNA
Phosphorus	water	river	kg	3.06	kg PO4-Eq	4.49E-11	kg/MJ	1.37E-10	Ecoinvent V2, natural gas, at consumer, RNA
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.46E-13	kg/MJ	4.47E-13	Ecoinvent V2, natural gas, at consumer, RNA
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq			0.00E+00	Ecoinvent V2, natural gas, at consumer, RNA
								9.49E-07	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.99E-05	kg/MJ	4.94E-04	Ecoinvent V2, natural gas, at consumer, RNA
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	4.13E-04	kg/MJ	7.89E-03	Ecoinvent V2, natural gas, at consumer, RNA
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.78E-06	Nm3/MJ	1.11E-04	Ecoinvent V2, natural gas, at consumer, RNA
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.89E-02	Nm3/MJ	1.11E+00	Ecoinvent V2, natural gas, at consumer, RNA
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.92E-05	kg/MJ	1.34E-03	Ecoinvent V2, natural gas, at consumer, RNA
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.44E-09	kg/MJ	1.43E-08	Ecoinvent V2, natural gas, at consumer, RNA
								1.12E+00	

E11 **Combust natural gas**

The module includes fuel input from high pressure (RER) network, infrastructure (boiler), emissions to air, and electricity needed for operation.

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	6.13E-02	kg/MJ	6.13E-02	natural gas, burned in industrial furnace >100kW, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.60E-03	kg/MJ	2.60E-03	natural gas, burned in industrial furnace >100kW, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.80E-11	kg/MJ	1.80E-11	natural gas, burned in industrial furnace >100kW, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	2.62E-04	kg/MJ	2.62E-04	natural gas, burned in industrial furnace >100kW, RER
Carbon dioxide	**air**	**total**	**kg**	**1**	**kg CO2-Eq**	**5.10E-02**	**kg/MJ**	**5.10E-02**	**See calculations above**
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	5.89E-06	kg/MJ	9.26E-06	natural gas, burned in industrial furnace >100kW, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	4.87E-06	kg/MJ	7.65E-06	natural gas, burned in industrial furnace >100kW, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.12E-14	kg/MJ	3.33E-14	natural gas, burned in industrial furnace >100kW, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	4.87E-06	kg/MJ	7.65E-06	natural gas, burned in industrial furnace >100kW, RER

Carbon monoxide	**air**	**total**	**kg**	**1.5714**	**kg CO2-Eq**	**1.70E-05**	**kg/MJ**	**2.67E-05**	**See calculations above**
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.84E-13	kg/MJ	8.52E-12	natural gas, burned in industrial furnace >100kW, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.09E-14	kg/MJ	3.28E-13	natural gas, burned in industrial furnace >100kW, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.08E-21	kg/MJ	3.25E-20	natural gas, burned in industrial furnace >100kW, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.90E-07	kg/MJ	5.65E-05	natural gas, burned in industrial furnace >100kW, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.73E-08	kg/MJ	8.15E-06	natural gas, burned in industrial furnace >100kW, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.72E-16	kg/MJ	5.12E-14	natural gas, burned in industrial furnace >100kW, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.43E-08	kg/MJ	4.26E-06	natural gas, burned in industrial furnace >100kW, RER
Dinitrogen monoxide	**air**	**total**	**kg**	**298**	**kg CO2-Eq**	**9.35E-07**	**kg/MJ**	**2.79E-04**	**See calculations above**
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	5.95E-15	kg/MJ	8.51E-12	natural gas, burned in industrial furnace >100kW, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.79E-13	kg/MJ	8.28E-10	natural gas, burned in industrial furnace >100kW, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	3.60E-11	kg/MJ	5.15E-08	natural gas, burned in industrial furnace >100kW, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.08E-15	kg/MJ	6.62E-12	natural gas, burned in industrial furnace >100kW, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	7.19E-13	kg/MJ	8.92E-11	natural gas, burned in industrial furnace >100kW, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	9.96E-12	kg/MJ	9.96E-08	natural gas, burned in industrial furnace >100kW, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	9.21E-14	kg/MJ	1.12E-09	natural gas, burned in industrial furnace >100kW, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	8.95E-12	kg/MJ	1.09E-07	natural gas, burned in industrial furnace >100kW, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	6.07E-10	kg/MJ	1.52E-08	natural gas, burned in industrial furnace >100kW, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.53E-08	kg/MJ	8.82E-07	natural gas, burned in industrial furnace >100kW, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.12E-08	kg/MJ	2.79E-07	natural gas, burned in industrial furnace >100kW, RER
Methane	**air**	**total**	**kg**	**25**	**kg CO2-Eq**	**9.78E-07**	**kg/MJ**	**2.44E-05**	**See calculations above**
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.93E-21	kg/MJ	1.47E-20	natural gas, burned in industrial furnace >100kW, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.58E-09	kg/MJ	2.98E-06	natural gas, burned in industrial furnace >100kW, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.96E-18	kg/MJ	1.40E-14	natural gas, burned in industrial furnace >100kW, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	5.13E-12	kg/MJ	3.66E-08	natural gas, burned in industrial furnace >100kW, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.09E-13	kg/MJ	1.97E-10	natural gas, burned in industrial furnace >100kW, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	5.41E-09	kg/MJ	9.78E-06	natural gas, burned in industrial furnace >100kW, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.89E-14	kg/MJ	2.52E-13	natural gas, burned in industrial furnace >100kW, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.24E-14	kg/MJ	2.82E-13	natural gas, burned in industrial furnace >100kW, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.32E-14	kg/MJ	1.44E-10	natural gas, burned in industrial furnace >100kW, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	5.36E-12	kg/MJ	5.85E-08	natural gas, burned in industrial furnace >100kW, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.95E-21	kg/MJ	2.13E-17	natural gas, burned in industrial furnace >100kW, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.69E-17	kg/MJ	3.56E-15	natural gas, burned in industrial furnace >100kW, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	2.64E-06	kg/MJ	6.60E-05	natural gas, burned in industrial furnace >100kW, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.58E-04	kg/MJ	3.96E-03	natural gas, burned in industrial furnace >100kW, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.86E-16	kg/MJ	7.16E-15	natural gas, burned in industrial furnace >100kW, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	5.94E-09	kg/MJ	1.49E-07	natural gas, burned in industrial furnace >100kW, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	3.96E-12	kg/MJ	5.54E-09	natural gas, burned in industrial furnace >100kW, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	8.72E-19	kg/MJ	1.22E-15	natural gas, burned in industrial furnace >100kW, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.70E-14	kg/MJ	2.73E-10	natural gas, burned in industrial furnace >100kW, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	8.05E-11	kg/MJ	5.95E-07	natural gas, burned in industrial furnace >100kW, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.75E-17	kg/MJ	1.31E-13	natural gas, burned in industrial furnace >100kW, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	5.39E-15	kg/MJ	7.98E-11	natural gas, burned in industrial furnace >100kW, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	4.70E-14	kg/MJ	1.07E-09	natural gas, burned in industrial furnace >100kW, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.46E-10	kg/MJ	3.32E-06	natural gas, burned in industrial furnace >100kW, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	5.27E-16	kg/MJ	6.85E-15	natural gas, burned in industrial furnace >100kW, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	5.91E-14	kg/MJ	7.69E-13	natural gas, burned in industrial furnace >100kW, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.08E-07	kg/MJ	2.08E-07	natural gas, burned in industrial furnace >100kW, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
								5.14E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	4.48E-09	kg/MJ	8.42E-09	natural gas, burned in industrial furnace >100kW, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.07E-09	kg/MJ	9.52E-09	natural gas, burned in industrial furnace >100kW, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.62E-08	kg/MJ	4.93E-08	natural gas, burned in industrial furnace >100kW, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	4.07E-09	kg/MJ	3.58E-09	natural gas, burned in industrial furnace >100kW, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	5.30E-08	kg/MJ	4.66E-08	natural gas, burned in industrial furnace >100kW, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	8.43E-09	kg/MJ	7.42E-09	natural gas, burned in industrial furnace >100kW, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.71E-10	kg/MJ	2.73E-10	natural gas, burned in industrial furnace >100kW, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.18E-08	kg/MJ	1.89E-08	natural gas, burned in industrial furnace >100kW, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.82E-09	kg/MJ	2.91E-09	natural gas, burned in industrial furnace >100kW, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	9.60E-13	kg/MJ	1.81E-12	natural gas, burned in industrial furnace >100kW, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	7.53E-07	kg/MJ	1.42E-06	natural gas, burned in industrial furnace >100kW, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.53E-09	kg/MJ	2.87E-09	natural gas, burned in industrial furnace >100kW, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.31E-05	kg/MJ	2.32E-05	natural gas, burned in industrial furnace >100kW, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	7.69E-06	kg/MJ	5.38E-06	natural gas, burned in industrial furnace >100kW, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.43E-06	kg/MJ	1.00E-06	natural gas, burned in industrial furnace >100kW, RER
Nitrogen oxides	**air**	**total**	**kg**	**0.7**	**kg SO2-Eq**	**4.00E-05**	**kg/MJ**	**2.80E-05**	**See calculations above**
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.23E-06	kg/MJ	1.23E-06	natural gas, burned in industrial furnace >100kW, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.38E-05	kg/MJ	2.38E-05	natural gas, burned in industrial furnace >100kW, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	2.41E-07	kg/MJ	2.41E-07	natural gas, burned in industrial furnace >100kW, RER
Sulfur dioxide	**air**	**total**	**kg**	**1**	**kg SO2-Eq**	**2.55E-07**	**kg/MJ**	**2.55E-07**	**See calculations above**
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.53E-10	kg/MJ	2.87E-10	natural gas, burned in industrial furnace >100kW, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.95E-17	kg/MJ	1.92E-17	natural gas, burned in industrial furnace >100kW, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	7.14E-16	kg/MJ	4.64E-16	natural gas, burned in industrial furnace >100kW, RER
								2.98E-05	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	9.67E-11	kg/MJ	2.96E-10	natural gas, burned in industrial furnace >100kW, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	7.17E-12	kg/MJ	2.20E-11	natural gas, burned in industrial furnace >100kW, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.85E-11	kg/MJ	5.66E-11	natural gas, burned in industrial furnace >100kW, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	4.62E-14	kg/MJ	1.41E-13	natural gas, burned in industrial furnace >100kW, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.64E-10	kg/MJ	1.11E-09	natural gas, burned in industrial furnace >100kW, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	7.23E-09	kg/MJ	2.21E-08	natural gas, burned in industrial furnace >100kW, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.52E-06	kg/MJ	3.35E-08	natural gas, burned in industrial furnace >100kW, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.07E-08	kg/MJ	6.75E-10	natural gas, burned in industrial furnace >100kW, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.73E-06	kg/MJ	3.80E-08	natural gas, burned in industrial furnace >100kW, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.09E-08	kg/MJ	6.79E-10	natural gas, burned in industrial furnace >100kW, RER
Phosphate	water	river	kg	1	kg PO4-Eq	7.21E-10	kg/MJ	7.21E-10	natural gas, burned in industrial furnace >100kW, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	4.31E-10	kg/MJ	1.32E-09	natural gas, burned in industrial furnace >100kW, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	6.61E-12	kg/MJ	2.02E-11	natural gas, burned in industrial furnace >100kW, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq			0.00E+00	natural gas, burned in industrial furnace >100kW, RER
								9.85E-08	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	3.22E-04	kg/MJ	3.19E-03	natural gas, burned in industrial furnace >100kW, RER

Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	3.18E-04	kg/MJ	6.07E-03	natural gas, burned in industrial furnace >100kW, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	3.07E-06	Nm3/MJ	1.22E-04	natural gas, burned in industrial furnace >100kW, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	3.06E-02	Nm3/MJ	1.17E+00	natural gas, burned in industrial furnace >100kW, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.40E-04	kg/MJ	6.42E-03	natural gas, burned in industrial furnace >100kW, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.42E-07	kg/MJ	2.39E-06	natural gas, burned in industrial furnace >100kW, RER
								1.19E+00	

E3	**Generate electricity**						
back to top		**These emissions replace Ecoinvent emissions below**	Ammonia	4.85E-03	air	g / kWh	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Carbon Dioxide Equivalents	9.30E+02	air	g / kWh	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
			Nitrogen Oxides	1.60E+00	air	g / kWh	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Sulphur Dioxide	2.43E+00	air	g / kWh	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Ammonia - 2004 Power Generation Emissions	2.63E+02	air	tonnes NH3	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Carbon Monoxide - 2004 Power Generation	1.07E+04	air	tonnes CO	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Nitrogen Oxides - 2004 Power Generation	8.67E+04	air	tonnes Nox	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Sulphur Dioxide - 2004 Power Generation	1.32E+05	air	tonnes SO2	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Total Particulate Matter - Power Generation	1.09E+04	air	tonnes TPM	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Volatile Organic Compounds - 2004 Power Generation Emissions	9.39E+02	air	tonnes VOC	Alberta Environment Summary Report on 2004 NPRI Air Emissions, http://environment.gov.ab.ca/info/library/7758.pdf
			Electricity Generation in Alberta (2004)	5.64E+04		GWh	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
			Transmission Line Losses in Alberta	4.00E-02			Environment Canada. 2005. Report of the Development of a Canadian Electricity Sector Module for the Integrated Planning Model. Chapter 3: Canadian Module Power System Operation Assumptions. Accessed online February 2009 at http://www.ec.gc.ca/cleanair-airpur/caol/canus/IPM_TECHNICAL/ipm_technical_report/c3_e.cfm. Values model the wholesale electric market and do not include the loss of energy in the retail distribution of electricity. Canada average is weighted average on 2006 power generation. NWT, Yukon and Nunavut and NGCC use Canada average and specific data is not available.
			Line Loss Multiplier:	1.04E+00			

Generate electricity This dataset describes the transmission of low voltage electricity. Included are electricity losses and direct SF6 emissions to air as well as the grid infrastructure.

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	4.06E-02	kg / kWh	4.06E-02	Ecoinvent V2, electricity, low voltage, at grid, US
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.19E-01	kg / kWh	6.19E-01	Ecoinvent V2, electricity, low voltage, at grid, US
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.92E-09	kg / kWh	1.92E-09	Ecoinvent V2, electricity, low voltage, at grid, US
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.28E-01	kg / kWh	1.28E-01	Ecoinvent V2, electricity, low voltage, at grid, US
Total Carbon Dioxide Equivalents	**air**		kg	1	kg CO2-Eq	**9.30E-01**	**kg / kWh**	9.30E-01	**See calculations above**
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	9.35E-06	kg / kWh	1.47E-05	Ecoinvent V2, electricity, low voltage, at grid, US
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	8.35E-05	kg / kWh	1.31E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.25E-12	kg / kWh	3.54E-12	Ecoinvent V2, electricity, low voltage, at grid, US
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.58E-04	kg / kWh	4.05E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.33E-10	kg / kWh	6.99E-09	Ecoinvent V2, electricity, low voltage, at grid, US
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.18E-08	kg / kWh	3.54E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.11E-14	kg / kWh	3.33E-13	Ecoinvent V2, electricity, low voltage, at grid, US
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	3.57E-06	kg / kWh	1.06E-03	Ecoinvent V2, electricity, low voltage, at grid, US
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.95E-05	kg / kWh	5.82E-03	Ecoinvent V2, electricity, low voltage, at grid, US
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.82E-14	kg / kWh	5.44E-12	Ecoinvent V2, electricity, low voltage, at grid, US
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.69E-06	kg / kWh	8.03E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	8.80E-13	kg / kWh	1.26E-09	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.12E-09	kg / kWh	1.60E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.04E-09	kg / kWh	2.92E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	7.34E-14	kg / kWh	4.50E-10	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.45E-10	kg / kWh	1.80E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.59E-08	kg / kWh	1.59E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	8.64E-12	kg / kWh	1.05E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.51E-09	kg / kWh	3.07E-05	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	6.44E-08	kg / kWh	1.61E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	7.97E-06	kg / kWh	1.99E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.87E-06	kg / kWh	9.67E-05	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.01E-14	kg / kWh	1.51E-13	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	8.19E-11	kg / kWh	1.55E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	8.68E-16	kg / kWh	6.20E-12	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	5.21E-10	kg / kWh	3.72E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.38E-11	kg / kWh	2.50E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	6.83E-10	kg / kWh	1.24E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.00E-11	kg / kWh	1.74E-10	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.50E-08	kg / kWh	3.04E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.53E-12	kg / kWh	1.67E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.05E-13	kg / kWh	3.33E-09	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.00E-14	kg / kWh	2.18E-10	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.50E-15	kg / kWh	5.26E-13	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	5.10E-06	kg / kWh	1.28E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	8.12E-04	kg / kWh	2.03E-02	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	3.04E-14	kg / kWh	7.60E-13	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	6.58E-04	kg / kWh	1.64E-02	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.00E-10	kg / kWh	2.80E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	8.96E-12	kg / kWh	1.25E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	7.48E-12	kg / kWh	5.52E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.26E-08	kg / kWh	1.67E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.06E-15	kg / kWh	1.93E-11	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	7.96E-13	kg / kWh	1.18E-08	Ecoinvent V2, electricity, low voltage, at grid, US

Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.48E-07	kg / kWh	3.37E-03	Ecoinvent V2, electricity, low voltage, at grid, US
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	5.75E-09	kg / kWh	1.31E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	9.92E-14	kg / kWh	1.29E-12	Ecoinvent V2, electricity, low voltage, at grid, US
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	6.38E-08	kg / kWh	8.30E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	5.96E-05	kg / kWh	5.96E-05	Ecoinvent V2, electricity, low voltage, at grid, US
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
								9.30E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	8.28E-07	kg / kWh	1.56E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	2.20E-06	kg / kWh	4.14E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.98E-05	kg / kWh	5.60E-05	Ecoinvent V2, electricity, low voltage, at grid, US
Ammonia	**air**			1.88	kg SO2-Eq	**4.85E-06**	**kg / kWh**	**9.12E-06**	**See calculations above**
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	8.33E-07	kg / kWh	7.33E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.48E-04	kg / kWh	1.30E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	6.21E-07	kg / kWh	5.47E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	4.04E-08	kg / kWh	6.47E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.87E-05	kg / kWh	2.99E-05	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.35E-07	kg / kWh	2.16E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	5.79E-10	kg / kWh	1.09E-09	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	8.16E-08	kg / kWh	1.53E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	7.08E-08	kg / kWh	1.33E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.14E-04	kg / kWh	7.98E-05	Ecoinvent V2, electricity, low voltage, at grid, US
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.06E-03	kg / kWh	7.42E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	4.16E-04	kg / kWh	2.91E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Nitrogen oxides	**air**		kg	0.7	kg SO2-Eq	**1.60E-03**	**kg / kWh**	**1.12E-03**	**See calculations above**
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.47E-04	kg / kWh	2.47E-04	Ecoinvent V2, electricity, low voltage, at grid, US
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.03E-03	kg / kWh	3.03E-03	Ecoinvent V2, electricity, low voltage, at grid, US
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.12E-03	kg / kWh	1.12E-03	Ecoinvent V2, electricity, low voltage, at grid, US
Sulfur dioxide	**air**		kg	1	kg SO2-Eq	**2.43E-03**	**kg / kWh**	**2.43E-03**	**See calculations above**
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.91E-09	kg / kWh	5.47E-09	Ecoinvent V2, electricity, low voltage, at grid, US
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.01E-15	kg / kWh	1.30E-15	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.41E-13	kg / kWh	9.18E-14	Ecoinvent V2, electricity, low voltage, at grid, US
								3.72E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.62E-08	kg / kWh	1.11E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	6.11E-10	kg / kWh	1.87E-09	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	8.96E-09	kg / kWh	2.74E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	7.09E-12	kg / kWh	2.17E-11	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.50E-07	kg / kWh	4.60E-07	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.21E-08	kg / kWh	6.76E-08	Ecoinvent V2, electricity, low voltage, at grid, US
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.71E-04	kg / kWh	3.77E-06	Ecoinvent V2, electricity, low voltage, at grid, US
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.29E-05	kg / kWh	7.23E-07	Ecoinvent V2, electricity, low voltage, at grid, US
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.75E-04	kg / kWh	3.84E-06	Ecoinvent V2, electricity, low voltage, at grid, US
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.41E-05	kg / kWh	1.19E-06	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphate	water	river	kg	1	kg PO4-Eq	6.02E-08	kg / kWh	6.02E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.52E-08	kg / kWh	4.64E-08	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	6.33E-11	kg / kWh	1.94E-10	Ecoinvent V2, electricity, low voltage, at grid, US
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq			0.00E+00	Ecoinvent V2, electricity, low voltage, at grid, US
								1.03E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	3.82E-02	kg / kWh	3.78E-01	Ecoinvent V2, electricity, low voltage, at grid, US
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	3.30E-01	kg / kWh	6.31E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.17E-03	Nm3 / kWh	8.63E-02	Ecoinvent V2, electricity, low voltage, at grid, US
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	6.11E-02	Nm3 / kWh	2.34E+00	Ecoinvent V2, electricity, low voltage, at grid, US
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.51E-02	kg / kWh	6.90E-01	Ecoinvent V2, electricity, low voltage, at grid, US
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.30E-07	kg / kWh	4.26E-06	Ecoinvent V2, electricity, low voltage, at grid, US
								9.81E+00	

E6	**Transmit electricity**	Included in E3 above.

back to top

R1, R4, R7, R10 — Ecoinvent V2, tied housing system, cattle, operation, CH

back to top

O&M for cattle buildings

The inventory takes into account the energy and auxiliary materials like water, lubricating oil and cleaning agents for the use of the described module for one year. Also included is the use of the infrastructure with the binding of a certain part of the appropriate infrastructure module. Not taken into account were the direct emission of the animal husbandry, fodder production and produced waste water.

LU= livestock unit

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.19E+02	kg/LU	1.19E+02	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.17E+02	kg/LU	1.17E+02	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.49E-05	kg/LU	1.49E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.82E+02	kg/LU	1.82E+02	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	7.55E-02	kg/LU	1.19E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.00E-01	kg/LU	3.14E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.74E-08	kg/LU	2.74E-08	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	9.83E-01	kg/LU	1.54E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	4.83E-07	kg/LU	1.45E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.38E-08	kg/LU	4.13E-07	Ecoinvent V2, tied housing system, cattle, operation, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.22E-14	kg/LU	3.67E-13	Ecoinvent V2, tied housing system, cattle, operation, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.60E-03	kg/LU	1.37E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.98E-03	kg/LU	8.88E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.41E-10	kg/LU	4.21E-08	Ecoinvent V2, tied housing system, cattle, operation, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	9.14E-03	kg/LU	2.72E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	9.40E-09	kg/LU	1.34E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.65E-07	kg/LU	8.07E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.52E-05	kg/LU	6.46E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.11E-09	kg/LU	6.81E-06	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	3.12E-07	kg/LU	3.87E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.12E-05	kg/LU	1.12E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	8.42E-08	kg/LU	1.03E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.38E-05	kg/LU	1.68E-01	Ecoinvent V2, tied housing system, cattle, operation, CH

Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	9.92E-04	kg/LU	2.48E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.13E-02	kg/LU	2.83E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.68E-03	kg/LU	6.69E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.31E-14	kg/LU	1.66E-13	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.40E-06	kg/LU	2.65E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.39E-12	kg/LU	1.70E-08	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.24E-06	kg/LU	8.87E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	7.53E-07	kg/LU	1.36E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	6.36E-06	kg/LU	1.15E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	8.16E-08	kg/LU	7.10E-07	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	4.07E-08	kg/LU	3.54E-07	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	9.48E-09	kg/LU	1.03E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.99E-09	kg/LU	4.35E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.20E-14	kg/LU	2.40E-10	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.67E-11	kg/LU	5.61E-09	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.19E-01	kg/LU	2.96E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	6.40E-01	kg/LU	1.60E+01	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.36E-10	kg/LU	5.89E-09	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	6.01E-03	kg/LU	1.50E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.26E-06	kg/LU	1.77E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	9.85E-12	kg/LU	1.38E-08	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.61E-08	kg/LU	1.19E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.24E-04	kg/LU	9.18E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.34E-11	kg/LU	2.06E-07	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	8.51E-09	kg/LU	1.26E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.62E-07	kg/LU	3.69E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	5.11E-05	kg/LU	1.17E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.68E-08	kg/LU	2.18E-07	Ecoinvent V2, tied housing system, cattle, operation, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	7.44E-08	kg/LU	9.67E-07	Ecoinvent V2, tied housing system, cattle, operation, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.18E-02	kg/LU	1.18E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
								4.47E+02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	7.84E-03	kg/LU	1.47E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.75E-03	kg/LU	3.29E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	4.56E-02	kg/LU	8.57E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.54E-03	kg/LU	3.11E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	6.29E-03	kg/LU	5.53E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.74E-02	kg/LU	1.53E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.40E-04	kg/LU	2.25E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.74E-03	kg/LU	2.78E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.71E-03	kg/LU	2.73E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	4.21E-05	kg/LU	7.92E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.10E-03	kg/LU	2.06E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.68E-04	kg/LU	5.04E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.70E-01	kg/LU	1.19E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.38E-01	kg/LU	1.66E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	6.11E-01	kg/LU	4.28E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.69E-01	kg/LU	1.69E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	5.68E-01	kg/LU	5.68E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.03E-01	kg/LU	1.03E-01	Ecoinvent V2, tied housing system, cattle, operation, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.69E-05	kg/LU	5.05E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.03E-11	kg/LU	1.97E-11	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.11E-10	kg/LU	2.02E-10	Ecoinvent V2, tied housing system, cattle, operation, CH
								1.69E+00	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	4.30E-05	kg/LU	1.31E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.09E-06	kg/LU	6.40E-06	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.83E-05	kg/LU	5.60E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	3.92E-08	kg/LU	1.20E-07	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.18E-04	kg/LU	3.60E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.82E-05	kg/LU	1.17E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.54E-01	kg/LU	5.59E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.69E-03	kg/LU	1.03E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.83E-01	kg/LU	6.22E-03	Ecoinvent V2, tied housing system, cattle, operation, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.19E-03	kg/LU	1.14E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.60E-04	kg/LU	1.60E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.92E-04	kg/LU	8.94E-04	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.62E-05	kg/LU	4.96E-05	Ecoinvent V2, tied housing system, cattle, operation, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/LU	0.00E+00	Ecoinvent V2, tied housing system, cattle, operation, CH
								1.38E-02	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	5.12E+01	kg/LU	5.07E+02	Ecoinvent V2, tied housing system, cattle, operation, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	6.82E+01	kg/LU	1.30E+03	Ecoinvent V2, tied housing system, cattle, operation, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	7.11E-01	Nm3/LU	2.83E+01	Ecoinvent V2, tied housing system, cattle, operation, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	3.29E+01	Nm3/LU	1.26E+03	Ecoinvent V2, tied housing system, cattle, operation, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.53E+01	kg/LU	1.62E+03	Ecoinvent V2, tied housing system, cattle, operation, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	8.11E-03	kg/LU	8.03E-02	Ecoinvent V2, tied housing system, cattle, operation, CH
								4.71E+03	
R2	**Remove damaged/worn components**								
	Remove damaged steel	includes energy for dismantling							proxy of Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	5.36E-03	kg/kg	5.36E-03	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	3.73E-03	kg/kg	3.73E-03	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.39E-10	kg/kg	3.39E-10	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	4.67E-02	kg/kg	4.67E-02	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.11E-06	kg/kg	1.75E-06	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	6.79E-06	kg/kg	1.07E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	3.98E-13	kg/kg	6.25E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH

Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.89E-04	kg/kg	2.97E-04	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	8.31E-13	kg/kg	2.49E-11	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.46E-14	kg/kg	7.39E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	6.79E-21	kg/kg	2.04E-19	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	5.94E-08	kg/kg	1.77E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	7.49E-08	kg/kg	2.23E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.22E-15	kg/kg	9.61E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.78E-06	kg/kg	5.31E-04	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.85E-14	kg/kg	5.50E-11	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.26E-12	kg/kg	1.80E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.28E-10	kg/kg	3.27E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.34E-14	kg/kg	8.18E-11	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.63E-12	kg/kg	2.02E-10	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.18E-11	kg/kg	2.18E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	9.60E-13	kg/kg	1.17E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.30E-11	kg/kg	2.81E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	6.21E-10	kg/kg	1.55E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.31E-08	kg/kg	8.27E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.45E-08	kg/kg	6.12E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.84E-20	kg/kg	9.20E-20	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.08E-11	kg/kg	5.82E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	6.67E-18	kg/kg	4.76E-14	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	5.77E-10	kg/kg	4.12E-06	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	9.88E-13	kg/kg	1.79E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.16E-10	kg/kg	2.09E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	5.70E-14	kg/kg	4.96E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	7.29E-14	kg/kg	6.35E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	5.61E-14	kg/kg	6.12E-10	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.49E-13	kg/kg	1.62E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.22E-20	kg/kg	1.33E-16	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.10E-16	kg/kg	2.30E-14	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.12E-06	kg/kg	2.80E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.32E-05	kg/kg	8.31E-04	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	5.37E-15	kg/kg	1.34E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	2.37E-06	kg/kg	5.92E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.07E-11	kg/kg	1.50E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	5.47E-18	kg/kg	7.66E-15	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	8.36E-14	kg/kg	6.18E-10	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.07E-10	kg/kg	1.53E-06	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.78E-16	kg/kg	8.44E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	3.48E-14	kg/kg	5.16E-10	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.21E-13	kg/kg	2.77E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	2.77E-10	kg/kg	6.32E-06	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.50E-15	kg/kg	1.94E-14	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.33E-13	kg/kg	1.73E-12	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.03E-07	kg/kg	3.03E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
								5.76E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.83E-08	kg/kg	3.44E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	6.69E-08	kg/kg	1.26E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	4.15E-07	kg/kg	7.81E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	5.38E-08	kg/kg	4.73E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.33E-07	kg/kg	1.17E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.31E-08	kg/kg	4.67E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.72E-09	kg/kg	5.95E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	2.79E-08	kg/kg	4.46E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	8.17E-09	kg/kg	1.31E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.23E-12	kg/kg	6.06E-12	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.52E-08	kg/kg	4.74E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	7.00E-09	kg/kg	1.32E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	5.55E-06	kg/kg	3.88E-06	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.14E-05	kg/kg	1.50E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	6.49E-04	kg/kg	4.54E-04	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.68E-05	kg/kg	1.68E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	5.21E-05	kg/kg	5.21E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.58E-05	kg/kg	1.58E-05	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	7.23E-10	kg/kg	1.36E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.65E-16	kg/kg	2.37E-16	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.61E-15	kg/kg	1.05E-15	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
								5.59E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.63E-10	kg/kg	1.11E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.17E-11	kg/kg	9.71E-11	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	4.18E-11	kg/kg	1.28E-10	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	7.74E-14	kg/kg	2.37E-13	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	6.19E-10	kg/kg	1.89E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.49E-08	kg/kg	7.63E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.96E-04	kg/kg	4.30E-06	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.35E-07	kg/kg	2.97E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.97E-04	kg/kg	4.33E-06	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.36E-07	kg/kg	2.98E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.46E-08	kg/kg	1.46E-08	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	3.20E-09	kg/kg	9.80E-09	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.21E-11	kg/kg	6.75E-11	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
								8.74E-06	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	7.49E-04	kg/kg	7.41E-03	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.04E-03	kg/kg	1.99E-02	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.01E-05	kg/kg	4.03E-04	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.27E-03	kg/kg	4.88E-02	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.68E-02	kg/kg	7.68E-01	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH

Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.12E-08	kg/kg	1.11E-07	Ecoinvent V2, disposal, building, reinforcement steel, to recycling, CH
								8.45E-01	
	Remove damaged wood	Includes transport to dismantling facilities, final disposal of waste material							Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	5.62E-03	kg/kg	5.62E-03	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.42E-03	kg/kg	1.42E-03	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	7.57E-10	kg/kg	7.57E-10	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	4.57E-03	kg/kg	4.57E-03	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.53E-06	kg/kg	2.41E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.19E-06	kg/kg	3.44E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	8.89E-13	kg/kg	1.40E-12	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	3.10E-05	kg/kg	4.87E-05	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.69E-12	kg/kg	5.07E-11	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.13E-14	kg/kg	6.39E-13	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.32E-20	kg/kg	3.97E-19	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.22E-06	kg/kg	1.26E-03	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.11E-08	kg/kg	6.30E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	7.21E-15	kg/kg	2.15E-12	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	5.01E-08	kg/kg	1.49E-05	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.54E-13	kg/kg	2.20E-10	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	9.57E-13	kg/kg	1.37E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	6.10E-09	kg/kg	8.72E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	6.50E-14	kg/kg	3.98E-10	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.02E-12	kg/kg	1.26E-10	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.73E-11	kg/kg	1.73E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	4.50E-12	kg/kg	5.49E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	6.95E-11	kg/kg	8.48E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	6.38E-06	kg/kg	1.60E-04	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	2.29E-08	kg/kg	5.73E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.43E-08	kg/kg	3.58E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.59E-20	kg/kg	1.79E-19	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.14E-10	kg/kg	2.15E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	9.64E-17	kg/kg	6.88E-13	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	6.70E-11	kg/kg	4.78E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.46E-12	kg/kg	4.46E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.98E-10	kg/kg	7.20E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	7.39E-14	kg/kg	6.43E-13	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	6.31E-14	kg/kg	5.49E-13	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	4.19E-13	kg/kg	4.57E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.89E-13	kg/kg	4.24E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.39E-20	kg/kg	2.60E-16	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	4.38E-16	kg/kg	9.20E-14	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	5.04E-07	kg/kg	1.26E-05	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.26E-05	kg/kg	5.64E-04	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.20E-14	kg/kg	3.00E-13	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	6.26E-08	kg/kg	1.56E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.15E-11	kg/kg	3.00E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.07E-17	kg/kg	1.49E-14	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	5.23E-14	kg/kg	3.87E-10	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.26E-10	kg/kg	4.62E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	7.11E-16	kg/kg	3.38E-12	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.39E-13	kg/kg	2.06E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.40E-13	kg/kg	3.20E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.67E-10	kg/kg	3.81E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.35E-15	kg/kg	3.06E-14	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.15E-13	kg/kg	1.50E-12	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.22E-07	kg/kg	1.22E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
								1.37E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	8.56E-06	kg/kg	1.61E-05	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.66E-08	kg/kg	3.13E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.71E-07	kg/kg	3.21E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	4.43E-08	kg/kg	3.90E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	7.05E-08	kg/kg	6.20E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.98E-08	kg/kg	5.26E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.32E-08	kg/kg	2.12E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.54E-08	kg/kg	2.47E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.01E-08	kg/kg	1.62E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.32E-10	kg/kg	2.48E-10	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	6.78E-08	kg/kg	1.27E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	7.72E-09	kg/kg	1.45E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.53E-04	kg/kg	2.47E-04	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	4.88E-06	kg/kg	3.42E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.84E-05	kg/kg	1.99E-05	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	3.80E-06	kg/kg	3.80E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	8.39E-06	kg/kg	8.39E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.87E-06	kg/kg	1.87E-06	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	8.07E-10	kg/kg	1.52E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.78E-15	kg/kg	1.15E-15	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.01E-15	kg/kg	6.57E-16	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
								3.02E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.09E-07	kg/kg	3.34E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.47E-11	kg/kg	1.06E-10	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	3.15E-11	kg/kg	9.62E-11	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.89E-13	kg/kg	5.77E-13	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.70E-10	kg/kg	1.13E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.06E-09	kg/kg	6.31E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.50E-05	kg/kg	5.50E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH

BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.48E-07	kg/kg	3.26E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.71E-05	kg/kg	8.17E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.48E-07	kg/kg	3.27E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphate	water	river	kg	1	kg PO4-Eq	2.82E-08	kg/kg	2.82E-08	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.45E-09	kg/kg	4.44E-09	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	9.87E-12	kg/kg	3.02E-11	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
								1.75E-06	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.22E-04	kg/kg	4.18E-03	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.04E-03	kg/kg	1.98E-02	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.07E-05	kg/kg	4.24E-04	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.32E-03	kg/kg	8.89E-02	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.51E-03	kg/kg	6.91E-02	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	5.35E-08	kg/kg	5.30E-07	Ecoinvent V2, disposal, building, waste wood, untreated, to final disposal, CH
								1.82E-01	

Remove concrete Energy for dismantling, particulate matter emissions from dismantling and handling — Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	3.74E-04	kg/kg	3.74E-04	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.61E-04	kg/kg	2.61E-04	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	2.36E-11	kg/kg	2.36E-11	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	3.26E-03	kg/kg	3.26E-03	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	7.76E-08	kg/kg	1.22E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	4.74E-07	kg/kg	7.45E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.78E-14	kg/kg	4.36E-14	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.32E-05	kg/kg	2.08E-05	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	5.80E-14	kg/kg	1.74E-12	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.72E-15	kg/kg	5.16E-14	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	4.74E-22	kg/kg	1.42E-20	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.15E-09	kg/kg	1.24E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	5.23E-09	kg/kg	1.56E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	2.25E-16	kg/kg	6.71E-14	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.24E-07	kg/kg	3.71E-05	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.69E-15	kg/kg	3.84E-12	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	8.78E-14	kg/kg	1.26E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.59E-11	kg/kg	2.28E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	9.32E-16	kg/kg	5.71E-12	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.14E-13	kg/kg	1.41E-11	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.52E-12	kg/kg	1.52E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	6.70E-14	kg/kg	8.18E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.61E-12	kg/kg	1.96E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	4.33E-11	kg/kg	1.08E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	2.31E-09	kg/kg	5.77E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.71E-09	kg/kg	4.27E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.29E-21	kg/kg	6.43E-21	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	2.15E-12	kg/kg	4.06E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	4.66E-19	kg/kg	3.33E-15	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	4.03E-11	kg/kg	2.88E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	6.89E-14	kg/kg	1.25E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	8.07E-12	kg/kg	1.46E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	3.98E-15	kg/kg	3.46E-14	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	5.09E-15	kg/kg	4.43E-14	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.92E-15	kg/kg	4.27E-11	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.04E-14	kg/kg	1.13E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	8.54E-22	kg/kg	9.31E-18	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	7.64E-18	kg/kg	1.61E-15	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	7.83E-08	kg/kg	1.96E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.32E-06	kg/kg	5.80E-05	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	3.75E-16	kg/kg	9.38E-15	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.65E-07	kg/kg	4.13E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	7.47E-13	kg/kg	1.05E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.82E-19	kg/kg	5.35E-16	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	5.84E-15	kg/kg	4.31E-11	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.45E-11	kg/kg	1.07E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.24E-17	kg/kg	5.89E-14	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.43E-15	kg/kg	3.60E-11	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	8.47E-15	kg/kg	1.93E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.93E-11	kg/kg	4.41E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.04E-16	kg/kg	1.36E-15	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	9.30E-15	kg/kg	1.21E-13	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.11E-08	kg/kg	2.11E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
								4.02E-03	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.28E-09	kg/kg	2.40E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	4.67E-09	kg/kg	8.78E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.90E-08	kg/kg	5.45E-08	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.75E-09	kg/kg	3.30E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	9.26E-09	kg/kg	8.14E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	3.71E-09	kg/kg	3.26E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	2.60E-10	kg/kg	4.15E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.95E-09	kg/kg	3.12E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	5.70E-10	kg/kg	9.13E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.25E-13	kg/kg	4.23E-13	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.76E-09	kg/kg	3.31E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	4.89E-10	kg/kg	9.19E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.87E-07	kg/kg	2.71E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.50E-06	kg/kg	1.05E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	4.53E-05	kg/kg	3.17E-05	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.17E-06	kg/kg	1.17E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	3.64E-06	kg/kg	3.64E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH

Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.11E-06	kg/kg	1.11E-06	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	5.05E-11	kg/kg	9.49E-11	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.55E-17	kg/kg	1.65E-17	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.13E-16	kg/kg	7.32E-17	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
								3.90E-05	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.53E-11	kg/kg	7.75E-11	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.21E-12	kg/kg	6.78E-12	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.92E-12	kg/kg	8.94E-12	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	5.40E-15	kg/kg	1.65E-14	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	4.32E-11	kg/kg	1.32E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.74E-09	kg/kg	5.33E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.36E-05	kg/kg	3.00E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	9.43E-09	kg/kg	2.07E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.37E-05	kg/kg	3.02E-07	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	9.46E-09	kg/kg	2.08E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.02E-09	kg/kg	1.02E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.23E-10	kg/kg	6.84E-10	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.54E-12	kg/kg	4.71E-12	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
								6.10E-07	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	5.23E-05	kg/kg	5.17E-04	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	7.28E-05	kg/kg	1.39E-03	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	7.07E-07	kg/kg	2.81E-05	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	8.89E-05	kg/kg	3.41E-03	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.17E-03	kg/kg	5.36E-02	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	7.81E-10	kg/kg	7.73E-09	Ecoinvent V2, disposal, building, concrete gravel, to recycling, CH
								5.90E-02	

R5a **Transport steel to recycle center** See Transport, lorry >32t, EURO4

back to top

R8a **Recycle steel components**

back to top

R5b **Transport wood to recycle center** Transport included in R2 - remove damaged wood. See R2

back to top

Recycle wood components No recycling. Wood is considered waste. See R2

back to top

R5c **Transport concrete for reuse as aggregate** See Transport, lorry >32t, EURO4

back to top

R3 **Extract Gravel Materials_1**

Mine, gravel-sand includes the area of the infrastructure (buildings, paved roads, etc.) and the machines used for the gravel mining, does not include the area of the actual mine, which is included in mining — Ecoinvent V2, mine, gravel/sand, CH

back to top

								unit	
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	5.55E+05	kg/unit	5.55E+05	Ecoinvent V2, mine, gravel/sand, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	4.45E+05	kg/unit	4.45E+05	Ecoinvent V2, mine, gravel/sand, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	4.33E-02	kg/unit	4.33E-02	Ecoinvent V2, mine, gravel/sand, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.04E+06	kg/unit	1.04E+06	Ecoinvent V2, mine, gravel/sand, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.38E+02	kg/unit	3.73E+02	Ecoinvent V2, mine, gravel/sand, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	7.72E+02	kg/unit	1.21E+03	Ecoinvent V2, mine, gravel/sand, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	5.09E-05	kg/unit	8.00E-05	Ecoinvent V2, mine, gravel/sand, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.40E+04	kg/unit	2.21E+04	Ecoinvent V2, mine, gravel/sand, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	3.69E-04	kg/unit	1.11E-02	Ecoinvent V2, mine, gravel/sand, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	3.05E-05	kg/unit	9.15E-04	Ecoinvent V2, mine, gravel/sand, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.82E-10	kg/unit	5.46E-09	Ecoinvent V2, mine, gravel/sand, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.65E+01	kg/unit	4.92E+03	Ecoinvent V2, mine, gravel/sand, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	8.26E+00	kg/unit	2.46E+03	Ecoinvent V2, mine, gravel/sand, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	4.13E-07	kg/unit	1.23E-04	Ecoinvent V2, mine, gravel/sand, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.25E+01	kg/unit	3.72E+03	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	9.38E-06	kg/unit	1.34E-02	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.38E-04	kg/unit	4.83E-01	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.03E-01	kg/unit	2.91E+02	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.48E-06	kg/unit	2.13E-02	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.68E-04	kg/unit	3.32E-02	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	5.82E-03	kg/unit	5.82E+01	Ecoinvent V2, mine, gravel/sand, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.46E-04	kg/unit	3.01E+00	Ecoinvent V2, mine, gravel/sand, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	6.96E-01	kg/unit	8.50E+03	Ecoinvent V2, mine, gravel/sand, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	3.23E+00	kg/unit	8.06E+01	Ecoinvent V2, mine, gravel/sand, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.06E+01	kg/unit	2.65E+02	Ecoinvent V2, mine, gravel/sand, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.72E+00	kg/unit	9.30E+01	Ecoinvent V2, mine, gravel/sand, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	4.94E-10	kg/unit	2.47E-09	Ecoinvent V2, mine, gravel/sand, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	7.20E-03	kg/unit	1.36E+01	Ecoinvent V2, mine, gravel/sand, CH

Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	4.91E-09	kg/unit	3.51E-05	Ecoinvent V2, mine, gravel/sand, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	6.70E-03	kg/unit	4.78E+01	Ecoinvent V2, mine, gravel/sand, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.95E-02	kg/unit	3.54E+01	Ecoinvent V2, mine, gravel/sand, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.68E-02	kg/unit	4.85E+01	Ecoinvent V2, mine, gravel/sand, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.71E-04	kg/unit	2.36E-03	Ecoinvent V2, mine, gravel/sand, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	9.02E-05	kg/unit	7.85E-04	Ecoinvent V2, mine, gravel/sand, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.42E-05	kg/unit	1.55E-01	Ecoinvent V2, mine, gravel/sand, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.47E-05	kg/unit	2.69E-01	Ecoinvent V2, mine, gravel/sand, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	3.28E-10	kg/unit	3.58E-06	Ecoinvent V2, mine, gravel/sand, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.67E-08	kg/unit	5.60E-06	Ecoinvent V2, mine, gravel/sand, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	7.33E+02	kg/unit	1.83E+04	Ecoinvent V2, mine, gravel/sand, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.77E+03	kg/unit	9.43E+04	Ecoinvent V2, mine, gravel/sand, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	6.88E-07	kg/unit	1.72E-05	Ecoinvent V2, mine, gravel/sand, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	3.15E+01	kg/unit	7.87E+02	Ecoinvent V2, mine, gravel/sand, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.11E-02	kg/unit	1.55E+01	Ecoinvent V2, mine, gravel/sand, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.47E-07	kg/unit	2.05E-04	Ecoinvent V2, mine, gravel/sand, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.38E-05	kg/unit	1.02E-01	Ecoinvent V2, mine, gravel/sand, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.27E+00	kg/unit	4.63E+04	Ecoinvent V2, mine, gravel/sand, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.33E-08	kg/unit	2.06E-04	Ecoinvent V2, mine, gravel/sand, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	8.49E-06	kg/unit	1.26E-01	Ecoinvent V2, mine, gravel/sand, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.53E-04	kg/unit	5.76E+00	Ecoinvent V2, mine, gravel/sand, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.33E-02	kg/unit	9.87E+02	Ecoinvent V2, mine, gravel/sand, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	9.07E-06	kg/unit	1.18E-04	Ecoinvent V2, mine, gravel/sand, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.65E-04	kg/unit	2.14E-03	Ecoinvent V2, mine, gravel/sand, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.62E+02	kg/unit	2.62E+02	Ecoinvent V2, mine, gravel/sand, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
								2.25E+06	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.26E+01	kg/unit	2.36E+01	Ecoinvent V2, mine, gravel/sand, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	3.68E+01	kg/unit	6.92E+01	Ecoinvent V2, mine, gravel/sand, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.91E+03	kg/unit	3.60E+03	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.00E+01	kg/unit	2.64E+01	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.66E+01	kg/unit	2.34E+01	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	8.44E+02	kg/unit	7.43E+02	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.06E+00	kg/unit	1.70E+00	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	6.47E+00	kg/unit	1.03E+01	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.81E+01	kg/unit	4.49E+01	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	5.58E-02	kg/unit	1.05E-01	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	9.93E+00	kg/unit	1.87E+01	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	3.28E+00	kg/unit	6.16E+00	Ecoinvent V2, mine, gravel/sand, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	7.76E+02	kg/unit	5.43E+02	Ecoinvent V2, mine, gravel/sand, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.48E+03	kg/unit	1.04E+03	Ecoinvent V2, mine, gravel/sand, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	4.22E+03	kg/unit	2.96E+03	Ecoinvent V2, mine, gravel/sand, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.04E+03	kg/unit	1.04E+03	Ecoinvent V2, mine, gravel/sand, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	5.66E+03	kg/unit	5.66E+03	Ecoinvent V2, mine, gravel/sand, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.06E+03	kg/unit	1.06E+03	Ecoinvent V2, mine, gravel/sand, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.67E-01	kg/unit	6.90E-01	Ecoinvent V2, mine, gravel/sand, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	9.50E-08	kg/unit	6.18E-08	Ecoinvent V2, mine, gravel/sand, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.66E-07	kg/unit	1.73E-07	Ecoinvent V2, mine, gravel/sand, CH
								1.69E+04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.62E-01	kg/unit	4.96E-01	Ecoinvent V2, mine, gravel/sand, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.56E-02	kg/unit	4.77E-02	Ecoinvent V2, mine, gravel/sand, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.03E-02	kg/unit	3.15E-02	Ecoinvent V2, mine, gravel/sand, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.98E-03	kg/unit	6.05E-03	Ecoinvent V2, mine, gravel/sand, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.50E-01	kg/unit	1.07E+00	Ecoinvent V2, mine, gravel/sand, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.39E-01	kg/unit	7.32E-01	Ecoinvent V2, mine, gravel/sand, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.58E+03	kg/unit	3.47E+01	Ecoinvent V2, mine, gravel/sand, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	8.06E+01	kg/unit	1.77E+00	Ecoinvent V2, mine, gravel/sand, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.78E+03	kg/unit	3.92E+01	Ecoinvent V2, mine, gravel/sand, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	8.21E+01	kg/unit	1.81E+00	Ecoinvent V2, mine, gravel/sand, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.52E+00	kg/unit	1.52E+00	Ecoinvent V2, mine, gravel/sand, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.69E+00	kg/unit	5.18E+00	Ecoinvent V2, mine, gravel/sand, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	4.14E-02	kg/unit	1.27E-01	Ecoinvent V2, mine, gravel/sand, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/unit	0.00E+00	Ecoinvent V2, mine, gravel/sand, CH
								8.67E+01	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.39E+05	kg/unit	1.37E+06	Ecoinvent V2, mine, gravel/sand, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	4.68E+05	kg/unit	8.94E+06	Ecoinvent V2, mine, gravel/sand, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	4.62E+03	Nm3/unit	1.84E+05	Ecoinvent V2, mine, gravel/sand, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.77E+05	Nm3/unit	6.79E+06	Ecoinvent V2, mine, gravel/sand, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.94E+05	kg/unit	8.88E+06	Ecoinvent V2, mine, gravel/sand, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	5.79E+01	kg/unit	5.73E+02	Ecoinvent V2, mine, gravel/sand, CH
								2.62E+07	
	Gravel, crushed, at mine	includes the whole manufacturing process, internal processes (transport, etc.) and infrastructure. No administration is included. Dust emission (particulates >PM10, >PM2.5 <PM10 and <PM2.5) share according to "mining limestone" process. Recultivation is taken into account.							Ecoinvent V2, gravel, crushed, at mine, CH
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.21E-03	kg/kg	1.21E-03	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.03E-03	kg/kg	1.03E-03	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	6.07E-11	kg/kg	6.07E-11	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.78E-03	kg/kg	1.78E-03	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	4.52E-07	kg/kg	7.11E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	8.14E-07	kg/kg	1.28E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	7.13E-14	kg/kg	1.12E-13	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.35E-05	kg/kg	2.12E-05	Ecoinvent V2, gravel, crushed, at mine, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	3.95E-12	kg/kg	1.19E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.30E-13	kg/kg	3.89E-12	Ecoinvent V2, gravel, crushed, at mine, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.80E-19	kg/kg	5.39E-18	Ecoinvent V2, gravel, crushed, at mine, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.44E-08	kg/kg	7.29E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.48E-08	kg/kg	7.40E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.78E-16	kg/kg	1.72E-13	Ecoinvent V2, gravel, crushed, at mine, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	9.73E-08	kg/kg	2.90E-05	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.20E-14	kg/kg	3.14E-11	Ecoinvent V2, gravel, crushed, at mine, CH

Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	4.91E-12	kg/kg	7.03E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.79E-10	kg/kg	2.56E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.30E-15	kg/kg	2.02E-11	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.65E-12	kg/kg	3.28E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	9.77E-11	kg/kg	9.77E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.92E-13	kg/kg	3.57E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.18E-10	kg/kg	2.66E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.40E-09	kg/kg	6.01E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.94E-08	kg/kg	9.84E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.19E-08	kg/kg	5.49E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	4.87E-19	kg/kg	2.44E-18	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.07E-11	kg/kg	2.02E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.75E-17	kg/kg	1.25E-13	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	2.48E-11	kg/kg	1.77E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.94E-11	kg/kg	3.51E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	4.92E-11	kg/kg	8.90E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.91E-13	kg/kg	1.66E-12	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.84E-13	kg/kg	3.34E-12	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	2.86E-14	kg/kg	3.12E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.05E-14	kg/kg	3.33E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	3.24E-19	kg/kg	3.53E-15	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	6.25E-17	kg/kg	1.31E-14	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	7.51E-07	kg/kg	1.88E-05	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	5.63E-06	kg/kg	1.41E-04	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	9.63E-16	kg/kg	2.41E-14	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	8.39E-08	kg/kg	2.10E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	9.73E-12	kg/kg	1.36E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.45E-16	kg/kg	2.03E-13	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.36E-13	kg/kg	1.01E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.96E-09	kg/kg	1.45E-05	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.02E-16	kg/kg	4.82E-13	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.99E-14	kg/kg	2.94E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.80E-13	kg/kg	4.11E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.10E-10	kg/kg	9.36E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	9.80E-15	kg/kg	1.27E-13	Ecoinvent V2, gravel, crushed, at mine, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	7.00E-13	kg/kg	9.11E-12	Ecoinvent V2, gravel, crushed, at mine, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.11E-07	kg/kg	2.11E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
								4.28E-03	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	9.87E-09	kg/kg	1.86E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	3.75E-08	kg/kg	7.05E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.83E-06	kg/kg	3.44E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.28E-08	kg/kg	2.00E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.90E-08	kg/kg	4.32E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	8.28E-07	kg/kg	7.29E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	8.79E-10	kg/kg	1.41E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.39E-08	kg/kg	2.22E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.13E-08	kg/kg	1.81E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	5.09E-11	kg/kg	9.58E-11	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	9.79E-09	kg/kg	1.84E-08	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.67E-09	kg/kg	5.02E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.20E-06	kg/kg	8.43E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.45E-06	kg/kg	1.71E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.80E-05	kg/kg	1.26E-05	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.76E-06	kg/kg	1.76E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	4.73E-06	kg/kg	4.73E-06	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	9.93E-07	kg/kg	9.93E-07	Ecoinvent V2, gravel, crushed, at mine, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.87E-10	kg/kg	5.40E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	9.01E-17	kg/kg	5.86E-17	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.64E-15	kg/kg	1.71E-15	Ecoinvent V2, gravel, crushed, at mine, CH
								2.70E-05	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.72E-10	kg/kg	5.25E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.04E-11	kg/kg	6.24E-11	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.59E-10	kg/kg	4.87E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	6.22E-13	kg/kg	1.90E-12	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	5.04E-10	kg/kg	1.54E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	9.60E-10	kg/kg	2.94E-09	Ecoinvent V2, gravel, crushed, at mine, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	7.03E-06	kg/kg	1.55E-07	Ecoinvent V2, gravel, crushed, at mine, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.96E-08	kg/kg	1.31E-09	Ecoinvent V2, gravel, crushed, at mine, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	7.20E-06	kg/kg	1.58E-07	Ecoinvent V2, gravel, crushed, at mine, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.10E-08	kg/kg	1.34E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.46E-09	kg/kg	1.46E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.64E-09	kg/kg	5.00E-09	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	3.95E-11	kg/kg	1.21E-10	Ecoinvent V2, gravel, crushed, at mine, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, gravel, crushed, at mine, CH
								3.28E-07	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.03E-04	kg/kg	3.99E-03	Ecoinvent V2, gravel, crushed, at mine, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	5.58E-04	kg/kg	1.07E-02	Ecoinvent V2, gravel, crushed, at mine, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	5.53E-06	Nm3/kg	2.20E-04	Ecoinvent V2, gravel, crushed, at mine, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.47E-04	Nm3/kg	9.46E-03	Ecoinvent V2, gravel, crushed, at mine, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	6.93E-04	kg/kg	3.18E-02	Ecoinvent V2, gravel, crushed, at mine, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.49E-08	kg/kg	4.44E-07	Ecoinvent V2, gravel, crushed, at mine, CH
								5.61E-02	
R6	**Transport gravel materials**	See Transport, lorry >32t, EURO4							

back to top

R9	**Grade access roads**	
back to top		Included in total energy used on beef farms
		Pembina Institute _ http://lcva.ca/documents/Build_Gravel_Road
CC1	**Plant cover crop or green manure**	not specific for Alberta practices. Not calculated.
back to top		Included in total energy used on beef farms
CC2	**Cultivate soil**	Ecoinvent V2, tillage, harrowing, by spring tine harrow
back to top		Included in total energy used on beef farms

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	4.17E+00	kg/ha	4.17E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.62E+01	kg/ha	1.62E+01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	2.59E-07	kg/ha	2.59E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	3.21E+00	kg/ha	3.21E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.74E-03	kg/ha	2.74E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	3.17E-02	kg/ha	4.98E-02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	3.04E-10	kg/ha	4.77E-10	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	5.84E-02	kg/ha	9.18E-02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.08E-09	kg/ha	6.24E-08	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Chloroform	air	low population density	kg	30	kg CO2-Eq	7.81E-11	kg/ha	2.34E-09	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.88E-16	kg/ha	5.65E-15	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	8.42E-05	kg/ha	2.51E-02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	5.81E-04	kg/ha	1.73E-01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	2.46E-12	kg/ha	7.34E-10	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	4.27E-05	kg/ha	1.27E-02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	4.98E-11	kg/ha	7.12E-08	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.55E-09	kg/ha	3.64E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	8.55E-07	kg/ha	1.22E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.78E-11	kg/ha	1.09E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.81E-09	kg/ha	2.24E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	4.89E-08	kg/ha	4.89E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.27E-09	kg/ha	1.55E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	4.69E-07	kg/ha	5.72E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	8.90E-06	kg/ha	2.23E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	3.54E-05	kg/ha	8.85E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.02E-05	kg/ha	5.06E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	5.10E-16	kg/ha	2.55E-15	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	2.46E-08	kg/ha	4.65E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.22E-12	kg/ha	8.69E-09	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	2.49E-07	kg/ha	1.78E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.15E-09	kg/ha	2.07E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	9.51E-08	kg/ha	1.72E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.07E-10	kg/ha	9.34E-10	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.31E-10	kg/ha	2.01E-09	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	6.60E-11	kg/ha	7.19E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	9.07E-11	kg/ha	9.88E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	3.39E-16	kg/ha	3.70E-12	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.42E-13	kg/ha	2.97E-11	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.39E-03	kg/ha	3.47E-02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.26E-02	kg/ha	8.14E-01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	4.10E-12	kg/ha	1.03E-10	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	6.26E-05	kg/ha	1.57E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.21E-08	kg/ha	1.69E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.52E-13	kg/ha	2.12E-10	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	9.29E-11	kg/ha	6.86E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	4.22E-06	kg/ha	3.12E-02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.30E-13	kg/ha	1.09E-09	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	4.51E-11	kg/ha	6.67E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.51E-09	kg/ha	3.45E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	2.72E-07	kg/ha	6.21E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.98E-12	kg/ha	2.58E-11	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.22E-10	kg/ha	5.49E-09	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.62E-04	kg/ha	1.62E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
								2.49E+01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	2.78E-05	kg/ha	5.22E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.34E-04	kg/ha	2.51E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	3.21E-04	kg/ha	6.03E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.94E-04	kg/ha	1.70E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	8.60E-05	kg/ha	7.57E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.07E-04	kg/ha	9.39E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	6.84E-06	kg/ha	1.09E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	2.01E-05	kg/ha	3.21E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.74E-05	kg/ha	4.39E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	8.99E-07	kg/ha	1.69E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	4.33E-05	kg/ha	8.15E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.76E-05	kg/ha	3.30E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	4.21E-03	kg/ha	2.95E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.10E-01	kg/ha	1.47E-01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	9.44E-03	kg/ha	6.61E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	8.44E-03	kg/ha	8.44E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.35E-02	kg/ha	2.35E-02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	3.05E-03	kg/ha	3.05E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.84E-06	kg/ha	3.47E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow

Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	4.87E-13	kg/ha	3.17E-13	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.80E-12	kg/ha	1.17E-12	Ecoinvent V2, tillage, harrowing, by spring tine harrow
								1.93E-01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	5.27E-07	kg/ha	1.61E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	8.02E-08	kg/ha	2.45E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	8.26E-08	kg/ha	2.53E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.34E-09	kg/ha	4.10E-09	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	5.01E-07	kg/ha	1.53E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	6.67E-06	kg/ha	2.04E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	4.48E-02	kg/ha	9.86E-04	Ecoinvent V2, tillage, harrowing, by spring tine harrow
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.58E-04	kg/ha	5.68E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	4.56E-02	kg/ha	1.00E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.60E-04	kg/ha	5.72E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphate	water	river	kg	1	kg PO4-Eq	7.22E-06	kg/ha	7.22E-06	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	water	river	kg	3.06	kg PO4-Eq	4.50E-06	kg/ha	1.38E-05	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	5.05E-08	kg/ha	1.54E-07	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
								2.05E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	5.29E-01	kg/ha	5.24E+00	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.14E+00	kg/ha	4.08E+01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.10E-02	Nm3/ha	8.36E-01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	8.88E-01	Nm3/ha	3.40E+01	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	5.90E+00	kg/ha	2.70E+02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.68E-04	kg/ha	1.66E-03	Ecoinvent V2, tillage, harrowing, by spring tine harrow
								3.51E+02	Ecoinvent V2, tillage, harrowing, by spring tine harrow
		Ecoinvent V2, Tillage, cultivating, chiseling							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	8.82E+00	kg/ha	8.82E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	5.45E+01	kg/ha	5.45E+01	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	5.79E-07	kg/ha	5.79E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	5.03E+00	kg/ha	5.03E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.54E-03	kg/ha	5.56E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.41E-01	kg/ha	2.22E-01	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	6.80E-10	kg/ha	1.07E-09	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	9.71E-02	kg/ha	1.53E-01	Ecoinvent V2, Tillage, cultivating, chiseling
Chloroform	air	high population density	kg	30	kg CO2-Eq	3.81E-09	kg/ha	1.14E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.47E-10	kg/ha	4.41E-09	Ecoinvent V2, Tillage, cultivating, chiseling
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.77E-16	kg/ha	1.13E-14	Ecoinvent V2, Tillage, cultivating, chiseling
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.59E-04	kg/ha	4.73E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.98E-03	kg/ha	5.89E-01	Ecoinvent V2, Tillage, cultivating, chiseling
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.51E-12	kg/ha	1.64E-09	Ecoinvent V2, Tillage, cultivating, chiseling
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	8.20E-05	kg/ha	2.45E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.01E-10	kg/ha	1.45E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	4.68E-09	kg/ha	6.70E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.91E-06	kg/ha	2.73E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.67E-11	kg/ha	2.25E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	3.49E-09	kg/ha	4.33E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	8.91E-08	kg/ha	8.91E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.61E-09	kg/ha	3.19E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	9.91E-07	kg/ha	1.21E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.45E-05	kg/ha	3.64E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	6.87E-05	kg/ha	1.72E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	4.08E-05	kg/ha	1.02E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.02E-15	kg/ha	5.11E-15	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	4.49E-08	kg/ha	8.49E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.61E-12	kg/ha	1.87E-08	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	8.00E-07	kg/ha	5.71E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.27E-09	kg/ha	4.11E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.75E-07	kg/ha	3.16E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.08E-10	kg/ha	1.81E-09	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	4.35E-10	kg/ha	3.78E-09	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.33E-10	kg/ha	1.45E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.79E-10	kg/ha	1.96E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.79E-16	kg/ha	7.40E-12	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.88E-13	kg/ha	6.04E-11	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.09E-03	kg/ha	7.72E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	8.37E-02	kg/ha	2.09E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	9.19E-12	kg/ha	2.30E-10	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.01E-04	kg/ha	2.52E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.25E-08	kg/ha	3.15E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.04E-13	kg/ha	4.25E-10	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.80E-10	kg/ha	1.33E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	8.92E-06	kg/ha	6.59E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.67E-13	kg/ha	2.22E-09	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	9.16E-11	kg/ha	1.36E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.63E-09	kg/ha	3.72E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	5.38E-07	kg/ha	1.23E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	3.60E-12	kg/ha	4.68E-11	Ecoinvent V2, Tillage, cultivating, chiseling
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	7.94E-10	kg/ha	1.03E-08	Ecoinvent V2, Tillage, cultivating, chiseling
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.79E-04	kg/ha	3.79E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
								7.16E+01	Ecoinvent V2, Tillage, cultivating, chiseling
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	4.83E-05	kg/ha	9.09E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	4.11E-04	kg/ha	7.72E-04	Ecoinvent V2, Tillage, cultivating, chiseling

Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	5.41E-04	kg/ha	1.02E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.29E-04	kg/ha	2.89E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.84E-04	kg/ha	1.62E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.78E-04	kg/ha	1.56E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.25E-05	kg/ha	2.00E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.21E-05	kg/ha	6.74E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	4.98E-05	kg/ha	7.96E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	9.17E-07	kg/ha	1.72E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	7.29E-05	kg/ha	1.37E-04	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.90E-05	kg/ha	5.45E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	9.19E-03	kg/ha	6.43E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	6.41E-01	kg/ha	4.49E-01	Ecoinvent V2, Tillage, cultivating, chiseling
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.72E-02	kg/ha	1.21E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.04E-02	kg/ha	2.04E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	6.59E-02	kg/ha	6.59E-02	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	4.93E-03	kg/ha	4.93E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.04E-06	kg/ha	5.72E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.00E-12	kg/ha	6.51E-13	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.47E-12	kg/ha	2.26E-12	Ecoinvent V2, Tillage, cultivating, chiseling
								5.61E-01	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	8.92E-07	kg/ha	2.73E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.33E-07	kg/ha	4.07E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.52E-07	kg/ha	4.65E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.83E-09	kg/ha	8.67E-09	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.01E-06	kg/ha	3.09E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.12E-05	kg/ha	6.49E-05	Ecoinvent V2, Tillage, cultivating, chiseling
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.43E-01	kg/ha	3.14E-03	Ecoinvent V2, Tillage, cultivating, chiseling
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.29E-04	kg/ha	9.44E-06	Ecoinvent V2, Tillage, cultivating, chiseling
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.45E-01	kg/ha	3.18E-03	Ecoinvent V2, Tillage, cultivating, chiseling
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.32E-04	kg/ha	9.51E-06	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphate	water	river	kg	1	kg PO4-Eq	1.44E-05	kg/ha	1.44E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	water	river	kg	3.06	kg PO4-Eq	9.38E-06	kg/ha	2.87E-05	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	8.56E-08	kg/ha	2.62E-07	Ecoinvent V2, Tillage, cultivating, chiseling
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, cultivating, chiseling
								6.46E-03	Ecoinvent V2, Tillage, cultivating, chiseling
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.10E+00	kg/ha	1.09E+01	Ecoinvent V2, Tillage, cultivating, chiseling
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	3.63E+00	kg/ha	6.93E+01	Ecoinvent V2, Tillage, cultivating, chiseling
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	3.54E-02	Nm3/ha	1.41E+00	Ecoinvent V2, Tillage, cultivating, chiseling
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.15E+00	Nm3/ha	8.21E+01	Ecoinvent V2, Tillage, cultivating, chiseling
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.88E+01	kg/ha	8.63E+02	Ecoinvent V2, Tillage, cultivating, chiseling
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.92E-04	kg/ha	2.89E-03	Ecoinvent V2, Tillage, cultivating, chiseling
								1.03E+03	
		Ecoinvent V2, Tillage, rotary cultivator							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.20E+01	kg/ha	1.20E+01	Ecoinvent V2, Tillage, rotary cultivator
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	5.11E+01	kg/ha	5.11E+01	Ecoinvent V2, Tillage, rotary cultivator
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	6.10E-07	kg/ha	6.10E-07	Ecoinvent V2, Tillage, rotary cultivator
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	8.59E+00	kg/ha	8.59E+00	Ecoinvent V2, Tillage, rotary cultivator
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	4.42E-03	kg/ha	6.95E-03	Ecoinvent V2, Tillage, rotary cultivator
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.03E-01	kg/ha	3.19E-01	Ecoinvent V2, Tillage, rotary cultivator
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	7.16E-10	kg/ha	1.13E-09	Ecoinvent V2, Tillage, rotary cultivator
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.86E-01	kg/ha	2.93E-01	Ecoinvent V2, Tillage, rotary cultivator
Chloroform	air	high population density	kg	30	kg CO2-Eq	5.85E-09	kg/ha	1.76E-07	Ecoinvent V2, Tillage, rotary cultivator
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.07E-10	kg/ha	6.22E-09	Ecoinvent V2, Tillage, rotary cultivator
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.92E-16	kg/ha	1.18E-14	Ecoinvent V2, Tillage, rotary cultivator
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.10E-04	kg/ha	6.27E-02	Ecoinvent V2, Tillage, rotary cultivator
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.83E-03	kg/ha	5.46E-01	Ecoinvent V2, Tillage, rotary cultivator
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.81E-12	kg/ha	1.73E-09	Ecoinvent V2, Tillage, rotary cultivator
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.18E-04	kg/ha	3.53E-02	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.15E-10	kg/ha	1.64E-07	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	7.44E-09	kg/ha	1.06E-05	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.22E-06	kg/ha	3.17E-03	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.89E-11	kg/ha	2.38E-07	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	5.30E-09	kg/ha	6.57E-07	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.43E-07	kg/ha	1.43E-03	Ecoinvent V2, Tillage, rotary cultivator
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.81E-09	kg/ha	3.43E-05	Ecoinvent V2, Tillage, rotary cultivator
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	8.29E-07	kg/ha	1.01E-02	Ecoinvent V2, Tillage, rotary cultivator
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.44E-05	kg/ha	3.60E-04	Ecoinvent V2, Tillage, rotary cultivator
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	9.41E-05	kg/ha	2.35E-03	Ecoinvent V2, Tillage, rotary cultivator
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	5.92E-05	kg/ha	1.48E-03	Ecoinvent V2, Tillage, rotary cultivator
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.06E-15	kg/ha	5.32E-15	Ecoinvent V2, Tillage, rotary cultivator
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	7.29E-08	kg/ha	1.38E-04	Ecoinvent V2, Tillage, rotary cultivator
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.05E-12	kg/ha	1.47E-08	Ecoinvent V2, Tillage, rotary cultivator
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	7.63E-07	kg/ha	5.44E-03	Ecoinvent V2, Tillage, rotary cultivator
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.70E-09	kg/ha	4.89E-06	Ecoinvent V2, Tillage, rotary cultivator
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.81E-07	kg/ha	5.09E-04	Ecoinvent V2, Tillage, rotary cultivator
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.81E-10	kg/ha	2.45E-09	Ecoinvent V2, Tillage, rotary cultivator
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	6.14E-10	kg/ha	5.34E-09	Ecoinvent V2, Tillage, rotary cultivator
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.55E-10	kg/ha	1.69E-06	Ecoinvent V2, Tillage, rotary cultivator
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.70E-10	kg/ha	2.94E-06	Ecoinvent V2, Tillage, rotary cultivator
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	7.07E-16	kg/ha	7.71E-12	Ecoinvent V2, Tillage, rotary cultivator
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	3.27E-13	kg/ha	6.87E-11	Ecoinvent V2, Tillage, rotary cultivator
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	2.99E-03	kg/ha	7.46E-02	Ecoinvent V2, Tillage, rotary cultivator
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.01E-01	kg/ha	2.52E+00	Ecoinvent V2, Tillage, rotary cultivator
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	9.68E-12	kg/ha	2.42E-10	Ecoinvent V2, Tillage, rotary cultivator
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.19E-04	kg/ha	2.98E-03	Ecoinvent V2, Tillage, rotary cultivator

Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	3.19E-08	kg/ha	4.47E-05	Ecoinvent V2, Tillage, rotary cultivator
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.16E-13	kg/ha	4.43E-10	Ecoinvent V2, Tillage, rotary cultivator
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	2.72E-10	kg/ha	2.01E-06	Ecoinvent V2, Tillage, rotary cultivator
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	7.46E-06	kg/ha	5.51E-02	Ecoinvent V2, Tillage, rotary cultivator
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	5.31E-13	kg/ha	2.52E-09	Ecoinvent V2, Tillage, rotary cultivator
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.04E-10	kg/ha	1.54E-06	Ecoinvent V2, Tillage, rotary cultivator
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.19E-09	kg/ha	4.99E-05	Ecoinvent V2, Tillage, rotary cultivator
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	7.86E-07	kg/ha	1.79E-02	Ecoinvent V2, Tillage, rotary cultivator
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	5.12E-12	kg/ha	6.66E-11	Ecoinvent V2, Tillage, rotary cultivator
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.12E-09	kg/ha	1.46E-08	Ecoinvent V2, Tillage, rotary cultivator
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	4.66E-04	kg/ha	4.66E-04	Ecoinvent V2, Tillage, rotary cultivator
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
								7.56E+01	Ecoinvent V2, Tillage, rotary cultivator
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	5.72E-05	kg/ha	1.08E-04	Ecoinvent V2, Tillage, rotary cultivator
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	4.18E-04	kg/ha	7.86E-04	Ecoinvent V2, Tillage, rotary cultivator
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	8.69E-04	kg/ha	1.63E-03	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	6.35E-04	kg/ha	5.59E-04	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.46E-04	kg/ha	2.16E-04	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	3.20E-04	kg/ha	2.81E-04	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	2.22E-05	kg/ha	3.54E-05	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	5.66E-05	kg/ha	9.05E-05	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	7.42E-05	kg/ha	1.19E-04	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.18E-06	kg/ha	2.22E-06	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.38E-04	kg/ha	2.59E-04	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	5.72E-05	kg/ha	1.08E-04	Ecoinvent V2, Tillage, rotary cultivator
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.21E-02	kg/ha	8.50E-03	Ecoinvent V2, Tillage, rotary cultivator
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	6.19E-01	kg/ha	4.33E-01	Ecoinvent V2, Tillage, rotary cultivator
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.41E-02	kg/ha	1.69E-02	Ecoinvent V2, Tillage, rotary cultivator
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.53E-02	kg/ha	2.53E-02	Ecoinvent V2, Tillage, rotary cultivator
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	7.00E-02	kg/ha	7.00E-02	Ecoinvent V2, Tillage, rotary cultivator
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	8.99E-03	kg/ha	8.99E-03	Ecoinvent V2, Tillage, rotary cultivator
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	6.02E-06	kg/ha	1.13E-05	Ecoinvent V2, Tillage, rotary cultivator
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.06E-12	kg/ha	6.90E-13	Ecoinvent V2, Tillage, rotary cultivator
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	5.27E-12	kg/ha	3.42E-12	Ecoinvent V2, Tillage, rotary cultivator
								5.67E-01	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.47E-06	kg/ha	4.50E-06	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.60E-07	kg/ha	7.96E-07	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.42E-07	kg/ha	7.40E-07	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.38E-09	kg/ha	7.27E-09	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.45E-06	kg/ha	4.43E-06	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.05E-05	kg/ha	6.26E-05	Ecoinvent V2, Tillage, rotary cultivator
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.37E-01	kg/ha	3.02E-03	Ecoinvent V2, Tillage, rotary cultivator
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	8.33E-04	kg/ha	1.83E-05	Ecoinvent V2, Tillage, rotary cultivator
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.39E-01	kg/ha	3.06E-03	Ecoinvent V2, Tillage, rotary cultivator
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	8.37E-04	kg/ha	1.84E-05	Ecoinvent V2, Tillage, rotary cultivator
Phosphate	water	river	kg	1	kg PO4-Eq	1.73E-05	kg/ha	1.73E-05	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.20E-05	kg/ha	3.67E-05	Ecoinvent V2, Tillage, rotary cultivator
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	9.94E-08	kg/ha	3.04E-07	Ecoinvent V2, Tillage, rotary cultivator
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, Tillage, rotary cultivator
								6.24E-03	Ecoinvent V2, Tillage, rotary cultivator
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.52E+00	kg/ha	1.51E+01	Ecoinvent V2, Tillage, rotary cultivator
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	6.73E+00	kg/ha	1.29E+02	Ecoinvent V2, Tillage, rotary cultivator
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	6.56E-02	Nm3/ha	2.61E+00	Ecoinvent V2, Tillage, rotary cultivator
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.62E+00	Nm3/ha	1.00E+02	Ecoinvent V2, Tillage, rotary cultivator
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.80E+01	kg/ha	8.24E+02	Ecoinvent V2, Tillage, rotary cultivator
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.89E-04	kg/ha	2.86E-03	Ecoinvent V2, Tillage, rotary cultivator
								1.07E+03	

CC3	**Apply fertilizer**	
		Broadcasting, See FC2
		Ecoinvent V2, fertilizing, by broadcaster, CH

Ecoinvent, V2 tillage, harrowing, by rotary harrow

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.03E+01	kg/ha	1.03E+01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	4.19E+01	kg/ha	4.19E+01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	5.18E-07	kg/ha	5.18E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	7.28E+00	kg/ha	7.28E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.84E-03	kg/ha	6.04E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.04E-01	kg/ha	1.64E-01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	6.09E-10	kg/ha	9.57E-10	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.63E-01	kg/ha	2.56E-01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Chloroform	air	high population density	kg	30	kg CO2-Eq	5.08E-09	kg/ha	1.52E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.81E-10	kg/ha	5.43E-09	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.47E-16	kg/ha	1.04E-14	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.79E-04	kg/ha	5.33E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.50E-03	kg/ha	4.47E-01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	4.94E-12	kg/ha	1.47E-09	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.01E-04	kg/ha	3.02E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	9.87E-11	kg/ha	1.41E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	6.46E-09	kg/ha	9.23E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.82E-06	kg/ha	2.61E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.33E-11	kg/ha	2.04E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	4.57E-09	kg/ha	5.67E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.24E-07	kg/ha	1.24E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow

Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.41E-09	kg/ha	2.94E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	7.39E-07	kg/ha	9.01E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.19E-05	kg/ha	2.96E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	8.04E-05	kg/ha	2.01E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	5.09E-05	kg/ha	1.27E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	9.42E-16	kg/ha	4.71E-15	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	6.33E-08	kg/ha	1.20E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.84E-12	kg/ha	1.32E-08	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	6.27E-07	kg/ha	4.48E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.28E-09	kg/ha	4.13E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.44E-07	kg/ha	4.41E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.43E-10	kg/ha	2.11E-09	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	5.36E-10	kg/ha	4.66E-09	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.33E-10	kg/ha	1.44E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.33E-10	kg/ha	2.54E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.26E-16	kg/ha	6.83E-12	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.81E-13	kg/ha	5.89E-11	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	2.57E-03	kg/ha	6.42E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	8.50E-02	kg/ha	2.12E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	8.23E-12	kg/ha	2.06E-10	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	9.61E-05	kg/ha	2.40E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.70E-08	kg/ha	3.78E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.80E-13	kg/ha	3.92E-10	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	2.35E-10	kg/ha	1.74E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.65E-06	kg/ha	4.91E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.56E-13	kg/ha	2.16E-09	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	8.93E-11	kg/ha	1.32E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.61E-09	kg/ha	3.66E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	6.77E-07	kg/ha	1.54E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	4.35E-12	kg/ha	5.66E-11	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	9.78E-10	kg/ha	1.27E-08	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.95E-04	kg/ha	3.95E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
								6.27E+01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	4.75E-05	kg/ha	8.93E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	3.46E-04	kg/ha	6.50E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	7.47E-04	kg/ha	1.40E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	5.55E-04	kg/ha	4.89E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.10E-04	kg/ha	1.85E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.76E-04	kg/ha	2.43E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.93E-05	kg/ha	3.08E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.85E-05	kg/ha	7.77E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	6.51E-05	kg/ha	1.04E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	8.41E-07	kg/ha	1.58E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.20E-04	kg/ha	2.26E-04	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	5.00E-05	kg/ha	9.41E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.04E-02	kg/ha	7.25E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	4.99E-01	kg/ha	3.49E-01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.01E-02	kg/ha	1.41E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.15E-02	kg/ha	2.15E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	5.84E-02	kg/ha	5.84E-02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	7.79E-03	kg/ha	7.79E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	5.26E-06	kg/ha	9.89E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	9.10E-13	kg/ha	5.91E-13	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	4.55E-12	kg/ha	2.95E-12	Ecoinvent, V2 tillage, harrowing, by rotary harrow
								4.62E-01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.27E-06	kg/ha	3.88E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.27E-07	kg/ha	6.96E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.10E-07	kg/ha	6.42E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.12E-09	kg/ha	6.47E-09	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.24E-06	kg/ha	3.81E-06	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.69E-05	kg/ha	5.16E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.13E-01	kg/ha	2.49E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.28E-04	kg/ha	1.60E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.14E-01	kg/ha	2.52E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.31E-04	kg/ha	1.61E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphate	water	river	kg	1	kg PO4-Eq	1.51E-05	kg/ha	1.51E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.03E-05	kg/ha	3.15E-05	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	8.15E-08	kg/ha	2.49E-07	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
								5.14E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.30E+00	kg/ha	1.29E+01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	5.87E+00	kg/ha	1.12E+02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	5.71E-02	Nm3/ha	2.27E+00	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.22E+00	Nm3/ha	8.50E+01	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.48E+01	kg/ha	6.78E+02	Ecoinvent, V2 tillage, harrowing, by rotary harrow
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.44E-04	kg/ha	2.42E-03	Ecoinvent, V2 tillage, harrowing, by rotary harrow
								8.90E+02	

CC4	**Plant Crop**	Ecoinvent V2, planting, CH

Planting

The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the planter. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. The planting material is not taken into account. Not included are dust other than from combustion and noise.

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.07E+01	kg/ha	2.07E+01	Ecoinvent V2, planting, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.26E+01	kg/ha	6.26E+01	Ecoinvent V2, planting, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.71E-06	kg/ha	1.71E-06	Ecoinvent V2, planting, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.04E+01	kg/ha	1.04E+01	Ecoinvent V2, planting, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.13E-02	kg/ha	1.77E-02	Ecoinvent V2, planting, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.19E-01	kg/ha	1.86E-01	Ecoinvent V2, planting, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.01E-09	kg/ha	3.15E-09	Ecoinvent V2, planting, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.01E-01	kg/ha	3.16E-01	Ecoinvent V2, planting, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.00E-08	kg/ha	3.01E-07	Ecoinvent V2, planting, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.59E-10	kg/ha	1.38E-08	Ecoinvent V2, planting, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.68E-15	kg/ha	5.05E-14	Ecoinvent V2, planting, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.19E-04	kg/ha	1.25E-01	Ecoinvent V2, planting, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.24E-03	kg/ha	6.67E-01	Ecoinvent V2, planting, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.63E-11	kg/ha	4.85E-09	Ecoinvent V2, planting, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.85E-04	kg/ha	5.51E-02	Ecoinvent V2, planting, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.35E-10	kg/ha	4.79E-07	Ecoinvent V2, planting, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.14E-08	kg/ha	1.62E-05	Ecoinvent V2, planting, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	3.20E-06	kg/ha	4.57E-03	Ecoinvent V2, planting, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.30E-10	kg/ha	7.95E-07	Ecoinvent V2, planting, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	7.78E-09	kg/ha	9.64E-07	Ecoinvent V2, planting, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.16E-07	kg/ha	2.16E-03	Ecoinvent V2, planting, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	9.13E-09	kg/ha	1.11E-04	Ecoinvent V2, planting, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	4.90E-06	kg/ha	5.98E-02	Ecoinvent V2, planting, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	6.22E-05	kg/ha	1.55E-03	Ecoinvent V2, planting, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.69E-04	kg/ha	4.21E-03	Ecoinvent V2, planting, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	8.69E-05	kg/ha	2.17E-03	Ecoinvent V2, planting, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	4.56E-15	kg/ha	2.28E-14	Ecoinvent V2, planting, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.04E-07	kg/ha	1.96E-04	Ecoinvent V2, planting, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.34E-11	kg/ha	9.57E-08	Ecoinvent V2, planting, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.03E-06	kg/ha	7.36E-03	Ecoinvent V2, planting, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	6.33E-09	kg/ha	1.15E-05	Ecoinvent V2, planting, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	4.02E-07	kg/ha	7.27E-04	Ecoinvent V2, planting, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	5.95E-10	kg/ha	5.18E-09	Ecoinvent V2, planting, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.36E-09	kg/ha	1.18E-08	Ecoinvent V2, planting, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	4.19E-10	kg/ha	4.56E-06	Ecoinvent V2, planting, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.81E-10	kg/ha	4.16E-06	Ecoinvent V2, planting, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	3.03E-15	kg/ha	3.30E-11	Ecoinvent V2, planting, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	9.53E-13	kg/ha	2.00E-10	Ecoinvent V2, planting, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.11E-02	kg/ha	2.78E-01	Ecoinvent V2, planting, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.23E-01	kg/ha	3.08E+00	Ecoinvent V2, planting, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.71E-11	kg/ha	6.78E-10	Ecoinvent V2, planting, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	2.85E-04	kg/ha	7.13E-03	Ecoinvent V2, planting, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	4.90E-08	kg/ha	6.86E-05	Ecoinvent V2, planting, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.36E-12	kg/ha	1.90E-09	Ecoinvent V2, planting, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	4.00E-10	kg/ha	2.96E-06	Ecoinvent V2, planting, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	4.41E-05	kg/ha	3.26E-01	Ecoinvent V2, planting, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.55E-12	kg/ha	7.35E-09	Ecoinvent V2, planting, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	3.03E-10	kg/ha	4.49E-06	Ecoinvent V2, planting, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	4.29E-09	kg/ha	9.78E-05	Ecoinvent V2, planting, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.23E-06	kg/ha	2.79E-02	Ecoinvent V2, planting, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	8.69E-12	kg/ha	1.13E-10	Ecoinvent V2, planting, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.48E-09	kg/ha	3.22E-08	Ecoinvent V2, planting, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	7.13E-04	kg/ha	7.13E-04	Ecoinvent V2, planting, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
								9.89E+01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.51E-04	kg/ha	2.84E-04	Ecoinvent V2, planting, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.16E-04	kg/ha	9.70E-04	Ecoinvent V2, planting, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.35E-03	kg/ha	2.54E-03	Ecoinvent V2, planting, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	5.91E-04	kg/ha	5.20E-04	Ecoinvent V2, planting, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	3.96E-04	kg/ha	3.49E-04	Ecoinvent V2, planting, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	3.55E-04	kg/ha	3.12E-04	Ecoinvent V2, planting, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	2.22E-05	kg/ha	3.55E-05	Ecoinvent V2, planting, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	9.56E-05	kg/ha	1.53E-04	Ecoinvent V2, planting, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.60E-04	kg/ha	2.57E-04	Ecoinvent V2, planting, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.55E-06	kg/ha	4.79E-06	Ecoinvent V2, planting, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.53E-04	kg/ha	2.87E-04	Ecoinvent V2, planting, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	5.74E-05	kg/ha	1.08E-04	Ecoinvent V2, planting, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.84E-02	kg/ha	1.29E-02	Ecoinvent V2, planting, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	8.09E-01	kg/ha	5.66E-01	Ecoinvent V2, planting, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	3.37E-02	kg/ha	2.36E-02	Ecoinvent V2, planting, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	3.66E-02	kg/ha	3.66E-02	Ecoinvent V2, planting, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.03E-01	kg/ha	1.03E-01	Ecoinvent V2, planting, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.11E-02	kg/ha	1.11E-02	Ecoinvent V2, planting, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	6.02E-06	kg/ha	1.13E-05	Ecoinvent V2, planting, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.54E-12	kg/ha	2.30E-12	Ecoinvent V2, planting, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	7.73E-12	kg/ha	5.03E-12	Ecoinvent V2, planting, CH
								7.59E-01	

Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.13E-06	kg/ha	6.50E-06	Ecoinvent V2, planting, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.67E-07	kg/ha	8.17E-07	Ecoinvent V2, planting, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	3.65E-07	kg/ha	1.12E-06	Ecoinvent V2, planting, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.40E-08	kg/ha	4.27E-08	Ecoinvent V2, planting, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.16E-06	kg/ha	6.62E-06	Ecoinvent V2, planting, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.76E-05	kg/ha	8.44E-05	Ecoinvent V2, planting, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.87E-01	kg/ha	4.11E-03	Ecoinvent V2, planting, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	8.58E-04	kg/ha	1.89E-05	Ecoinvent V2, planting, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.90E-01	kg/ha	4.17E-03	Ecoinvent V2, planting, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	8.69E-04	kg/ha	1.91E-05	Ecoinvent V2, planting, CH
Phosphate	water	river	kg	1	kg PO4-Eq	5.15E-05	kg/ha	5.15E-05	Ecoinvent V2, planting, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.46E-05	kg/ha	7.54E-05	Ecoinvent V2, planting, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.68E-07	kg/ha	8.22E-07	Ecoinvent V2, planting, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, planting, CH
								8.55E-03	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.37E+00	kg/ha	2.35E+01	Ecoinvent V2, planting, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	7.43E+00	kg/ha	1.42E+02	Ecoinvent V2, planting, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	7.23E-02	Nm3/ha	2.88E+00	Ecoinvent V2, planting, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	3.94E+00	Nm3/ha	1.51E+02	Ecoinvent V2, planting, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.49E+01	kg/ha	1.14E+03	Ecoinvent V2, planting, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.29E-03	kg/ha	1.27E-02	Ecoinvent V2, planting, CH
								1.46E+03	

CC5	**Irrigate Crop**	See Irrigate crop	

back to top

CC6	**Apply Chemical Treatment**	Ecoinvent V2, application of plant protection products, by field sprayer, CH

The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the application of plant protection. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. The amount of sprayed plant protection products is not taken into account. Not included are dust other than from

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.24E+00	kg/ha	2.24E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.68E+00	kg/ha	6.68E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.61E-07	kg/ha	1.61E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.54E+00	kg/ha	1.54E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.09E-03	kg/ha	1.71E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.22E-02	kg/ha	1.91E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.89E-10	kg/ha	2.97E-10	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	3.18E-02	kg/ha	4.99E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.19E-09	kg/ha	3.57E-08	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.77E-11	kg/ha	1.43E-09	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.38E-16	kg/ha	4.14E-15	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.54E-05	kg/ha	1.35E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.37E-04	kg/ha	7.07E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.53E-12	kg/ha	4.56E-10	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.22E-05	kg/ha	6.61E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.20E-11	kg/ha	4.57E-08	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.41E-09	kg/ha	2.01E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	3.80E-07	kg/ha	5.44E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.19E-11	kg/ha	7.29E-08	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	9.62E-10	kg/ha	1.19E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.70E-08	kg/ha	2.70E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	8.43E-10	kg/ha	1.03E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	3.53E-07	kg/ha	4.31E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	5.62E-06	kg/ha	1.40E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.87E-05	kg/ha	4.69E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.05E-05	kg/ha	2.64E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.74E-16	kg/ha	1.87E-15	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.32E-08	kg/ha	2.50E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	9.44E-13	kg/ha	6.74E-09	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.07E-07	kg/ha	7.64E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	6.45E-10	kg/ha	1.17E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	5.10E-08	kg/ha	9.23E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	6.38E-11	kg/ha	5.55E-10	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.41E-10	kg/ha	1.23E-09	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	4.08E-11	kg/ha	4.45E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	4.76E-11	kg/ha	5.19E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.49E-16	kg/ha	2.71E-12	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	9.09E-14	kg/ha	1.91E-11	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	9.73E-04	kg/ha	2.43E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.51E-02	kg/ha	3.79E-01	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.55E-12	kg/ha	6.38E-11	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	2.99E-05	kg/ha	7.48E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	6.28E-09	kg/ha	8.79E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.11E-13	kg/ha	1.56E-10	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	4.95E-11	kg/ha	3.65E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	3.18E-06	kg/ha	2.35E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.48E-13	kg/ha	7.01E-10	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.89E-11	kg/ha	4.28E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH

Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	5.48E-10	kg/ha	1.25E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.48E-07	kg/ha	3.37E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.02E-12	kg/ha	1.33E-11	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.58E-10	kg/ha	3.35E-09	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	8.02E-05	kg/ha	8.02E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
								1.11E+01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.52E-05	kg/ha	2.86E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.87E-05	kg/ha	1.10E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.68E-04	kg/ha	3.16E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	8.52E-05	kg/ha	7.50E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.47E-05	kg/ha	3.93E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.48E-05	kg/ha	4.82E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.03E-06	kg/ha	4.86E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.06E-05	kg/ha	1.70E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.69E-05	kg/ha	2.70E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.17E-07	kg/ha	5.96E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.36E-05	kg/ha	4.43E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	9.54E-06	kg/ha	1.79E-05	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.08E-03	kg/ha	1.46E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	8.47E-02	kg/ha	5.93E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	4.35E-03	kg/ha	3.05E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	4.05E-03	kg/ha	4.05E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.10E-02	kg/ha	1.10E-02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.63E-03	kg/ha	1.63E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.00E-06	kg/ha	1.89E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.25E-13	kg/ha	2.11E-13	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	9.56E-13	kg/ha	6.22E-13	Ecoinvent V2, application of plant protection products, by field sprayer, CH
								8.12E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.51E-07	kg/ha	7.69E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.36E-08	kg/ha	1.34E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	4.55E-08	kg/ha	1.39E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.01E-09	kg/ha	3.08E-09	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.60E-07	kg/ha	7.95E-07	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.87E-06	kg/ha	8.79E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.93E-02	kg/ha	4.25E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.39E-04	kg/ha	3.06E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.96E-02	kg/ha	4.32E-04	Ecoinvent V2, application of plant protection products, by field sprayer, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.40E-04	kg/ha	3.08E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphate	water	river	kg	1	kg PO4-Eq	4.72E-06	kg/ha	4.72E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.63E-06	kg/ha	8.04E-06	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.88E-08	kg/ha	8.81E-08	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
								8.87E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.75E-01	kg/ha	2.72E+00	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.13E+00	kg/ha	2.16E+01	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.10E-02	Nm3/ha	4.38E-01	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	4.48E-01	Nm3/ha	1.71E+01	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.56E+00	kg/ha	1.17E+02	Ecoinvent V2, application of plant protection products, by field sprayer, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.15E-04	kg/ha	1.14E-03	Ecoinvent V2, application of plant protection products, by field sprayer, CH
								1.59E+02	

CC7	**Apply mechanical treatment**								Ecoinvent V2, tillage, currying, by weeder, CH

back to top

The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the currying. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. Not included are dust other than from

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.29E+00	kg/ha	2.29E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	6.17E+00	kg/ha	6.17E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.36E-07	kg/ha	1.36E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.91E+00	kg/ha	1.91E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	9.78E-04	kg/ha	1.54E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.03E-02	kg/ha	1.62E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.59E-10	kg/ha	2.50E-10	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	3.56E-02	kg/ha	5.59E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.21E-09	kg/ha	3.64E-08	Ecoinvent V2, tillage, currying, by weeder, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.54E-11	kg/ha	1.36E-09	Ecoinvent V2, tillage, currying, by weeder, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.08E-16	kg/ha	3.23E-15	Ecoinvent V2, tillage, currying, by weeder, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.73E-05	kg/ha	1.41E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.17E-04	kg/ha	6.46E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.29E-12	kg/ha	3.85E-10	Ecoinvent V2, tillage, currying, by weeder, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.41E-05	kg/ha	7.18E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.75E-11	kg/ha	3.93E-08	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.49E-09	kg/ha	2.13E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.31E-07	kg/ha	6.16E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	9.78E-12	kg/ha	5.99E-08	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.03E-09	kg/ha	1.28E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.86E-08	kg/ha	2.86E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	6.99E-10	kg/ha	8.53E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.62E-07	kg/ha	3.20E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	5.11E-06	kg/ha	1.28E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.98E-05	kg/ha	4.96E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.13E-05	kg/ha	2.82E-04	Ecoinvent V2, tillage, currying, by weeder, CH

Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	2.92E-16	kg/ha	1.46E-15	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.44E-08	kg/ha	2.72E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	6.77E-13	kg/ha	4.84E-09	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	9.89E-08	kg/ha	7.06E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	6.28E-10	kg/ha	1.14E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	5.55E-08	kg/ha	1.00E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	6.09E-11	kg/ha	5.29E-10	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.34E-10	kg/ha	1.17E-09	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.64E-11	kg/ha	3.97E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	5.12E-11	kg/ha	5.58E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	1.94E-16	kg/ha	2.11E-12	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	7.82E-14	kg/ha	1.64E-11	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	7.38E-04	kg/ha	1.84E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.57E-02	kg/ha	3.94E-01	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.15E-12	kg/ha	5.38E-11	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	3.54E-05	kg/ha	8.84E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	6.79E-09	kg/ha	9.51E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	8.67E-14	kg/ha	1.21E-10	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	5.29E-11	kg/ha	3.91E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.36E-06	kg/ha	1.74E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.27E-13	kg/ha	6.03E-10	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.49E-11	kg/ha	3.68E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	8.99E-10	kg/ha	2.05E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.54E-07	kg/ha	3.50E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.13E-12	kg/ha	1.46E-11	Ecoinvent V2, tillage, currying, by weeder, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.45E-10	kg/ha	3.19E-09	Ecoinvent V2, tillage, currying, by weeder, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	8.33E-05	kg/ha	8.33E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
								1.10E+01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.57E-05	kg/ha	2.95E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.57E-05	kg/ha	1.05E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.90E-04	kg/ha	3.56E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.18E-04	kg/ha	1.03E-04	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.66E-05	kg/ha	4.10E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	6.38E-05	kg/ha	5.62E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	4.03E-06	kg/ha	6.45E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.10E-05	kg/ha	1.75E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.63E-05	kg/ha	2.60E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	5.36E-07	kg/ha	1.01E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.63E-05	kg/ha	4.95E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.08E-05	kg/ha	2.02E-05	Ecoinvent V2, tillage, currying, by weeder, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.25E-03	kg/ha	1.57E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	7.72E-02	kg/ha	5.41E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	5.26E-03	kg/ha	3.68E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	4.28E-03	kg/ha	4.28E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.06E-02	kg/ha	1.06E-02	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.85E-03	kg/ha	1.85E-03	Ecoinvent V2, tillage, currying, by weeder, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.13E-06	kg/ha	2.13E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.67E-13	kg/ha	1.74E-13	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.02E-12	kg/ha	6.65E-13	Ecoinvent V2, tillage, currying, by weeder, CH
								7.69E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.13E-07	kg/ha	9.58E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.90E-08	kg/ha	1.50E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	4.82E-08	kg/ha	1.48E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	7.48E-10	kg/ha	2.29E-09	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.79E-07	kg/ha	8.53E-07	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.68E-06	kg/ha	8.21E-06	Ecoinvent V2, tillage, currying, by weeder, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.80E-02	kg/ha	3.96E-04	Ecoinvent V2, tillage, currying, by weeder, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.58E-04	kg/ha	3.47E-06	Ecoinvent V2, tillage, currying, by weeder, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.84E-02	kg/ha	4.04E-04	Ecoinvent V2, tillage, currying, by weeder, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.59E-04	kg/ha	3.49E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphate	water	river	kg	1	kg PO4-Eq	4.10E-06	kg/ha	4.10E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.47E-06	kg/ha	7.55E-06	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.85E-08	kg/ha	8.71E-08	Ecoinvent V2, tillage, currying, by weeder, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, tillage, currying, by weeder, CH
								8.29E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.90E-01	kg/ha	2.87E+00	Ecoinvent V2, tillage, currying, by weeder, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.29E+00	kg/ha	2.47E+01	Ecoinvent V2, tillage, currying, by weeder, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.27E-02	Nm3/ha	5.04E-01	Ecoinvent V2, tillage, currying, by weeder, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	4.49E-01	Nm3/ha	1.72E+01	Ecoinvent V2, tillage, currying, by weeder, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.36E+00	kg/ha	1.08E+02	Ecoinvent V2, tillage, currying, by weeder, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	9.62E-05	kg/ha	9.52E-04	Ecoinvent V2, tillage, currying, by weeder, CH
								1.53E+02	

CC8	**Harvest Crop (Grain and Straw)**								Ecoinvent V2, combine harvesting, CH

back to top

The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the harvesting by combined harvester. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. The amount of harvested fodder is not taken into account. Not included are dust other than from combustion

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.92E+01	kg/ha	1.92E+01	Ecoinvent V2, combine harvesting, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.17E+02	kg/ha	1.17E+02	Ecoinvent V2, combine harvesting, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.24E-06	kg/ha	1.24E-06	Ecoinvent V2, combine harvesting, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.11E+01	kg/ha	1.11E+01	Ecoinvent V2, combine harvesting, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	9.10E-03	kg/ha	1.43E-02	Ecoinvent V2, combine harvesting, CH

Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	3.44E-01	kg/ha	5.40E-01	Ecoinvent V2, combine harvesting, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.46E-09	kg/ha	2.30E-09	Ecoinvent V2, combine harvesting, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.38E-01	kg/ha	3.74E-01	Ecoinvent V2, combine harvesting, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	9.18E-09	kg/ha	2.75E-07	Ecoinvent V2, combine harvesting, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.78E-10	kg/ha	1.43E-08	Ecoinvent V2, combine harvesting, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.79E-15	kg/ha	5.38E-14	Ecoinvent V2, combine harvesting, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	3.78E-04	kg/ha	1.13E-01	Ecoinvent V2, combine harvesting, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	4.29E-03	kg/ha	1.28E+00	Ecoinvent V2, combine harvesting, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.19E-11	kg/ha	3.53E-09	Ecoinvent V2, combine harvesting, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.02E-04	kg/ha	6.03E-02	Ecoinvent V2, combine harvesting, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.20E-10	kg/ha	3.14E-07	Ecoinvent V2, combine harvesting, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.17E-08	kg/ha	1.67E-05	Ecoinvent V2, combine harvesting, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.16E-06	kg/ha	5.95E-03	Ecoinvent V2, combine harvesting, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	7.87E-11	kg/ha	4.83E-07	Ecoinvent V2, combine harvesting, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	8.05E-09	kg/ha	9.98E-07	Ecoinvent V2, combine harvesting, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.21E-07	kg/ha	2.21E-03	Ecoinvent V2, combine harvesting, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	5.63E-09	kg/ha	6.86E-05	Ecoinvent V2, combine harvesting, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	7.26E-06	kg/ha	8.86E-02	Ecoinvent V2, combine harvesting, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	4.04E-05	kg/ha	1.01E-03	Ecoinvent V2, combine harvesting, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.79E-04	kg/ha	4.49E-03	Ecoinvent V2, combine harvesting, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	9.18E-05	kg/ha	2.29E-03	Ecoinvent V2, combine harvesting, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	4.86E-15	kg/ha	2.43E-14	Ecoinvent V2, combine harvesting, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.12E-07	kg/ha	2.12E-04	Ecoinvent V2, combine harvesting, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.15E-12	kg/ha	2.25E-08	Ecoinvent V2, combine harvesting, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.71E-06	kg/ha	1.22E-02	Ecoinvent V2, combine harvesting, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	4.82E-09	kg/ha	8.73E-06	Ecoinvent V2, combine harvesting, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	4.32E-07	kg/ha	7.82E-04	Ecoinvent V2, combine harvesting, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	5.26E-10	kg/ha	4.58E-09	Ecoinvent V2, combine harvesting, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.41E-09	kg/ha	1.23E-08	Ecoinvent V2, combine harvesting, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	2.89E-10	kg/ha	3.15E-06	Ecoinvent V2, combine harvesting, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	4.37E-10	kg/ha	4.76E-06	Ecoinvent V2, combine harvesting, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	3.23E-15	kg/ha	3.52E-11	Ecoinvent V2, combine harvesting, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	6.25E-13	kg/ha	1.31E-10	Ecoinvent V2, combine harvesting, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	9.20E-03	kg/ha	2.30E-01	Ecoinvent V2, combine harvesting, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.84E-01	kg/ha	4.61E+00	Ecoinvent V2, combine harvesting, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.98E-11	kg/ha	4.94E-10	Ecoinvent V2, combine harvesting, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	2.62E-04	kg/ha	6.54E-03	Ecoinvent V2, combine harvesting, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	5.15E-08	kg/ha	7.21E-05	Ecoinvent V2, combine harvesting, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.45E-12	kg/ha	2.02E-09	Ecoinvent V2, combine harvesting, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	4.14E-10	kg/ha	3.06E-06	Ecoinvent V2, combine harvesting, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.54E-05	kg/ha	4.83E-01	Ecoinvent V2, combine harvesting, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.02E-12	kg/ha	4.82E-09	Ecoinvent V2, combine harvesting, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.99E-10	kg/ha	2.94E-06	Ecoinvent V2, combine harvesting, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.71E-09	kg/ha	6.19E-05	Ecoinvent V2, combine harvesting, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.27E-06	kg/ha	2.90E-02	Ecoinvent V2, combine harvesting, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	7.94E-12	kg/ha	1.03E-10	Ecoinvent V2, combine harvesting, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.58E-09	kg/ha	3.36E-08	Ecoinvent V2, combine harvesting, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	8.31E-04	kg/ha	8.31E-04	Ecoinvent V2, combine harvesting, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
								1.55E+02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.20E-04	kg/ha	2.26E-04	Ecoinvent V2, combine harvesting, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	9.06E-04	kg/ha	1.70E-03	Ecoinvent V2, combine harvesting, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.57E-03	kg/ha	2.94E-03	Ecoinvent V2, combine harvesting, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	6.53E-04	kg/ha	5.75E-04	Ecoinvent V2, combine harvesting, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.55E-04	kg/ha	4.01E-04	Ecoinvent V2, combine harvesting, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	4.01E-04	kg/ha	3.53E-04	Ecoinvent V2, combine harvesting, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	2.56E-05	kg/ha	4.10E-05	Ecoinvent V2, combine harvesting, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.10E-04	kg/ha	1.77E-04	Ecoinvent V2, combine harvesting, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.19E-04	kg/ha	3.50E-04	Ecoinvent V2, combine harvesting, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.43E-06	kg/ha	2.68E-06	Ecoinvent V2, combine harvesting, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.74E-04	kg/ha	3.26E-04	Ecoinvent V2, combine harvesting, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	6.65E-05	kg/ha	1.25E-04	Ecoinvent V2, combine harvesting, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.07E-02	kg/ha	1.45E-02	Ecoinvent V2, combine harvesting, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.77E+00	kg/ha	1.24E+00	Ecoinvent V2, combine harvesting, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	3.92E-02	kg/ha	2.74E-02	Ecoinvent V2, combine harvesting, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	4.47E-02	kg/ha	4.47E-02	Ecoinvent V2, combine harvesting, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.56E-01	kg/ha	1.56E-01	Ecoinvent V2, combine harvesting, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.30E-02	kg/ha	1.30E-02	Ecoinvent V2, combine harvesting, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	6.98E-06	kg/ha	1.31E-05	Ecoinvent V2, combine harvesting, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	2.15E-12	kg/ha	1.40E-12	Ecoinvent V2, combine harvesting, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	8.00E-12	kg/ha	5.20E-12	Ecoinvent V2, combine harvesting, CH
								1.50E+00	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.62E-06	kg/ha	4.95E-06	Ecoinvent V2, combine harvesting, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.07E-07	kg/ha	9.38E-07	Ecoinvent V2, combine harvesting, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	3.74E-07	kg/ha	1.14E-06	Ecoinvent V2, combine harvesting, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.07E-08	kg/ha	6.33E-08	Ecoinvent V2, combine harvesting, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.27E-06	kg/ha	6.94E-06	Ecoinvent V2, combine harvesting, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	4.51E-05	kg/ha	1.38E-04	Ecoinvent V2, combine harvesting, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.03E-01	kg/ha	6.66E-03	Ecoinvent V2, combine harvesting, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.00E-03	kg/ha	2.20E-05	Ecoinvent V2, combine harvesting, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.06E-01	kg/ha	6.74E-03	Ecoinvent V2, combine harvesting, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.01E-03	kg/ha	2.22E-05	Ecoinvent V2, combine harvesting, CH
Phosphate	water	river	kg	1	kg PO4-Eq	2.22E-05	kg/ha	2.22E-05	Ecoinvent V2, combine harvesting, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.88E-05	kg/ha	8.82E-05	Ecoinvent V2, combine harvesting, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.98E-07	kg/ha	6.05E-07	Ecoinvent V2, combine harvesting, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, combine harvesting, CH
								1.37E-02	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.62E+00	kg/ha	2.59E+01	Ecoinvent V2, combine harvesting, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	8.47E+00	kg/ha	1.62E+02	Ecoinvent V2, combine harvesting, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	8.23E-02	Nm3/ha	3.27E+00	Ecoinvent V2, combine harvesting, CH

Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	5.03E+00	Nm3/ha	1.93E+02	Ecoinvent V2, combine harvesting, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	4.04E+01	kg/ha	1.85E+03	Ecoinvent V2, combine harvesting, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	8.75E-04	kg/ha	8.66E-03	Ecoinvent V2, combine harvesting, CH
								2.23E+03	
CC9	**Transport harvested crop (grain)**	all included CC9, FL6, FL11							
back to top									
FC1	**Cultivate soil (not annually)**								Ecoinvent v2, tillage, cultivating, chiseling, CH
back to top		The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the tillage cultivating by chiseling. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. Not included are dust other							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	8.82E+00	kg/ha	8.82E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	5.45E+01	kg/ha	5.45E+01	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	5.79E-07	kg/ha	5.79E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	5.03E+00	kg/ha	5.03E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.54E-03	kg/ha	5.56E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.41E-01	kg/ha	2.22E-01	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	6.80E-10	kg/ha	1.07E-09	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	9.71E-02	kg/ha	1.53E-01	Ecoinvent v2, tillage, cultivating, chiseling, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	3.81E-09	kg/ha	1.14E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.47E-10	kg/ha	4.41E-09	Ecoinvent v2, tillage, cultivating, chiseling, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.77E-16	kg/ha	1.13E-14	Ecoinvent v2, tillage, cultivating, chiseling, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.59E-04	kg/ha	4.73E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.98E-03	kg/ha	5.89E-01	Ecoinvent v2, tillage, cultivating, chiseling, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.51E-12	kg/ha	1.64E-09	Ecoinvent v2, tillage, cultivating, chiseling, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	8.20E-05	kg/ha	2.45E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.01E-10	kg/ha	1.45E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	4.68E-09	kg/ha	6.70E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.91E-06	kg/ha	2.73E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.67E-11	kg/ha	2.25E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	3.49E-09	kg/ha	4.33E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	8.91E-08	kg/ha	8.91E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.61E-09	kg/ha	3.19E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	9.91E-07	kg/ha	1.21E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.45E-05	kg/ha	3.64E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	6.87E-05	kg/ha	1.72E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	4.08E-05	kg/ha	1.02E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.02E-15	kg/ha	5.11E-15	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	4.49E-08	kg/ha	8.49E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.61E-12	kg/ha	1.87E-08	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	8.00E-07	kg/ha	5.71E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.27E-09	kg/ha	4.11E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.75E-07	kg/ha	3.16E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.08E-10	kg/ha	1.81E-09	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	4.35E-10	kg/ha	3.78E-09	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.33E-10	kg/ha	1.45E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.79E-10	kg/ha	1.96E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.79E-16	kg/ha	7.40E-12	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.88E-13	kg/ha	6.04E-11	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.09E-03	kg/ha	7.72E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	8.37E-02	kg/ha	2.09E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	9.19E-12	kg/ha	2.30E-10	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.01E-04	kg/ha	2.52E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.25E-08	kg/ha	3.15E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.04E-13	kg/ha	4.25E-10	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.80E-10	kg/ha	1.33E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	8.92E-06	kg/ha	6.59E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.67E-13	kg/ha	2.22E-09	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	9.16E-11	kg/ha	1.36E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.63E-09	kg/ha	3.72E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	5.38E-07	kg/ha	1.23E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	3.60E-12	kg/ha	4.68E-11	Ecoinvent v2, tillage, cultivating, chiseling, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	7.94E-10	kg/ha	1.03E-08	Ecoinvent v2, tillage, cultivating, chiseling, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.79E-04	kg/ha	3.79E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
								7.16E+01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	4.83E-05	kg/ha	9.09E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	4.11E-04	kg/ha	7.72E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	5.41E-04	kg/ha	1.02E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.29E-04	kg/ha	2.89E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.84E-04	kg/ha	1.62E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.78E-04	kg/ha	1.56E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.25E-05	kg/ha	2.00E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.21E-05	kg/ha	6.74E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	4.98E-05	kg/ha	7.96E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	9.17E-07	kg/ha	1.72E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	7.29E-05	kg/ha	1.37E-04	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.90E-05	kg/ha	5.45E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	9.19E-03	kg/ha	6.43E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	6.41E-01	kg/ha	4.49E-01	Ecoinvent v2, tillage, cultivating, chiseling, CH

Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.72E-02	kg/ha	1.21E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.04E-02	kg/ha	2.04E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	6.59E-02	kg/ha	6.59E-02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	4.93E-03	kg/ha	4.93E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.04E-06	kg/ha	5.72E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.00E-12	kg/ha	6.51E-13	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.47E-12	kg/ha	2.26E-12	Ecoinvent v2, tillage, cultivating, chiseling, CH
								5.61E-01	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	8.92E-07	kg/ha	2.73E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.33E-07	kg/ha	4.07E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.52E-07	kg/ha	4.65E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.83E-09	kg/ha	8.67E-09	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.01E-06	kg/ha	3.09E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.12E-05	kg/ha	6.49E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.43E-01	kg/ha	3.14E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.29E-04	kg/ha	9.44E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.45E-01	kg/ha	3.18E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.32E-04	kg/ha	9.51E-06	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.44E-05	kg/ha	1.44E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	9.38E-06	kg/ha	2.87E-05	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	8.56E-08	kg/ha	2.62E-07	Ecoinvent v2, tillage, cultivating, chiseling, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
								6.46E-03	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.10E+00	kg/ha	1.09E+01	Ecoinvent v2, tillage, cultivating, chiseling, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	3.63E+00	kg/ha	6.93E+01	Ecoinvent v2, tillage, cultivating, chiseling, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	3.54E-02	Nm3/ha	1.41E+00	Ecoinvent v2, tillage, cultivating, chiseling, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.15E+00	Nm3/ha	8.21E+01	Ecoinvent v2, tillage, cultivating, chiseling, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.88E+01	kg/ha	8.63E+02	Ecoinvent v2, tillage, cultivating, chiseling, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	2.92E-04	kg/ha	2.89E-03	Ecoinvent v2, tillage, cultivating, chiseling, CH
								1.03E+03	
FC2	**Apply Fertilizer (Includes Manure)**								Ecoinvent V2, fertilizing, by broadcaster, CH
back to top	fertilizing, by broadcaster	The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the fertilizing. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. The amount of spread fertilizer is not taken into account. Not included are dust other than from combustion and noise.							
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	3.75E+00	kg/ha	3.75E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.88E+01	kg/ha	1.88E+01	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	2.99E-07	kg/ha	2.99E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.69E+00	kg/ha	1.69E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.85E-03	kg/ha	2.91E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.48E-02	kg/ha	3.90E-02	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	3.51E-10	kg/ha	5.52E-10	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	3.33E-02	kg/ha	5.24E-02	Ecoinvent V2, fertilizing, by broadcaster, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.66E-09	kg/ha	4.98E-08	Ecoinvent V2, fertilizing, by broadcaster, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	7.35E-11	kg/ha	2.21E-09	Ecoinvent V2, fertilizing, by broadcaster, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	2.56E-16	kg/ha	7.68E-15	Ecoinvent V2, fertilizing, by broadcaster, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	7.07E-05	kg/ha	2.11E-02	Ecoinvent V2, fertilizing, by broadcaster, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	6.81E-04	kg/ha	2.03E-01	Ecoinvent V2, fertilizing, by broadcaster, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	2.85E-12	kg/ha	8.48E-10	Ecoinvent V2, fertilizing, by broadcaster, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	3.27E-05	kg/ha	9.74E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	5.50E-11	kg/ha	7.87E-08	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.92E-09	kg/ha	2.74E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	6.84E-07	kg/ha	9.79E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.11E-11	kg/ha	1.29E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.38E-09	kg/ha	1.71E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	3.63E-08	kg/ha	3.63E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.49E-09	kg/ha	1.81E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	7.39E-07	kg/ha	9.01E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	9.15E-06	kg/ha	2.29E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	2.92E-05	kg/ha	7.31E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.59E-05	kg/ha	3.98E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	6.93E-16	kg/ha	3.47E-15	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.76E-08	kg/ha	3.33E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.02E-12	kg/ha	1.44E-08	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	2.86E-07	kg/ha	2.04E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.08E-09	kg/ha	1.95E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	6.86E-08	kg/ha	1.24E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	9.92E-11	kg/ha	8.63E-10	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.18E-10	kg/ha	1.89E-09	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	6.94E-11	kg/ha	7.57E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	6.93E-11	kg/ha	7.55E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	4.61E-16	kg/ha	5.03E-12	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.57E-13	kg/ha	3.29E-11	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.84E-03	kg/ha	4.61E-02	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.93E-02	kg/ha	7.33E-01	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	4.74E-12	kg/ha	1.19E-10	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	4.48E-05	kg/ha	1.12E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	8.72E-09	kg/ha	1.22E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.06E-13	kg/ha	2.89E-10	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	7.09E-11	kg/ha	5.24E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.65E-06	kg/ha	4.91E-02	Ecoinvent V2, fertilizing, by broadcaster, CH

Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.54E-13	kg/ha	1.21E-09	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	4.98E-11	kg/ha	7.37E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	5.31E-10	kg/ha	1.21E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	2.19E-07	kg/ha	4.98E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	1.48E-12	kg/ha	1.92E-11	Ecoinvent V2, fertilizing, by broadcaster, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.97E-10	kg/ha	5.16E-09	Ecoinvent V2, fertilizing, by broadcaster, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.46E-04	kg/ha	1.46E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
								2.54E+01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	2.39E-05	kg/ha	4.49E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.43E-04	kg/ha	2.69E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.17E-04	kg/ha	4.09E-04	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	9.96E-05	kg/ha	8.76E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	7.43E-05	kg/ha	6.54E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.99E-05	kg/ha	5.27E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.98E-06	kg/ha	6.36E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.75E-05	kg/ha	2.80E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.51E-05	kg/ha	4.01E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.00E-07	kg/ha	5.64E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.54E-05	kg/ha	4.78E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	9.58E-06	kg/ha	1.80E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	3.57E-03	kg/ha	2.50E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.43E-01	kg/ha	1.70E-01	Ecoinvent V2, fertilizing, by broadcaster, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	6.13E-03	kg/ha	4.29E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	7.73E-03	kg/ha	7.73E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.46E-02	kg/ha	2.46E-02	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.79E-03	kg/ha	1.79E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.00E-06	kg/ha	1.89E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	5.76E-13	kg/ha	3.74E-13	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.37E-12	kg/ha	8.91E-13	Ecoinvent V2, fertilizing, by broadcaster, CH
								2.12E-01	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	3.41E-07	kg/ha	1.04E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.45E-08	kg/ha	1.36E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	6.17E-08	kg/ha	1.89E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.11E-09	kg/ha	6.44E-09	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.96E-07	kg/ha	1.21E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	7.58E-06	kg/ha	2.32E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	5.12E-02	kg/ha	1.13E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.43E-04	kg/ha	3.15E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	5.18E-02	kg/ha	1.14E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.45E-04	kg/ha	3.19E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphate	water	river	kg	1	kg PO4-Eq	8.17E-06	kg/ha	8.17E-06	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	4.32E-06	kg/ha	1.32E-05	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	4.25E-08	kg/ha	1.30E-07	Ecoinvent V2, fertilizing, by broadcaster, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/ha	0.00E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
								2.32E-03	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.40E-01	kg/ha	4.35E+00	Ecoinvent V2, fertilizing, by broadcaster, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.25E+00	kg/ha	2.38E+01	Ecoinvent V2, fertilizing, by broadcaster, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.21E-02	Nm3/ha	4.82E-01	Ecoinvent V2, fertilizing, by broadcaster, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	8.28E-01	Nm3/ha	3.17E+01	Ecoinvent V2, fertilizing, by broadcaster, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	6.79E+00	kg/ha	3.11E+02	Ecoinvent V2, fertilizing, by broadcaster, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.92E-04	kg/ha	1.90E-03	Ecoinvent V2, fertilizing, by broadcaster, CH
								3.71E+02	

FC3	**Plant crop (not annually)**	See Plant crop
back to top		
FC4	**Irrigate crops_FC**	See Irrigate crop
back to top		
FC5	**Apply chemical treatment_FC**	See Apply chemical treatment
back to top	Plant protection	Ecoinvent V2, application of plant protection products, by field sprayer
FC6	**Harvest crop (multiple times per year)**	See Harvest crop
back to top	see CC8	
FC7	**Transport harvested crop (feed)**	See Transport lorry>16t
back to top		
FC8	**Treat harvested crop (feed)**	
back to top		
FL1	**Deposit Manure**	
back to top		
FL2	**Collect manure**	Included in total energy used on beef farms
back to top		
FL7	**Transfer manure**	Included in total energy used on beef farms

back to top

FL12

back to top

Manure Management

Methane - Dairy Cows	2.96E+01	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Dairy Heifers	1.54E+01	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Bulls	3.60E+00	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Beef Cows	3.30E+00	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Beef Heifers	2.70E+00	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Heifers for Slaughter	2.10E+00	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Steers	1.90E+00	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Calves	2.10E+00	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Manure N Excretion Rate - Dairy Cows	1.06E+02	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Manure N Excretion Rate - Beef Cows	6.79E+01	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Manure N Excretion Rate - Bulls	7.93E+01	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Manure N Excretion Rate - Heifers	5.14E+01	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Manure N Excretion Rate - Steers	6.53E+01	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Manure N Excretion Rate - Calves	3.19E+01	air	kg/head/year	Environment Canada. 2008. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006,Table A3-23, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.

Store and process manure as slurry

The inventory takes into account the energy and auxiliary materials like water, lubricating oil and cleaning agents. Also included is the use of the infrastructure. Not taken into account were the direct emission of the animal husbandry, fodder production and produced waste water.

Ecoinvent V2, slurry store and processing, operation, CH

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.51E-02	kg/m3	1.51E-02	Ecoinvent V2, slurry store and processing, operation, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	3.06E-02	kg/m3	3.06E-02	Ecoinvent V2, slurry store and processing, operation, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	9.52E-10	kg/m3	9.52E-10	Ecoinvent V2, slurry store and processing, operation, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	5.90E-03	kg/m3	5.90E-03	Ecoinvent V2, slurry store and processing, operation, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	8.97E-06	kg/m3	1.41E-05	Ecoinvent V2, slurry store and processing, operation, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.23E-05	kg/m3	1.93E-05	Ecoinvent V2, slurry store and processing, operation, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.12E-12	kg/m3	1.76E-12	Ecoinvent V2, slurry store and processing, operation, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	4.51E-05	kg/m3	7.09E-05	Ecoinvent V2, slurry store and processing, operation, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.66E-10	kg/m3	4.98E-09	Ecoinvent V2, slurry store and processing, operation, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	4.64E-12	kg/m3	1.39E-10	Ecoinvent V2, slurry store and processing, operation, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.62E-19	kg/m3	4.85E-18	Ecoinvent V2, slurry store and processing, operation, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	6.08E-07	kg/m3	1.81E-04	Ecoinvent V2, slurry store and processing, operation, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	8.43E-07	kg/m3	2.51E-04	Ecoinvent V2, slurry store and processing, operation, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	9.06E-15	kg/m3	2.70E-12	Ecoinvent V2, slurry store and processing, operation, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.19E-06	kg/m3	6.54E-04	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	5.88E-13	kg/m3	8.41E-10	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	2.14E-10	kg/m3	3.06E-07	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.40E-09	kg/m3	2.00E-06	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.28E-14	kg/m3	1.40E-10	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.11E-10	kg/m3	1.38E-08	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	4.27E-09	kg/m3	4.27E-05	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	4.31E-12	kg/m3	5.26E-08	Ecoinvent V2, slurry store and processing, operation, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	5.80E-10	kg/m3	7.08E-06	Ecoinvent V2, slurry store and processing, operation, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.07E-08	kg/m3	2.69E-07	Ecoinvent V2, slurry store and processing, operation, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.43E-06	kg/m3	3.57E-05	Ecoinvent V2, slurry store and processing, operation, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	8.70E-07	kg/m3	2.17E-05	Ecoinvent V2, slurry store and processing, operation, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	4.38E-19	kg/m3	2.19E-18	Ecoinvent V2, slurry store and processing, operation, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	2.66E-10	kg/m3	5.02E-07	Ecoinvent V2, slurry store and processing, operation, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	6.63E-16	kg/m3	4.73E-12	Ecoinvent V2, slurry store and processing, operation, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	7.67E-11	kg/m3	5.48E-07	Ecoinvent V2, slurry store and processing, operation, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	8.93E-12	kg/m3	1.62E-08	Ecoinvent V2, slurry store and processing, operation, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.42E-09	kg/m3	2.56E-06	Ecoinvent V2, slurry store and processing, operation, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	9.83E-12	kg/m3	8.55E-11	Ecoinvent V2, slurry store and processing, operation, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.37E-11	kg/m3	1.20E-10	Ecoinvent V2, slurry store and processing, operation, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	7.75E-13	kg/m3	8.45E-09	Ecoinvent V2, slurry store and processing, operation, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	5.78E-13	kg/m3	6.30E-09	Ecoinvent V2, slurry store and processing, operation, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.91E-19	kg/m3	3.18E-15	Ecoinvent V2, slurry store and processing, operation, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.67E-15	kg/m3	3.51E-13	Ecoinvent V2, slurry store and processing, operation, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	4.12E-06	kg/m3	1.03E-04	Ecoinvent V2, slurry store and processing, operation, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.03E-04	kg/m3	2.58E-03	Ecoinvent V2, slurry store and processing, operation, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	1.51E-14	kg/m3	3.78E-13	Ecoinvent V2, slurry store and processing, operation, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	9.43E-08	kg/m3	2.36E-06	Ecoinvent V2, slurry store and processing, operation, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	3.78E-11	kg/m3	5.29E-08	Ecoinvent V2, slurry store and processing, operation, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.30E-16	kg/m3	1.82E-13	Ecoinvent V2, slurry store and processing, operation, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	5.72E-12	kg/m3	4.23E-08	Ecoinvent V2, slurry store and processing, operation, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	5.22E-09	kg/m3	3.86E-05	Ecoinvent V2, slurry store and processing, operation, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.72E-15	kg/m3	1.29E-11	Ecoinvent V2, slurry store and processing, operation, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	5.32E-13	kg/m3	7.88E-09	Ecoinvent V2, slurry store and processing, operation, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	6.63E-12	kg/m3	1.51E-07	Ecoinvent V2, slurry store and processing, operation, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.82E-08	kg/m3	4.16E-04	Ecoinvent V2, slurry store and processing, operation, CH

Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	7.31E-14	kg/m3	9.50E-13	Ecoinvent V2, slurry store and processing, operation, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	2.51E-11	kg/m3	3.26E-10	Ecoinvent V2, slurry store and processing, operation, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.14E-06	kg/m3	3.14E-06	Ecoinvent V2, slurry store and processing, operation, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
								5.60E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.25E-07	kg/m3	2.36E-07	Ecoinvent V2, slurry store and processing, operation, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	2.32E-07	kg/m3	4.35E-07	Ecoinvent V2, slurry store and processing, operation, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.59E-06	kg/m3	2.99E-06	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.53E-07	kg/m3	1.34E-07	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.43E-06	kg/m3	1.26E-06	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.07E-07	kg/m3	9.43E-08	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	6.36E-09	kg/m3	1.02E-08	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.52E-07	kg/m3	7.24E-07	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.62E-08	kg/m3	4.19E-08	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	8.19E-11	kg/m3	1.54E-10	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	1.44E-07	kg/m3	2.72E-07	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.17E-08	kg/m3	4.08E-08	Ecoinvent V2, slurry store and processing, operation, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.12E-05	kg/m3	1.49E-05	Ecoinvent V2, slurry store and processing, operation, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	4.38E-05	kg/m3	3.07E-05	Ecoinvent V2, slurry store and processing, operation, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	2.74E-05	kg/m3	1.91E-05	Ecoinvent V2, slurry store and processing, operation, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.94E-05	kg/m3	1.94E-05	Ecoinvent V2, slurry store and processing, operation, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	8.44E-05	kg/m3	8.44E-05	Ecoinvent V2, slurry store and processing, operation, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	3.55E-06	kg/m3	3.55E-06	Ecoinvent V2, slurry store and processing, operation, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.67E-09	kg/m3	3.13E-09	Ecoinvent V2, slurry store and processing, operation, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	6.23E-16	kg/m3	4.05E-16	Ecoinvent V2, slurry store and processing, operation, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.11E-13		7.20E-14	Ecoinvent V2, slurry store and processing, operation, CH
								1.78E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	4.64E-09	kg/m3	1.42E-08	Ecoinvent V2, slurry store and processing, operation, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.44E-10	kg/m3	1.36E-09	Ecoinvent V2, slurry store and processing, operation, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	6.93E-09	kg/m3	2.12E-08	Ecoinvent V2, slurry store and processing, operation, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.63E-12	kg/m3	4.98E-12	Ecoinvent V2, slurry store and processing, operation, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.89E-08	kg/m3	5.78E-08	Ecoinvent V2, slurry store and processing, operation, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.68E-09	kg/m3	1.12E-08	Ecoinvent V2, slurry store and processing, operation, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.94E-05	kg/m3	4.28E-07	Ecoinvent V2, slurry store and processing, operation, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.05E-07	kg/m3	4.50E-09	Ecoinvent V2, slurry store and processing, operation, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.00E-05	kg/m3	4.40E-07	Ecoinvent V2, slurry store and processing, operation, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.06E-07	kg/m3	4.53E-09	Ecoinvent V2, slurry store and processing, operation, CH
Phosphate	water	river	kg	1	kg PO4-Eq	8.24E-09	kg/m3	8.24E-09	Ecoinvent V2, slurry store and processing, operation, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	4.53E-09	kg/m3	1.38E-08	Ecoinvent V2, slurry store and processing, operation, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	3.77E-11	kg/m3	1.15E-10	Ecoinvent V2, slurry store and processing, operation, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry store and processing, operation, CH
								1.00E-06	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.41E-02	kg/m3	1.39E-01	Ecoinvent V2, slurry store and processing, operation, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.17E-02	kg/m3	2.24E-01	Ecoinvent V2, slurry store and processing, operation, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.18E-04	Nm3/m3	4.69E-03	Ecoinvent V2, slurry store and processing, operation, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	4.65E-03	Nm3/m3	1.78E-01	Ecoinvent V2, slurry store and processing, operation, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.05E-03	kg/m3	9.38E-02	Ecoinvent V2, slurry store and processing, operation, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.37E-07	kg/m3	1.35E-06	Ecoinvent V2, slurry store and processing, operation, CH
								6.40E-01	

FL24	**Dispose of Manure (Transport Off-Site)**		
back to top	transport, lorry >16t	See Transport lorry>16t	
	Slurry spreading	The inventory takes into account the diesel fuel consumption and the amount of agricultural machinery and of the shed, which has to be attributed to the slurry spreading. Also taken into consideration is the amount of emissions to the air from combustion and the emission to the soil from tyre abrasion during the work process. The following activities where considered part of the work process: preliminary work at the farm, like attaching the adequate machine to the tractor; transfer to field (with an assumed distance of 1 km); field work (for a parcel of land of 1 ha surface); transfer to farm and concluding work, like uncoupling the machine. The overlapping during the field work is considered. The amount of spread slurry is not taken into account. Not included are dust other than from combustion and noise.	Ecoinvent V2, slurry spreading, by vacuum tanker, CH

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.10E-01	kg/m3	2.10E-01	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	7.97E-01	kg/m3	7.97E-01	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.60E-08	kg/m3	1.60E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.45E-01	kg/m3	1.45E-01	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.05E-04	kg/m3	1.66E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.80E-03	kg/m3	2.83E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.87E-11	kg/m3	2.95E-11	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.88E-03	kg/m3	4.53E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	1.11E-10	kg/m3	3.34E-09	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	7.27E-12	kg/m3	2.18E-10	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.41E-17	kg/m3	1.02E-15	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	4.45E-06	kg/m3	1.33E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.86E-05	kg/m3	8.52E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.52E-13	kg/m3	4.53E-11	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.15E-06	kg/m3	6.42E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.10E-12	kg/m3	4.44E-09	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.32E-10	kg/m3	1.89E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.03E-08	kg/m3	5.76E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.16E-12	kg/m3	7.10E-09	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	9.15E-11	kg/m3	1.13E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.52E-09	kg/m3	2.52E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	8.21E-11	kg/m3	1.00E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	3.05E-08	kg/m3	3.73E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	5.44E-07	kg/m3	1.36E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.79E-06	kg/m3	4.49E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH

Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.02E-06	kg/m3	2.55E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	9.25E-17	kg/m3	4.62E-16	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.29E-09	kg/m3	2.43E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	8.10E-14	kg/m3	5.78E-10	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.23E-08	kg/m3	8.81E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	6.33E-11	kg/m3	1.15E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	4.95E-09	kg/m3	8.96E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	6.17E-12	kg/m3	5.37E-11	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.15E-11	kg/m3	1.87E-10	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.97E-12	kg/m3	4.33E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	4.71E-12	kg/m3	5.14E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.15E-17	kg/m3	6.70E-13	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	8.83E-15	kg/m3	1.85E-12	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	9.60E-05	kg/m3	2.40E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.59E-03	kg/m3	3.98E-02	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.53E-13	kg/m3	6.33E-12	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	4.19E-06	kg/m3	1.05E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	6.06E-10	kg/m3	8.48E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.75E-14	kg/m3	3.85E-11	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	4.70E-12	kg/m3	3.48E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.75E-07	kg/m3	2.03E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.43E-14	kg/m3	6.81E-11	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.81E-12	kg/m3	4.16E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	5.33E-11	kg/m3	1.21E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.41E-08	kg/m3	3.22E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	9.88E-14	kg/m3	1.28E-12	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	3.93E-11	kg/m3	5.11E-10	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	8.10E-06	kg/m3	8.10E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
								1.21E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.50E-06	kg/m3	2.82E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	6.64E-06	kg/m3	1.25E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.75E-05	kg/m3	3.28E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	8.41E-06	kg/m3	7.40E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.47E-06	kg/m3	3.94E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	5.06E-06	kg/m3	4.45E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	3.02E-07	kg/m3	4.83E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.05E-06	kg/m3	1.69E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.50E-06	kg/m3	2.40E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.02E-08	kg/m3	5.69E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.17E-06	kg/m3	4.08E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	8.64E-07	kg/m3	1.62E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.07E-04	kg/m3	1.45E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	9.96E-03	kg/m3	6.97E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	4.40E-04	kg/m3	3.08E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	4.15E-04	kg/m3	4.15E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.20E-03	kg/m3	1.20E-03	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.50E-04	kg/m3	1.50E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	9.08E-08	kg/m3	1.71E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.17E-14	kg/m3	2.06E-14	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	9.09E-14		5.91E-14	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
								9.27E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.40E-08	kg/m3	7.35E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.96E-09	kg/m3	1.21E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	4.26E-09	kg/m3	1.30E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	8.71E-11	kg/m3	2.67E-10	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.52E-08	kg/m3	7.70E-08	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.29E-07	kg/m3	1.01E-06	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.21E-03	kg/m3	4.86E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.27E-05	kg/m3	2.79E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.24E-03	kg/m3	4.93E-05	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.28E-05	kg/m3	2.82E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphate	water	river	kg	1	kg PO4-Eq	4.24E-07	kg/m3	4.24E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.50E-07	kg/m3	7.64E-07	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.81E-09	kg/m3	8.61E-09	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/m3	0.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
								1.01E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.70E-02	kg/m3	2.67E-01	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.05E-01	kg/m3	2.00E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.02E-03	Nm3/m3	4.06E-02	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	4.66E-02	Nm3/m3	1.78E+00	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.94E-01	kg/m3	1.35E+01	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.11E-05	kg/m3	1.09E-04	Ecoinvent V2, slurry spreading, by vacuum tanker, CH
								1.76E+01	

FL3	**Collect Garbage (On-Site)**	See information on "Combust/Produce/Deliver Diesel" and "Combust/Produce/Deliver Gasoline" for on-site equipment usage

back to top

FL8	**Store Garbage**	No emissions involved in this activity

back to top

FL25	**Dispose of Garbage**	Emissions from Burning Plastic

back to top

Hidden cells : process of garbage disposal, as municipal (landfill, incineration) or plastics (landfill, incineration)

3.13E-01

plastic garbage from livestock industry is burned		Because agricultural films often come in contact with the ground or most farm products, many recyclers currently reject this material due to contamination http://www.gov.mb.ca/conservation/pollutionprevention/plastic_bags.html							
Open Burning of Municipal Refuse (Table 2.5-1 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)									
Particulate	air		kg/Mg	8					Open Burning of Municipal Refuse (Table 2.5-1 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Sulfur oxides	air		kg/Mg	0.5					Open Burning of Municipal Refuse (Table 2.5-1 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
CO	air		kg/Mg	42					Open Burning of Municipal Refuse (Table 2.5-1 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
CH4	air		kg/Mg	6.5					Open Burning of Municipal Refuse (Table 2.5-1 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
NMOC	air		kg/Mg	15					Open Burning of Municipal Refuse (Table 2.5-1 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Nitrogen Oxides	air		kg/Mg	3					Open Burning of Municipal Refuse (Table 2.5-1 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Agricultural Plastic Film - used for ground moisture and weed control (similar type of plastic) Plastic films gathered together and burned in a pile - Tables 2.5-7 and 2.5-8 (assumes it has been exposed to vegetation and pesticides)									
Benzene	air		mg/kg	0.0123					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Toluene	air		mg/kg	0.0033					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Ethyl benzene	air		mg/kg	0.0012					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
1-Hexane	air		mg/kg	0.0043					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Anthracene	air		ug/kg	1.32					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Benzo(A)pyrene	air		ug/kg	7.53					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Benzo(B)fluoranthene	air		ug/kg	9.25					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Benzo(e)pyrene	air		ug/kg	9.65					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Benzo(G,H,I)perylene	air		ug/kg	14.93					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Benzon(K)fluoranthene	air		ug/kg	2.51					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Benzo(A)anthracene	air		ug/kg	14.41					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Chrysene	air		ug/kg	17.18					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Fluoranthene	air		ug/kg	107.05					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Indeno(1,2,3-CD)pyrene	air		ug/kg	10.7					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Phenanthrene	air		ug/kg	24.05					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Pyrene	air		ug/kg	58.81					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
Retene	air		ug/kg	18.77					Used Plastic Burned in a Pile (Tables 2.5-7 and 2.5-8 of http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf)
CH4 emission factor for open burning of MSW	air		g/tonne	6500					2006 IPCC Guidelines, Emissions for open burning of MSW based on plastics (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf)
N2O emission factor for open burning of MSW	air		g/tonne	150					2006 IPCC Guidelines, Emissions for open burning of MSW based on plastics (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf)
CO2 emission factor for open burning of MSW	air		kg/kg	1.595					2006 IPCC Guidelines, Emissions for open burning of MSW based on plastics composition, Equation 5.2 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf)
CH4 emission factor for open burning of MSW					25	6.50E-03	kg/kg	1.63E-01	
CO2 emission factor for open burning of MSW					1	1.595	kg/kg	1.60E+00	
N2O emission factor for open burning of MSW					298	1.50E-04	kg/kg	4.47E-02	
								1.80E+00	
Sulfur oxides						5.00E-04	kg/kg	5.00E-04	

CO2 Emission Factor = sum j (WF j * dm j * CF j * FCF j * OF j) * 44/12

WF j	j in the MSW (as wet weight incinerated or open-burned) - All plastic			
dm j	y matter content of plastic	100	%	;, Section 2.3, Table 2.4
CF j	of carbon in dry matter - plastic	75	%	;, Section 2.3, Table 2.4
FCF j	on fraction of total carbon for plastic	100	%	;, Section 2.3, Table 2.4
OF j	ion factor in % of carbon input	58	%	for MSW
44/12	ersion factor from C to CO2			
with:	sum j WF j = 1			
j	, wood, garden (yard) and park waste, disposable nappies, rubber and leather, plastics, metal, glass, other inert waste.			

FL4	**Collect Mortalities (On-Site)**	Included in total energy used on beef farms
back to top		
FL14	**Transport mortalities**	See Transport lorry>16t
back to top		
FL26	**Dispose of Mortalities**	Rendering and on-farm disposal
back to top		

FL5	**Producing bedding material**								
	Straw Bed for Livestock	The inventories include the cultivation of straw on a straw area. Included steps are harvest and loading for transport.							Ecoinvent V2, straw, from straw areas, at field, CH
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	8.27E-03	kg/kg	8.27E-03	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.99E-02	kg/kg	2.99E-02	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	5.43E-10	kg/kg	5.43E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	6.22E-03	kg/kg	6.22E-03	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.66E-06	kg/kg	5.75E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	4.40E-05	kg/kg	6.92E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	6.38E-13	kg/kg	1.00E-12	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.32E-04	kg/kg	2.08E-04	Ecoinvent V2, straw, from straw areas, at field, CH

Chloroform	air	high population density	kg	30	kg CO2-Eq	4.45E-12	kg/kg	1.33E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.66E-13	kg/kg	4.97E-12	Ecoinvent V2, straw, from straw areas, at field, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.99E-19	kg/kg	1.20E-17	Ecoinvent V2, straw, from straw areas, at field, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.63E-07	kg/kg	4.86E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.66E-04	kg/kg	4.95E-02	Ecoinvent V2, straw, from straw areas, at field, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.17E-15	kg/kg	1.54E-12	Ecoinvent V2, straw, from straw areas, at field, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	8.48E-08	kg/kg	2.53E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.06E-13	kg/kg	1.52E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.40E-12	kg/kg	7.72E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.53E-09	kg/kg	2.18E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.84E-14	kg/kg	2.35E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	3.74E-12	kg/kg	4.63E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.04E-10	kg/kg	1.04E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.74E-12	kg/kg	3.34E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	8.91E-10	kg/kg	1.09E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.70E-08	kg/kg	4.25E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	6.89E-08	kg/kg	1.72E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	4.10E-08	kg/kg	1.03E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.08E-18	kg/kg	5.41E-18	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	5.14E-11	kg/kg	9.71E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.32E-15	kg/kg	1.65E-11	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	4.62E-10	kg/kg	3.30E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.25E-12	kg/kg	4.07E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.98E-10	kg/kg	3.59E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.28E-13	kg/kg	1.98E-12	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	4.91E-13	kg/kg	4.27E-12	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.38E-13	kg/kg	1.50E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.87E-13	kg/kg	2.04E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	7.19E-19	kg/kg	7.83E-15	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	3.02E-16	kg/kg	6.35E-14	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	3.07E-06	kg/kg	7.67E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	6.43E-05	kg/kg	1.61E-03	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	8.62E-15	kg/kg	2.15E-13	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.01E-07	kg/kg	2.53E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.46E-11	kg/kg	3.44E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.21E-16	kg/kg	4.50E-13	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.92E-13	kg/kg	1.42E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	8.02E-09	kg/kg	5.93E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.91E-16	kg/kg	2.33E-12	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	9.62E-14	kg/kg	1.42E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.88E-12	kg/kg	4.28E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	5.69E-10	kg/kg	1.30E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	3.82E-15	kg/kg	4.96E-14	Ecoinvent V2, straw, from straw areas, at field, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	8.96E-13	kg/kg	1.16E-11	Ecoinvent V2, straw, from straw areas, at field, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.14E-07	kg/kg	3.14E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
								9.60E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	5.09E-08	kg/kg	9.57E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	2.59E-07	kg/kg	4.86E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	6.35E-07	kg/kg	1.19E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	3.46E-07	kg/kg	3.05E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.70E-07	kg/kg	1.49E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.27E-07	kg/kg	2.00E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.23E-08	kg/kg	1.97E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	3.97E-08	kg/kg	6.36E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	5.87E-08	kg/kg	9.39E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.05E-09	kg/kg	1.98E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	9.77E-08	kg/kg	1.84E-07	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	4.05E-08	kg/kg	7.61E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	8.01E-06	kg/kg	5.61E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	3.82E-04	kg/kg	2.67E-04	Ecoinvent V2, straw, from straw areas, at field, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.71E-05	kg/kg	1.20E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.60E-05	kg/kg	1.60E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	4.49E-05	kg/kg	4.49E-05	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	6.55E-06	kg/kg	6.55E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	4.25E-09	kg/kg	8.00E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.05E-15	kg/kg	6.81E-16	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.72E-15	kg/kg	2.42E-15	Ecoinvent V2, straw, from straw areas, at field, CH
								3.55E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	9.27E-10	kg/kg	2.84E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.84E-10	kg/kg	5.63E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.75E-10	kg/kg	5.35E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	2.55E-12	kg/kg	7.79E-12	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.01E-09	kg/kg	3.08E-09	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.24E-08	kg/kg	3.78E-08	Ecoinvent V2, straw, from straw areas, at field, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	8.29E-05	kg/kg	1.82E-06	Ecoinvent V2, straw, from straw areas, at field, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.85E-07	kg/kg	1.29E-08	Ecoinvent V2, straw, from straw areas, at field, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	8.41E-05	kg/kg	1.85E-06	Ecoinvent V2, straw, from straw areas, at field, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.89E-07	kg/kg	1.30E-08	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.72E-04	kg/kg	1.72E-04	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.31E-06	kg/kg	7.08E-06	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	9.98E-11	kg/kg	3.05E-10	Ecoinvent V2, straw, from straw areas, at field, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, straw, from straw areas, at field, CH
								1.83E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.05E-03	kg/kg	1.04E-02	Ecoinvent V2, straw, from straw areas, at field, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	4.66E-03	kg/kg	8.90E-02	Ecoinvent V2, straw, from straw areas, at field, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	4.54E-05	kg/kg	1.81E-03	Ecoinvent V2, straw, from straw areas, at field, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.78E-03	kg/kg	6.81E-02	Ecoinvent V2, straw, from straw areas, at field, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.10E-02	kg/kg	5.03E-01	Ecoinvent V2, straw, from straw areas, at field, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	3.50E-07	kg/kg	3.46E-06	Ecoinvent V2, straw, from straw areas, at field, CH

6.72E-01

FL10	**Transport bedding**	See Transport lorry>16t
back to top		
FL15	**Store Bedding**	No emissions involved in this activity
back to top		
FL27	**Bed livestock**	Included in total energy used on beef farms
back to top		
FL6	**Process (roll) grains, mix feed**	See FL 11
back to top		
FL11	**Store feed**	
back to top	includes CC9, FL6, FL11	The inventory includes the transport of the raw materials to the feed processing centre, processing feedstuff (crushing or milling, heat treatment, dosing, mixing squeezing and pelleting) and the storage of the feed mixes. It also includes water use and wastewater treatment, the transformation and use of land related to the storage buildings. No process emissions were included except heat waste from the use of electricity. Packaging is not included.

	Barley								Ecoinvent V2, barley IP, at feed mill, CH
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	7.49E-02	kg/kg	7.49E-02	Ecoinvent V2, barley IP, at feed mill, CH
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	9.46E-02	kg/kg	9.46E-02	Ecoinvent V2, barley IP, at feed mill, CH
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	4.41E-08	kg/kg	4.41E-08	Ecoinvent V2, barley IP, at feed mill, CH
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	3.81E-02	kg/kg	3.81E-02	Ecoinvent V2, barley IP, at feed mill, CH
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.55E-05	kg/kg	4.01E-05	Ecoinvent V2, barley IP, at feed mill, CH
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.78E-04	kg/kg	2.79E-04	Ecoinvent V2, barley IP, at feed mill, CH
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	5.19E-11	kg/kg	8.15E-11	Ecoinvent V2, barley IP, at feed mill, CH
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.86E-04	kg/kg	4.49E-04	Ecoinvent V2, barley IP, at feed mill, CH
Chloroform	air	high population density	kg	30	kg CO2-Eq	9.90E-11	kg/kg	2.97E-09	Ecoinvent V2, barley IP, at feed mill, CH
Chloroform	air	low population density	kg	30	kg CO2-Eq	1.15E-12	kg/kg	3.44E-11	Ecoinvent V2, barley IP, at feed mill, CH
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.27E-18	kg/kg	3.82E-17	Ecoinvent V2, barley IP, at feed mill, CH
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.01E-04	kg/kg	6.00E-02	Ecoinvent V2, barley IP, at feed mill, CH
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	6.90E-04	kg/kg	2.06E-01	Ecoinvent V2, barley IP, at feed mill, CH
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	4.20E-13	kg/kg	1.25E-10	Ecoinvent V2, barley IP, at feed mill, CH
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.19E-06	kg/kg	3.56E-04	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	8.89E-12	kg/kg	1.27E-08	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	4.43E-11	kg/kg	6.34E-08	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	7.16E-08	kg/kg	1.02E-04	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	3.82E-12	kg/kg	2.34E-08	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	3.02E-11	kg/kg	3.74E-09	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	8.55E-10	kg/kg	8.55E-06	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	2.64E-10	kg/kg	3.22E-06	Ecoinvent V2, barley IP, at feed mill, CH
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	6.87E-09	kg/kg	8.39E-05	Ecoinvent V2, barley IP, at feed mill, CH
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	6.97E-08	kg/kg	1.74E-06	Ecoinvent V2, barley IP, at feed mill, CH
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	8.71E-07	kg/kg	2.18E-05	Ecoinvent V2, barley IP, at feed mill, CH
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.28E-07	kg/kg	8.19E-06	Ecoinvent V2, barley IP, at feed mill, CH
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.45E-18	kg/kg	1.73E-17	Ecoinvent V2, barley IP, at feed mill, CH
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	1.19E-09	kg/kg	2.25E-06	Ecoinvent V2, barley IP, at feed mill, CH
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	5.24E-15	kg/kg	3.74E-11	Ecoinvent V2, barley IP, at feed mill, CH
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.82E-09	kg/kg	1.30E-05	Ecoinvent V2, barley IP, at feed mill, CH
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.35E-10	kg/kg	2.44E-07	Ecoinvent V2, barley IP, at feed mill, CH
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	4.27E-09	kg/kg	7.72E-06	Ecoinvent V2, barley IP, at feed mill, CH
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	4.88E-12	kg/kg	4.25E-11	Ecoinvent V2, barley IP, at feed mill, CH
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	3.39E-12	kg/kg	2.95E-11	Ecoinvent V2, barley IP, at feed mill, CH
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.76E-11	kg/kg	1.92E-07	Ecoinvent V2, barley IP, at feed mill, CH
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	4.09E-12	kg/kg	4.46E-08	Ecoinvent V2, barley IP, at feed mill, CH
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.30E-18	kg/kg	2.50E-14	Ecoinvent V2, barley IP, at feed mill, CH
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	2.53E-14	kg/kg	5.31E-12	Ecoinvent V2, barley IP, at feed mill, CH
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.48E-05	kg/kg	3.71E-04	Ecoinvent V2, barley IP, at feed mill, CH
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.13E-04	kg/kg	7.82E-03	Ecoinvent V2, barley IP, at feed mill, CH
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	7.01E-13	kg/kg	1.75E-11	Ecoinvent V2, barley IP, at feed mill, CH
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.51E-06	kg/kg	3.77E-05	Ecoinvent V2, barley IP, at feed mill, CH
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.31E-10	kg/kg	1.83E-07	Ecoinvent V2, barley IP, at feed mill, CH
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	1.03E-15	kg/kg	1.44E-12	Ecoinvent V2, barley IP, at feed mill, CH
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.55E-12	kg/kg	1.15E-08	Ecoinvent V2, barley IP, at feed mill, CH
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	6.19E-08	kg/kg	4.57E-04	Ecoinvent V2, barley IP, at feed mill, CH
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	4.11E-14	kg/kg	1.95E-10	Ecoinvent V2, barley IP, at feed mill, CH
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	8.05E-12	kg/kg	1.19E-07	Ecoinvent V2, barley IP, at feed mill, CH
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	8.98E-12	kg/kg	2.05E-07	Ecoinvent V2, barley IP, at feed mill, CH
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.97E-09	kg/kg	1.13E-04	Ecoinvent V2, barley IP, at feed mill, CH
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	8.42E-14	kg/kg	1.10E-12	Ecoinvent V2, barley IP, at feed mill, CH
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	6.19E-12	kg/kg	8.05E-11	Ecoinvent V2, barley IP, at feed mill, CH
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.16E-05	kg/kg	2.16E-05	Ecoinvent V2, barley IP, at feed mill, CH
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
								4.83E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	8.50E-05	kg/kg	1.60E-04	Ecoinvent V2, barley IP, at feed mill, CH
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.38E-03	kg/kg	2.59E-03	Ecoinvent V2, barley IP, at feed mill, CH

Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	2.83E-06	kg/kg	5.31E-06	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.21E-06	kg/kg	1.07E-06	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.34E-06	kg/kg	1.18E-06	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	6.78E-07	kg/kg	5.97E-07	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	4.34E-07	kg/kg	6.94E-07	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	7.23E-07	kg/kg	1.16E-06	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	2.42E-07	kg/kg	3.87E-07	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	3.17E-09	kg/kg	5.95E-09	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	6.77E-07	kg/kg	1.27E-06	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	6.48E-08	kg/kg	1.22E-07	Ecoinvent V2, barley IP, at feed mill, CH
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.88E-04	kg/kg	1.32E-04	Ecoinvent V2, barley IP, at feed mill, CH
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.15E-03	kg/kg	8.04E-04	Ecoinvent V2, barley IP, at feed mill, CH
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	3.16E-04	kg/kg	2.21E-04	Ecoinvent V2, barley IP, at feed mill, CH
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.40E-04	kg/kg	2.40E-04	Ecoinvent V2, barley IP, at feed mill, CH
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.66E-04	kg/kg	2.66E-04	Ecoinvent V2, barley IP, at feed mill, CH
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.46E-05	kg/kg	1.46E-05	Ecoinvent V2, barley IP, at feed mill, CH
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	6.65E-09	kg/kg	1.25E-08	Ecoinvent V2, barley IP, at feed mill, CH
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.04E-13	kg/kg	6.78E-14	Ecoinvent V2, barley IP, at feed mill, CH
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.00E-14	kg/kg	1.95E-14	Ecoinvent V2, barley IP, at feed mill, CH
								4.44E-03	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	4.04E-09	kg/kg	1.24E-08	Ecoinvent V2, barley IP, at feed mill, CH
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	3.49E-10	kg/kg	1.07E-09	Ecoinvent V2, barley IP, at feed mill, CH
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.44E-09	kg/kg	4.40E-09	Ecoinvent V2, barley IP, at feed mill, CH
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.95E-11	kg/kg	5.98E-11	Ecoinvent V2, barley IP, at feed mill, CH
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	9.56E-09	kg/kg	2.93E-08	Ecoinvent V2, barley IP, at feed mill, CH
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	5.72E-08	kg/kg	1.75E-07	Ecoinvent V2, barley IP, at feed mill, CH
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.68E-04	kg/kg	8.09E-06	Ecoinvent V2, barley IP, at feed mill, CH
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.02E-06	kg/kg	2.25E-08	Ecoinvent V2, barley IP, at feed mill, CH
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.73E-04	kg/kg	8.20E-06	Ecoinvent V2, barley IP, at feed mill, CH
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.03E-06	kg/kg	2.27E-08	Ecoinvent V2, barley IP, at feed mill, CH
Phosphate	water	river	kg	1	kg PO4-Eq	1.39E-04	kg/kg	1.39E-04	Ecoinvent V2, barley IP, at feed mill, CH
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.91E-05	kg/kg	5.83E-05	Ecoinvent V2, barley IP, at feed mill, CH
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.63E-10	kg/kg	8.06E-10	Ecoinvent V2, barley IP, at feed mill, CH
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, barley IP, at feed mill, CH
								2.14E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	8.29E-03	kg/kg	8.21E-02	Ecoinvent V2, barley IP, at feed mill, CH
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	1.18E-02	kg/kg	2.26E-01	Ecoinvent V2, barley IP, at feed mill, CH
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	1.16E-04	kg/kg	4.61E-03	Ecoinvent V2, barley IP, at feed mill, CH
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	2.60E-02	kg/kg	9.97E-01	Ecoinvent V2, barley IP, at feed mill, CH
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	4.44E-02	kg/kg	2.03E+00	Ecoinvent V2, barley IP, at feed mill, CH
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.51E-06	kg/kg	1.50E-05	Ecoinvent V2, barley IP, at feed mill, CH
								3.34E+00	

FL16	**Transport feed**	See transport							
back to top									
FL28	**Feed livestock**	Included in total energy used on beef farms							
back to top									
FL17	**Produce Mineral lime, from carbonation, at regional storehouse**								
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.05E-03	kg/kg	1.05E-03	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.10E-03	kg/kg	1.10E-03	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.50E-09	kg/kg	1.50E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	9.00E-03	kg/kg	9.00E-03	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	5.79E-07	kg/kg	9.09E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.57E-06	kg/kg	2.47E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.76E-12	kg/kg	2.77E-12	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.78E-05	kg/kg	4.36E-05	Ecoinvent V2, lime, from carbonation, at regional storehouse
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.81E-12	kg/kg	8.42E-11	Ecoinvent V2, lime, from carbonation, at regional storehouse
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.18E-14	kg/kg	6.53E-13	Ecoinvent V2, lime, from carbonation, at regional storehouse
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.35E-20	kg/kg	1.00E-18	Ecoinvent V2, lime, from carbonation, at regional storehouse
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.97E-08	kg/kg	5.88E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.99E-08	kg/kg	5.93E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.43E-14	kg/kg	4.26E-12	Ecoinvent V2, lime, from carbonation, at regional storehouse
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.24E-07	kg/kg	3.70E-05	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.99E-13	kg/kg	4.28E-10	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	7.61E-13	kg/kg	1.09E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.41E-08	kg/kg	3.45E-05	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.29E-13	kg/kg	7.92E-10	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	5.97E-13	kg/kg	7.40E-11	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.44E-11	kg/kg	1.44E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	8.92E-12	kg/kg	1.09E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.44E-10	kg/kg	1.76E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	3.03E-09	kg/kg	7.59E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.15E-08	kg/kg	2.88E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	7.19E-09	kg/kg	1.80E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	9.07E-20	kg/kg	4.53E-19	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	5.79E-12	kg/kg	1.09E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.73E-16	kg/kg	2.66E-12	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.52E-10	kg/kg	1.09E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	4.60E-12	kg/kg	8.33E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.35E-11	kg/kg	4.25E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse

Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.00E-13	kg/kg	8.72E-13	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	6.44E-14	kg/kg	5.60E-13	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.34E-13	kg/kg	3.65E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.43E-14	kg/kg	2.64E-10	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.03E-20	kg/kg	6.57E-16	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	8.51E-16	kg/kg	1.79E-13	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	6.31E-07	kg/kg	1.58E-05	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.42E-05	kg/kg	3.56E-04	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.38E-14	kg/kg	5.96E-13	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.42E-07	kg/kg	3.54E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	5.88E-12	kg/kg	8.23E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.70E-17	kg/kg	3.77E-14	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.07E-14	kg/kg	2.27E-10	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.30E-09	kg/kg	9.58E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.38E-15	kg/kg	6.56E-12	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.71E-13	kg/kg	4.01E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.70E-13	kg/kg	3.88E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	9.77E-11	kg/kg	2.23E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.48E-15	kg/kg	3.22E-14	Ecoinvent V2, lime, from carbonation, at regional storehouse
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.18E-13	kg/kg	1.53E-12	Ecoinvent V2, lime, from carbonation, at regional storehouse
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.16E-07	kg/kg	1.16E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse
								1.17E-02	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	6.62E-09	kg/kg	1.24E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.60E-08	kg/kg	3.00E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.33E-07	kg/kg	2.50E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.28E-08	kg/kg	1.13E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	3.29E-08	kg/kg	2.90E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	3.08E-08	kg/kg	2.71E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	8.26E-10	kg/kg	1.32E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	7.45E-09	kg/kg	1.19E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	6.29E-09	kg/kg	1.01E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	5.03E-11	kg/kg	9.46E-11	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	7.79E-09	kg/kg	1.47E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.93E-09	kg/kg	5.51E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.28E-06	kg/kg	8.98E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	5.67E-06	kg/kg	3.97E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	9.12E-05	kg/kg	6.39E-05	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.90E-06	kg/kg	2.90E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	8.05E-06	kg/kg	8.05E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	9.06E-07	kg/kg	9.06E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.06E-10	kg/kg	5.75E-10	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.53E-15	kg/kg	2.30E-15	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	5.93E-16	kg/kg	3.86E-16	Ecoinvent V2, lime, from carbonation, at regional storehouse
								8.10E-05	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	5.95E-11	kg/kg	1.82E-10	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.38E-11	kg/kg	4.24E-11	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.47E-11	kg/kg	7.57E-11	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	4.10E-13	kg/kg	1.26E-12	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.80E-10	kg/kg	5.52E-10	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.72E-09	kg/kg	1.14E-08	Ecoinvent V2, lime, from carbonation, at regional storehouse
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.43E-05	kg/kg	5.35E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.62E-08	kg/kg	1.24E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.46E-05	kg/kg	5.41E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	5.67E-08	kg/kg	1.25E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphate	water	river	kg	1	kg PO4-Eq	4.59E-09	kg/kg	4.59E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.20E-09	kg/kg	3.67E-09	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.43E-11	kg/kg	4.37E-11	Ecoinvent V2, lime, from carbonation, at regional storehouse
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, lime, from carbonation, at regional storehouse
								1.10E-06	Ecoinvent V2, lime, from carbonation, at regional storehouse
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.97E-04	kg/kg	1.95E-03	Ecoinvent V2, lime, from carbonation, at regional storehouse
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	3.94E-04	kg/kg	7.53E-03	Ecoinvent V2, lime, from carbonation, at regional storehouse
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	3.86E-06	kg/kg	1.54E-04	Ecoinvent V2, lime, from carbonation, at regional storehouse
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	3.65E-04	kg/kg	1.40E-02	Ecoinvent V2, lime, from carbonation, at regional storehouse
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.49E-03	kg/kg	1.60E-01	Ecoinvent V2, lime, from carbonation, at regional storehouse
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	7.23E-08	kg/kg	7.16E-07	Ecoinvent V2, lime, from carbonation, at regional storehouse
								1.83E-01	Ecoinvent V2, lime, from carbonation, at regional storehouse

No LCA-data for production of dicalcium phosphate were available in Ecoinvent, instead LCA-data for the production of natrium phosphate were used back to top	**Sodium phosphate**	This module contains material and energy input, production of waste and emissions for the production of sodium phosphate out of phosphoric acid. Transport and infrastructure have been estimated. No water emissions are accounted for.	(as replacement for dicalcium phosphate, not available in database)						Ecoinvent V2, sodium phosphate, at plant RER
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.92E+00	kg/kg	1.92E+00	Ecoinvent V2, sodium phosphate, at plant RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	5.95E-01	kg/kg	5.95E-01	Ecoinvent V2, sodium phosphate, at plant RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.39E-06	kg/kg	1.39E-06	Ecoinvent V2, sodium phosphate, at plant RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	2.61E-01	kg/kg	2.61E-01	Ecoinvent V2, sodium phosphate, at plant RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	4.23E-04	kg/kg	6.64E-04	Ecoinvent V2, sodium phosphate, at plant RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.31E-03	kg/kg	2.05E-03	Ecoinvent V2, sodium phosphate, at plant RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	1.64E-09	kg/kg	2.57E-09	Ecoinvent V2, sodium phosphate, at plant RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.32E-03	kg/kg	2.08E-03	Ecoinvent V2, sodium phosphate, at plant RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	4.43E-09	kg/kg	1.33E-07	Ecoinvent V2, sodium phosphate, at plant RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	8.99E-12	kg/kg	2.70E-10	Ecoinvent V2, sodium phosphate, at plant RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	1.21E-17	kg/kg	3.63E-16	Ecoinvent V2, sodium phosphate, at plant RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	1.40E-05	kg/kg	4.16E-03	Ecoinvent V2, sodium phosphate, at plant RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.01E-05	kg/kg	3.02E-03	Ecoinvent V2, sodium phosphate, at plant RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.33E-11	kg/kg	3.96E-09	Ecoinvent V2, sodium phosphate, at plant RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	8.80E-06	kg/kg	2.62E-03	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	2.81E-10	kg/kg	4.02E-07	Ecoinvent V2, sodium phosphate, at plant RER

Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.04E-10	kg/kg	4.35E-07	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	1.88E-07	kg/kg	2.69E-04	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.22E-10	kg/kg	7.47E-07	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	3.65E-10	kg/kg	4.53E-08	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	5.30E-09	kg/kg	5.30E-05	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	8.40E-09	kg/kg	1.03E-04	Ecoinvent V2, sodium phosphate, at plant RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	5.30E-08	kg/kg	6.46E-04	Ecoinvent V2, sodium phosphate, at plant RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.31E-06	kg/kg	3.28E-05	Ecoinvent V2, sodium phosphate, at plant RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	5.26E-05	kg/kg	1.32E-03	Ecoinvent V2, sodium phosphate, at plant RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	5.42E-06	kg/kg	1.35E-04	Ecoinvent V2, sodium phosphate, at plant RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	3.28E-17	kg/kg	1.64E-16	Ecoinvent V2, sodium phosphate, at plant RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	8.98E-09	kg/kg	1.70E-05	Ecoinvent V2, sodium phosphate, at plant RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.76E-15	kg/kg	2.69E-11	Ecoinvent V2, sodium phosphate, at plant RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	7.20E-09	kg/kg	5.14E-05	Ecoinvent V2, sodium phosphate, at plant RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	4.17E-09	kg/kg	7.56E-06	Ecoinvent V2, sodium phosphate, at plant RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	3.39E-08	kg/kg	6.13E-05	Ecoinvent V2, sodium phosphate, at plant RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.50E-10	kg/kg	1.31E-09	Ecoinvent V2, sodium phosphate, at plant RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.66E-11	kg/kg	2.31E-10	Ecoinvent V2, sodium phosphate, at plant RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	3.14E-10	kg/kg	3.43E-06	Ecoinvent V2, sodium phosphate, at plant RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	3.08E-11	kg/kg	3.36E-07	Ecoinvent V2, sodium phosphate, at plant RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	2.18E-17	kg/kg	2.37E-13	Ecoinvent V2, sodium phosphate, at plant RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	7.99E-13	kg/kg	1.68E-10	Ecoinvent V2, sodium phosphate, at plant RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.68E-04	kg/kg	4.21E-03	Ecoinvent V2, sodium phosphate, at plant RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.89E-03	kg/kg	7.22E-02	Ecoinvent V2, sodium phosphate, at plant RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	2.21E-11	kg/kg	5.53E-10	Ecoinvent V2, sodium phosphate, at plant RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	9.71E-06	kg/kg	2.43E-04	Ecoinvent V2, sodium phosphate, at plant RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	6.77E-09	kg/kg	9.48E-06	Ecoinvent V2, sodium phosphate, at plant RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	9.74E-15	kg/kg	1.36E-11	Ecoinvent V2, sodium phosphate, at plant RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.88E-11	kg/kg	1.39E-07	Ecoinvent V2, sodium phosphate, at plant RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	4.77E-07	kg/kg	3.52E-03	Ecoinvent V2, sodium phosphate, at plant RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.30E-12	kg/kg	6.16E-09	Ecoinvent V2, sodium phosphate, at plant RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	2.54E-10	kg/kg	3.76E-06	Ecoinvent V2, sodium phosphate, at plant RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	1.64E-10	kg/kg	3.74E-06	Ecoinvent V2, sodium phosphate, at plant RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	5.98E-08	kg/kg	1.36E-03	Ecoinvent V2, sodium phosphate, at plant RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	2.18E-12	kg/kg	2.84E-11	Ecoinvent V2, sodium phosphate, at plant RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.86E-11	kg/kg	6.32E-10	Ecoinvent V2, sodium phosphate, at plant RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.80E-03	kg/kg	3.80E-03	Ecoinvent V2, sodium phosphate, at plant RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
								2.87E+00	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	4.98E-04	kg/kg	9.37E-04	Ecoinvent V2, sodium phosphate, at plant RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.46E-05	kg/kg	2.74E-05	Ecoinvent V2, sodium phosphate, at plant RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	4.72E-05	kg/kg	8.87E-05	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.26E-04	kg/kg	1.11E-04	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	2.81E-05	kg/kg	2.48E-05	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	9.97E-06	kg/kg	8.78E-06	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	4.12E-06	kg/kg	6.59E-06	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	6.08E-05	kg/kg	9.73E-05	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	1.94E-06	kg/kg	3.11E-06	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.97E-09	kg/kg	3.70E-09	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	4.58E-06	kg/kg	8.60E-06	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	2.84E-07	kg/kg	5.35E-07	Ecoinvent V2, sodium phosphate, at plant RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	2.37E-03	kg/kg	1.66E-03	Ecoinvent V2, sodium phosphate, at plant RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.04E-03	kg/kg	7.28E-04	Ecoinvent V2, sodium phosphate, at plant RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	1.67E-03	kg/kg	1.17E-03	Ecoinvent V2, sodium phosphate, at plant RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	3.00E-02	kg/kg	3.00E-02	Ecoinvent V2, sodium phosphate, at plant RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	2.50E-03	kg/kg	2.50E-03	Ecoinvent V2, sodium phosphate, at plant RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.22E-04	kg/kg	1.22E-04	Ecoinvent V2, sodium phosphate, at plant RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	2.64E-08	kg/kg	4.97E-08	Ecoinvent V2, sodium phosphate, at plant RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	3.33E-12	kg/kg	2.16E-12	Ecoinvent V2, sodium phosphate, at plant RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	3.63E-13	kg/kg	2.36E-13	Ecoinvent V2, sodium phosphate, at plant RER
								3.75E-02	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.62E-07	kg/kg	8.01E-07	Ecoinvent V2, sodium phosphate, at plant RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.58E-09	kg/kg	4.83E-09	Ecoinvent V2, sodium phosphate, at plant RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.00E-08	kg/kg	3.07E-08	Ecoinvent V2, sodium phosphate, at plant RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	1.50E-10	kg/kg	4.58E-10	Ecoinvent V2, sodium phosphate, at plant RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.30E-07	kg/kg	7.03E-07	Ecoinvent V2, sodium phosphate, at plant RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.48E-07	kg/kg	7.60E-07	Ecoinvent V2, sodium phosphate, at plant RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.88E-03	kg/kg	6.33E-05	Ecoinvent V2, sodium phosphate, at plant RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.80E-06	kg/kg	1.06E-07	Ecoinvent V2, sodium phosphate, at plant RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.94E-03	kg/kg	6.46E-05	Ecoinvent V2, sodium phosphate, at plant RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	4.86E-06	kg/kg	1.07E-07	Ecoinvent V2, sodium phosphate, at plant RER
Phosphate	water	river	kg	1	kg PO4-Eq	1.32E-05	kg/kg	1.32E-05	Ecoinvent V2, sodium phosphate, at plant RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	6.55E-05	kg/kg	2.01E-04	Ecoinvent V2, sodium phosphate, at plant RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.67E-09	kg/kg	5.12E-09	Ecoinvent V2, sodium phosphate, at plant RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium phosphate, at plant RER
								3.44E-04	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.66E-01	kg/kg	1.65E+00	Ecoinvent V2, sodium phosphate, at plant RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.65E-01	kg/kg	5.06E+00	Ecoinvent V2, sodium phosphate, at plant RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.61E-03	kg/kg	1.04E-01	Ecoinvent V2, sodium phosphate, at plant RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.91E-01	kg/kg	7.30E+00	Ecoinvent V2, sodium phosphate, at plant RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.82E-01	kg/kg	8.33E+00	Ecoinvent V2, sodium phosphate, at plant RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	3.31E-05	kg/kg	3.28E-04	Ecoinvent V2, sodium phosphate, at plant RER
								2.24E+01	

Sodium chloride — this module includes the solution mining process of sodium chloride, its cleaning form impurities, and the drying step. It is sold as bulk and therefore no packaging materials are included. — Ecoinvent V2, sodium chloride, powder, at plant, RER

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	6.39E-02	kg/kg	6.39E-02	Ecoinvent V2, sodium chloride, powder, at plant, RER

Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	9.25E-02	kg/kg	9.25E-02	Ecoinvent V2, sodium chloride, powder, at plant, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.26E-07	kg/kg	3.26E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	1.39E-02	kg/kg	1.39E-02	Ecoinvent V2, sodium chloride, powder, at plant, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.66E-05	kg/kg	2.62E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	9.93E-05	kg/kg	1.56E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	3.83E-10	kg/kg	6.02E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.62E-04	kg/kg	2.54E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	5.41E-10	kg/kg	1.62E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.08E-12	kg/kg	6.25E-11	Ecoinvent V2, sodium chloride, powder, at plant, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	2.69E-18	kg/kg	8.06E-17	Ecoinvent V2, sodium chloride, powder, at plant, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.30E-06	kg/kg	6.85E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.41E-06	kg/kg	4.19E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.10E-12	kg/kg	9.25E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.35E-06	kg/kg	4.03E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	6.58E-11	kg/kg	9.41E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	7.17E-11	kg/kg	1.03E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.58E-09	kg/kg	6.54E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.85E-11	kg/kg	1.75E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	9.05E-11	kg/kg	1.12E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.24E-09	kg/kg	1.24E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.97E-09	kg/kg	2.40E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.14E-08	kg/kg	1.39E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.99E-06	kg/kg	4.97E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.65E-06	kg/kg	4.12E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	1.36E-06	kg/kg	3.41E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	7.28E-18	kg/kg	3.64E-17	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	6.15E-10	kg/kg	1.16E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	2.72E-16	kg/kg	1.94E-12	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	5.02E-10	kg/kg	3.59E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	9.69E-10	kg/kg	1.75E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.89E-09	kg/kg	5.23E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.03E-11	kg/kg	1.76E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	6.16E-12	kg/kg	5.36E-11	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	7.36E-11	kg/kg	8.02E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.10E-12	kg/kg	2.29E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	4.84E-18	kg/kg	5.28E-14	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.87E-13	kg/kg	3.93E-11	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	8.79E-06	kg/kg	2.20E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	2.59E-04	kg/kg	6.48E-03	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	5.17E-12	kg/kg	1.29E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	4.38E-07	kg/kg	1.10E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	3.21E-10	kg/kg	4.50E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.16E-15	kg/kg	3.03E-12	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	4.66E-12	kg/kg	3.44E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.03E-07	kg/kg	7.60E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.04E-13	kg/kg	1.44E-09	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	5.96E-11	kg/kg	8.82E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.80E-11	kg/kg	8.66E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.56E-08	kg/kg	3.55E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	5.62E-13	kg/kg	7.31E-12	Ecoinvent V2, sodium chloride, powder, at plant, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.13E-11	kg/kg	1.46E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	9.59E-06	kg/kg	9.59E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER
								1.80E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	1.12E-05	kg/kg	2.10E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	5.69E-07	kg/kg	1.07E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	7.48E-06	kg/kg	1.41E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	2.83E-06	kg/kg	2.49E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	7.04E-06	kg/kg	6.20E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.67E-06	kg/kg	1.47E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.07E-07	kg/kg	1.70E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.54E-06	kg/kg	2.47E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	4.10E-07	kg/kg	6.56E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	2.38E-10	kg/kg	4.47E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	3.22E-07	kg/kg	6.05E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	4.67E-08	kg/kg	8.79E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	8.96E-05	kg/kg	6.27E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.58E-04	kg/kg	1.10E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	8.22E-05	kg/kg	5.76E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.18E-04	kg/kg	1.18E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	4.41E-04	kg/kg	4.41E-04	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.29E-05	kg/kg	1.29E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	4.01E-09	kg/kg	7.53E-09	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	7.79E-13	kg/kg	5.07E-13	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	8.99E-14	kg/kg	5.84E-14	Ecoinvent V2, sodium chloride, powder, at plant, RER
								8.52E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.65E-08	kg/kg	5.04E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	2.80E-10	kg/kg	8.56E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.37E-09	kg/kg	7.26E-09	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	3.24E-11	kg/kg	9.91E-11	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.92E-08	kg/kg	1.20E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	2.04E-08	kg/kg	6.23E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.70E-04	kg/kg	3.74E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.96E-07	kg/kg	1.53E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.51E-04	kg/kg	5.52E-06	Ecoinvent V2, sodium chloride, powder, at plant, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.08E-07	kg/kg	1.56E-08	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphate	water	river	kg	1	kg PO4-Eq	1.11E-05	kg/kg	1.11E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	2.36E-07	kg/kg	7.23E-07	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.71E-10	kg/kg	8.30E-10	Ecoinvent V2, sodium chloride, powder, at plant, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, sodium chloride, powder, at plant, RER

								2.14E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	4.21E-02	kg/kg	4.17E-01	Ecoinvent V2, sodium chloride, powder, at plant, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.97E-02	kg/kg	5.68E-01	Ecoinvent V2, sodium chloride, powder, at plant, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.90E-04	kg/kg	1.15E-02	Ecoinvent V2, sodium chloride, powder, at plant, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.31E-02	kg/kg	5.03E-01	Ecoinvent V2, sodium chloride, powder, at plant, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.35E-02	kg/kg	6.17E-01	Ecoinvent V2, sodium chloride, powder, at plant, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.17E-06	kg/kg	4.13E-05	Ecoinvent V2, sodium chloride, powder, at plant, RER
								2.12E+00	

potassium chloride, as K2O, at regional storehouse

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.88E-01	kg/kg	2.88E-01	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	7.06E-02	kg/kg	7.06E-02	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	5.49E-07	kg/kg	5.49E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	8.15E-02	kg/kg	8.15E-02	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	3.94E-04	kg/kg	6.19E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	6.87E-05	kg/kg	1.08E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	6.45E-10	kg/kg	1.01E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	5.45E-04	kg/kg	8.56E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Chloroform	air	high population density	kg	30	kg CO2-Eq	8.83E-10	kg/kg	2.65E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.24E-12	kg/kg	6.71E-11	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Chloroform	air	unspecified	kg	30	kg CO2-Eq	4.65E-18	kg/kg	1.40E-16	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	3.24E-05	kg/kg	9.65E-03	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.15E-06	kg/kg	3.44E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	5.23E-12	kg/kg	1.56E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.85E-06	kg/kg	8.50E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	1.11E-10	kg/kg	1.58E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	5.14E-11	kg/kg	7.35E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	7.77E-08	kg/kg	1.11E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	4.81E-11	kg/kg	2.95E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	5.88E-11	kg/kg	7.29E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	8.96E-10	kg/kg	8.96E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	3.32E-09	kg/kg	4.05E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.05E-08	kg/kg	2.50E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	2.11E-07	kg/kg	5.27E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	2.58E-06	kg/kg	6.44E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	8.67E-07	kg/kg	2.17E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.26E-17	kg/kg	6.30E-17	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	6.53E-09	kg/kg	1.23E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.36E-15	kg/kg	9.72E-12	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	2.15E-09	kg/kg	1.53E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	1.63E-09	kg/kg	2.96E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.29E-08	kg/kg	4.14E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	3.32E-11	kg/kg	2.89E-10	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	6.62E-12	kg/kg	5.76E-11	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	1.23E-10	kg/kg	1.35E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.23E-11	kg/kg	2.43E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	8.38E-18	kg/kg	9.13E-14	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	3.14E-13	kg/kg	6.60E-11	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	2.94E-04	kg/kg	7.34E-03	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.40E-03	kg/kg	3.50E-02	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	8.72E-12	kg/kg	2.18E-10	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	3.71E-06	kg/kg	9.27E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	2.29E-09	kg/kg	3.20E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.75E-15	kg/kg	5.25E-12	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.03E-12	kg/kg	2.24E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.84E-07	kg/kg	1.36E-03	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	5.10E-13	kg/kg	2.42E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	1.00E-10	kg/kg	1.48E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	5.85E-11	kg/kg	1.33E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	8.97E-09	kg/kg	2.04E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	7.95E-13	kg/kg	1.03E-11	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.21E-11	kg/kg	1.57E-10	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.03E-05	kg/kg	1.03E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
								4.98E-01	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	6.13E-06	kg/kg	1.15E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	7.49E-07	kg/kg	1.41E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.24E-05	kg/kg	2.33E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.18E-05	kg/kg	1.04E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.58E-06	kg/kg	4.03E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	3.21E-06	kg/kg	2.83E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	1.08E-07	kg/kg	1.73E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	1.05E-06	kg/kg	1.68E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	8.23E-07	kg/kg	1.32E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	7.90E-10	kg/kg	1.49E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	3.25E-06	kg/kg	6.11E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	9.32E-08	kg/kg	1.75E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	4.93E-04	kg/kg	3.45E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	1.97E-04	kg/kg	1.38E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	8.31E-04	kg/kg	5.81E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.85E-04	kg/kg	1.85E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	5.23E-04	kg/kg	5.23E-04	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse

Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	3.67E-05	kg/kg	3.67E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	9.39E-09	kg/kg	1.76E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	1.31E-12	kg/kg	8.54E-13	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	5.84E-14	kg/kg	3.80E-14	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
								1.87E-03	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	1.31E-08	kg/kg	4.02E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	4.68E-10	kg/kg	1.43E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.68E-09	kg/kg	5.13E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	5.77E-11	kg/kg	1.77E-10	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	3.12E-08	kg/kg	9.56E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	7.75E-08	kg/kg	2.37E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.08E-04	kg/kg	6.79E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.82E-06	kg/kg	4.00E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	3.16E-04	kg/kg	6.94E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	1.84E-06	kg/kg	4.05E-08	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphate	water	river	kg	1	kg PO4-Eq	1.03E-06	kg/kg	1.03E-06	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	water	river	kg	3.06	kg PO4-Eq	8.92E-08	kg/kg	2.73E-07	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	5.71E-10	kg/kg	1.75E-09	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
								1.55E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.70E-02	kg/kg	2.68E-01	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.66E-02	kg/kg	5.08E-01	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.60E-04	kg/kg	1.03E-02	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.32E-01	kg/kg	5.04E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	4.89E-02	kg/kg	2.24E+00	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	9.83E-06	kg/kg	9.73E-05	Ecoinvent v2, potassium chloride, as K2O, at regional storehouse
								8.06E+00	

zinc oxide, at plant

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	2.42E+00	kg/kg	2.42E+00	Ecoinvent V2, zinc oxide, at plant
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	2.45E-01	kg/kg	2.45E-01	Ecoinvent V2, zinc oxide, at plant
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.28E-07	kg/kg	3.28E-07	Ecoinvent V2, zinc oxide, at plant
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	5.12E-02	kg/kg	5.12E-02	Ecoinvent V2, zinc oxide, at plant
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	2.43E-04	kg/kg	3.82E-04	Ecoinvent V2, zinc oxide, at plant
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	2.40E-04	kg/kg	3.76E-04	Ecoinvent V2, zinc oxide, at plant
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	3.85E-10	kg/kg	6.05E-10	Ecoinvent V2, zinc oxide, at plant
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	4.82E-04	kg/kg	7.57E-04	Ecoinvent V2, zinc oxide, at plant
Chloroform	air	high population density	kg	30	kg CO2-Eq	5.81E-10	kg/kg	1.74E-08	Ecoinvent V2, zinc oxide, at plant
Chloroform	air	low population density	kg	30	kg CO2-Eq	3.65E-12	kg/kg	1.09E-10	Ecoinvent V2, zinc oxide, at plant
Chloroform	air	unspecified	kg	30	kg CO2-Eq	2.91E-18	kg/kg	8.72E-17	Ecoinvent V2, zinc oxide, at plant
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	9.81E-06	kg/kg	2.92E-03	Ecoinvent V2, zinc oxide, at plant
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	3.61E-06	kg/kg	1.07E-03	Ecoinvent V2, zinc oxide, at plant
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.12E-12	kg/kg	9.30E-10	Ecoinvent V2, zinc oxide, at plant
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	3.76E-06	kg/kg	1.12E-03	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	6.65E-11	kg/kg	9.51E-08	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	1.54E-10	kg/kg	2.20E-07	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	4.74E-08	kg/kg	6.78E-05	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.86E-11	kg/kg	1.75E-07	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	1.95E-10	kg/kg	2.42E-08	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	2.65E-09	kg/kg	2.65E-05	Ecoinvent V2, zinc oxide, at plant
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.98E-09	kg/kg	2.41E-05	Ecoinvent V2, zinc oxide, at plant
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.61E-08	kg/kg	1.97E-04	Ecoinvent V2, zinc oxide, at plant
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.04E-07	kg/kg	2.60E-06	Ecoinvent V2, zinc oxide, at plant
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	4.26E-06	kg/kg	1.07E-04	Ecoinvent V2, zinc oxide, at plant
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	2.95E-06	kg/kg	7.38E-05	Ecoinvent V2, zinc oxide, at plant
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	7.88E-18	kg/kg	3.94E-17	Ecoinvent V2, zinc oxide, at plant
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	6.13E-08	kg/kg	1.16E-04	Ecoinvent V2, zinc oxide, at plant
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	1.14E-15	kg/kg	8.14E-12	Ecoinvent V2, zinc oxide, at plant
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	9.16E-10	kg/kg	6.54E-06	Ecoinvent V2, zinc oxide, at plant
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	9.91E-10	kg/kg	1.79E-06	Ecoinvent V2, zinc oxide, at plant
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.12E-07	kg/kg	3.84E-04	Ecoinvent V2, zinc oxide, at plant
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.36E-11	kg/kg	2.06E-10	Ecoinvent V2, zinc oxide, at plant
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	1.08E-11	kg/kg	9.39E-11	Ecoinvent V2, zinc oxide, at plant
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	7.52E-11	kg/kg	8.20E-07	Ecoinvent V2, zinc oxide, at plant
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.09E-10	kg/kg	2.28E-06	Ecoinvent V2, zinc oxide, at plant
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	5.24E-18	kg/kg	5.71E-14	Ecoinvent V2, zinc oxide, at plant
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.89E-13	kg/kg	3.97E-11	Ecoinvent V2, zinc oxide, at plant
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.12E-04	kg/kg	2.80E-03	Ecoinvent V2, zinc oxide, at plant
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	6.48E-03	kg/kg	1.62E-01	Ecoinvent V2, zinc oxide, at plant
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	5.20E-12	kg/kg	1.30E-10	Ecoinvent V2, zinc oxide, at plant
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	2.50E-06	kg/kg	6.25E-05	Ecoinvent V2, zinc oxide, at plant
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	4.30E-10	kg/kg	6.01E-07	Ecoinvent V2, zinc oxide, at plant
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.34E-15	kg/kg	3.28E-12	Ecoinvent V2, zinc oxide, at plant
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.00E-11	kg/kg	7.42E-08	Ecoinvent V2, zinc oxide, at plant
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.45E-07	kg/kg	1.07E-03	Ecoinvent V2, zinc oxide, at plant
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	3.07E-13	kg/kg	1.46E-09	Ecoinvent V2, zinc oxide, at plant
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	6.02E-11	kg/kg	8.91E-07	Ecoinvent V2, zinc oxide, at plant
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	4.59E-11	kg/kg	1.05E-06	Ecoinvent V2, zinc oxide, at plant
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	3.42E-08	kg/kg	7.80E-04	Ecoinvent V2, zinc oxide, at plant
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	5.86E-13	kg/kg	7.62E-12	Ecoinvent V2, zinc oxide, at plant
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.97E-11	kg/kg	2.56E-10	Ecoinvent V2, zinc oxide, at plant
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	2.49E-05	kg/kg	2.49E-05	Ecoinvent V2, zinc oxide, at plant
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant

								2.89E+00	Ecoinvent V2, zinc oxide, at plant
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	7.30E-07	kg/kg	1.37E-06	Ecoinvent V2, zinc oxide, at plant
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.11E-06	kg/kg	2.09E-06	Ecoinvent V2, zinc oxide, at plant
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.10E-05	kg/kg	2.07E-05	Ecoinvent V2, zinc oxide, at plant
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.56E-06	kg/kg	1.38E-06	Ecoinvent V2, zinc oxide, at plant
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.50E-05	kg/kg	1.32E-05	Ecoinvent V2, zinc oxide, at plant
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	2.57E-06	kg/kg	2.26E-06	Ecoinvent V2, zinc oxide, at plant
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	7.13E-08	kg/kg	1.14E-07	Ecoinvent V2, zinc oxide, at plant
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	3.29E-06	kg/kg	5.27E-06	Ecoinvent V2, zinc oxide, at plant
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	6.30E-07	kg/kg	1.01E-06	Ecoinvent V2, zinc oxide, at plant
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	4.23E-10	kg/kg	7.96E-10	Ecoinvent V2, zinc oxide, at plant
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	2.93E-05	kg/kg	5.52E-05	Ecoinvent V2, zinc oxide, at plant
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.35E-07	kg/kg	2.53E-07	Ecoinvent V2, zinc oxide, at plant
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.38E-03	kg/kg	9.68E-04	Ecoinvent V2, zinc oxide, at plant
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	5.62E-04	kg/kg	3.94E-04	Ecoinvent V2, zinc oxide, at plant
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	4.37E-04	kg/kg	3.06E-04	Ecoinvent V2, zinc oxide, at plant
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.83E-04	kg/kg	1.83E-04	Ecoinvent V2, zinc oxide, at plant
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	1.64E-03	kg/kg	1.64E-03	Ecoinvent V2, zinc oxide, at plant
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	3.00E-05	kg/kg	3.00E-05	Ecoinvent V2, zinc oxide, at plant
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.21E-08	kg/kg	2.28E-08	Ecoinvent V2, zinc oxide, at plant
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	7.82E-13	kg/kg	5.08E-13	Ecoinvent V2, zinc oxide, at plant
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	1.94E-13	kg/kg	1.26E-13	Ecoinvent V2, zinc oxide, at plant
								3.63E-03	Ecoinvent V2, zinc oxide, at plant
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	2.27E-08	kg/kg	6.95E-08	Ecoinvent V2, zinc oxide, at plant
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	7.44E-10	kg/kg	2.28E-09	Ecoinvent V2, zinc oxide, at plant
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	5.07E-09	kg/kg	1.55E-08	Ecoinvent V2, zinc oxide, at plant
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	4.64E-11	kg/kg	1.42E-10	Ecoinvent V2, zinc oxide, at plant
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	8.37E-08	kg/kg	2.56E-07	Ecoinvent V2, zinc oxide, at plant
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.06E-07	kg/kg	9.36E-07	Ecoinvent V2, zinc oxide, at plant
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.40E-04	kg/kg	5.29E-06	Ecoinvent V2, zinc oxide, at plant
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.20E-06	kg/kg	4.84E-08	Ecoinvent V2, zinc oxide, at plant
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.52E-04	kg/kg	5.54E-06	Ecoinvent V2, zinc oxide, at plant
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	2.22E-06	kg/kg	4.89E-08	Ecoinvent V2, zinc oxide, at plant
Phosphate	water	river	kg	1	kg PO4-Eq	5.97E-07	kg/kg	5.97E-07	Ecoinvent V2, zinc oxide, at plant
Phosphorus	water	river	kg	3.06	kg PO4-Eq	3.92E-08	kg/kg	1.20E-07	Ecoinvent V2, zinc oxide, at plant
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	6.11E-10	kg/kg	1.87E-09	Ecoinvent V2, zinc oxide, at plant
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/kg	0.00E+00	Ecoinvent V2, zinc oxide, at plant
								1.29E-05	Ecoinvent V2, zinc oxide, at plant
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	9.02E-02	kg/kg	8.93E-01	Ecoinvent V2, zinc oxide, at plant
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	6.13E-02	kg/kg	1.17E+00	Ecoinvent V2, zinc oxide, at plant
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	5.97E-04	kg/kg	2.38E-02	Ecoinvent V2, zinc oxide, at plant
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.19E+00	kg/kg	4.56E+01	Ecoinvent V2, zinc oxide, at plant
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	2.44E-02	kg/kg	1.12E+00	Ecoinvent V2, zinc oxide, at plant
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.35E-05	kg/kg	1.34E-04	Ecoinvent V2, zinc oxide, at plant
								4.89E+01	

FL29	**Transport mineral**	See Transport lorry>16t	

back to top

FL18	**Produce trace mineral**	Included in minerals above (FL29) (minerals comprising of less than 1% of the total minerals required have not been included in the analysis)

back to top

FL30	**Transport trace mineral**	Not applicable - see FL 18

back to top

FL19	**Produce Cobalt (Iodized)**	

back to top

Very low quantities (see Diet Supplements tab). Cobalt Iodized Salt Block - considered within the sodium chloride production

FL31	**Transport cobalt (iodized)**	Not considered. Very low quantities (see Diet Supplements tab). Included in sodium chloride salt

back to top

FL20	**Produce millrun carrier**	Not considered

back to top

FL32	**Transport millrun carrier**	See Transport lorry 3.5-16t

back to top

FL21	**Produce Vitamin**

back to top

FL33	**Transport vitamin**	See Transport lorry 3.5-16t	See Transport

back to top

FL22	**Produce Growth Promotant**	
back to top		
FL34	**Transport growth promotant**	See Transport lorry 3.5-16t
back to top		
FL23	**Produce Vaccination/Antibiotic**	
back to top		
FL35	**Transport vaccination/ antibiotic**	See Transport lorry 3.5-16t
back to top		
FL36	**Supply water to livestock**	
back to top		See information on "Generate Electricity"

TRANSPORT - ALL

	Transport, lorry 3.5-16t
back to top	

	Transport, lorry > 16t	transport, lorry >16t, fleet average, RER							Ecoinvent V2, road transport, lorry >16t, fleet average RER
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.23E-02	kg/tkm	1.23E-02	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.24E-02	kg/tkm	1.24E-02	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	2.36E-08	kg/tkm	2.36E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	9.46E-02	kg/tkm	9.46E-02	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	8.54E-06	kg/tkm	1.34E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.77E-05	kg/tkm	2.78E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.78E-11	kg/tkm	4.37E-11	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	3.15E-04	kg/tkm	4.94E-04	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	4.24E-11	kg/tkm	1.27E-09	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.73E-13	kg/tkm	8.19E-12	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	4.64E-19	kg/tkm	1.39E-17	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.66E-07	kg/tkm	7.92E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	2.30E-07	kg/tkm	6.84E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	2.25E-13	kg/tkm	6.71E-11	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	3.46E-06	kg/tkm	1.03E-03	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	4.73E-12	kg/tkm	6.76E-09	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	9.01E-12	kg/tkm	1.29E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.46E-07	kg/tkm	3.51E-04	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	2.05E-12	kg/tkm	1.26E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	7.11E-12	kg/tkm	8.81E-10	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.70E-10	kg/tkm	1.70E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.41E-10	kg/tkm	1.72E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	2.23E-09	kg/tkm	2.73E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	4.96E-08	kg/tkm	1.24E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.39E-07	kg/tkm	3.49E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	8.64E-08	kg/tkm	2.16E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.26E-18	kg/tkm	6.28E-18	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	7.00E-11	kg/tkm	1.32E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.80E-15	kg/tkm	2.71E-11	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.64E-09	kg/tkm	1.17E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	7.11E-11	kg/tkm	1.29E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.85E-10	kg/tkm	5.15E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.49E-12	kg/tkm	1.30E-11	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	8.08E-13	kg/tkm	7.03E-12	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	5.27E-12	kg/tkm	5.75E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.86E-13	kg/tkm	3.11E-09	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	8.35E-19	kg/tkm	9.11E-15	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.34E-14	kg/tkm	2.82E-12	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	9.55E-06	kg/tkm	2.39E-04	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.57E-04	kg/tkm	3.94E-03	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	3.75E-13	kg/tkm	9.38E-12	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	8.41E-06	kg/tkm	2.10E-04	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	8.08E-11	kg/tkm	1.13E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.74E-16	kg/tkm	5.23E-13	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	3.66E-13	kg/tkm	2.70E-09	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	2.01E-08	kg/tkm	1.49E-04	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.18E-14	kg/tkm	1.04E-10	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	4.28E-12	kg/tkm	6.33E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.54E-12	kg/tkm	5.80E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	1.17E-09	kg/tkm	2.66E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	3.70E-14	kg/tkm	4.81E-13	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.47E-12	kg/tkm	1.92E-11	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.39E-06	kg/tkm	1.39E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
								1.26E-01	

Ammonia	air	high population density	kg	1.88	kg SO2-Eq	9.32E-08	kg/tkm	1.75E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.85E-07	kg/tkm	3.48E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.53E-06	kg/tkm	2.88E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.62E-07	kg/tkm	1.43E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	4.03E-07	kg/tkm	3.54E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	3.74E-07	kg/tkm	3.29E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	9.94E-09	kg/tkm	1.59E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	9.17E-08	kg/tkm	1.47E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	8.92E-08	kg/tkm	1.43E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	5.19E-10	kg/tkm	9.76E-10	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	9.93E-08	kg/tkm	1.87E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	3.79E-08	kg/tkm	7.13E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.51E-05	kg/tkm	1.06E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	6.26E-05	kg/tkm	4.38E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	9.64E-04	kg/tkm	6.74E-04	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	3.30E-05	kg/tkm	3.30E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	8.97E-05	kg/tkm	8.97E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.10E-05	kg/tkm	1.10E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.96E-09	kg/tkm	7.45E-09	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	5.59E-14	kg/tkm	3.64E-14	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	7.07E-15	kg/tkm	4.59E-15	Ecoinvent V2, road transport, lorry >16t, fleet average RER
								8.67E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	7.25E-10	kg/tkm	2.22E-09	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.78E-10	kg/tkm	5.45E-10	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.92E-10	kg/tkm	8.95E-10	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	6.36E-12	kg/tkm	1.94E-11	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	2.18E-09	kg/tkm	6.67E-09	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.95E-08	kg/tkm	1.21E-07	Ecoinvent V2, road transport, lorry >16t, fleet average RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.58E-04	kg/tkm	5.67E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.27E-07	kg/tkm	1.60E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.61E-04	kg/tkm	5.75E-06	Ecoinvent V2, road transport, lorry >16t, fleet average RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	7.33E-07	kg/tkm	1.61E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphate	water	river	kg	1	kg PO4-Eq	6.33E-08	kg/tkm	6.33E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.52E-08	kg/tkm	4.64E-08	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	2.09E-10	kg/tkm	6.40E-10	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/tkm	0.00E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
								1.17E-05	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	2.40E-03	kg/tkm	2.38E-02	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	5.04E-03	kg/tkm	9.63E-02	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	4.92E-05	Nm3/tkm	1.96E-03	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	4.20E-03	Nm3/tkm	1.61E-01	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.75E-02	kg/tkm	1.72E+00	Ecoinvent V2, road transport, lorry >16t, fleet average RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	1.19E-06	kg/tkm	1.18E-05	Ecoinvent V2, road transport, lorry >16t, fleet average RER
								2.00E+00	

	Transport, lorry > 32t, EURO4	Ecoinvent V2, transport, lorry >32t, EURO4, RER

back to top

Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	1.02E-02	kg/tkm	1.02E-02	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	1.04E-02	kg/tkm	1.04E-02	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	1.93E-08	kg/tkm	1.93E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	7.70E-02	kg/tkm	7.70E-02	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	7.00E-06	kg/tkm	1.10E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	1.48E-05	kg/tkm	2.33E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	2.26E-11	kg/tkm	3.56E-11	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	1.31E-04	kg/tkm	2.05E-04	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Chloroform	air	high population density	kg	30	kg CO2-Eq	3.45E-11	kg/tkm	1.04E-09	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Chloroform	air	low population density	kg	30	kg CO2-Eq	2.22E-13	kg/tkm	6.65E-12	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.82E-19	kg/tkm	1.15E-17	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	2.19E-07	kg/tkm	6.52E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	1.89E-07	kg/tkm	5.62E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	1.84E-13	kg/tkm	5.47E-11	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	2.84E-06	kg/tkm	8.47E-04	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	3.85E-12	kg/tkm	5.51E-09	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	7.29E-12	kg/tkm	1.04E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.00E-07	kg/tkm	2.87E-04	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.67E-12	kg/tkm	1.02E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	5.82E-12	kg/tkm	7.21E-10	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	1.37E-10	kg/tkm	1.37E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.15E-10	kg/tkm	1.40E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.83E-09	kg/tkm	2.23E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	4.05E-08	kg/tkm	1.01E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	1.14E-07	kg/tkm	2.86E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	7.12E-08	kg/tkm	1.78E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	1.04E-18	kg/tkm	5.18E-18	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	5.88E-11	kg/tkm	1.11E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	3.10E-15	kg/tkm	2.21E-11	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	1.36E-09	kg/tkm	9.74E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	5.84E-11	kg/tkm	1.06E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	2.38E-10	kg/tkm	4.31E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	1.22E-12	kg/tkm	1.06E-11	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	6.56E-13	kg/tkm	5.71E-12	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	4.30E-12	kg/tkm	4.69E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	2.39E-13	kg/tkm	2.60E-09	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.88E-19	kg/tkm	7.50E-15	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.10E-14	kg/tkm	2.30E-12	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	7.83E-06	kg/tkm	1.96E-04	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	1.33E-04	kg/tkm	3.32E-03	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	3.06E-13	kg/tkm	7.65E-12	Ecoinvent V2, transport, lorry >32t, EURO4, RER

Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	7.12E-07	kg/tkm	1.78E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	6.68E-11	kg/tkm	9.35E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	3.08E-16	kg/tkm	4.31E-13	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	2.99E-13	kg/tkm	2.21E-09	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	1.65E-08	kg/tkm	1.22E-04	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	1.78E-14	kg/tkm	8.45E-11	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	3.49E-12	kg/tkm	5.16E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	2.08E-12	kg/tkm	4.73E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	9.55E-10	kg/tkm	2.18E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	3.03E-14	kg/tkm	3.94E-13	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	1.20E-12	kg/tkm	1.56E-11	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	1.15E-06	kg/tkm	1.15E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
								1.03E-01	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	7.66E-08	kg/tkm	1.44E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	1.55E-07	kg/tkm	2.91E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	1.32E-06	kg/tkm	2.48E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.37E-07	kg/tkm	1.20E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	3.34E-07	kg/tkm	2.94E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	3.35E-07	kg/tkm	2.95E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	8.25E-09	kg/tkm	1.32E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	7.59E-08	kg/tkm	1.21E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	7.52E-08	kg/tkm	1.20E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	4.25E-10	kg/tkm	7.98E-10	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	8.54E-08	kg/tkm	1.61E-07	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	3.29E-08	kg/tkm	6.19E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	1.25E-05	kg/tkm	8.72E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	5.21E-05	kg/tkm	3.65E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	4.71E-04	kg/tkm	3.29E-04	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	2.70E-05	kg/tkm	2.70E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	7.37E-05	kg/tkm	7.37E-05	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	9.50E-06	kg/tkm	9.50E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	3.44E-09	kg/tkm	6.47E-09	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	4.56E-14	kg/tkm	2.96E-14	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	5.78E-15	kg/tkm	3.76E-15	Ecoinvent V2, transport, lorry >32t, EURO4, RER
								4.89E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	6.06E-10	kg/tkm	1.85E-09	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	1.54E-10	kg/tkm	4.70E-10	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	2.37E-10	kg/tkm	7.24E-10	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	5.20E-12	kg/tkm	1.59E-11	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.80E-09	kg/tkm	5.50E-09	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	3.23E-08	kg/tkm	9.89E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.09E-04	kg/tkm	4.61E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.31E-07	kg/tkm	1.39E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	2.12E-04	kg/tkm	4.67E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	6.36E-07	kg/tkm	1.40E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphate	water	river	kg	1	kg PO4-Eq	5.17E-08	kg/tkm	5.17E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphorus	water	river	kg	3.06	kg PO4-Eq	1.27E-08	kg/tkm	3.88E-08	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	1.75E-10	kg/tkm	5.35E-10	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
								9.51E-06	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.99E-03	kg/tkm	1.97E-02	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	4.32E-03	kg/tkm	8.26E-02	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	4.22E-05	Nm3/tkm	1.68E-03	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	3.51E-03	Nm3/tkm	1.34E-01	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	3.10E-02	kg/tkm	1.42E+00	Ecoinvent V2, transport, lorry >32t, EURO4, RER
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	9.70E-07	kg/tkm	9.60E-06	Ecoinvent V2, transport, lorry >32t, EURO4, RER
								1.66E+00	
	Transport, freight, rail, diesel								Ecoinvent V2, transport, freight, rail, diesel, US
back to top									
Carbon dioxide, fossil	air	high population density	kg	1	kg CO2-Eq	5.98E-03	kg/tkm	5.98E-03	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon dioxide, fossil	air	low population density	kg	1	kg CO2-Eq	4.20E-03	kg/tkm	4.20E-03	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon dioxide, fossil	air	lower stratosphere + upper troposphere	kg	1	kg CO2-Eq	3.55E-10	kg/tkm	3.55E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon dioxide, fossil	air	unspecified	kg	1	kg CO2-Eq	3.80E-02	kg/tkm	3.80E-02	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon monoxide, fossil	air	high population density	kg	1.5714	kg CO2-Eq	1.37E-06	kg/tkm	2.16E-06	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon monoxide, fossil	air	low population density	kg	1.5714	kg CO2-Eq	7.16E-06	kg/tkm	1.13E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon monoxide, fossil	air	lower stratosphere + upper troposphere	kg	1.5714	kg CO2-Eq	4.17E-13	kg/tkm	6.55E-13	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon monoxide, fossil	air	unspecified	kg	1.5714	kg CO2-Eq	2.35E-04	kg/tkm	3.69E-04	Ecoinvent V2, transport, freight, rail, diesel, US
Chloroform	air	high population density	kg	30	kg CO2-Eq	2.60E-12	kg/tkm	7.80E-11	Ecoinvent V2, transport, freight, rail, diesel, US
Chloroform	air	low population density	kg	30	kg CO2-Eq	7.76E-14	kg/tkm	2.33E-12	Ecoinvent V2, transport, freight, rail, diesel, US
Chloroform	air	unspecified	kg	30	kg CO2-Eq	3.51E-20	kg/tkm	1.05E-18	Ecoinvent V2, transport, freight, rail, diesel, US
Dinitrogen monoxide	air	high population density	kg	298	kg CO2-Eq	8.53E-08	kg/tkm	2.54E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Dinitrogen monoxide	air	low population density	kg	298	kg CO2-Eq	8.70E-08	kg/tkm	2.59E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Dinitrogen monoxide	air	lower stratosphere + upper troposphere	kg	298	kg CO2-Eq	3.38E-15	kg/tkm	1.01E-12	Ecoinvent V2, transport, freight, rail, diesel, US
Dinitrogen monoxide	air	unspecified	kg	298	kg CO2-Eq	1.14E-06	kg/tkm	3.41E-04	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	high population density	kg	1430	kg CO2-Eq	5.49E-14	kg/tkm	7.85E-11	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	low population density	kg	1430	kg CO2-Eq	3.59E-12	kg/tkm	5.14E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	air	unspecified	kg	1430	kg CO2-Eq	2.26E-09	kg/tkm	3.22E-06	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	high population density	kg	6130	kg CO2-Eq	1.76E-14	kg/tkm	1.08E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	air	unspecified	kg	6130	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,1-difluoro-, HFC-152a	air	high population density	kg	124	kg CO2-Eq	2.97E-12	kg/tkm	3.68E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,1-difluoro-, HFC-152a	air	low population density	kg	124	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	air	low population density	kg	10000	kg CO2-Eq	6.71E-11	kg/tkm	6.71E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	air	unspecified	kg	609	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, hexafluoro-, HFC-116	air	high population density	kg	12200	kg CO2-Eq	1.28E-12	kg/tkm	1.57E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Ethane, hexafluoro-, HFC-116	air	unspecified	kg	12200	kg CO2-Eq	1.08E-09	kg/tkm	1.31E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, biogenic	air	high population density	kg	25	kg CO2-Eq	1.94E-09	kg/tkm	4.84E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, biogenic	air	low population density	kg	25	kg CO2-Eq	5.67E-08	kg/tkm	1.42E-06	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, biogenic	air	unspecified	kg	25	kg CO2-Eq	3.72E-08	kg/tkm	9.30E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, bromo-, Halon 1001	air	unspecified	kg	5	kg CO2-Eq	9.52E-20	kg/tkm	4.76E-19	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, bromochlorodifluoro-, Halon 1211	air	low population density	kg	1890	kg CO2-Eq	3.36E-11	kg/tkm	6.35E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, bromotrifluoro-, Halon 1301	air	high population density	kg	7140	kg CO2-Eq	4.46E-17	kg/tkm	3.18E-13	Ecoinvent V2, transport, freight, rail, diesel, US

Methane, bromotrifluoro-, Halon 1301	air	low population density	kg	7140	kg CO2-Eq	4.54E-10	kg/tkm	3.24E-06	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, chlorodifluoro-, HCFC-22	air	high population density	kg	1810	kg CO2-Eq	2.35E-12	kg/tkm	4.25E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, chlorodifluoro-, HCFC-22	air	low population density	kg	1810	kg CO2-Eq	1.34E-10	kg/tkm	2.42E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, chlorotrifluoro-, CFC-13	air	unspecified	kg	14400	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, dichloro-, HCC-30	air	high population density	kg	8.7	kg CO2-Eq	2.73E-13	kg/tkm	2.37E-12	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, dichloro-, HCC-30	air	low population density	kg	8.7	kg CO2-Eq	2.30E-13	kg/tkm	2.00E-12	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, dichlorodifluoro-, CFC-12	air	high population density	kg	10900	kg CO2-Eq	7.90E-14	kg/tkm	8.62E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, dichlorodifluoro-, CFC-12	air	low population density	kg	10900	kg CO2-Eq	1.45E-13	kg/tkm	1.58E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, dichlorodifluoro-, CFC-12	air	unspecified	kg	10900	kg CO2-Eq	6.33E-20	kg/tkm	6.90E-16	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, dichlorofluoro-, HCFC-21	air	high population density	kg	210	kg CO2-Eq	1.56E-16	kg/tkm	3.28E-14	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, fossil	air	high population density	kg	25	kg CO2-Eq	1.17E-06	kg/tkm	2.92E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, fossil	air	low population density	kg	25	kg CO2-Eq	3.71E-05	kg/tkm	9.29E-04	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, fossil	air	lower stratosphere + upper troposphere	kg	25	kg CO2-Eq	5.63E-15	kg/tkm	1.41E-13	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, fossil	air	unspecified	kg	25	kg CO2-Eq	1.45E-06	kg/tkm	3.62E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, tetrachloro-, R-10	air	high population density	kg	1400	kg CO2-Eq	1.41E-11	kg/tkm	1.97E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, tetrachloro-, R-10	air	unspecified	kg	1400	kg CO2-Eq	2.83E-17	kg/tkm	3.96E-14	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, tetrafluoro-, R-14	air	high population density	kg	7390	kg CO2-Eq	1.53E-13	kg/tkm	1.13E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, tetrafluoro-, R-14	air	unspecified	kg	7390	kg CO2-Eq	9.68E-09	kg/tkm	7.16E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, trichlorofluoro-, CFC-11	air	high population density	kg	4750	kg CO2-Eq	2.54E-16	kg/tkm	1.20E-12	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, trifluoro-, HFC-23	air	high population density	kg	14800	kg CO2-Eq	4.97E-14	kg/tkm	7.35E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfur hexafluoride	air	high population density	kg	22800	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfur hexafluoride	air	low population density	kg	22800	kg CO2-Eq	3.35E-13	kg/tkm	7.64E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfur hexafluoride	air	unspecified	kg	22800	kg CO2-Eq	4.84E-10	kg/tkm	1.10E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, monochloro-, R-40	air	high population density	kg	13	kg CO2-Eq	3.26E-15	kg/tkm	4.24E-14	Ecoinvent V2, transport, freight, rail, diesel, US
Methane, monochloro-, R-40	air	low population density	kg	13	kg CO2-Eq	4.19E-13	kg/tkm	5.45E-12	Ecoinvent V2, transport, freight, rail, diesel, US
Carbon dioxide, land transformation	air	low population density	kg	1	kg CO2-Eq	3.42E-07	kg/tkm	3.42E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Nitrogen fluoride	air	high population density	kg	17200	kg CO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
								5.01E-02	
Ammonia	air	high population density	kg	1.88	kg SO2-Eq	2.82E-08	kg/tkm	5.29E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Ammonia	air	low population density	kg	1.88	kg SO2-Eq	7.80E-08	kg/tkm	1.47E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Ammonia	air	unspecified	kg	1.88	kg SO2-Eq	6.38E-07	kg/tkm	1.20E-06	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen chloride	air	high population density	kg	0.88	kg SO2-Eq	1.21E-07	kg/tkm	1.07E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen chloride	air	low population density	kg	0.88	kg SO2-Eq	1.79E-07	kg/tkm	1.58E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen chloride	air	unspecified	kg	0.88	kg SO2-Eq	1.67E-07	kg/tkm	1.47E-07	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen fluoride	air	high population density	kg	1.6	kg SO2-Eq	5.64E-09	kg/tkm	9.03E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen fluoride	air	low population density	kg	1.6	kg SO2-Eq	4.06E-08	kg/tkm	6.49E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen fluoride	air	unspecified	kg	1.6	kg SO2-Eq	4.33E-08	kg/tkm	6.93E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen sulfide	air	high population density	kg	1.88	kg SO2-Eq	1.41E-11	kg/tkm	2.65E-11	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen sulfide	air	low population density	kg	1.88	kg SO2-Eq	4.81E-08	kg/tkm	9.04E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen sulfide	air	unspecified	kg	1.88	kg SO2-Eq	1.85E-08	kg/tkm	3.47E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Nitrogen oxides	air	high population density	kg	0.7	kg SO2-Eq	6.49E-06	kg/tkm	4.54E-06	Ecoinvent V2, transport, freight, rail, diesel, US
Nitrogen oxides	air	low population density	kg	0.7	kg SO2-Eq	2.06E-05	kg/tkm	1.44E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Nitrogen oxides	air	unspecified	kg	0.7	kg SO2-Eq	6.05E-04	kg/tkm	4.24E-04	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfur dioxide	air	high population density	kg	1	kg SO2-Eq	1.57E-05	kg/tkm	1.57E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfur dioxide	air	low population density	kg	1	kg SO2-Eq	4.62E-05	kg/tkm	4.62E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfur dioxide	air	unspecified	kg	1	kg SO2-Eq	1.01E-05	kg/tkm	1.01E-05	Ecoinvent V2, transport, freight, rail, diesel, US
Hydrogen sulfide	water	river	kg	1.88	kg SO2-Eq	1.93E-09	kg/tkm	3.63E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfuric acid	soil	agricultural	kg	0.65	kg SO2-Eq	4.80E-16	kg/tkm	3.12E-16	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphoric acid	air	high population density	kg	0.98	kg SO2-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
Sulfuric acid	air	low population density	kg	0.65	kg SO2-Eq	2.95E-15	kg/tkm	1.92E-15	Ecoinvent V2, transport, freight, rail, diesel, US
								5.17E-04	
Phosphorus	air	high population density	kg	3.06	kg PO4-Eq	4.95E-10	kg/tkm	1.51E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphorus	air	low population density	kg	3.06	kg PO4-Eq	8.54E-11	kg/tkm	2.61E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphorus	air	low population density, long-term	kg	3.06	kg PO4-Eq	1.17E-10	kg/tkm	3.57E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphorus	air	unspecified	kg	3.06	kg PO4-Eq	3.07E-12	kg/tkm	9.39E-12	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphorus	soil	agricultural	kg	3.06	kg PO4-Eq	1.19E-09	kg/tkm	3.64E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphorus	soil	industrial	kg	3.06	kg PO4-Eq	1.93E-08	kg/tkm	5.89E-08	Ecoinvent V2, transport, freight, rail, diesel, US
BOD5, Biological Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.50E-04	kg/tkm	3.30E-06	Ecoinvent V2, transport, freight, rail, diesel, US
BOD5, Biological Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.53E-07	kg/tkm	7.78E-09	Ecoinvent V2, transport, freight, rail, diesel, US
COD, Chemical Oxygen Demand	water	river	kg	0.022	kg PO4-Eq	1.51E-04	kg/tkm	3.33E-06	Ecoinvent V2, transport, freight, rail, diesel, US
COD, Chemical Oxygen Demand	water	unspecified	kg	0.022	kg PO4-Eq	3.54E-07	kg/tkm	7.79E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphate	water	river	kg	1	kg PO4-Eq	8.19E-09	kg/tkm	8.19E-09	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphorus	water	river	kg	3.06	kg PO4-Eq	4.17E-09	kg/tkm	1.27E-08	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphorus	water	unspecified	kg	3.06	kg PO4-Eq	4.18E-11	kg/tkm	1.28E-10	Ecoinvent V2, transport, freight, rail, diesel, US
Phosphoric acid	air	high population density	kg	0.97	kg PO4-Eq		kg/tkm	0.00E+00	Ecoinvent V2, transport, freight, rail, diesel, US
								6.73E-06	
Coal, brown, in ground	resource	in ground	kg	9.9	MJ-Eq	1.06E-03	kg/tkm	1.05E-02	Ecoinvent V2, transport, freight, rail, diesel, US
Coal, hard, unspecified, in ground	resource	in ground	kg	19.1	MJ-Eq	2.46E-03	kg/tkm	4.70E-02	Ecoinvent V2, transport, freight, rail, diesel, US
Gas, mine, off-gas, process, coal mining	resource	in ground	Nm3	39.8	MJ-Eq	2.44E-05	Nm3/tkm	9.71E-04	Ecoinvent V2, transport, freight, rail, diesel, US
Gas, natural, in ground	resource	in ground	Nm3	38.293	MJ-Eq	1.20E-03	Nm3/tkm	4.59E-02	Ecoinvent V2, transport, freight, rail, diesel, US
Oil, crude, in ground	resource	in ground	kg	45.8	MJ-Eq	1.31E-02	kg/tkm	5.99E-01	Ecoinvent V2, transport, freight, rail, diesel, US
Peat, in ground	resource	biotic	kg	9.9	MJ-Eq	4.46E-08	kg/tkm	4.42E-07	Ecoinvent V2, transport, freight, rail, diesel, US
								7.03E-01	

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back to top

Methane - Dairy Cows	air	1.35E+02	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Dairy Heifers	air	7.30E+01	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Bulls	air	9.29E+01	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Beef Cows	air	8.48E+01	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Beef Heifers	air	7.53E+01	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Heifers for Slaughter	air	6.70E+01	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Steers	air	6.04E+01	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.
Methane - Calves	air	4.83E+01	kg/head/year	Environment Canada. 2006. NATIONAL INVENTORY REPORT: GREENHOUSE GAS SOURCES AND SINKS IN CANADA, 1990-2006, Table A3-17, http://www.ec.gc.ca/pdb/ghg/inventory_report/2006_report/tdm-toc_eng.cfm.

Methane - Beef Cows - Pregnant - Confined Location - Jan-Apr				
Method 1: IPCC Tier 2	air	6.17E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	1.14E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	1.00E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Beef Cows - Lactating - Pasture - May-				
Method 1: IPCC Tier 2	air	1.03E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	1.35E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	1.14E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Beef Cows - Pregnant - Confined Location - Oct-Dec				
Method 1: IPCC Tier 2	air	7.36E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	9.75E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	8.19E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Breeding Bulls - Confined Location - Jan-				
Method 1: IPCC Tier 2	air	8.45E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	1.24E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	1.54E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Breeding Bulls Grazing - Pasture - May-				
Method 1: IPCC Tier 2	air	1.14E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	1.11E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	1.40E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Breeding Bulls - Confined Location - Nov-				
Method 1: IPCC Tier 2	air	9.29E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	1.35E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	1.67E+02	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Beef Cows Grazing <6 months - Pasture - Apr-Sept				
Method 1: IPCC Tier 2	air	2.34E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	2.03E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	2.56E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Beef Calves - Import/Steer 8-9 mths - Feedlot - Jan-Jul				
Method 1: IPCC Tier 2	air	4.60E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.95E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	8.01E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Beef Calves - Import/Heifer 8-9 mths - Feedlot - Jan-Jul				
Method 1: IPCC Tier 2	air	4.77E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.75E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.77E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Replacement Heifers 6-7 mths - Confined - Oct-Dec				
Method 1: IPCC Tier 2	air	4.47E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.52E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	5.76E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Heifers 6-7 mths - Feedlot - Oct-				
Method 1: IPCC Tier 2	air	4.47E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.66E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	5.59E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Steers 6-7 mths - Feedlot - Oct-				
Method 1: IPCC Tier 2	air	4.43E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.93E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	5.83E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Finished Heifers 6-7 mths - Feedlot - Oct-				
Method 1: IPCC Tier 2	air	3.13E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	3.10E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	5.35E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Finished Steers 6-7 mths - Feedlot - Oct-				
Method 1: IPCC Tier 2	air	3.19E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	3.35E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	5.55E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Replacement Heifers 9-10 mths - Confined - Jan-May				
Method 1: IPCC Tier 2	air	5.42E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	6.86E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.20E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Replacement Heifers 14-15 mths - Pasture - Jun-Sept				
Method 1: IPCC Tier 2	air	7.77E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	6.15E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.59E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Replacement Heifers 18-19 mths - Confined - Oct-Dec				
Method 1: IPCC Tier 2	air	7.03E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	8.45E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	8.99E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Finished Heifers 8-9 mths - Feedlot - Jan-				
Method 1: IPCC Tier 2	air	4.94E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.90E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	8.08E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Heifers 8-9 mths - Feedlot - Jan-				
Method 1: IPCC Tier 2	air	5.42E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	6.90E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	6.79E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Heifers 13-14 mths - Pasture - Jun-Sept				
Method 1: IPCC Tier 2	air	7.06E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	6.01E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.43E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Finished Heifers 17-18 mths - Feedlot - Oct-Dec				
Method 1: IPCC Tier 2	air	5.45E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.24E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	8.42E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Finished Steers 8-9 mths - Feedlot - Jan-				

Method 1: IPCC Tier 2	air	4.84E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.24E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	8.42E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Steers 8-9 mths - Feedlot - Jan-				
Method 1: IPCC Tier 2	air	5.36E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	7.26E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.12E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Steers 13-14 mths - Pasture - Jun-Sept				
Method 1: IPCC Tier 2	air	6.88E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.80E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.10E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Finished Steers 17-18 mths - Feedlot - Oct-Dec				
Method 1: IPCC Tier 2	air	5.30E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.53E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	8.71E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Import Heifers - 8-9 mths - Pasture - Jun-Sept				
Method 1: IPCC Tier 2	air	5.83E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.69E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	5.74E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Import Heifers - 12-13 mths - Feedlot - Oct-Dec				
Method 1: IPCC Tier 2	air	4.83E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.75E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.56E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Import Heifers - 8-9 mths - Feedlot - Jun-				
Method 1: IPCC Tier 2	air	4.74E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.36E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	6.62E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Stocker Import Steers - 8-9 mths - Pasture - Jun-Sept				
Method 1: IPCC Tier 2	air	5.80E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	5.25E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	6.47E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Import Steers - 12-13 mths - Feedlot - Oct-Dec				
Method 1: IPCC Tier 2	air	4.75E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.95E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	7.79E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Methane - Import Steers - 8-9 mths - Feedlot - Jun-				
Method 1: IPCC Tier 2	air	4.62E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 2: Literature Values	air	4.61E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.
Method 3: CowBytes © & Blaxter & Clapperton	air	6.86E+01	kg/head/year	Basarab, J.A. et. al. Methane Emissions From Enteric Fermentation in Alberta's Beef Cattle Population. June 2005.

CountryCode	Country
2 letter codes:	http://www.iso.org/iso/en/prods-services/iso3166ma/02iso-3166-code-lists/index.html
CH	Switzerland
NO	Norway
RER	Europe
RME	Middle East
RNA	North America

END WORKSHEET

back to top

APPENDIX D

FEEDLOT NUTRITION, GENERIC RATIONS FOR ALBERTA BEEF CATTLE
(RECEIVED FROM MR. DWIGHT KARREN)

TABLE D1

RATIONS FOR BACKGROUNDED CALVES
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	***Diet 1***	***Diet 2***
RATION (DRY MATTER BASIS)			
Barley	%	0	14.3
Barley Silage	%	96.0	81.7
Barley Straw	%	0	0
Supplement	%	4.0	4.0
Total	%	100	100
RATION (AS FED BASIS)			
Barley	%	0	6.6
Barley Silage	%	98.4	91.6
Barley Straw	%	0	0
Supplement	%	1.6	1.8
Total	%	100	100
Barley	lbs	0	195.3
Barley Silage	lbs	5710.2	2714.8
Supplement	lbs	95.7	53.5
ANALYSIS			
Date In	-	5-Jan	1-Oct
Date Out	-	29-May	5-Jan
Days on feed	d	144	96
Start Weight	lbs	600	500
End Weight	lbs	750	600
Gain	lbs	150	100
ADG	lbs/d	1.04	1.04
DMI	lbs/d	15.28	12.81

NOTES:

%	- percent
ADG	- Average daily gain
DMI	- Dry matter intake
lbs	- pounds
lbs/d	- pounds per day
d	- day

TABLE D2

SUPPLEMENTS FOR BACKGROUNDED CALVES
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Supplement	*Units*	*Ingredient*	*Amount*
Calcium	lb/head/d	lime	51.11
Potassium	lb/head/d	potassium chloride	1.48
Sodium	lb/head/d	sodium chloride	6.17
Copper	lb/head/d	copper sulfate	0.16
Manganese	lb/head/d	manganese oxide	0.10
Zinc	lb/head/d	zinc oxide	2.08
Selenium	lb/head/d	selinite	0.00078
Cobalt	lb/head/d	cobalt carbonate	0.0018
Iodine	lb/head/d	EDDI	0.0030
Vitamin A	lb/head/d	VitApremix	0.016
Vitamin D	lb/head/d	VitDpremix	0.0021
Vitamin E	lb/head/d	VitEpremix	0.065
Monensin	lb/head/d	Rumnesin	0.62
min-vit	lb/head/d	-	61.81
Millrun Carrier	lb/head/d	-	87.34

<u>NOTES:</u>

lb/head/d - pounds of ingredient per head per day on feed

TABLE D3

RATIONS FOR LONG STEER YEARLINGS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	*Diet 1*	*Diet 2*	*Diet 3*	*Diet 4*	*Diet 5*	*Diet 6*	*Diet 7*
RATION (DRY MATTER BASIS)								
Barley	%	0	14.3	28.7	43.0	57.3	71.7	86.0
Barley Silage	%	96.0	81.7	67.3	53.0	38.7	24.3	10.0
Barley Straw	%	0	0	0	0	0	0	0
Supplement	%	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total	%	100	100	100	100	100	100	100
RATION (AS FED BASIS)								
Barley	%	0	6.6	14.6	24.5	36.9	53.2	75.3
Barley Silage	%	98.4	91.6	83.4	73.3	60.6	43.9	21.3
Barley Straw	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Supplement	%	1.6	1.8	2.0	2.2	2.5	2.9	3.4
Total	%	100	100	100	100	100	100	100
Barley	lbs	0	19.5	48.2	66.6	100.2	138.1	2977.8
Barley Silage	lbs	95.7	270.6	274.9	199.7	164.7	113.8	842.2
Supplement	lbs	1.6	5.3	6.6	6.1	6.8	7.5	135.5
ANALYSIS								
Date In	-	1-Sep	4-Sep	11-Sep	18-Sep	25-Sep	2-Oct	9-Oct
Date Out	-	4-Sep	10-Sep	18-Sep	25-Sep	2-Oct	9-Oct	11-Feb
Days on feed	d	3	7	7	7	7	7	126
Start Weight	lbs	850	851	860	875	890	910	935
End Weight	lbs	851	860	875	890	910	935	1450
Gain	lbs	1	9	15	15	20	25	515
ADG	lbs/d	0.33	1.29	2.14	2.14	2.86	3.57	4.10
DMI	lbs/d	12.18	17.51	21.59	19.91	22.49	24.76	24.76

NOTES:

%	- percent
ADG	- Average daily gain
DMI	- Dry matter intake
lbs	- pounds
lbs/d	- pounds per day
d	- day

TABLE D4

**SUPPLEMENTS FOR LONG STEER YEARLINGS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA**

Supplement	***Units***	***Ingredient***	***Amount***
Calcium	lb/head/d	lime	58.07
Potassium	lb/head/d	potassium chloride	1.68
Sodium	lb/head/d	sodium chloride	7.01
Copper	lb/head/d	copper sulfate	0.18
Manganese	lb/head/d	manganese oxide	0.12
Zinc	lb/head/d	zinc oxide	2.36
Selenium	lb/head/d	selinite	0.00088
Cobalt	lb/head/d	cobalt carbonate	0.0020996
Iodine	lb/head/d	EDDI	0.0034
Vitamin A	lb/head/d	VitApremix	0.018
Vitamin D	lb/head/d	VitDpremix	0.0024
Vitamin E	lb/head/d	VitEpremix	0.074
Monensin	lb/head/d	Rumnesin	0.70
min-vit	lb/head/d	-	70.22
Millrun Carrier	lb/head/d	-	99.22

NOTES:

lb/head/d - pounds of ingredient per head per day on feed

TABLE D5

RATIONS FOR LONG HEIFER YEARLINGS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	***Diet 1***	***Diet 2***	***Diet 3***	***Diet 4***	***Diet 5***	***Diet 6***	***Diet 7***
RATION (DRY MATTER BASIS)								
Barley	%	0	14.3	28.7	43.0	57.3	71.7	86.0
Barley Silage	%	96.0	81.7	67.3	53.0	38.7	24.3	10.0
Barley Straw	%	0	0	0	0	0	0	0
Supplement	%	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total	%	100	100	100	100	100	100	100
RATION (AS FED BASIS)								
Barley	%	0	6.6	14.6	24.5	36.9	53.2	75.3
Barley Silage	%	98.4	91.6	83.4	73.3	60.6	43.9	21.3
Barley Straw	%	0	0	0	0	0	0	0
Supplement	%	1.6	1.8	2.0	2.2	2.5	2.9	3.4
Total	%	100	100	100	100	100	100	100
Barley	lbs	0	18.6	36.1	50.0	97.0	113.3	3036.1
Barley Silage	lbs	88.6	257.8	206.0	149.9	159.3	93.4	858.7
Supplement	lbs	1.5	5.1	4.9	4.5	6.6	6.2	138.1
ANALYSIS								
Date In	-	1-Sep	4-Sep	11-Sep	18-Sep	25-Sep	2-Oct	9-Oct
Date Out	-	4-Sep	10-Sep	17-Sep	24-Sep	2-Oct	8-Oct	27-Feb
Days on feed	d	3	7	7	7	7	7	142
Start Weight	lbs	750	751	760	770	780	800	820
End Weight	lbs	751	760	770	780	800	820	1350
Gain	lbs	1	9	10	10	20	20	530
ADG	lbs/d	0.33	1.29	1.43	1.43	2.86	2.86	3.73
DMI	lbs/d	11.27	16.68	16.18	14.95	21.75	20.31	22.33

NOTES:

%	- percent
ADG	- Average daily gain
DMI	- Dry matter intake
lbs	- pounds
lbs/d	- pounds per day
d	- day

TABLE D6

**SUPPLEMENTS FOR LONG HEIFER YEARLINGS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA**

Supplement	***Units***	***Ingredient***	***Amount***
Calcium	lb/head/d	lime	57.22813428
Potassium	lb/head/d	potassium chloride	1.651948738
Sodium	lb/head/d	sodium chloride	6.91006042
Copper	lb/head/d	copper sulfate	0.177804728
Manganese	lb/head/d	manganese oxide	0.116852946
Zinc	lb/head/d	zinc oxide	2.324861162
Selenium	lb/head/d	selinite	0.000869682
Cobalt	lb/head/d	cobalt carbonate	0.002069087
Iodine	lb/head/d	EDDI	0.00338572
Vitamin A	lb/head/d	VitApremix	0.018211863
Vitamin D	lb/head/d	VitDpremix	0.002337676
Vitamin E	lb/head/d	VitEpremix	0.0724687
Monensin	lb/head/d	Rumnesin	0.688788286
min-vit	lb/head/d	-	69.19779328
Millrun Carrier	lb/head/d	-	97.78118517

NOTES:

lb/head/d - pounds of ingredient per head per day on feed

TABLE D7

RATIONS FOR YEARLINGS ON PASTURE
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	*Pasture*	*Total*
Days on feed	d	120	120
Mineral	lbs	0.1875	22.5

NOTES:

lbs - pounds
d - day

TABLE D8

SUPPLEMENTS FOR YEARLINGS ON PASTURE
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Supplement	*Units*	*Ingredient*	*Amount*
Phosphorus	lb/head/d	dicalphos	15.28
Sodium	lb/head/d	sodium chloride	6.25
Magnesium	lb/head/d	potassium chloride	0.17
Iodine	lb/head/d	EDDI	0.0046
Copper	lb/head/d	copper sulfate	0.29
Manganese	lb/head/d	manganese oxide	0.22
Zinc	lb/head/d	zinc oxide	0.28
Cobalt	lb/head/d	cobalt carbonate	0.0027
Selenium	lb/head/d	selinite	0.0016
Vitamin A	lb/head/d	VitApremix	0.00014
Vitamin D	lb/head/d	VitDpremix	0.000049
Vitamin E	lb/head/d	VitEpremix	0.00029

NOTES:

lb/head/d - pounds of ingredient per head per day on feed

TABLE D9

RATIONS FOR FED STEERS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	***Diet 3***	***Diet 4***	***Diet 5***	***Diet 6***	***Diet 7***
RATION (DRY MATTER BASIS)						
Barley	%	28.7	43.0	57.3	71.7	86.0
Barley Silage	%	67.3	53.0	38.7	24.3	10.0
Barley Straw	%	0	0	0	0	0
Supplement	%	4.0	4.0	4.0	4.0	4.0
Total	%	100	100	100	100	100
RATION (AS FED BASIS)						
Barley	%	14.6	24.5	36.9	53.2	75.3
Barley Silage	%	83.4	73.3	60.6	43.9	21.3
Barley Straw	%	0	0	0	0	0
Supplement	%	2.0	2.2	2.5	2.9	3.4
Total	%	100	100	100	100	100
Barley	lbs	45.0	145.6	394.4	512.4	3760.7
Barley Silage	lbs	256.4	436.7	648.0	422.4	1063.7
Supplement	lbs	6.1	13.3	26.9	28.0	171.1
ANALYSIS						
Date In	-	1-Oct	15-Oct	29-Oct	11-Oct	25-Oct
Date Out	-	14-Oct	29-Oct	25-Nov	7-Nov	22-Apr
Days on feed	d	14	14	28	28	180
Start Weight	lbs	550	560	600	690	790
End Weight	lbs	560	600	690	790	1450
Gain	lbs	10	40	90	100	660
ADG	lbs/d	0.71	2.86	3.21	3.57	3.67
DMI	lbs/d	10.07	21.77	22.13	22.97	21.86

NOTES:

%	- percent
ADG	- Average daily gain
DMI	- Dry matter intake
lbs	- pounds
lbs/d	- pounds per day
d	- day

TABLE D10

SUPPLEMENTS FOR FED STEERS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Supplement	*Units*	*Ingredient*	*Amount*
Calcium	lb/head/d	lime	84.10
Potassium	lb/head/d	potassium chloride	2.43
Sodium	lb/head/d	sodium chloride	10.16
Copper	lb/head/d	copper sulfate	0.26
Manganese	lb/head/d	manganese oxide	0.17
Zinc	lb/head/d	zinc oxide	3.42
Selenium	lb/head/d	selinite	0.0013
Cobalt	lb/head/d	cobalt carbonate	0.0030
Iodine	lb/head/d	EDDI	0.0050
Vitamin A	lb/head/d	VitApremix	0.027
Vitamin D	lb/head/d	VitDpremix	0.0034
Vitamin E	lb/head/d	VitEpremix	0.11
Monensin	lb/head/d	Rumnesin	1.01
min-vit	lb/head/d	-	101.70
Millrun Carrier	lb/head/d	-	143.70

NOTES:

lb/head/d - pounds of ingredient per head per day on feed

TABLE D11

RATIONS FOR FED HEIFERS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	***Diet 3***	***Diet 4***	***Diet 5***	***Diet 6***	***Diet 7***
RATION (DRY MATTER BASIS)						
Barley	%	28.7	43.0	57.3	71.7	86.0
Barley Silage	%	67.3	53.0	38.7	24.3	10.0
Barley Straw	%	0	0	0	0	0
Supplement	%	4.0	4.0	4.0	4.0	4.0
Total	%	100	100	100	100	100
RATION (AS FED BASIS)						
Barley	%	14.6	24.5	36.9	53.2	75.3
Barley Silage	%	83.4	73.3	60.6	43.9	21.3
Barley Straw	%	0	0	0	0	0
Supplement	%	2.0	2.2	2.5	2.9	3.4
Total	%	100	100	100	100	100
Barley	lbs	43.1	114.5	351.5	460.9	3552.7
Barley Silage	lbs	245.6	343.2	577.5	380.0	1004.8
Supplement	lbs	5.9	10.4	24.0	25.2	161.6
ANALYSIS						
Date In	-	1-Oct	15-Oct	29-Oct	11-Oct	25-Oct
Date Out	-	14-Oct	29-Oct	26-Nov	7-Nov	19-Apr
Days on feed	d	14	14	28	28	176
Start Weight	lbs	500	510	540	620	710
End Weight	lbs	510	540	620	710	1350
Gain	lbs	10	30	80	90	640
ADG	lbs/d	0.71	2.14	2.86	3.21	3.64
DMI	lbs/d	9.64	17.11	19.72	20.66	21.12

NOTES:

%	- percent
ADG	- Average daily gain
DMI	- Dry matter intake
lbs	- pounds
lbs/d	- pounds per day
d	- day

TABLE D12

SUPPLEMENTS FOR FED HEIFERS
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Supplement	***Units***	***Ingredient***	***Amount***
Calcium	lb/head/d	lime	77.83
Potassium	lb/head/d	potassium chloride	2.25
Sodium	lb/head/d	sodium chloride	9.40
Copper	lb/head/d	copper sulfate	0.24
Manganese	lb/head/d	manganese oxide	0.16
Zinc	lb/head/d	zinc oxide	3.16
Selenium	lb/head/d	selinite	0.0012
Cobalt	lb/head/d	cobalt carbonate	0.0028
Iodine	lb/head/d	EDDI	0.0046
Vitamin A	lb/head/d	VitApremix	0.025
Vitamin D	lb/head/d	VitDpremix	0.0032
Vitamin E	lb/head/d	VitEpremix	0.10
Monensin	lb/head/d	Rumnesin	0.94
min-vit	lb/head/d	-	94.11
Millrun Carrier	lb/head/d	-	132.99

NOTES:

lb/head/d - pounds of ingredient per head per day on feed

TABLE D13

RATIONS FOR THE COW AND BULL HERD
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	*Winter*	*Calving*	*Breeding*	*Pasture*	*Total*
Days on feed	d	90	90	60	125	365
Alfalfa grass hay	lbs	28	35	-	-	5670.00
Pasture	lbs	-	-	FC	FC	FC
Mineral	lbs	0.19	0.19	0.19	0.19	68.44

NOTES:

lbs	- pounds
d	- day
FC	- Free choice, amount of feed consumed undetermined

TABLE D14

SUPPLEMENTS FOR THE COW AND BULL HERD
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

Supplement	*Units*	*Ingredient*	*Amount*
Phosphorus	lb/head/d	dicalphos	46.47
Sodium	lb/head/d	sodium chloride	19.00
Magnesium	lb/head/d	potassium chloride	0.52
Iodine	lb/head/d	EDDI	0.014
Copper	lb/head/d	copper sulfate	0.88
Manganese	lb/head/d	manganese oxide	0.68
Zinc	lb/head/d	zinc oxide	0.86
Cobalt	lb/head/d	cobalt carbonate	0.0081
Selenium	lb/head/d	selinite	0.0049
Vitamin A	lb/head/d	VitApremix	0.00041
Vitamin D	lb/head/d	VitDpremix	0.00015
Vitamin E	lb/head/d	VitEpremix	0.00090

NOTES:

lb/head/d - pounds of ingredient per head per day on feed

TABLE D15

RATION ENERGY AND PROTEIN CONTENT
PROVIDED BY FEEDLOT NUTRITION
ALBERTA BEEF LIFE CYCLE ANALYSIS
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

	Units	***Diet 1***	***Diet 2***	***Diet 3***	***Diet 4***	***Diet 5***	***Diet 6***	***Diet 7***
DM	lbs	37.91	41.49	45.84	51.19	57.93	66.80	78.78
eNDF	%	37.14	32.71	28.24	23.81	19.38	14.91	10.48
DE	Mcal/kg	2.76	2.91	3.06	3.21	3.37	3.52	3.67
NE_m	Mcal/kg	1.31	1.43	1.55	1.66	1.78	1.90	2.02
NE_g	Mcal/kg	0.75	0.85	0.94	1.03	1.13	1.22	1.31
DIP	%	8.96	8.98	9.00	9.02	9.04	9.06	9.09
CP	%	11.82	11.89	11.96	12.04	12.11	12.18	12.25

NOTES:

DM	- dry matter
eNDF	- effective neutral detergent fiber
DE	- digestible energy
NE_m	- net energy for maintenance
NE_g	- net energy for growth
DIP	- digestible intake protein
CP	- crude protein
lbs	- pounds
%	- percent
Mcal/kg	- mega calories per kilogram

APPENDIX E

DESCRIPTION OF MODELLING PROCESS AND CALCULATIONS

APPENDIX E

DESCRIPTION OF MODELLING PROCESS AND CALCULATIONS

The Life Cycle Analysis (LCA) spreadsheet (Microsoft Office Excel) model was designed as a first approximation for the beef production in Alberta and to allow for versatility and further refinement of the model. The calculations throughout the model are all linked to the primary and secondary data, allowing for easy manipulation of the model for exploring "what if" scenarios and implementing new data.

The following paragraphs describe the spreadsheet tabs within the spreadsheet model.

Introduction tab – overall presentation of the structure of the spreadsheet.

Figure 1a tab – Activity Map of the LCA system, containing the processes that characterize the LCA of the beef production, from cradle to farm-gate. This tab includes the processes for construction and operation and maintenance.

Figure 1b tab – continuation of the Activity Map of the LCA system. This tab includes the additional tabs for operation and maintenance and decommissioning.

Beef Data tab – a top-down compilation of livestock, agricultural and miscellaneous system-related data. The data sources are referenced in a transparent manner to allow for easy tracking of the used data. Assumptions made due to lack of available data are clearly documented within the **Beef Data** tab. The cells containing data values in the **Beef Data** tab are designed as "source" cells. Further calculations performed through the model are linked to the data within this tab. Modifications or updates to the source cells in the **Beef Data** tab will result in automatic update of the entire model.

Beef Data Check tab – validation of data presented in the **Beef Data** tab. Validation of data is performed against the following criteria: vintage, geography, precision, completeness, representativity, reproducibility, source and uncertainty.

Diets tab – summary of the components of the diets per class of cattle, based on the diet information prepared by the ruminant nutritionist for this project. For each class of cattle (cow, bull, calf-fed calves, yearling-fed calves) the data is structured as follows:

- Feeding periods
- Typical days spent on each feeding period
- Components of diet per day per head per feeding period

- Total "cattle*days" (based on the number of cattle) for the respective feeding period
- Total amount of feed and supplement for the respective feeding period for cattle. In the **Diets** tab, the supplement data is presented as a lumped value of the components included in the composition of the supplement.

The summarized quantities of feed and supplement within the diet represent the total requirements of the components of the diet for the entire population of cattle, during the entire period considered in the study (calf crop).

The "cattle*days" selected as a unit allows a versatile quantification of the emissions related to the activity of the cattle and, eventually, calculation of the environmental footprints corresponding to each type of animal, for the period of time considered within the boundaries of the beef production system (calf crop). As the system is quite complex with imported and exported cattle, mortalities, and cattle from the dairy industry, the use of "cattle*days" simplified the calculations to allow for inflows and outflows of the system. Table 6 of the report provides an example calculation of the 'cattle*days' for cows.

Diet Supplements tab – represents a summary of the individual components of the supplements from the diets per class of cattle, based on the diet information prepared by the ruminant nutritionist for this project.

The supplements are classified as:

- Supplement requirements – all minerals, vitamins and other supplemental components included in the composition of the supplement
- Millrun carrier, an inert additive to be mixed with the supplements.

The total supplement and the millrun carrier requirements per day, respectively, are calculated for each type of cattle (cow, bull, calf-fed calves, yearling-fed calves). The requirements per day are multiplied by the total number of 'cattle*days' for each type of cattle for each feeding period to obtain the total supplement and millrun carrier requirements.

Cow–Rplc FC, Bull–Rplc FC, Calf FC, and **Yearling FC** tabs

Flow charts were prepared for the cows, bulls, calf-fed calves, and yearling-fed calves included in the system for the production of one calf crop. The flow charts allowed for easy tracking of each type of cattle throughout the production of one calf crop. The May 15, 2001 census data from Statistics Canada for all categories of animals was used as the starting numbers (i.e. January 2001 values for cows and bulls, and May 1, 2001 for calves). Slaughtered cows and bulls in Alberta 2001 based on Alberta Agriculture Statistics Yearbook (2008) were incorporated into the shrunk live weight portion of the functional unit. Slaughtered heifers and steers in Alberta for 2002 based on Alberta Agriculture Statistics Yearbook were also incorporated into the shrunk live weight portion of the functional unit.

Calculations were conducted for cows and bulls for one year to account for one entire cycle of calf production. Statistics Canada May 15, 2001 census data was used as the initial number of cows and bulls in the Alberta beef system for January 2001.

The replacement heifers as of May 15, 2001 have also been incorporated into the cow flow chart for January 2001. Calculations were worked in a bottom-up approach from the slaughtered number of cows in 2001 to the assumed number of cows in January 2001. It was assumed that there were no cow imports based on lack of sufficient data to account for cow imports. It was also assumed that all cows leaving the cow/calf operations for export or slaughter and cow mortalities were removed on December 1, 2001 for simplicity purposes. It was assumed that the slaughtered cow number included all cull cows from dairy. Based on the available information, the number of cows in each stage of the Alberta beef cycle (i.e. winter feeding, calving, breeding, pasture, cows sent to local auction, cows sent to feedlot, cow mortalities, cows for export, cows from the dairy industry, cows for slaughter) were calculated.

The difference between Statistics Canada January 1, 2001 number for bulls in the Alberta beef system and the May 15, 2001 census data was assumed to account for the replacement bulls. The rest of the calculations performed for the bull flow chart were calculated using the same method as for the cows. The same assumptions mentioned above for the cows are also applicable for the calculations of bulls.

The May 15, 2001 census data from Statistics Canada was assumed to be the total number of calves born by May 1, 2001. This total was divided between calves for the calf-fed system and the yearling-fed system based on the 45 percent to 55 percent split as provided by Alberta Agriculture and Rural Development (ARD). It was assumed that all newborn mortalities have been excluded from the census data. Both the calf-fed and yearling-fed flow charts were worked in a bottom-up approach from the 2002 slaughtered heifer and steer numbers as based on Alberta Agriculture Statistics Yearbook (2008) to the May 15, 2001 census data. Imports and exports were incorporated before the backgrounding feedlot stage and before the slaughterhouse stage for both systems. Calves from the Alberta dairy system were also incorporated into both flow charts prior to the backgrounding feedlot stage. Mortalities were removed from each flow chart prior to weaning, prior to the finishing feedlot and prior to the slaughterhouse based on the mortality rates used. The stages included in the calf-fed system were the pre-weaning period, local auction, backgrounding feedlot, finishing feedlot, and slaughter. The stages included in the yearling-fed system were the pre-weaning period, local auction, backgrounding feedlot, backgrounding pasture, finishing feedlot, and slaughter. Refer to Section 4.2 within the report for a description of the time spent in each of these stages for each system.

Table 4 within the report provides a summary of the cattle population numbers included in this study.

Note that there are discrepancies between some of the references used to calculate the number of animals in each stage of the calf crop cycle, and it may be warranted to further investigate the animal numbers throughout the entire system as they interconnect for any future iterations of this analysis.

Slaughterhouse tab – This tab provides information on the number of cattle within each cattle type that have been slaughtered during the production of one calf crop. The number of cows and bulls slaughtered in 2001 are provided, and the number of heifers and steers slaughtered in 2002 have been provided. The heifers and steers have been divided into the calf-fed and yearling-fed systems based on the 45 percent calf-fed to 55 percent yearling-fed ratio. The weight leaving the feedlot and the shrunk live weight at the slaughterhouse are also given in order to calculate the total weight slaughtered for the system, which is provided as total shrunk live weight at the slaughterhouse door. The total shrunk live weight was also divided between the calf-fed and yearling-fed systems to allow for the LCA analysis of each system.

Emission Factor Data tab – presents the emission factors gathered for the Life Cycle Inventory (LCI) for all the processes identified on the Activity Maps (Figures 1a and 1b).

The structure of the Emission Factor Data tab includes an index with all the processes identified on the Activity Maps (Figures 1a and 1b). Each process in the index is linked to the corresponding emission factors located further down the tab.

The presentation of the emission factor data for each process is structured as follows:

Parameter: the emission factors associated with a certain process from the Activity Map (i.e. E1 Produce crude)

Category: environmental media of the emission (air, water, soil) or resource consumption (resource)

Subcategory: characteristics of the environmental media of the emission

Life Cycle Impact Assessment (LCIA) unit – the emission factors are grouped into environmental impact categories (GWP, aquatic acidification, aquatic eutrophication, non-renewable resources). For each environmental impact category, the total emissions are calculated, based on selected LCIA methodology:

- GWP – IPCC 2007
- Aquatic acidification – IMPACT 2002+
- Aquatic eutrophication – IMPACT 2002+
- Non-renewable resources – IMPACT 2002+

The equivalent emissions for each category are calculated per unit of environmental release (LCIA unit) (i.e. kg).

Equivalence factors (eq factors): the characterization of the environmental impact uses science-based conversion factors, called equivalence factors, to convert and combine the LCI results into representative indicators of impacts to the environment. Equivalence factors translate the different inventory inputs into directly comparable environmental impact indicators.

Equivalence units (eq units): units for the equivalence factors, common for a selected environmental impact category:

- GWP – kg CO_2-Eq
- Aquatic acidification – IMPACT 2002+ - kg SO_2-Eq
- Aquatic eutrophication – IMPACT 2002+ - kg PO_4-Eq
- Non-renewable resources – IMPACT 2002+ - MJ-Eq

Mean Value Process – the value of emission factor as obtained from the quantification of environmental releases from the selected process
Unit process - equivalent emissions from each unit of the respective LCIA per unit of the quantified process.

Emissions/unit – the value of emissions factor multiplied by the equivalence factor (i.e. kg CO_2-Eq per kg crude oil produced)

Source – source/reference of the emission factor data

For each process:

- The emission factors are grouped into environmental impact categories (GWP, aquatic acidification, aquatic eutrophication, non-renewable resources) as shown with colour-coding of the rows
- The equivalent emissions/unit are calculated and summarized separately for each environmental impact category
- The total (summarized values) for each environmental impact category represent the contribution of the selected process to the respective environmental impact category

The cells containing data in the Parameter, Category, Subcategory, LCIA unit, eq factors, eq units, Mean Value Process, Unit process columns are designed as "source cells". The model can be adjusted or refined further based on revised values of the emission factors and equivalence units. Modification or update of the source cells in the Emission Factor Data tab will result in automatic update of the entire model.

Emission Factor Data Check tab - validation of data presented in the Emission Factor Data tab. Validation of data is performed against the following criteria: vintage, geography, precision, completeness, representativity, reproducibility, source and uncertainty.

EF Data – LCIA Categories tab – summarizes all LCIA data from the Emission Factor Data tab. The LCIA data is linked directly, as dependant, with the LCIA emission factors within the Emission Factor Data tab.

The Index summarizes all the processes identified on the Activity Maps (Figures 1a and 1b). Each process is linked to the corresponding LCIA results further down the tab.

For the aquatic acidification environmental impact category, the emissions/process quantified based on the IMPACT 2002+ method can be replaced by the user with corresponding emissions/process from alternative LCIA methods, such as CML2001, EDIP2003, TRACI (yellow highlighted cells).

Fertilizer Data tab – data used to calculate the fertilizer needs for the feed required in the system

Fertilizer from Manure–Calcs tab – quantifies the degree to which synthetic fertilizer use is offset by the application of feedlot cattle manure

Calculations are based on the total number of steers and heifers passing through feedlots under both the calf-fed and yearling-fed systems for the duration of the LCA study (one calf crop). The numbers of heifers and steers were based on slaughter numbers from the Alberta Agriculture Statistics Yearbook (2008).

Manure generation was calculated based on estimates of manure generation from Statistics Canada. It was assumed that all manure from the calf-fed and yearling-fed systems was available for application at the same time. Nitrogen availability was estimated to be 65 percent in the first year following application. No consideration of remnant nutrients was made for subsequent applications. No estimates of nutrient losses due to volatilization, run-off, or other loss vectors were made.

The nutrient composition of manure was based on information from the Saskatchewan Soil Conservation Association.

Total fertilizer needs were based on ARD-recommended fertilizer application rates and the area requirements for feed production for the duration of the LCA study. Offset of synthetic fertilizer application was estimated by the degree to which manure application satisfied the total fertilizer needs of the crop.

Fertilizer Requirements tab – bottom-up approach of data calculation. Calculation of fertilizer need per each component of the diet (barley, barley silage, and alfalfa grass) based on the total amount of feed required for all cattle for the entire period considered in the LCA study (one calf crop).

The next seven tabs in the model describe the subsystems of the entire LCA of beef production, as presented on the Activity Maps (Figure 1a and Figure 1b) (forage and cereal sub-activities, energy generation activities, operation and maintenance activities, cereal activities, forage activities, feedlot and pasture activities, and cattle transportation activities).

Forage and Cereal Sub-Act tab – quantifies the amounts required for all activities within the Forage and Cereal Sub-Activities section of the Activity Map (Figure 1a)

Bottom-up approach of data calculation, starting with the major components for diets, and yield per cultivated hectare.

The values obtained in this tab are used further to calculate the environmental impacts associated with each individual process from the Activity Map.

Energy Generation Act tab – quantifies the amounts required for all activities within the Energy Generation Activities section of the Activity Map (Figure 1a).

Top-down approach of data calculation, starting with the gasoline and diesel consumption for all beef-related farm operations in Alberta, for the entire period considered in the LCA study (one calf crop).

The values obtained in this tab are used further to calculate the environmental impacts associated with each individual process from the Activity Map.

O&M Activities tab – quantifies the amounts required for all activities within the Operation and Maintenance Activities section of the Activity Map (Figure 1a).

Bottom-up approach of data calculation, starting with the needs for operation and maintenance on the livestock farms, including maintenance of livestock constructions, maintenance of roads and replacement of worn components in the livestock constructions, for the entire period considered in the LCA study.

Note that this was a data gap for this study, and the emissions associated with these processes are assumed to be negligible compared to the rest of the study. Data gaps encountered during the LCI process are marked on the appropriate cells in the **O&M Activities** tab. Further improvement of the model allows replacement of the data gaps with new data. Modification or update of the source cells for data gaps will result in automatic update of the entire model.

The values obtained in this tab are used further to calculate the environmental impacts associated with each individual process from the Activity Map.

Cereal Activities tab - quantifies the amounts required for all activities within the Cereal Activities section of the Activity Map (Figure 1a).

Bottom-up approach of data calculation, starting with the total cultivated area required for the cereal components of the diets for all class of cattle, for the entire period of the LCA study (one calf crop).

The emissions from the agricultural processes described on the Activity Map were quantified based on the emissions generated by similar processes described and quantified in the Ecoinvent V2 database. However, while the result of the agricultural process is the same for both systems, Canadian and, in the case of Ecoinvent, either generic or European, the technology behind the process might be different. The technical notes documenting the agricultural processes in Ecoinvent and the calculation methodology for the corresponding environmental emissions were used to adjust the emissions, to better reflect the conditions for Alberta. The adjustment of emissions was based on the fuel consumption for the same agricultural process for Alberta and, respectively, Ecoinvent specific conditions.

The values obtained within this tab are used further to calculate the environmental impacts associated with each individual process from the Activity Map.

Forage Activities tab - quantifies the amounts required for all activities within the Forage Activities section of the Activity Map (Figure 1a).

Bottom-up approach of data calculation, starting with the total cultivated area required for the forage components of the diets for all class of cattle, for the entire period of the LCA study (one calf crop).

The emissions from the agricultural processes described on the Activity Map were quantified based on the emissions generated by similar processes described and quantified in the Ecoinvent V2 database. However, while the result of the agricultural process is the same for both systems, Canadian and, in the case of Ecoinvent, either generic or European, the technology behind the process might be different. The technical notes documenting the agricultural processes in Ecoinvent and the calculation methodology for the corresponding environmental emissions were used to adjust the emissions, to better reflect the conditions for Alberta. The adjustment of emissions was based on the fuel consumption for the same agricultural process for Alberta and, respectively, Ecoinvent specific conditions.

The values obtained within this tab are used further to calculate the environmental impacts associated with each individual process from the Activity Map.

Feedlot & Pasture Act tab - quantifies the amounts required for all activities within the Feedlot & Pasture Activities section of the Activity Map (Figure 1b).

Bottom-up approach of data calculation.

Data gaps encountered during the LCI process are marked on the appropriate cells in the **Feedlot & Pasture Act** tab. Further improvement of the model allows replacement of the data gaps with new data. Modification or update of the source cells for data gaps will result in automatic update of the entire model.

The values obtained within this tab are used further to calculate the environmental impacts associated with each individual process from the Activity Map.

Cattle Transport Activities tab - quantifies the amounts required for all transportation activities within the Cattle Transport Activities section of the Activity Map (Figure 1b).

Calculations are based on the total number of cattle transported during a certain transportation activity, average weight of transported cattle, total weight transported, and distance of transportation.

The values obtained within this tab are used further to calculate the environmental impacts associated with each individual process from the Activity Map.

The next 21 tabs in the model describe the emissions related to the biological activity of the cattle (methane [CH_4] emissions from enteric fermentation, nitrous oxide [N_2O] and CH_4 emissions from manure) and from soil cropping practices. The emissions associated with the biological activity of the cattle and the soil cropping were added to the LCI data used for the quantification of Global Warming Potential (GWP) from the processes presented on the Activity Map. The additional emissions associated with the total phosphorus generated by the surface run-off of the cropped land, expressed as PO_4 equivalents are added to the LCI data used for the quantification of aquatic eutrophication from the processes presented on the Activity Map. The calculation of these emissions are presented in tab **P run-off.**

Cattle CH4 Enteric Emissions tab – calculation of the total cattle CH_4 enteric fermentation emissions per calf crop.

Calculations use a modified IPCC 2006 Tier 2 methodology using location-specific data and information provided by the ruminant nutritionist for this project. Methane emissions from enteric fermentation in Alberta's beef cattle population were calculated for one calf crop. See Appendix F in the report for the calculations table and for more information.

Calculations are performed for each class of cattle (type of animal) and for each feeding period.

Cattle CH4 Manure Emission tab – calculation of the total cattle CH_4 manure emissions per calf crop. Calculations use the methodology described in Holos (2008) and IPCC 2006. Calculations are performed for each class of cattle (type of animal) and for each feeding period.

Cattle N Excretion tab – calculation of the nitrogen excreted from the cattle per calf crop. Calculations use the methodology described in Holos (2008), National Research Council

2000, IPCC 2006, and expert opinion. Calculations are performed for each class of cattle (type of animal) and for each feeding period.

N20 Dir Manure emission Holos tab – calculation of the direct N_2O emissions from manure. Calculations use the methodology described in Holos (2008), National Research Council 2000, and IPCC 2006. Calculations are performed for each class of cattle (type of animal), for each feeding period, and for each type of manure management system.

N20 Indir Manure emiss Holos tab – calculation of the indirect N_2O emissions from manure. Calculations use the methodology described in Holos (2008), National Research Council 2000, and IPCC 2006. Calculations are performed for each class of cattle (type of animal), for each feeding period, and for each type of manure management system.

CO2 Direct Soils tab – direct CO_2 emissions from the application of synthetic fertilizers to soil. Calculations use the methodology described by IPCC 2006, Tier 1, eq 11.13.

C Change in Soil From Land Use tab – calculation of soil carbon change from the change in land use.

Calculations use the methodology described in Holos (2008) and McConkey et al, 2007, and are performed within this tab as follows:

1.0 Soil carbon change emissions from land use
    1.1 Carbon change in mineral soils
        1.1.1 Carbon change due to change in tillage practice
        1.1.2 Carbon change due to change in fallow area
        1.1.3 Carbon change due to change in perennial / annual crop areas
        1.1.4 Carbon change due to change in grassland
        1.1.5 Carbon change in mineral soils
    1.2 Carbon change in organic soils

The differences in tillage practices from 2001 to 2006 were used within this tab to calculate the soil carbon change over these 5 years (based on available data). The results for 2 years were allocated to this project. There was assumed to be no change in land use between these years, and therefore, the soil carbon change from land use changes was calculated.

SOC on land tab – an estimate of the rate of soil organic carbon (SOC) sequestered on grazed pasture for beef production in Alberta.

This tab was introduced as a placeholder for the rate of SOC sequestration as requested by ARD. The rate of SOC sequestration has been estimated based upon expert opinion from ARD. The calculations have only made use of a single average sequestration rate and the total pasture land area of Alberta used for beef production. Due to the highly approximated nature of this estimation, it has been included only for discussion purposes and the amount of carbon dioxide sequestered by pastures has not been included in the total footprint reported by this LCA study of beef production in Alberta.

Summary soil N2O crop, land use tab – a summary of the calculations for the total N_2O emissions per crop and land use. The next 9 tabs in the model present in detail the calculations for each category of crop and land.

All calculations use the methodology described in Holos (2008) and are performed as follows:

1.2 Direct emissions
- 1.2.1 Emissions due to N inputs from
  - 1.2.1.1 fertilizer
  - 1.2.1.2 crop residues
  - 1.2.1.3 mineralization
  - 1.2.1.4 application of manure on land
- 1.2.2 Emissions due to tillage
- 1.2.3 Emissions due to soil texture
- 1.2.4 Emissions due to irrigation
- 1.2.5 Emissions due to landscape/topography
- 1.2.6 Emissions due to fallow

1.3 Indirect emissions
- 1.3.1 Emissions due to leaching and run-off
- 1.3.2 Emissions due to volatilization

1.4 Emissions due to organic soil cultivation

1.5 Total emissions

1.2.1 Emissions due to inputs tab – calculation of direct N_2O emissions due to inputs of fertilizer, crop residues, mineralization, and application of manure on land.

1.2.2 Emissions due to tillage tab – calculation of direct N_2O emissions due to tillage.

1.2.3 Emissions due to soil tex tab – calculation of direct N_2O emissions due to soil texture.

1.2.4 Emiss due to irrig tab – calculation of direct N_2O emissions due to irrigation.

1.2.5 Emiss due to topography tab – calculation of direct N_2O emissions due to topography.

1.2.6 Emiss due to fallow tab – calculation of direct N_2O emissions due to fallow.

1.3.1 & 1.3.2 Run-off & volat tab – calculation of indirect N_2O emissions due to run-off and volatilization.

1.4 Emiss organic soil cultivat tab – calculation of N_2O emissions due to organic soil cultivation.

Total emissions tab – numerical summary of all N_2O emissions from crop and land use.

P run-off tab – calculation of P_2O_5 run-off based on P_2O_5 crop fertilizing needs for all cultivated components of the diet. Calculations are based on the methodology from Nemecek et al. 2007.

Beef activ, soil & crop tab – summary of all GHG emissions from beef activity, soil and cropping practice, as follows:

- Cattle Enteric Fermentation Emissions
- Cattle Methane Emissions from Manure
- Direct N_2O Emissions From Manure Management
- Indirect N_2O Emissions From Manure Management
- Direct CO_2 Emissions From Managed Soils
- Soil Carbon Change in Soil From Land Use
- Total N_2O emissions from cropping and land use
- Total P emissions from run-off

LCIA calculations activity map tab – calculation of the total environmental impacts for each process described on the Activity Map (Figures 1a and 1b).

The final emissions are calculated based on the emissions per unit for each selected environmental impact multiplied by the number of units in the assessed process.
For example:

Produce Mineral - Lime: 107,974,342 kg of lime requirements for the entire number of cattle and period of time considered in the LCA

For each kg of lime, the following equivalent emissions apply:

	lime, from carbonation, at regional storehouse		
GLO	IPCC 2007	1.17E-02	kg CO_2-Eq
RER	IMPACT 2002+ (Midpoint)	8.10E-05	kg SO_2-Eq
RER	IMPACT 2002+ (Midpoint)	1.10E-06	kg PO_4-Eq
GLO	cumulative energy demand	1.83E-01	MJ-Eq

Total emissions from production of lime: multiply the quantity of lime (as kg) with emissions per kg.

Results are summarized, respectively, by sections of the Activity Map and as totals for all processes (activities). A summary table has been provided at the bottom of this tab to summarize the emissions associated with each environmental impact category.

The next 21 tabs of the model present the graphical output of the LCIA calculations. For each environmental impact category (GWP, aquatic acidification, aquatic eutrophication, non-renewable resources), the tabular data is presented separately for Forage and Cereal activities, Feedlot and Pasture activities, Cattle transportation activities and Energy generation activities.

For & Cer act-results (GHG), (acid), (eutrof) and **(resourc)** tabs

Fdlt & Pstr-results (GHG), (acid), (eutrof) and **(resources)** tabs

Cattle Transport-results (GHG), (acid), (eutr) and **(res)** tabs

Energy-results (GHG), (acid), (eutrof) and **(resources)** tabs

Enteric-results (GHG) tab

Total Results (GHG), (acid), (eutrof) and **(resources)** tabs

Used Processes tab – presents a comprehensive list of all the processes used to quantify the emissions from the units of the Activity Map. For each activity described on the Activity Map, the source of the process used to quantify the emissions is indicated. Where the emissions from the processes were modified to reflect conditions more appropriate for the characteristics of the project, a description of this modification has been provided in the table. A reference to the methodology details of the modifications is also presented.

Feed Processing tab – description of the calculations of emissions based on the total electricity, natural gas and water used for processing of the feed.

APPENDIX F

CATTLE ENTERIC FERMENTATION EMISSIONS CALCULATION TABLE
FROM LCA MODEL

APPENDIX F

CATTLE ENTERIC FERMENTATION EMISSIONS CALCULATIONS TABLE FROM LCA MODEL
ALBERTA AGRICULTURE AND RURAL DEVELOPMENT
EDMONTON, ALBERTA

__Cattle Enteric Fermentation Emissions__
Modified IPCC 2006 Tier 2 Approach Using Location Specific Data and Information Provided by the Nutritionist

Emission Factor	=	GE * (Ym/100) * 365	55.65	energy content of methane (MJ / kg CH_4)
(kg CH_4/head/yr)		55.65	GE	gross energy intake (MJ / head / day)
			Ym	methane conversion factor (% feed converted to methane)
			365	days/year
GE	=	DMI * Energy Density of Fee	DMI	dry matter intake (kg dry matter/day)
		Energy density of feed from IPCC	18.45	MJ/kg

Type of Animal	Diet	Total No. of Days on Diet (days) *(nutritionist)*	No. of Animals * Days (head * day) *(Calculated)*	Average Weight (kg) *from Beef Data tab and from nutritionist*	Average Dry Matter Intake, DMI (lbs dry matter / head / day) *(nutritionist and John Basarab)*	Average Dry Matter Intake, DMI (kg dry matter / head / day) *(Calculated)*	Methane Conversion Factor, Ym (% feed energy converted to CH_4) *(IPCC 2006 Tier 2 Values)*	Energy Density of Feed (MJ/kg) *(IPCC Tier 2 Value)*	Gross Energy Intake (MJ / head / day) *(Calculated)*	Methane Emission Factor (kg / head / day) *(Calculated)*	Methane Emissions (kg CH_4) *(Calculated)*
Calves before weaning - stage 1	0-3 months	92	194,427,747		0.00	0.00	0.00	18.45	0	0	0
Calves before weaning - stage 2	3-6 months	92	190,420,680		8.25	3.74	6.50	18.45	69.00	0.08060	15,347,240
Cows	Winter Diet	90	214,305,471	605.55	25.20	11.43	6.50	18.45	210.89	0.24633	52,789,081
	Calving Diet	90	226,189,268	605.55	31.50	14.29	6.50	18.45	263.62	0.30791	69,645,466
	Breeding Diet	60	149,973,319	605.55	30.00	13.61	6.50	18.45	251.06	0.29325	43,979,021
	Pasture	125	299,946,638	605.55	30.00	13.61	6.50	18.45	251.06	0.29325	87,958,042
Bulls	Winter Diet	90	9,230,053	997.90	30.00	13.61	6.50	18.45	251.06	0.29325	2,706,673
	Calving Diet	90	10,067,374	997.90	30.00	13.61	6.50	18.45	251.06	0.29325	2,952,213
	Breeding Diet	60	6,675,106	997.90	30.00	13.61	6.50	18.45	251.06	0.29325	1,957,446
	Pasture	125	13,350,213	997.90	30.00	13.61	6.50	18.45	251.06	0.29325	3,914,892
Backgrounding - Calf-Fed	Backgrounding	96	110,770,800	226.80	12.81	5.81	6.50	18.45	107.18	0.12518	13,866,766
Calf-Fed (Heifer)	Diet 3	14	8,532,928	229.00	9.64	4.37	6.50	18.45	80.71	0.09426	804,355
	Diet 4	14	8,532,928	238.00	17.11	7.76	6.50	18.45	143.21	0.16727	1,427,336
	Diet 5	28	17,065,856	263.00	19.72	8.94	6.50	18.45	165.03	0.19276	3,289,540
	Diet 6	28	17,065,856	302.00	20.66	9.37	6.50	18.45	172.93	0.20198	3,447,005
	Diet 7	178	108,459,610	467.00	21.12	9.58	3.00	18.45	176.79	0.09530	10,336,565
Calf-Fed (Steer)	Diet 3	14	7,298,065	252.00	10.07	4.57	6.50	18.45	84.27	0.09843	718,359
	Diet 4	14	7,298,065	263.00	21.77	9.88	6.50	18.45	182.23	0.21284	1,553,346
	Diet 5	28	14,596,131	293.00	22.13	10.04	6.50	18.45	185.16	0.21627	3,156,726
	Diet 6	28	14,596,131	336.00	22.97	10.42	6.50	18.45	192.24	0.22454	3,277,399
	Diet 7	178	92,763,625	508.00	21.86	9.92	3.00	18.45	182.98	0.09864	9,150,440
Backgrounding - Yearling-Fed	Backgrounding	144	202,133,931	272.16	15.28	6.93	6.50	18.45	127.90	0.14939	30,197,219
Yearling - Pasture	Pasture	120	169,233,166	340.19	20.00	9.07	6.50	18.45	167.38	0.19550	33,084,591
Yearling-Fed (Heifer)	Diet 1	3	2,234,814	340.00	11.27	5.11	6.50	18.45	94.33	0.11018	246,233
	Diet 2	7	5,214,567	343.00	16.68	7.57	6.50	18.45	139.58	0.16303	850,137
	Diet 3	7	5,214,567	347.00	16.18	7.34	6.50	18.45	135.43	0.15818	824,843
	Diet 4	7	5,214,567	352.00	14.95	6.78	6.50	18.45	125.08	0.14609	761,802
	Diet 5	7	5,214,567	358.00	21.75	9.87	6.50	18.45	182.06	0.21265	1,108,870
	Diet 6	7	5,214,567	367.00	20.31	9.21	6.50	18.45	169.98	0.19854	1,035,292
	Diet 7	126	93,824,961	492.00	22.33	10.13	3.00	18.45	186.86	0.10073	9,451,138
Yearling-Fed (Steer)	Diet 1	3	1,911,398	386.00	12.18	5.52	6.50	18.45	101.90	0.11902	227,486
	Diet 2	7	4,459,929	388.00	17.51	7.94	6.50	18.45	146.54	0.17116	763,356
	Diet 3	7	4,459,929	393.00	21.59	9.79	6.50	18.45	180.67	0.21102	941,154
	Diet 4	7	4,459,929	400.00	19.91	9.03	6.50	18.45	166.65	0.19465	868,115
	Diet 5	7	4,459,929	408.00	22.49	10.20	6.50	18.45	188.22	0.21984	980,486
	Diet 6	7	4,459,929	418.00	24.76	11.23	6.50	18.45	207.19	0.24200	1,079,305
	Diet 7	126	80,246,863	541.00	24.76	11.23	3.00	18.45	207.18	0.11169	8,962,495

TOTAL METHANE EMISSIONS	**423,660,431** **kg CH_4**
Global Warming Potential of Methane	**25**
Source: Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (SAR) (100 year)	
kg CO_2eq	**10,591,510,783**
kg live weight	**1,426,781,002**
kg CO_2eq / kg live weight	**7.4**

Note:
Heifer replacements are included in the calf-fed, yearling-fed, and cow numbers.
As per IPCC 2006 Tier 2 guidelines, milk fed calves have zero methane emissions from enteric fermentation.
DMI for calves before weaning (3 to 6 months) values given as expert opinion by John Basarab.

References
2006 IPCC Guidelines for National Greenhouse Gas Inventories
http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
IPCC Emission Factor Data Search Engine - methane conversion factor for calves on forage
(http://www.ipcc-nggip.iges.or.jp/EFDB/find_ef_ft.php).