Millar Western Forest Products Ltd.

Population Projections and Impacts

2007-2016 Detailed Forest Management Plan

Prepared by Population Landscape Projection Group

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EXECUTIVE SUMMARY

Introduction

The primary purpose of this report is to develop a two-hundred year "most plausible" base case projection of population, employment by detailed industry, and implied land use for Census Division (CD) 4811 and CD 4813 in Alberta, Canada. Census Division 4811 contains the City of Edmonton, the largest urban area near the operations of Millar Western Forest Products in Whitecourt. Census Division 4813 contains the Town of Whitecourt, home to a substantial proportion of Millar Western's wood products and pulp production.

The base case projection has been developed taking into consideration probable future world and Canadian trends in energy use and production, technological advancement, economic shifts, and demographic factors such as fertility, mortality, and migration. It identifies the risks resulting from human encroachment over the next two centuries to Millar Western's Forest Management Area (FMA) near Whitecourt.

The most common approach to understanding and planning for the future is to construct scenarios. Scenarios are not water tight visions of the future but they must be plausible. Scenarios are driven by "conceivable and consistent" shifts in the macro parameters of technological, economic, socio-political, and demographic trends. Furthermore, these future stories are of necessity based on what we know now. However, scenarios are not beholden completely to the past and present. Scenario builders can embellish their art by taking key forces to new and creative outcomes that stop short of the cataclysmic.

The population and land use projection scenarios developed in this report evolve out of a contextual analysis of selected driving forces -- energy production and use, technology, economics, and demographics. The analysis distinguishes between two aspects of the driving forces, "predetermined elements" and "critical uncertainties". Predetermined elements are not

linked to any particular chain of events and appear certain no matter what scenario comes to pass. Critical uncertainties are found by questioning the assumptions underlying predetermined elements.

The empirical projections for Whitecourt and Edmonton emerge from a number of scenarios about the future economy and population of Alberta, Canada, and the world. The projections are based on assumptions rooted in the analysis of the driving forces.

Scenario Driving Forces

Energy Production and Consumption

Energy production, particularly from fossil fuel sources, is the lifeblood of Alberta's current economy, and a strategic export resource for Canada. The global economy is still one that depends on energy produced from fossil-fuel sources. In 2002, oil, gas, and coal represented 80 percent of the global total primary energy supply, down a mere six percentage points from 1973. Canada, in large part due to Alberta's natural resource base, is a key player in the global energy realm. In 2003, Canada accounted for 3.7 percent of the world's oil production and 6.7 percent of natural gas production. It ranked second behind Russia in the export of natural gas and ninth in the export of oil. Canada ranks first as a source of imported crude oil and refined products for the United States. Sixty-two percent of Alberta's total crude oil and equivalent production is exported to the United States. Alberta's oil sands reserve is one of the largest in the world, with remaining established reserves of 174.5 billion barrels. Only two percent of the initial established resource has been produced. Alberta has 84 trillion cubic feet of recoverable conventional natural gas. Additional gas recovery potential exists in the province's coalbed methane deposits.

From now until 2050, most observers think that fossil fuels will continue to drive the global economy. Given the potential production from non-conventional reserves, the prospect of supply shortages does not appear imminent and may be further delayed by the deployment of fuel saving techniques in transportation and industry, more efficient extraction techniques, and increasing use of alternative fuels such as wind and solar. This trend augurs well for Alberta's economy. There will be continuing demand for oil and gas from not only the industrialized nations of North America and Europe but also the industrializing nations of Asia that are not significant producers of these fuels. Even as conventional reserves diminish over the next 20 years, non-conventional reserves in the oil sands and the potential of extraction from coalbed methane will likely keep supply levels buoyant.

By 2100, alternative fuels could have a share of the energy supply equivalent to that of fossil fuels across the globe. By 2200, technological advances and the environmental considerations might consign fossil fuels to the dustbin of history, thereby forcing Alberta's economy to make the transition from the exploitation of its natural resources to the exploitation of its knowledge resources in the form of the new technologies that are already emerging.

Technological Change

The information and communications technologies sector in Canada and most other industrialized nations is in the third quarter of the economic development cycle identified by C. Meyer and S. Davis (It's Alive: The Coming Convergence of Information, Biology, and Business): "Today, we're in the middle of the third quarter, the Growth phase, when every kind of business incorporates the new technologies to improve their value, cost, and quality performance (e.g., through mass customization, online order confirmation, and mobile connectivity), and to launch entirely new businesses based on real-time information like Yahoo!, OnStar, and Travelocity."

According to the World Robotics 2004, a survey produced jointly by the United Nations Economic Commission for Europe and the International Federation of Robotics, there are somewhere between 800,000 to one million robots are used in industry across the world. On the domestic front, in 2003 there were 610,000 robot vacuum cleaners and lawnmowers in operation. It is projected that an addition four million units will be added between 2004 and 2007. At the end of 2003, there was a global stock of 21,000 service robots such as medical robots and demolition robots. Projected increase in the stock between 2004 and 2007 is 54,000 units.

Two approaches are evident within the science of "genetics". The first is "somatic gene therapy": "Somatic gene therapy is … much like medicine. You take an existing patient with an existing condition, and you in essence try to convince her cells to manufacture the medicine she needs. Such a therapy doesn't attempt to change every cell in her body, just the specific type of cells that would be transplanted." (B. McKibben, Enough: Staying Human in an Engineered Age) "Germline" genetic engineering is the second way to manipulate human genes. The purpose of this approach is to "'improve' human beings – to modify the genes affecting everything from obesity to intelligence, eye color to gray matter."

In the 2005 edition of its predictions for the technology sector, Deloitte Touche Mohatsu, a globally-based consulting firm, observes that "[n]anotechnology – the set of technologies that enables manipulation of structures and processes at the atomic level – is likely to become a large-scale commercial reality." At the dawn of the 21st century, the fruits of nanotechnology are evident in a number of consumer products from sun block cream to stain resistant pants.

For Meyer and Davis, the "connectivity" that arises out of the creation of information and communication networks explains the permanent increase in volatility and the rate of change in what will be a fully mature ICT-based economy. A possible social reaction (with economic consequences) to a future world that is even faster paced than today has been glimpsed by Carl Honoré in his book In Praise of Slow: How a Worldwide Movement is Challenging the Cult of Speed. Honoré envisions a reaction to the "cult of speed" created by advances in information and communications technologies that may represent a preferred lifestyle for future Albertans: "Being "Slow" means living better in the hectic modern world by striking a balance between fast and slow."

From the perspective of the forest products industry, a future world dominated by digital technology might finally usher in the era of a "paperless world". If this does come to pass, the

demand for certain types of pulp will likely decline. However, the economic value of the forest may shift from paper products to tourism products if the "Slow" movement takes hold. "Living better in the hectic [future] world" might just include a serene day in the forest without yoke of connectivity.

Making information and communications technologies an inherent part of everyday life in the future will require an increase in computing capacity well beyond today's best machines. The next trend is the creation of "smart computers", machines with not only processing ability beyond that of the human brain but also consciousness. This development links well with the projected path of the science of robotics. According to the World Robotics 2004 survey, by the end of this decade robots will "not only clean our floors, mow our lawns and guard our homes but also assist old and handicapped people with sophisticated interactive equipment, carry out surgery, inspect pipes and sites that are hazardous to people, fight fire and bombs." Therefore, robotics appears to provide a means of arresting some of negative consequences of population aging, particularly a decline in productivity and labour shortages.

Consumer products based on nanotechnology are projected to become an increasingly important part of the world's manufacturing sector. However, the real impact of nanotechnology is not the prospect of its growth within the current manufacturing paradigm but rather its potential to displace this paradigm entirely and create a "post-manufacturing economy". The economic, political, and social consequences of this development are enormous. A world of nano-factories would impact the labour force (including the robots) and specific economic sectors such as energy profoundly. There is no consensus about how soon a post-manufacturing economy could emerge. The investment requirements and potential opposition from vested economic interests are substantial.

Economic Change

Canada currently ranks among the world's economic leaders. In 2004, its gross domestic product (GDP) in real terms was over a trillion dollars. The goods producing industries accounted for about 30 percent of GDP and the services producing industries, 70 percent. One of the strengths of Canada's current economy is its trade orientation. In 2004, Canada's exports of goods and related services by its top 25 industries were led by the automobile and light duty vehicle manufacturing (13.8 percent of total exports) and oil and gas extraction (12.3 percent) industries. The prime destination for all our exports was the United States, a trend that increased between 1995 and 2004 (from 79.2 to 84.5 percent of total exports). China, an emerging economic powerhouse, took in a mere 1.61 percent of our exports in 2004 (up from 1.32 percent in 1995).

In 2004, Alberta's GDP in real terms was fourth largest among Canada's provinces and territories (behind that of Ontario, Québec, and British Columbia). Its major trading partner was the United States. The United States accounted for 88.3 percent of Alberta's exports (77.5 percent in 1995) and 70.6 percent of imports (78.6 percent in 1995). Oil and gas extraction led the export parade by a wide margin over other industries with a share in 2004 of 68.1 percent, substantially higher than the 1995 share of 47.8 percent. China's share of Alberta's exports remained relatively stable between 1995 and 2004 at approximately 2.5 percent.

Although its significance as a trading partner for Canada and Alberta pales in comparison to that of the United States, China is starting to show up as more than a blip on the economic radar screen. Canada has benefited both from the direct effect of higher exports to China and indirectly from the upward pressure on commodity prices from China's rapid industrialization. Canadian exports to China are driven by resource products, which typically account for about 80 percent of total shipments.

At the beginning of the 21st century, Canada has a fully mature industrial economy; is entering the last quarter the information economy; and is at the doorstep of a "molecular economy" (Meyer and Davis) driven by the technological forces of genetics, robotics, and nanotechnology. In addition, Canada's historic trading relationship with the United States remains strong. Stronger economic ties with an emerging Asian economy are discernible but essentially limited to China.

The most compelling evidence of a future global economy in which nations in Asia and perhaps elsewhere in the now developing world play a more formidable role is provided by the case of China. According to Lester R. Brown, a noted environmentalist and founder and president of the Earth Policy Institute in Washington, D.C., "China is no longer just a developing country. It is an emerging economic superpower, one that is writing economic history. If the last century was the American century, this one looks to be the Chinese century." However, the rapid and seemingly unstoppable growth of China's economy has not occurred without costs, both current and potential (for example, poverty in the rural areas and related political unrest).

Both China and the United States are projected to be among the most populous countries in the world well into the future. Current economic trends point to a future in which the two countries are likely to be economic powerhouses as well as rivals. Canada, a trading nation, will be impacted by any developments affecting the roles of the United States and China (and other countries such as India, Brazil, and South Korea) in the global economy. With its apparent insatiable appetite for resources such as oil and gas, what share of the exports from Alberta's major industries will China have in 10 years, 50 years, or 200 years?

Demographic Change

At the beginning of the 20th century, the global population was 1.6 billion people. By the end, it stood at 6.1 billion, mainly because of unprecedented growth after 1960. Growth was not distributed evenly across the globe. The population of the developed regions more than doubled over the century, exceeding 1 billion by 2000. However, the most dramatic growth was in the developing regions, where population more than quadrupled (nearly 5 billion by 2000). This uneven regional growth reduced the developed countries' share of world population from one third to one-fifth over the century. Europe's relative share of world population fell most, from approximately one-quarter in 1900 to one-eighth in 2000. By comparison, the less developed countries in Africa, Latin America, and the Caribbean accounted for more than one-fifth of the world in 2000, up from one-eighth in 1900, and Asia contained nearly three-fifths of the world's people. Two Asian countries, China and India, each have well over a billion people.

Although the interplay of the demographic variables of fertility, mortality, and migration played out differently in different countries at different times, the dominant model of demographic change during the 20th century was the "demographic transition". The demographic transition refers to the shift from high to low mortality and fertility. This shift occurred throughout Europe, North America, and a number of other areas in the 19th and early 20th centuries, and started in many developing countries in the middle of the 20th century.

Demographers generally consider that fertility has the greatest influence on the population structure in nearly all countries. The total fertility rate (TFR) is the average number of children that a women has during her lifetime. A replacement level of fertility is 2.1. In 2004, the global TFR was 2.8. The TFR in the developed nations was 1.6; in the developing nations, 3.1 (3.5 if China is excluded).

The decline in mortality (or more positively the increase in life expectancy) is largely a consequence of improvements in public health and medical knowledge and technology. Life expectancy does vary by country and even within countries as well as in terms of socio-economic factors such as gender or income. Globally, life expectancy for males is 65 years and for females, 69. It is higher in the developed world at 72 and 80, respectively. In the developing world (including China), males can expect to live on average for 63 years and females for 67.

Migration refers to the movement of people both between countries (international) and within countries (intra-national). The international flow of people is the key to increasing a country's population through migration (movement within a country changes population at a regional level).

Until recently, the focus on population size and growth has largely ignored a critical demographic variable: the age structure of the population, i.e., the way the population is distributed across different age groups. Since individual and household economic behavior varies at different stages of life, changes in age structure can significantly affect national economic performance.

On July 1, 2004, Canada's population was estimated at 31,946,300, an increase of 285,900 since July 1, 2003. The growth rate for the 2003/04 period (9.0 per 1,000) was among the lowest since 1971. For the second consecutive year, the growth rate was below 10.0 per 1,000. Canada's population growth is characterized by a continuing decline in natural increase (births minus deaths). Gains through international migration continued to be the main factor in the growth of Canada's population. As an indicator of Canada's aging population, the median age is now 38.3 years, whereas in 1984 it was 30.6. All the provinces east of Ontario had median ages higher than the national average. Alberta (13.6 per 1,000), Ontario (11.0 per 1,000) and British Columbia (10.6 per 1,000) were the only provinces with population growth rates above that of the national average. On July 1, 2004, Alberta's population was 3,201,895, 10 percent of Canada's. About two-thirds of Canadians live in census metropolitan areas (CMA's).

At the start of the 21st century, Canada was typical of a country that has made the demographic transition. Its TFR was 1 49 in 2000, and life expectancy for males was 76.7 and for females, 82.0 years. Another factor is that population growth nationally is driven primarily by international migration as net natural increase declines. International migration is increasing the

ethnic/racial diversity of the population. Statistics Canada in its reference scenario projects a 76.3 percent increase in the "visible minority" population by 2017 (from 4,037,500 in 2001 to 7,116,200 in 2017). This compares with an increase of 3.3 percent in the non visible minority population.

Alberta's population growth during the last quarter of the 20th century was primarily driven by interprovincial migration. In addition, about two-thirds (64 percent) of its population in 2004 was resident in either the Edmonton (1,001,636) or Calgary (1,037,136) CMA's. Alberta also reflected the demographic transition with a TFR of 1.64 and life expectancy values of 77.1 (male) and 82.0 (female) in 2000.

The United Nations has projected the populations of its member countries out to the year 2300. Under the medium scenario based on replacement level fertility, India, China and the United States will continue to be the most populous countries in the world. By 2200, only six developed countries (as currently defined) will be among the countries that comprise 75 percent of the world's population. Canada, with a projected population of approximately 38.5 million under the medium scenario, does not qualify for membership in this group. The world population will continue to age rapidly with the median age rising from 26 years today to nearly 50 years in 2300.

Statistics Canada puts forward four projections – low (projection 1), medium (projection 2), high-west (projection 3), and high-central (projection 4) – that produce a population range of 34.2 to 38.6 million for Canada in 2026. The medium projection (projection 2) calls for a population of 36.2 million. Extending the medium projection to 2051, Canada's population is just less than 36.9 million. The results for Alberta under the medium scenario register a population of 3,576,600 in 2026. This result assumes a declining birth rate and increasing death rate, annual international migration of 14,000, and a precipitous drop in inter-provincial migration by 2026.

Economic-demographic Model, Scenarios, and Projections

We developed economic and demographic projections for Alberta and Census Divisions 4811 (Edmonton) and 4813 (Whitecourt) using an economic and demographic model that relates population growth to the labour market requirements of the economy. Based on various scenarios that consider alternative assumptions regarding future fertility rates, mortality rates, export growth, and productivity growth, we concluded that the key determinants of population growth in Alberta in the future relate to its potential for economic growth.

The population projections for Canada prepared by the United Nations (U.N.) and Statistics, respectively, were prepared using models that take account only of changes in key demographic drivers (fertility and mortality rates). Indeed, the U.N. projections after 2050 ignore the possibility of international migration.

We consider the projections prepared by the U.N. for the non-industrialized nations based on a replacement rate of fertility and rising life expectancies to be the most plausible. These projections imply falling rates of fertility for such countries and improved living standards, shifts

reflecting our view that increased international trade will gradually raise the undeveloped parts of the world out of poverty and set them onto tracks of gradually improving standards of living. In such a world, the rate of growth of the populations of these countries will gradually slow down.

We consider the projections prepared by the U.N. for the industrialized nations based on lower than replacement fertility rates and rising life expectancies to be the most credible. These projections tend result in either slow rates of growth or stable levels of population in the industrialized countries.

On balance, the U.N. projections we consider the most relevant for the industrialized and non-industrialized world envisage a world in which trade continues to grow but at a diminishing rate.

Our assessment of the prospects for economic and population growth for the province of Alberta leads us to conclude that its population could grow from 3.2 million people currently to as many as 10 million people in 2201. This Base Case scenario is based on the assumption that the growth rate of Alberta's exports will moderate over time in line with our expectations regarding world-wide economic and population growth. This assumption is consistent with a view that would see Canada's population growing to between 80 and 100 million over that period fuelled primarily by net in-migration driven, in turn, by a strong rate of international trade supported economic growth.

We consider a projection alternative for Alberta that assumes a higher but still moderating rate of export growth over the projection horizon. We conclude that such a profile could generate a population for the province of as many as 25 million people in 2201. This Strong Exports scenario generates greater labour market requirements than the Base Case scenario resulting in significantly higher population growth.

We point out, however, that if productivity growth in the future exceeds that of the past – a view held by many economists – labour market requirements would not grow as much in the future as they have in the past for a given rate of economic growth. We describe, therefore, a Strong Exports and Productivity scenario which concludes that the coincidence of both strong export growth and strong productivity growth would result in a total population in Alberta in 2201 no greater than that foreseen in the Base Case scenario (about 10 million people).

Should Alberta's exports grow faster in the future than foreseen in our Base Case scenario we would expect that a combination of factors – including economies of scale and the need to remain competitive – would lead to a coincident increase in the underlying rate of productivity growth. As a result we reject the Export Strong scenario as a plausible outcome for the province and recommend that the Base Case scenario and the Strong Exports and Productivity scenario be considered as the most plausible alternative futures for Alberta. Since the total population projected for Alberta by these two scenarios is nearly identical we are, in effect, recommending only one demographic projection for the province.

Potential Encroachment Threats

Population – Edmonton

Between 1951 and 2004, the total population of Alberta grew from 940,000 to 3.2 million. Between 1951 and 1971, Edmonton accounted for 42.3 percent of the growth; Calgary, 36.5 percent; and the rest of the province, 21.2 percent. Between 1971 and 1991, however, Calgary (38.5 percent) pulled slightly ahead of Edmonton (37.8 percent) while the share accounted for by the rest of the province increased compared to the 1951 to 1971 period. Since 1991, Calgary has taken a commanding lead (44.4 percent). Even the share accounted for by the rest of the province (31.4 percent) exceeded that of the Edmonton area (24.2 percent) by a wide margin.

If we assume that over the next two centuries the Edmonton CMA is able to maintain a share of 24.2 percent of Alberta's projected population growth, and if the 10 million total population for Alberta projection was to prevail, then the Edmonton CMA's population would grow from just over 1.0 million people today to 2.6 million people in 2201. If the 25 million projection was to prevail, Edmonton's population would reach 6.2 million.

The density of the Edmonton CMA in 2001 was 100 persons per square kilometer. The existing boundary of the Edmonton CMA could accommodate a population of 1.7 million people at the density of the Calgary CMA in 2001 (187 persons per square kilometer). It could accommodate 4.5 million at the density of the Hamilton CMA in 2001 (483 persons per square kilometer). It could accommodate 7.5 million people at the density of the Toronto CMA in 2001 (793 persons per square kilometer).

All of these population levels could be achieved without any development encroachment into the Whitecourt area or into the Millar Western FMA. Our projections found that the Edmonton CMA's population at most would be just under 7.5 million by 2201. Thus, we conclude that Millar Western's FMA is not threatened by any conceivable expansion of the population of the Edmonton CMA over the next two centuries.

Population – Whitecourt

Whitecourt accounts for 13.4 percent of the total population of CD 4813 but for only 0.1 percent of CD 4813's land mass. Whitecourt is the second most populated community within CD 4813. The most populated community is Lac Ste. Anne County with just over 9,000 people. Whitecourt itself accounted for 0.3 percent of Alberta's growth in population between 1991 and 2004, and it accounts for about 0.3 percent of its total population at this time.

If we assume that over the next two centuries Whitecourt itself, within CD 4813, is able to maintain a share of 0.3 percent of Alberta's projected population growth, and if the 10 million total population for Alberta projection was to prevail, then Whitecourt's population would grow from just under 9,000 people today to just over 30,000 people in 2201. If the 25 million projection for Alberta was to prevail, Whitecourt's population would reach about 80,000.

Whitecourt's current population density is 340 persons per square kilometer. If Whitecourt's population was to reach 30,000, its density would increase to 1,150 persons per square kilometer. The density of the City of Edmonton (not the CMA) at this time is 1,272 while that of the City of Calgary is 1,877. Thus, a population of 30,000 for Whitecourt could conceivably be accommodated within its existing boundary at densities approaching those of the cities of Edmonton and Calgary today.

If Whitecourt's population was to reach 80,000, its density would reach 3,050 per square kilometer. This total would generate a density exceeding that of the cities of Edmonton and Calgary today. Note that for Whitecourt's population to increase from 9,000 today to 30,000 in 2201 its economic base employment would have to more than triple in size. For its population to reach 80,000 its economic base employment would have to increase almost tenfold.

We conclude that it is highly unlikely Whitecourt will ever reach a total population of 80,000 between now and 2201, and not very likely it will ever reach a population of 30,000.

Agriculture

Agriculture's share of total GDP in Alberta has fluctuated since 1985, reaching as high as 3.0 percent in each of 1993 and 1995 and as low as 1.7 percent in 1985. Despite this variation, its contribution to the Alberta economy has been more stable than that of either oil and gas extraction or manufacturing.

Over the period 1997 to 2003, crop production and support activities accounted for an average of 58.2 percent of all agricultural value added in the province, with animal production and support activities accounting for an average of 26.4 percent. The remaining 15.3 percent reflects other agricultural activities including greenhouse, nursery and floriculture activities, and animal aquaculture.

Agricultural activities are spread out across the southern portion of the province, not concentrated in any one particular area. Census data regarding agricultural industry employment indicate that of the nearly 90,000 persons employed in agriculture in the province in 2001. There were 6,030 persons employed in agriculture in CD 4813 in 2001, the CD that includes Whitecourt. CD 4813 accounts for the next highest number of agriculture industry employed persons in Alberta after CD 4808. As of 2001, therefore, 6.8 percent of the people employed in agriculture in Alberta were located in CD 4813.

If Alberta's agriculture production in the future keeps pace with the projected population increases in Canada and other major trading nations, agricultural land requirements in the province could conceivably increase significantly and possibly represent a serious threat to the Millar Western FMA. However, this risk of encroachment from agriculture is best identified as a critical uncertainty for at least two reasons:

The rate of return on increased agricultural activity, more particularly in the animal slaughtering and processing sector, will have to be competitive with that for other land uses ranging from outdoor recreation to oil and gas production. If the land becomes more valued for grazing in the

future, it may well look first at the conversion of hectares currently devoted to crops before it expands into forest land that may also have a new competitive value (for example, outdoor recreation).

Alberta's agricultural commodities will need to respond to shifting consumer preferences and trading alliances. For example, China is a huge market for meat products but currently consumes more pork than beef, Alberta's premier commodity. Will the Chinese eventually consume more beef? Even if they do, they may well buy it from countries they are presently forging trade links with such as Brazil or Argentina.

Tourism

Tourism is currently a big business in the province of Alberta. Tourism revenues in 2004 totaled an estimated $4.7 billion. The province's Gross Domestic Product on an expenditure basis totaled about $180 billion in 2004; thus, tourism accounted for 2.6 percent of economy-wide expenditures.

Tourism supported over 83,000 jobs in Alberta in 2004, half directly in the industry, the other half indirectly. Employment in Alberta in 2004 totaled 1.8 million; thus, tourism accounted for 4.7 percent of all the jobs in the province. By way of comparison, mining (including oil and gas) in 2004 accounted for 107,000 jobs directly, agriculture for 66,000 directly, and forestry for 5,000 directly.

Of the $4.7 billion spent on tourism in 2004, Alberta residents accounted for $2.1 billion, other Canadian residents for $1.0 billion, and international visitors for $1.2 billion, including almost $700 million from American visitors and almost $600 million from other international visitors.

Of the 12.5 million overnight visits in Alberta in 2002, 5.2 million (41 percent) were for pleasure and 4.5 million (36 percent) were motivated by visiting friends and relatives. Business travel accounted for 1.7 million overnight visits (13 percent) while the remaining 1.4 million (11 percent) were for other reasons. Activities among the 12.5 million overnight visitors in Alberta in 2002 were diverse. Including multiple motivations, 7.8 million visited friends and relatives, 6.3 million went shopping, 4.7 million went sightseeing, 4.4 million participated in outdoor activities, 3.4 million visited parks and historic sights, 2.0 million participated in nightlife, 1.2 million attended a sporting event, 0.9 million attended theme parks, 0.7 million attended a festival, and 0.6 million participated in a cultural event.

The 12.5 million overnight visits in Alberta generated a total of 45.7 million person nights. Alberta Economic Development has designated six tourism areas within the province. The person nights in Alberta in 2002 broke down as follows: 11.1 million in Calgary and the Calgary area; 10.3 million in Edmonton and the Edmonton area; 8.3 million in the Central area; 7.7 million in the Rockies; 4.6 million in the South; and 2.9 million in the North. Whitecourt is found in the northwest section of the Alberta Central Area. The Alberta Central Area currently generates the third highest number of visitor person nights in the province.

The major individual tourism attractors in Alberta include: West Edmonton Mall; Calgary Tower; Banff National Park (4.6 million annually); Jasper National park (1.9 million annually); and Waterton Lakes National Park (368,000 annually).

It is impossible to project with precision the impacts of these factors on the demand for tourism in Alberta or on the number of visitors to Alberta in the future. It is safe to say that the industry will bigger than it is today, probably much bigger. Our recommended projections for Alberta's population identify a level ranging from 10 million to 25 million by 2201. These trends suggest that by 2201 tourism trips in the province could increase substantially from the annual rates witnessed in recent years.

While the metropolitan areas of the province will remain major tourism attractors in the future (since visiting friends and relatives is a significant reason for tourist travel), outdoor activities and visiting parks and historic sights will no doubt continue to be activities pursued by travelers in the future, particularly if such activities come to be seen as a release from a highly technological world. This suggests that Alberta's non-metropolitan travel regions, including the Central Area, all of which are well endowed with such attractors, could evolve into major tourism destinations for people from around the globe in the future.

We conclude that travel demand world-wide will grow faster than most other industries in the future. Alberta's tourism industry is likely to grow in tandem with this world-wide expansion. The extent to which tourism will encroach on Millar Western's Forest Management Area will be determined by the extent to which the Whitecourt area will be seen as a natural attractor and/or the extent to which either man-made attractors are permitted to develop in the area or, in a society dominated by high technology, "pastoral experiences" acquire an economic value well beyond competing economic uses. So long as the net present value of the land in the Whitecourt area remains high as a source of forest products, it is unlikely that any future provincial government would permit a change in its use. However, if the net present value of the area as a tourism destination was ever to reach or surpass its value as a provider of forest products, it is possible that some future provincial government would permit a change in its use. Encroachment from tourism presents a risk but it is one that remains a critical uncertainty.

Coalbed Methane

Coalbed methane (CBM) is natural gas contained in coal. CBM has the same fuel quality as the conventional gas taken from the deeper reservoirs. It can be put in the same pipelines, run through the same processors and burned in the same generators and home furnaces and cooking stoves as conventional natural gas. Alberta accounts for 70 to 90 percent of Canada's potential supply of CBM. The main difference between the two is that CBM is more difficult, and hence more costly, to extract.

Projections suggest that CBM will account for a growing share of national gas production in the United States and Canada. Preliminary projections produced by Natural Resources Canada indicate that CBM can be expected to account for a growing share of the nation's production of natural gas. The projections suggest that within the next 15 years conventional natural gas production (from the Western Canadian Sedimentary Basin that covers most of Alberta and the

southern part of Saskatchewan) will fall from 6 tcf per year to just over 4 tcf per year, or by about one-third. In contrast, by 2020 CBM will account for about one-quarter of Canada's natural gas production. Thus CBM is destined to become a major source of natural gas in North America within just a decade or two.

In Canada most of the nation's CBM will be produced in Alberta. To date CBM development has occurred in the southern portion of the province due to relatively easier access and lower production costs. Over time, however, CBM exploration will increasingly migrate to other areas of the province.

The Millar Western FMA is very close to several of the major potential CBM sites in the province.

Given that the demand for natural gas is likely to continue for some time in North America and that the potential for CBM production in North America is very high in Alberta it seems reasonable to conclude that CBM development will continue to migrate north within the province over the next two centuries, and that future CBM development poses a credible threat to Millar Western's FMA within that time frame.

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1. Introduction

1.1 Purpose of the Report

The primary purpose of this report is to develop a two-hundred year "most plausible" base case projection of population, employment by detailed industry, and implied land use for Census Division (CD) 4811 and CD 4813 in Alberta, Canada. Census Division 4811 contains the City of Edmonton, the largest urban area near the operations of Millar Western Forest Products in Whitecourt. Census Division 4813 contains the Town of Whitecourt, home to a substantial proportion of Millar Western's wood products and pulp production.

The base case projection has been developed taking into consideration probable future world and Canadian trends in energy use and production, technological advancement, economic shifts, and demographic factors such as fertility, mortality, and migration. It identifies the risks resulting from human encroachment over the next two centuries to Millar Western's Forest Management Area (FMA) near Whitecourt. The base case projection and the other analysis in this report forms part of the Detailed Forest Management Plan (DFMP) that Millar Western is required to submit to the Government of Alberta.

The report emanates from a partnership between two Ontario-based consulting firms, R.A.L. Consulting Limited (http://ralconsulting.ca) and the Centre for Spatial Economics (www.c4se.com). The authors of the report are Richard Loreto, President of R.A.L. Consulting Limited, and Tom McCormack, an Executive Director of the Centre for Spatial Economics. Detailed information about the authors can be found at the web sites of their respective firms.

1.2 Using Scenarios as a Means of Projecting the Future

The most common approach to understanding and planning for the future is to construct scenarios. Definitions of the concept of a scenario in the context of strategic planning abound. A report published by the Netherlands Bureau for Economic Policy Analysis defines scenarios as

"conceivable and consistent stories of the future."[1] The authors of the report add that scenarios "refer only to long-term, structural developments driven by fundamental changes. Developments in the short-term … are not taken into account."[2] The International Energy Agency in its projections of energy use to 2050 suggests that scenarios "… are conjectures about what could happen in the future based on our past and present experience of the world."[3] Peter Schwartz in his book The Art of the Long View states that "[s]cenarios are not about predicting the future, rather they are about perceiving futures in the present."[4]

These definitions point to, both implicitly and explicitly, other important features of scenarios as a planning tool. Scenarios are not water tight visions of the future but they must be plausible. A future that results from the impacts of extraordinary events such as wars or alien invasions is not the usual fodder for scenario building except possibly for military planners and writers of science fiction novels. Scenarios developed by businesses and civilian government agencies are driven by "conceivable and consistent" shifts in the macro parameters of technological, economic, socio-political, and demographic trends. Furthermore, these future stories are of necessity based on what we know now. Therefore, scenario builders must deal "with the concept of uncertainty and with the limitations of our knowledge."[5] However, scenarios are not beholden completely to the past and present. Scenario builders can embellish their art by taking key forces to new and creative outcomes that stop short of the cataclysmic. Constructing a future simply on the basis of the extrapolation of current trends carries the immense risk of what to do if things turn out differently than expected. Good scenario building answers the question "what strategy or course of action would maximize our chances of success in a wide range of different situations".[6]

The population and land use projection scenarios developed later in this report evolve out of a contextual analysis of selected driving forces. Schwartz observes that the first step in the process of building scenarios is the examination of driving forces or "the forces that influence the outcomes of events."[7] For Schwartz, one of the world's leading futurists, a "familiar litany of categories" is the starting point for identifying relevant driving forces: society, technology,

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1 Johannes Bollen, Ton Manders, and Machiel Mulder with contributions by Bas Eickhout, Mark Lijesen, Dale Rothman, and Detlef van Vuuren, Four Futures for Energy Markets and Climate Change (The Hague: CPB Netherlands Bureau for Economic Policy Analysis, April 2004), page 17.

2 Ibid.

3 International Energy Agency, Energy to 2050: Scenarios for a Sustainable Future (Paris: Organization for Economic Cooperation and Development, 2003), page 14. Accessed at http://www.iea.org/textbase/nppdf/free/2000/2050_2003.pdf.

4 Peter Schwartz, The Art of the Long View: Planning for the Future in an Uncertain World (New York: Currency Doubleday, 1996), page 36.

5 International Energy Agency, Energy to 2050, page 13.

6 Ibid.

7 Peter Schwartz, The Art of the Long View, page 101.

economics, politics, and environment.[8] The second step is to sort out "predetermined elements" and "critical uncertainties". Predetermined elements are not linked to any particular chain of events and appear certain no matter what scenario comes to pass. Critical uncertainties are found by questioning the assumptions underlying predetermined elements.[9]

Schwartz advocates four strategies for unearthing predetermined elements: slow-changing phenomena, constrained situations, in the pipeline, and inevitable collisions.[10] Demographic factors can be used to illustrate two of these strategies. Population change can be classified as a "slow-changing phenomenon". The population of a country can change through two means, net natural change (or the number of births versus deaths) and migration (or the influx of people from outside an area versus the exodus of people to another area). It can be argued that neither means can be manipulated through public policy or private action to orchestrate dramatic change in the short to medium term (say five to ten years). Hence, within a ten year and perhaps even twenty year planning horizon, the increase or decrease in the population is essentially a predetermined element. The area of demographics also illustrates the "in the pipeline" strategy. As Schwartz points out, the teenage population of a country ten years from now is known fairly accurately since they have all been born. All that is required is some adjustment for the impacts of migration and normal mortality.

The field of economics provides fertile ground for the illustration of critical uncertainties. For example, the United States has been the dominant economic power in the world for much of the last 50 years. The duration of its economic hegemony might suggest that looking ahead a planner should assume continued American dominance. However, as identified later in this report, there are signs that other countries, particularly China and India, are beginning to exhibit a potential to eclipse the economic influence of the United States. An assumption about the balance of global economic power 50 years on might be classified better as a critical uncertainty.

In this report, we review a number of driving forces deemed relevant to how the population and land use in the Whitecourt and Edmonton areas might change over the course of the next two hundred years. The selected forces – energy production and use, technology, economics, and demographics – echo the "litany" identified by Schwartz and are the primary drivers of population and land use change. Socio-political trends are not elevated to the status of a discrete driving force. This decision reflects the difficulty in extrapolating these trends over such a long time period.

Finally, our empirical projections for Whitecourt and Edmonton emerge from a number of scenarios about the future economy and population of Alberta, Canada, and the world. The projections are based on assumptions rooted in the analysis of the driving forces. The analysis provides both a rationale and greater plausibility for assumptions about the linkage between

8 Ibid., page 105.

9 Peter Schwartz, The Art of the Long View, pages 110 and 115.

10 Ibid., pages 111-112.

productivity and technology or how far into the future Alberta's economy can be carried by the development of its natural resources.

1.3 Scope and Organization of the Report

Beyond this point, the report is organized in three parts. Part 2 contains the analysis of the driving forces. Each of the four driving forces – energy, technology, economics, and demographics – is scrutinized in terms of past, current, and projected trends. The analysis of these trends is derived from a review of both primary and secondary literature. Emphasis is placed on a comparison between trends for Alberta and Canada versus the rest of the world. Part 3 describes our projection model and identifies a number of scenarios around which specific population and land use projections are devised. The most plausible scenario for the Whitecourt area is probed in depth including an analysis of the likelihood that Millar Western's FMA will suffer future encroachment from agricultural, energy, or tourism activities. Part 4 contains the report's conclusions. A list of References is contained at the end of the report.

2. Scenario Driving Forces

2.1 Energy Production and Consumption

2.1.1 Past and Current Trends

Energy production, particularly from fossil fuel sources, is the lifeblood of Alberta's current economy, and a strategic export resource for Canada. A snapshot of the dimensions of the province's energy industry can be gleaned from the statistics produced annually by the Alberta Government:[11]

- Canada ranks first as a source of imported crude oil and refined products for the United States.[12] Sixty-two percent of Alberta's total crude oil and equivalent production is exported to the United States.[13]

- Alberta's oil sands reserve is one of the largest in the world, with remaining established reserves of 174.5 billion barrels. Only two percent of the initial established resource has been produced.[14]

11 Data are for 2003 unless otherwise noted.

12 Accessed at http://www.energy.gov.ab.ca/803.asp.

13 Alberta Energy, Alberta's Energy Industry Overview (October 2004).

14 Ibid.

- Alberta has 84 trillion cubic feet (Tcf) of recoverable conventional natural gas. Additional gas recovery potential exists in the province's coalbed methane deposits. Almost two-thirds of natural gas production is exported to the United States and one-quarter to the rest of Canada.[15]

- Forty-five percent of the coal mined in Canada comes from Alberta.[16]

The abundance of its energy resources provides Alberta with a position of importance within the energy framework of the current global economy. Between 1973 and the early part of this decade, a number of trends were discernible in the production and consumption of energy across the world:[17]

- The world decreased its oil dependency in favour of gas and nuclear power. However, oil still accounted for over one-third of the world's total primary energy supply (TPES).

- The world's dependence on coal remained essentially unchanged (about one-quarter of TPES).

- The world's reliance on alternative fuels - combustible renewables and waste, geothermal, wind, and solar - remained virtually the same (11.2 percent in 1973 and 10.9 percent in 2002).

- The developed nations comprising the Organization for Economic Cooperation and Development (OECD) reflected the world trend but had a higher dependence on oil (40 versus 35 percent) and a lower dependence on coal (about one-fifth of TPES). The OECD's share of alternative fuels increased from 2.3 percent to 3.3 percent from 1973 to 2002.

- Asia (including China) accounted for a much higher share of the world's TPES (13 percent in 1973 and 24 percent in 2002). Asia's role as a coal producer increased substantially from 24 percent of the world's supply in 1973 to 50 percent in 2003. Asia remained a small player in the production of crude oil and natural gas with about a 10 percent share (although the share has increased since the 1970's). Asia's share of final energy consumption more than doubled between 1973 and 2002, from 11 percent to 24 percent.

- The OECD and Middle East had roughly equal shares of the world's oil production in 2002 (in 1973, the shares were 24 percent and 37 percent, respectively).

15 Alberta Energy, Alberta's Energy Industry Overview (October 2004).

16 Ibid.

17 International Energy Agency, Key World Energy Statistics 2004 (accessed at http://www.iea.org), pages 6-35. Some data are rounded to the nearest whole number.

- The OECD's lead in natural gas production had fallen substantially from 71 percent of the total to 42 percent. There is now more production from Russia and, to a lesser extent, Asia and Africa.

The global economy is still one that depends on energy produced from fossil-fuel sources. In 2002, oil, gas, and coal represented 80 percent of the global TPES, down a mere six percentage points from 1973.[18] Alternative fuels as a share of TPES actually declined somewhat. In addition, economic growth in Asia, especially in China, was reflected in that continent's expanding share of the global TPES and final energy consumption

Canada, in large part due to Alberta's natural resource base, is a key player in the global energy realm. In 2003, Canada accounted for 3.7 percent of the world's oil production and 6.7 percent of natural gas production. It ranked second behind Russia in the export of natural gas and ninth in the export of oil.[19] A world driven by fossil fuels sustains Canada's (and Alberta's) economy and population growth.

2.1.2 Projected Trends

How far into the future can the economies of Alberta, Canada, and the world rely on fossil fuels as the primary energy sources and levers of economic growth? Will supply continue to match demand either globally or regionally? Can the environmental impacts of using fossil fuels be managed successfully? Will new technology create fuel sources that replace fossil fuels? A number of organizations in Canada and elsewhere have attempted to answer these types of questions.

The Energy Information Administration (EIA) is an independent statistical and analytical agency within the U.S. Department of Energy. Its reference case projection on global energy consumption for the period from 2001 to 2025 suggests that:

- Total primary energy consumption will grow annually by 1.5 percent in North America; 0.7 percent in Western Europe; 1.5 percent in the former Soviet Union; 1.0 percent in industrialized Asia; and 3.0 percent in developing Asia. China, as part of developing Asia, will have an annual growth rate of 3.5 percent in total primary energy consumption.[20]

- By 2025 in the industrialized world (i.e., North America, Western Europe, Japan, and Australia/New Zealand), oil, gas, and coal will account for 84 percent of energy consumption. The share will be around 90 percent in the Eastern Europe/former Soviet Union and the developing countries of Asia such as China, India, and South Korea. Coal will remain

18 Ibid., page 6.

19 International Energy Agency, Key World Energy Statistics 2004, pages 11 and 13.

20 Energy Information Administration, International Energy Outlook 2004 (Washington, DC: U.S. Department of Energy), Appendix A, Table A1, page 163.

a key energy source in the developing world accounting for 30 percent of energy consumption compared to 17 percent in the industrialized countries.[21]

A recent study of Europe's energy future under various scenarios reaches conclusions about the primacy of fossil fuels that are in line with the EIA projections. Looking out to 2040, the Bureau for Economic Policy Analysis (BEPA) in the Netherlands does not project a supply shortage for oil. Even in a scenario of high economic growth where the reserves of the Middle East are pushed towards completion, the world's oil supply will be secured by non-conventional reserves (such as Alberta's oil sands and coalbed methane deposits). However, Europe's consumption of gas, particularly in the power sector, creates supply pressures in all of BEPA's scenarios. The dependency factor will be around 70 percent with a need for imports from Russia and the Middle East.[22]

The apparent primacy of fossil fuels in the first half of the 21st century may be impacted by other imperatives. Both environmental and supply considerations could force countries, especially in the industrialized world, to find ways to use energy more efficiently. Vehicular gas consumption is a favorite target of advocates of this perspective. Although one automotive industry executive predicts that internal combustion vehicles will occupy 85 percent of the market in 2025, John Heywood of the Sloan Automotive Laboratory at the Massachusetts Institute of Technology thinks that fuel consumption could be decreased by one-half by 2030 through technological advances ranging from "hybrid" engines to variable automatic transmissions.[23]

The biggest challenge to a fossil fuel future comes from the use of hydrogen fuel cells, particularly in vehicles. Hydrogen brings the advantage of both abundance of supply and a benign impact on the environment. However, the technological and economic challenges standing in the way of a hydrogen future are profound. At this point, prototype cars powered by hydrogen are five times more expensive than gas powered cars and the fuel tank takes up the entire trunk space.[24] General Motors Corporation projects a marketable hydrogen car by 2010 but other automobile industry companies do not envision the mass production of such vehicles for decades.[25] If the hydrogen is produced by the combustion of fossil fuels, the environmental advantage of only spewing heat and water out the tailpipe of the vehicle is substantially eroded.

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21 Calculations made from data in ibid., Appendix A, Table A2, pages 164-165,

22 Johannes Bollen, Ton Manders, and Machiel Mulder with contributions by Bas Eickhout, Mark Lijesen, Dale Rothman, and Detlef van Vuuren, Four Futures for Energy Markets and Climate Change , page 64.

23 "21st Century Cars Hit the Road", Business Week (United States), 2003 09 04, accessed at http://www.businessweek.com/technology/content/sep2003/tc2003094_5514_tc127.htm.

24 Michael Arndt, "Where Our Energy Will Come From", Business Week (United States), 2004 10 11, accessed at http://www.businessweek.com/magazine/content/04_41/b3903425.htm.

25 Danny Hakim, "George Jetson, Meet the Sequel", The New York Times, 2005 0109, accessed at http://query.nytimes.com/search/query?srcht=a&srchot=a&query=George+Jetson%2C+Meet+the+Sequel&field=body&daterange=day&mon0=01&day0=09&year0=2005&mon1=01&day1=01&year1=1996&mon2=05&day2=27&year2=2005&cre=The+New+York+Times&sort=closest&sources=all&submit.x=26&submit.y=9.

Methods of producing hydrogen from either water or sunlight are far from commercial viability.[26] Finally, hydrogen vehicles require a distribution infrastructure comparable to that of gas powered vehicles. Iceland, a small country that already has hydrogen-powered buses and filling stations (and abundant geo-thermal energy to produce the fuel), estimates that it will take fifty years to make the conversion to the hydrogen economy.[27]

From now until 2050, most observers think that fossil fuels will continue to drive the global economy. Given the potential production from non-conventional reserves, the prospect of supply shortages does not appear imminent and may be further delayed by the deployment of fuel saving techniques in transportation and industry, more efficient extraction techniques, and increasing use of alternative fuels such as wind and solar[28].

This trend augurs well for Alberta's economy. There will be continuing demand for oil and gas from not only the industrialized nations of North America and Europe but also the industrializing nations of Asia that are not significant producers of these fuels. Even as conventional reserves diminish over the next 20 years, non-conventional reserves in the oil sands and the potential of extraction from coalbed methane (estimated at 100 to 500 Tcf[29]) will likely keep supply levels buoyant. The pressure to develop the abundant non-conventional reserves will likely diminish the need to tap smaller conventional pools that lie beneath parts of the province that are currently covered by forest.

There is some question whether the trend towards alternative energy use will take hold in the developing world by 2050, especially in Asia, where the EIA projects coal to account for the largest share of energy consumption. As of 2003, China was the world's largest coal producer and second leading exporter.[30]

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26 John Gartner, "Sunlight to Fuel Hydrogen's Future", Wired News (United States), 2004 12 07, accessed at http://wired-vig.wired.com/news/technology/0,1282,65936,00.html; George W. Crabtree, Mildred S. Dresselhaus, and Michelle V. Buchanan, "The Hydrogen Economy", Physics Today Online (United States), 2004 12, accessed at http://www.physicstoday.org/pt/vol-57/iss-12/p39.html.

27 Michael Arndt, "Where Our Energy Will Come From", Business Week (United States), 2004 10 11, accessed at http://www.businessweek.com/magazine/content/04_41/b3903425.htm.

28 Diane Brady, "Reaping the Wind", Business Week (United States), 2004 10 11, accessed at http://www.businessweek.com/magazine/content/04_41/b3903465.htm; "Solar Project May Cut Alberta Energy Bills", Canadian Press, 2005 04 08, accessed at http://www.theglobeandmail.com/servlet/Page/document/v4/sub/MarketingPage?user_URL=http://www.theglobeandmail.com%2Fservlet%2Fstory%2FRTGAM.20050408.gtsolatr0408%2FBNStory%2FTechnology%2F%3Fquery%3Dsolar%2Benergy&ord=34784643&brand=theglobeandmail&redirect_reason=2&denial_reasons=none&force_login=false.

29 Alberta Energy, Alberta's Energy Industry Overview (October 2004).

30 International Energy Agency, Key World Energy Statistics 2004, page 15.

By 2100, alternative fuels could have a share of the energy supply equivalent to that of fossil fuels across the globe. By 2200, technological advances and the environmental considerations might consign fossil fuels to the dustbin of history, thereby forcing Alberta's economy to make the transition from the exploitation of its natural resources to the exploitation of its knowledge resources in the form of the new technologies that are already emerging.

2.2 Technological Change

2.2.1 Past and Current Trends

Information and Communications

Using a computer or cell phone or accessing a web site by the Internet are now commonplace occurrences for millions of people. The increasing economic significance of the information and communications technologies (ICT) sector of the global economy has characterized the last 25 years. The case of Canada is illustrative:[31]

- The ICT sector represented 5.4 percent of Canada's economic output in 2004, up from 4.0 percent in 1997.
- Since 1997, the sector's annual growth rate (8.3 percent) has been over twice that of the Canadian economy (3.6 percent).
- Research and development expenditures by companies in the sector accounted for 40 percent of such expenditures in the private sector during 2004.
- Annual work force growth in the sector (4.2 percent) outpaced growth economy-wide (2.3 percent) between 1997 and 2004.
- Compared to a national average of 21 percent, 38 percent of the workers in the ICT sector had a university degree in 2004.

The rapid diffusion of ICT products and services throughout the Canadian economy has been remarkable. This is evident by examining just a few statistics on how Canadians are using computers both at home and at work:

- Between 1999 and 2003, the share of households with a regular Internet user increased from 41.8 to 64.2 percent, an increase of just less than 54 percent.[32]

31 Industry Canada, "Canadian ICT Sector Profile", 2005 04, accessed at http://strategis.ic.gc.ca/epic/internet/inict-tic.nsf/en/h_it07229e.html.

32 Statistics Canada, "Table: Characteristics of household Internet users, by location of access", accessed at http://www40.statcan.ca/l01/cst01/comm10a.htm.

- By 2004, three-quarters of private sector businesses and almost all public sector organizations used electronic mail.[33]

The ICT sector in Canada and most other industrialized nations is in the third quarter of the economic development cycle identified by Meyer and Davis:

> Technology …enabled the manipulation of large quantities of data at high speed, building an infrastructure for providing cheap computer hardware, then software, then communications networks, and currently, an explosion of wireless devices. Today, we're in the middle of the third quarter, the Growth phase, when every kind of business incorporates the new technologies to improve their value, cost, and quality performance (e.g., through mass customization, online order confirmation, and mobile connectivity), and to launch entirely new businesses based on real-time information like Yahoo!, OnStar, and Travelocity. The information economy is just now beginning to glimpse its organizational phase, which will come into focus much more in the decade ahead.[34]

Robotics

The current status of the use of robots around the world is well documented in World Robotics 2004, a survey produced jointly by the United Nations Economic Commission for Europe and the International Federation of Robotics. Among the findings of this survey are:[35]

- World-wide somewhere between 800,000 to one million robots are used in industry. Using the lower limit of the range as the base, about 44 percent are in Japan, 31 percent in the European Union, and 14 percent in North America. In Japan, there are 320 robots for every 10,000 employees (the highest ratio among reporting countries) and one robot for every ten production workers in the automotive industry.

- On the domestic front, in 2003 there 610,000 robot vacuum cleaners and lawnmowers in operation. It is projected that an addition four million units will be added between 2004 and 2007.

- At the end of 2003, there was a global stock of 21,000 service robots such as medical robots and demolition robots. Projected increase in the stock between 2004 and 2007 is 54,000 units.

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33 Statistics Canada, "Table: Business and government use of information and communications technologies (enterprises that use electronic mail)", accessed at http://www40.statcan.ca/l01/cst01/econ146a.htm.

34 Christopher Meyer and Stan Davis, It's Alive: The Coming Convergence of Information, Biology, and Business (New York: Crown Press, 2003), page 9. For a more detailed explanation of the economic development cycle identified by Meyer and Davis, see pages 20-21 of this report.

35 United Nations Economic Commission for Europe, "Press Release ECE/STAT/04/P01" (Geneva: October 20, 2004), accessed at http://www.unece.org/press/pr2004/04stat_p01e.pdf.

A footnote to the 2004 survey is contained in the recent announcement by Toyota Motor that it will introduce robots which can work as well or better than humans at all 12 of its factories in Japan to cut costs and deal with a looming labour shortage as the country ages. Japan's top automaker currently uses 3,000 to 4,000 less advanced robots at its domestic factories to do welding, painting, and other potentially hazardous tasks. The new robots would also be used in finishing work, such as installation of seats and car interior fixtures, jobs that have been too complex for conventional robots up to now.[36]

Genetics

The science of "genetics" was taken to a new level in 1953 by James Watson and Francis Crick with the publication of their seminal article entitled "A Structure for Deoxyribose Nucleic Acid".[37] Over 50 years later, the societal consequences of the seed that they planted are enormous.

There are two ways to manipulate human genes. The first is "somatic gene therapy":

> Somatic gene therapy is … much like medicine. You take an existing patient with an existing condition, and you in essence try to convince her cells to manufacture the medicine she needs. Such a therapy doesn't attempt to change every cell in her body, just the specific type of cells that would be transplanted.[38]

This approach to genetics is most evident in the current debate around the use of stem cells. Significant investment in stem cell research is being made in Asian countries such as Korea and Japan but the opposition to this type of research by the Bush administration appears to be handicapping efforts in the United States.[39] Potentially, stem cell therapy holds the key to cures for a range of diseases such as diabetes or Parkinson's.

"Germline" genetic engineering is the second way to manipulate human genes. According to McKibben, the purpose of this approach is to "'improve' human beings – to modify the genes affecting everything from obesity to intelligence, eye color to gray matter."[40] Germline genetic

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36 "Toyota to Employ Robots", News24.com, (South Africa) 2005 01 06, accessed at http://www.finance24.com/articles/default/display_article.asp?Nav=ns&ArticleID=1518-24_1643625.

37 Bill McKibben, Enough: Staying Human in an Engineered Age (New York: Henry Holt and Company, 2003), page 7.

38 Ibid., page 9.

39 John Carey, ""The Stem-cell Also-ran: America", Business Week (United States), 2005 05 27, accessed at http://www.businessweek.com/technology/content/may2005/tc20050527_7309_tc120.htm.

40 Bill McKibben, Enough: Staying Human in an Engineered Age (New York: Henry Holt and Company, 2003), page 10.

engineering brings the technology of cloning into the picture. Cloning has been successful with a mammal ("Dolly" the sheep) and, in the opinion of some, may not be far off for humans.[41]

Nanotechnology

In the 2005 edition of its predictions for the technology sector, Deloitte Touche Mohatsu, a globally-based consulting firm, observes that "[n]anotechnology – the set of technologies that enables manipulation of structures and processes at the atomic level – is likely to become a large-scale commercial reality."[42] At the dawn of the 21st century, the fruits of nanotechnology are evident in a number of economic areas. Consumer products are reaching new levels of effectiveness and convenience as a result of the application of this technology. Hence, the marketplace now boasts fortified sun block creams, clothing that resists stains, and house windows that clean themselves (with a little help from Mother Nature in the form of sunlight and rain). Pharmaceuticals increasingly use nano-structures for targeted drug delivery. The capacities of the components found in consumer electronics (e.g., notebook computer batteries) are being exponentially enhanced by the application of nanotechnology. Nanotechnology holds out the promise of improving existing products and creating superior new products, and according to Deloitte, the nanotechnology era is already here.

2.2.2 Projected Trends

Information and Communications Technologies

Looking ahead, several trends appear to be in store for the ICT sector. These trends assume that the demand for the products and services of this sector will continue to grow until they are ubiquitous within developed societies and increasingly common within developing societies.

The first trend is identified by Meyer and Davis. They suggest that our current economy characterized by the rapid expansion of the ICT sector is on the cusp of entering the fourth stage of the economic development cycle:

> This is the beginning of a new organizational model built around a key technology from the growth phase: networks. The resultant social changes include the blending of work and the rest of life, the growing labor force working outside of a traditional full-time employment arrangement, the shift of economic power toward individuals, and the global economy …[43]

41 Ibid., page 11.

42 Deloitte, Technology, Media, and Telecommunications Trends: Predictions, 2005 (London: Deloitte & Touche LLP, 2005), page 1.

43 Christopher Meyer and Stan Davis, It's Alive: The Coming Convergence of Information, Biology, and Business (New York: Crown Press, 2003), pages 9-10.

For Meyer and Davis, the "connectivity" that arises out of the creation of information and communication networks explains the permanent increase in volatility and the rate of change in what will be a fully mature ICT-based economy:

> The time between internal management changes and external responses is shorter and shorter. And the degree of unexpected disruption is greater…. the rate of change is genuinely accelerating, the world is genuinely less predictable, and the swings in demand, mood, and prevailing wisdom are genuinely more volatile….When networks become intensely connected, they start to become "nonlinear"…. The more connected any system becomes, the harder it is to anticipate all such risks.[44]

A possible social reaction (with economic consequences) to a future world that is even faster paced than today has been glimpsed by Carl Honoré in his book In Praise of Slow: How a Worldwide Movement is Challenging the Cult of Speed.[45] Honoré envisions a reaction to the "cult of speed" created by advances in information and communications technologies that may represent a preferred lifestyle for future Albertans:

> These days, many of us live in fast forward – and pay a heavy price for it. Our work, health and relationships suffer. Over-stimulated, over-scheduled and overwrought, we struggle to relax, to enjoy things properly, to spend time with family and friends. The Slow movement offers a lifeline. It is not a Luddite plot to abolish all things modern. You don't have to shun technology, live in the wilderness or do everything at a snail's pace. Being "Slow" means living better in the hectic modern world by striking a balance between fast and slow.[46]

Making information and communications technologies an inherent part of everyday life in the future will require an increase in computing capacity well beyond today's best machines. The next trend is the creation of "smart computers", machines with not only processing ability beyond that of the human brain but also consciousness (see discussion of Robotics below). One advocate of this development is Jeff Hawkins, co-founder of Palm Computing and Handspring Inc. and co-author of the book entitled On Intelligence: How a New Understanding of the Brain Will Lead to the Creation of Truly Intelligent Machines.[47] These developments are alluded to by Ian Pearson, a futurologist working with BT in the United Kingdom.[48] In fact, Pearson sees the creation of a conscious computer with superhuman levels of intelligence before 2020. Ray

44 Ibid., pages 11-14.

45 Carl Honoré, In Praise of Slow: How a Worldwide Movement is Challenging the Cult of Speed (Toronto: Alfred A. Knopf Canada, 2004).

46 Accessed at http://www.inpraiseofslow.com/book.htm.

47 http://www.onintelligence.org/index.php

48 http://www.btinternet.com/~ian.pearson/

Kuzweil, noted scientist and futurist, also weighs in heavily on both the real possibility and desirability of computers attaining a level of intelligence beyond human capabilities.[49]

From the perspective of the forest products industry, a future world dominated by digital technology might finally usher in the era of a "paperless world". If this does come to pass, the demand for certain types of pulp will likely decline. However, the economic value of the forest may shift from paper products to tourism products if the "Slow" movement takes hold. "Living better in the hectic [future] world" might just include a serene day in the forest without the yoke of connectivity. As part of a counter-culture movement, being "unconnected" might be worth the price of admission.

Robotics

The future of robotics may well be depicted by the movie "I, Robot" released in 2004.[50] The setting is the city of Chicago in the year 2035. Robots are part of everyday life, delivering parcels, collecting the garbage, and doing household chores. Is this scenario realistic within the next 30 years or so?

One answer in the affirmative comes from Ray Kurzweil. Kurzweil predicts in his book The Age of Spiritual Machines (1999) that events will unfold as follows:[51]

- 2009: Most routine business transactions take place between a human and virtual personality.
- 2019: Most interaction with computers is through gestures and two-way natural language spoken communication … people are beginning to have relationships with automated personalities as companions, teachers, caretakers, and lovers.
- 2029: There is growing discussion about the legal rights of computers and what constitutes being human. Machines claim to be conscious and these claims are largely accepted.
- 2099: There is no longer any clear distinction between humans and computers.

Therefore, for Kurzweil, "I, Robot" would appear to be an accurate extrapolation of current trends.

Media reports also suggest that the "I, Robot" scenario is well along:

- An article in the newspaper USA Today contends that robots likely to serve the elderly will fall into three broad categories…. homebots, carebots and joybots. Aging boomers might buy

49 http://www.kurzweilai.net/meme/frame.html?main=/meme/memelist.html?m%3D19

50 http://www.irobotmovie.com/

51 Quoted in Bill McKibben, Enough: Staying Human in an Engineered Age (New York: Henry Holt and Company, 2003), page 76.

a specialized R2D2-like robot to clean the kitchen and another health carebot to monitor vital signs and make sure pills are taken. Yet another robot … might specialize in fetching things from shelves or the basement, making life easier and reducing chances for falls.[52]

- At Johns Hopkins University Hospital, a gadget dubbed Robo-doc helps busy doctors monitor patients following surgery. Carnegie Mellon has worked on robots that can safely walk nursing home patients, for instance, from their rooms to the dining hall — a task that would normally take up hours of staffers' time. Those are the early versions of carebots that could help tend to the elderly in their homes....[53]

- An article in The New York Times quotes a Pentagon prediction that robots will be a major fighting force in the American military in less than a decade, hunting and killing enemies in combat. Robots are a crucial part of the Army's effort to rebuild itself as a 21st-century fighting force, and a $127 billion project called Future Combat Systems is the biggest military contract in American history.[54]

The news on the future of robotics is backed up by the World Robotics 2004 survey: by the end of this decade robots will "not only clean our floors, mow our lawns and guard our homes but also assist old and handicapped people with sophisticated interactive equipment, carry out surgery, inspect pipes and sites that are hazardous to people, fight fire and bombs."[55]

The world's population and labour force are aging and will grow more slowly in the future (see later discussion of Demographic Change) but robotics appears to provide a means of arresting some of negative consequences of this demographic scenario, particularly a decline in productivity and labour shortages.

Nanotechnology

Products based on nanotechnology are projected to become an increasingly important part of the world's manufacturing sector. Lux Research sees sales of products incorporating nanotechnology rising from less than 0.1 percent of global manufacturing output to 15 percent in 2014 ($2.6

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52 Kevin Maney, "Domestic Bliss Through Mechanical Marvels?", USA Today, 2004 09 01, accessed at http://pqasb.pqarchiver.com/USAToday/results.html?num=25&st=basic&QryTxt=domestic+bliss+through+mechanical+marvels&sortby=REVERSE_CHRON&datetype=7&x=46&y=18.

53 Ibid.

54 Tim Weiner, "A New Model Army Soldier Rolls Closer to the Battlefield", The New York Times, 2005 02 16, accessed at http://query.nytimes.com/search/query?srcht=a&srchot=a&query=a+nwe+model+army+soldier+rolls+closer&field=body&daterange=day&mon0=02&day0=16&year0=2005&mon1=01&day1=01&year1=1996&mon2=05&day2=27&year2=2005&cre=The+New+York+Times&sort=closest&sources=all&submit.x=20&submit.y=9.

55 United Nations Economic Commission for Europe, "Press Release ECE/STAT/04/P01" (Geneva: October 20, 2004), accessed at http://www.unece.org/press/pr2004/04stat_p01e.pdf.

trillion). This value will approach the size of the information technology and telecom industries combined and will be 10 times larger than biotechnology.[56]

However, the real impact of nanotechnology is not the prospect of its growth within the current manufacturing paradigm but rather its potential to displace this paradigm entirely and create a "post-manufacturing economy". The ultimate potential of nanotechnology as a system of material production was forecast in 1986 by Eric Drexler in his book Engines of Creation: The Coming Era of Nanotechnology.[57] Drexler discusses the creation of "universal assemblers":

> [A]ssemblers will let us place atoms in almost any reasonable arrangement …[T]hey will let us build almost anything that the laws of nature allow to exist. In particular, they will let us build almost anything we can design - including more assemblers…. Assemblers will open a world of new technologies…. Advances in the technologies of medicine, space, computation, and production - and warfare - all depend on our ability to arrange atoms. With assemblers, we will be able to remake our world or destroy it.[58]

The economic, political, and social consequences of this development are enormous. In the view of the Centre for Responsible Nanotechnology:

> This has the potential to disrupt many aspects of society and politics. The power of the technology may cause two competing nations to enter a disruptive and unstable arms race. Weapons and surveillance devices could be made small, cheap, powerful, and very numerous. Cheap manufacturing and duplication of designs could lead to economic upheaval. Overuse of inexpensive products could cause widespread environmental damage. Attempts to control these and other risks may lead to abusive restrictions, or create demand for a black market that would be very risky and almost impossible to stop; small nanofactories will be very easy to smuggle, and fully dangerous.[59]

A world of nano-factories would impact the labour force (including the robots) and specific economic sectors such as energy profoundly:

> Production capacity will be essentially unlimited. An important product of the nanofactory would be solar cells. A lightweight design could collect enough energy to build another of the same size in a day or two. This implies that energy will not be a limiting factor in production capacity. And the main chemical element required would be carbon, which is plentifully available in many forms. Because a variety of physics factors work together to make molecular fabrication and nanoscale manipulation simpler than

[56] Lux Research, "Sizing Nanotechnology's Value Chain", 2004 10 25, accessed at http://www.luxresearchinc.com.

[57] Accessed at http://www.foresight.org/EOC/index.html#TOC.

[58] Accessed at http://www.foresight.org/EOC/EOC_Chapter_1.html#section10of10.

[59] Accessed at http://www.crnano.org/dangers.htm.

> large-scale industrial robotics, the factories are expected to be completely automated; this implies that labor costs (and manufacturing jobs) will disappear.[60]

How soon will the world of nanofactories and its projected societal upheaval be a reality? The Centre for Responsible Nanotechnology believes it could start to happen in five to twenty years from now.[61] McKibben reports similar time estimates from a variety of analysts.[62] The fundamental determinant is likely neither knowledge nor time but investment, especially by government.[63] One estimate of the cost by the NASA Institute for Advanced Concepts identifies a wide range from $100 million to $10 billion.[64]

Finally, Ronald Bailey speculates on an intriguing consequence of a future era of nanomanufacturing:

> I suspect that human needs for status, hierarchy, and competition will move away from the economic arena to art, scientific research, and politics. For example, handmade items, e.g., paintings and genetically modified orchids, will become much more expensive relative to consumer goods like cars and computers. Bryan Bruns [http://www.foresight.org/SrAssoc/BioBruns.html] foresees the growth of an "experience economy" in which novel experiences, not mere objects, will be sought after.[65]

Perhaps, when nanotechnology has devastated Alberta's natural resource economy, the economic value of a night in the forest or a hike in the mountains will be, to quote a current credit card television commercial, "priceless".

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[60] Centre for Responsible Nanotechnology, "Nanotechnology and Risk: Part 3", 2004 11 17, accessed at http://crnano.typepad.com/crnblog.

[61] Centre for Responsible Nanotechnology, "Nanotechnology and Risk: Part 4", 2004 11 18, accessed at http://crnano.typepad.com/crnblog.

[62] Bill McKibben, Enough: Staying Human in an Engineered Age (New York: Henry Holt and Company, 2003), pages 85-86.

[63] Ibid., page 84.

[64] Cited in Centre for Responsible Nanotechnology, "Nanotechnology and Risk: Part 4", 2004 11 18, accessed at http://crnano.typepad.com/crnblog.

[65] Ronald Bailey, "Nanotechnology: Heaven or Hell? Perhaps a Little Bit of Both", Reason Magazine, 2004 11 27, accessed at http://www.reason.com/rb/rb102704.shtml.

2.3 Economic Change

2.3.1 Past and Current Trends

Canada currently ranks among the world's economic leaders. In 2004, its gross domestic product (GDP) in real terms was over a trillion dollars. The goods producing industries accounted for about 30 percent of GDP and the services producing industries, 70 percent. Among the goods producing industries, manufacturing took the largest slice of GDP (17.3 percent). Mining and oil and gas extraction consumed 3.7 percent. Among the services-producing industries, the largest share was taken by ffinance and insurance, real estate, and renting and leasing and management of companies and enterprises (20.0 percent).[66]

One of the strengths of Canada's current economy is its trade orientation.[67] In 2004, Canada's exports of goods and related services by its top 25 industries were led by the automobile and light duty vehicle manufacturing (13.8 percent of total exports) and oil and gas extraction (12.3 percent) industries. Overall, the top 25 industries generated about 60 percent of total exports. In the ten-year period between 1995 and 2004, oil and gas extraction doubled its share of exports (from 6.0 to 12.7 percent). The prime destination for all our exports was the United States, a trend that increased between 1995 and 2004 (from 79.2 to 84.5 percent of total exports). China, an emerging economic powerhouse, took in a mere 1.61 percent of our exports in 2004 (up from 1.32 percent in 1995).

Most of Canada's imports (84.3 percent) came from ten countries – United States, China, Mexico, United Kingdom, Germany, South Korea, France, Norway, and Italy. The leading source country was the United States supplying 58.8 percent of imports, and the second leading supplier, China, was well behind at 6.8 percent. However, between 1995 and 2004, the American share slipped eight percentage points and the Chinese share rose from a level of 2.1 percent.

In 2004, Alberta's GDP in real terms was fourth largest among Canada's provinces and territories (behind that of Ontario, Québec, and British Columbia).[68] Its major trading partner was the United States. The United States accounted for 88.3 percent of Alberta's exports (77.5 percent in 1995) and 70.6 percent of imports (78.6 percent in 1995). Oil and gas extraction led the export parade by a wide margin over other industries with a share in 2004 of 68.1 percent, substantially higher than the 1995 share of 47.8 percent. Animal slaughtering and processing ranked fourth at 3.1 percent of exports. Over the past ten years, the share for this part of the province's agricultural sector has been as low as 2.6 percent in 1995 and as high as 4.5 percent in 1999. In 2004, most of Alberta's exports from the animal slaughtering and processing industry

[66] Calculations made from data provided by Statistics Canada, accessed at http://www40.statcan.ca/l01/cst01/econ15.htm.

[67] Data on exports and imports for Canada and Alberta are taken from Industry Canada, accessed at http://strategis.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tag.

[68] Statistics Canada, accessed at http://www40.statcan.ca/l01/cst01/econ50.htm.

were shipped to the United States (63.5 percent), Mexico (15.0 percent), and Japan (10.6 percent). Since 1995, the American share has fallen by almost ten percentage points and the Mexican share has increased substantially from 0.3 to 15.0 percent.

China's share of Alberta's exports remained relatively stable between 1995 and 2004 at approximately 2.5 percent. The share of exports from the animal slaughtering and processing industry increased from 0.6 to 1.3 percent; its share of oil and gas exports reached a high of 0.25 percent by the end of the period. Imports from China increased noticeably from 0.6 to 4.4 percent.

Although its significance as a trading partner for Canada and Alberta pales in comparison to that of the United States, China is starting to show up as more than a blip on the economic radar screen.[69] China is now the world's second largest economy after the United States, as measured by the purchasing power of GDP, and its export sector represents about one-quarter of GDP. In recent years, Canada has benefited both from the direct effect of higher exports to China and indirectly from the upward pressure on commodity prices from China's rapid industrialization.

Canadian imports from China have shifted from toys and trinkets to productivity-enhancing goods. In 2004, goods from China represented 6.8 percent of Canada's imports, with electronic equipment and mechanical machinery leading the way.

Canadian exports to China are driven by resource products, which typically account for about 80 percent of total shipments. Wheat used to dominate our exports to China up to the early 1990's and as recently as 1992, it accounted for 60 percent of our shipments. Since then, the share of wheat has slipped to just a little over 10 percent, supplanted by rapid gains for industrial materials (which rose to 45 percent) and forestry products (24 percent). Capital goods are about 11 percent, a share which has changed little over the last 15 years. Exports remain much smaller for autos (2 percent), energy (2 percent), and consumer goods (0.1 percent). Forestry products have seen rapid gains, raising their share of resource exports to China from only 9 percent in 1992 to close to one-third. China is now the largest importer of pulp in the world, and Canada the largest supplier in the world (and the second largest supplier to China after the United States). Pulp alone accounted for nearly one-fifth of all our exports to China in 2003. In 2003, lumber remained only a fraction of the importance of pulp, but exports have risen ten times since 1999.

Much more can be said about the structure and operation of Canada's economy at the beginning of the 21st century but our perspective is best summarized by the concept of an economic life cycle alluded to in earlier references to the ICT sector. Meyer and Davis, authors of the concept, describe a life cycle in terms of four sequential quarters of economic evolution:

> A new economic life cycle begins as science learns something new about the way the world works [Q1]. Next, technology shows us how to turn new science into new productive capabilities [Q2]. As a life cycle reaches maturity, every business employs the

[69] This discussion of Canada's trade with China is based on Francine Roy, "Canada's Trade with China", Canadian Economic Observer (Statistics Canada: June 2004), pages 3.1-3.7.

> new technology to improve its performance [Q3]. Ultimately, as an economy ages and the once-new technology becomes a commodity, we encode the deeper lessons from science and technology and apply them to the way work gets done and the way society is organized [Q4].[70]

The application of this life cycle concept to the three "economies" that characterize Canada's situation and that of other developed nations is depicted in Table 1:

Table 1. Four Phases of Three Economies[71]

	Industrial Economy	Information Economy	Molecular Economy
Q1 Science	Electrical engineering, chemistry	Solid-state physics, information theory	Biology, nanoscale science, materials science
Q2 Technology	Steel plants, oil, electrical equipment	Chips, operating systems, world wide web	Genomics, proteomics, nanotechnology, agent-based models
Q3 Business	Automobiles, consumer durables, skyscrapers	News media, information technology services, portals	Matter compiler, personal hospital, universal mentor, experience machine, social science simulator
Q4 Organization	Command and control, hierarchy, "scientific management"	"The Adaptive Enterprise"	Yet to emerge

At the beginning of the 21st century, Canada has a fully mature industrial economy; is entering the last quarter the information economy; and is at the doorstep of a "molecular economy" driven by the technological forces of genetics, robotics, and nanotechnology. In addition, Canada's historic trading relationship with the United States remains strong. Stronger economic ties with an emerging Asian economy are discernible but essentially limited to China.[72]

2.3.2 Projected Trends

In addition to the potential impacts of technology, energy development, and demographics on the future economies of Canada and Alberta, a key focus is the distribution of global economic power. Currently, two trade blocs, the North American Free Trade Agreement (NAFTA) and the European Union (EU), are predominant. However, as the new millennium dawned, countries in Asia, particularly China, India, and South Korea, began to serve notice of a shift in the global economy.

- The most compelling evidence of a future global economy in which nations in Asia and perhaps elsewhere in the now developing world play a more formidable role is provided by

[70] Christopher Meyer and Stan Davis, It's Alive: The Coming Convergence of Information, Biology, and Business (New York: Crown Press, 2003), page 7.

[71] Ibid., page 21.

[72] In 2004, India took in 0.21 percent of total exports and was the source of 0.44 percent of total imports. Data provided by Industry Canada, accessed at http://strategis.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tag.

the case of China. Consider what has been written about developments in China in the media during the past year:

- … China is the factory floor of choice for the world's low-road manufacturing … The productive might of China's vast low-cost manufacturing machine, along with the swelling appetites of its billion-plus consumers, have turned China's people into probably the greatest natural resource on the planet.[73]

- "The China price." They are the three scariest words in U.S. industry. In general, it means 30% to 50% less than what you can possibly make something for in the U.S. In the worst cases, it means below your cost of materials. Makers of apparel, footwear, electric appliances, and plastics products, which have been shutting U.S. factories for decades, know well the futility of trying to match the China price. It has been a big factor in the loss of 2.7 million manufacturing jobs since 2000. Meanwhile, America's deficit with China keeps soaring to new records. It is likely to pass $150 billion this year.[74]

- In bedroom furniture, 59 U.S. plants employing 15,500 workers have closed since January, 2001, as Chinese imports have rocketed 221 percent, to $1.4 billion -- half of the U.S. market. Prices have plunged 30 percent.[75]

- China is reaching out to countries in South America, dramatically increasing its trade with Brazil and Argentina, and negotiating its first free trade agreement with Chile.[76]

- I.B.M. has sold its personal computer division to Lenovo, China's largest personal computer manufacturer.[77]

- China is reported to be interested in having access to the output of Alberta's tar sands and perhaps even an equity investment stake, thereby siphoning off as much as one-third of the three million barrels exported daily.[78]

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[73] Ted C. Fishman, "The Chinese Century", The New York Times Magazine, 2004 07 01, accessed at http://query.nytimes.com/gst/abstract.html?res=F30E13FD3F5C0C778CDDAE0894DC404482&incamp=archive:search.

[74] Pete Engardio and Dexter Roberts with Brian Bremner, "The China Price", Business Week (United States), 2004 12 06, accessed at http://www.businessweek.com/magazine/content/04_49/b3911401.htm.

[75] Ibid.

[76] Jonathan Wheatley, Colin Barraclough, and Dexter Roberts, "Give Us You Soy, Your Iron, Your Grain …", Business Week (United States), 2004 10 04, accessed at http://www.businessweek.com/magazine/content/04_40/b3902074.htm.

[77] Steve Lohr, Andrew Ross Sorkin, and Gary Rivlin, "Sale of I.B.M. PC Unit is a Bridge Between Companies and Cultures", The New York Times, 2004 12 08, accessed at http://query.nytimes.com/gst/abstract.html?res=F00C12F639550C7B8CDDAB0994DC404482&incamp=archive:search.

- Carlos Gomes, Bank of Nova of Scotia economist, estimates that worldwide sales [of motor vehicles] hit 44.45 million vehicles this year [2004], about 3 per cent above the 2003 level, despite flattening sales in North America and Western Europe. China became the fourth-largest market, passing France and Italy, and will probably be No. 2 - ahead of Germany and Japan and behind only the United States - by the end of the decade. After a 71-per-cent growth spurt in 2003, Chinese auto sales probably rose another 15 per cent or more in 2004 to about 2.3 million vehicles. India overtook China as the fastest-growing market, with an estimated 29-per-cent jump to about 900,000.[79]

The scope of China's economic consumption has recently been analyzed by Lester R. Brown, a noted environmentalist and founder and president of the Earth Policy Institute in Washington, D.C. (http://www.earth-policy.org/index.htm). Brown observes that:[80]

- Among the five basic food, energy, and industrial commodities—grain and meat, oil and coal, and steel—consumption in China has already eclipsed that of the United States in all but oil.

- China's 2004 intake of 64 million tons of meat has climbed far above the 38 million tons consumed in the United States. While U.S. meat intake is rather evenly distributed between beef, pork, and poultry, in China pork totally dominates.

- As China's population urbanizes and as the country has moved into the construction phase of development, building hundreds of thousands of factories and high-rise apartment and office buildings, steel consumption has climbed to levels not seen in any other country.

- While oil use in the United States expanded by only 15 percent from 1994 to 2004, use in the new industrial giant more than doubled. Having recently eclipsed Japan as an oil consumer, China is now second only to the United States.

- Looking at energy use in China means also considering coal, which supplies nearly two thirds of energy demand. China's burning of 800 million tons easily exceeds the 574 million tons burned in the United States.

- In addition to steel, China also leads in the use of other metals, such as aluminum and copper.

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[78] Simon Romero, "China is Emerging as a Rival to U.S. for Oil in Canada", The New York Times, 2004 12 23, accessed at http://query.nytimes.com/gst/abstract.html?res=FB0D13FA3A540C708EDDAB0994DC404482&incamp=archive:search.

[79] "China, India Drive Record Sales of Cars", The Globe and Mail (Toronto), 2004 12 31, accessed at http://www.theglobeandmail.com.

[80] Accessed at http://www.earth-policy.org/Updates/Update45.htm.

- In another key area, fertilizer—essentially nitrates and potash—China's use is double that of the United States

- In 1996, China had 7 million cell phones and the United States had 44 million. By 2003 China had rocketed to 269 million versus 159 million in the United States. In effect, China is leapfrogging the traditional land-line telephone stage of communications development, going directly to mobile phones.

- After a late start, the number of personal computers jumped to 36 million in 2003 compared with 190 million in the United States. But with the number of computers in use doubling every 28 months, it will only be a matter of time before China, a country of 1.3 billion people, overtakes the United States

- With household appliances, such as television sets and refrigerators, China has long since moved ahead of the United States. Among the leading consumer products, China trails the United States only in automobiles.

- With a per capita annual income in 2004 of $5,300, one seventh the $38,000 in the United States, China has a long way to go to reach U.S. per capita consumption levels.

- China is now importing vast quantities of grain, soybeans, iron ore, aluminium, copper, platinum, phosphates, potash, oil and natural gas, forest products for lumber and paper, and the cotton needed for its world-dominating textile industry.

- The new industrial giant's need for access to raw materials and energy is shaping its foreign policy and security planning.

- The United States, the world's leading debtor nation, is now heavily dependent on Chinese capital to underwrite its fast-growing debt.

Brown's conclusion on China's growing economy may turn out to be prophetic:

China is no longer just a developing country. It is an emerging economic superpower, one that is writing economic history. If the last century was the American century, this one looks to be the Chinese century.

The rapid and seemingly unstoppable growth of China's economy has not occurred without costs, both current and potential. Concern has been expressed about the stability of its financial system when an economic downturn eventually hits based on a perception that there will be a reluctance to close up money losing state-run banks and enterprises and create substantial unemployment and political unrest.[81] Notwithstanding its overall population of 1.3 billion, the prospect of labour shortages exists as a result of improving incomes in the rural areas putting a brake on out-migration, the dearth of young female workers (an unintended consequence of the

[81] Michael Mandel, "China's Coming Financial Crisis", Business Week (United States), 2004 10

one-child policy), and the pace of construction outstripping available supply.[82] This problem may only be short-lived but whether China's workers will continue to work for relatively low wages is an important question. According to a report conducted for the Bureau of Labor Statistics in the United States, the cost of Chinese factory labour, in urban, suburban, and rural areas, is a paltry 64 cents an hour, a rate that includes both wages and employer contributions for benefits and social insurance. By comparison, hourly factory compensation in the U.S. in 2002 was $21.11, and an average of $14.22 in the 30 foreign countries covered by the report. Given China's low living costs, 64 cents buys as much as $2.96 in the U.S.[83]

Low wages and chronic unemployment in the rural areas appear to be a recipe for social conflict. There is already concern on the part of the Chinese government about the uneven distribution of the benefits of economic growth. According to some observers, protests are escalating to a point not seen since the crisis in Tiananmen Square in 1989. Police statistics show the number of public protests reached nearly 60,000 in 2003, an increase of nearly 15 percent from 2002 and eight times the number a decade ago. Martial law and paramilitary troops are commonly needed to restore order when the police lose control.[84]

Both China and the United States are projected to be among the most populous countries in the world well into the future (see discussion of Demographic Change below). Current economic trends point to a future in which the two countries are likely to be economic powerhouses as well as rivals. Will today's "developing" nations such as China and India continue to be content with the outsourcing of low skill, low wage production jobs from the "developed" nations or will they leverage their growing populations to acquire the high skill, high wage jobs in fields such as robotics and nanotechnology that for the past few centuries have been the domain of the developed nations?[85] Canada, a trading nation, will be impacted by any developments affecting the roles of the United States and China (and other countries such as India, Brazil, and South Korea) in the global economy. Mexico, a developing nation, increased its share of Alberta's animal slaughtering and processing exports fifty-fold between 1995 and 2004 (a development

82 Dexter Roberts and Frederik Balfour, "Is China Running Out of Workers?", Business Week (United States), 2004 10 25, accessed at http://www.businessweek.com/magazine/toc/04_43/B3905magazine.htm.

83 Judith Banister, Manufacturing Employment and Compensation in China (Washington, D.C.: Bureau of Labor Statistics, U.S. Department of Labor, December 2004), accessed at http://www.bls.gov/fls/chinareport.pdf.

84 Joseph Kahn and Chris Buckley, "China Worries About Economic Surge That Skips the Poor", The New York Times, 2005 03 05, accessed at http://query.nytimes.com/gst/abstract.html?res=F60916F93B590C778CDDAA0894DD404482&incamp=archive:search; Joseph Kahn and Chris Buckley, "China's 'Haves' Stir the 'Have Nots' to Violence", The New York Times, 2004 12 31, accessed at http://query.nytimes.com/gst/abstract.html?res=F00810F63F5D0C728FDDAB0994DC404482&incamp=archive:search; and Keith Bradsher, "The Two Faces of China", The New York Times, 2004 12 06, accessed at http://query.nytimes.com/gst/abstract.html?res=F30E17FF3F550C758CDDAB0994DC404482&incamp=archive:search.

85 Aaron Bernstein, "Shaking Up Trade Theory", Business Week (United States), 2004 12 06, accessed at http://www.businessweek.com/magazine/content/04_49/b3911408.htm.

facilitated by Mexico's participation in NAFTA). With its apparent insatiable appetite for resources such as oil and gas, what share of the exports from Alberta's major industries will China have in 10 years, 50 years, or 200 years?

2.4 Demographic Change

2.4.1 Past and Current Trends

The World[86]

At the beginning of the 20th century, the global population was 1.6 billion people. By the end, it stood at 6.1 billion, mainly because of unprecedented growth after 1960. Growth was not distributed evenly across the globe. The population of the developed regions more than doubled over the century, exceeding 1 billion by 2000. However, the most dramatic growth was in the developing regions, where population more than quadrupled (nearly 5 billion by 2000). This uneven regional growth reduced the developed countries' share of world population from one third to one-fifth over the century. Europe's relative share of world population fell most, from approximately one-quarter in 1900 to one-eighth in 2000. By comparison, the less developed countries in Africa, Latin America, and the Caribbean accounted for more than one-fifth of the world in 2000, up from one-eighth in 1900, and Asia contained nearly three-fifths of the world's people. Two Asian countries, China and India, each have well over a billion people.

Although the interplay of the demographic variables of fertility, mortality, and migration played out differently in different countries at different times, the dominant model of demographic change during the 20th century was the "demographic transition". The demographic transition refers to the shift from high to low mortality and fertility. This shift occurred throughout Europe, North America, and a number of other areas in the 19th and early 20th centuries, and started in many developing countries in the middle of the 20th century.

Demographers generally consider that fertility has the greatest influence on the population structure in nearly all countries. The total fertility rate (TFR) is the average number of children that a women has during her lifetime. A replacement level of fertility is 2.1. In 2004, the global TFR was 2.8. The TFR in the developed nations was 1.6; in the developing nations, 3.1 (3.5 if China is excluded).[87] Currently, 4 percent of the world's countries exhibit little or no decline in fertility (TFR of 6.0+); 12 percent, moderate decline (4.0-5.9); 41 percent, substantial decline (2.1-3.9); and 43 percent, below replacement fertility (2.0 or below).

86 This discussion of global demographic change is based on three reports published by the Population Reference Bureau (http://www.prb.org): Brian O'Neill and Deborah Balk, World Population Futures (Washington, D.C.: Population Bulletin, Vol. 56, No. 3, September 2001); Population Reference Bureau Staff, Transitions in World Population (Washington, D.C.: Population Bulletin, Vol. 59, No. 1, March 2004); and Nancy E. Riley, China's Population: New Trends and Challenges ((Washington, D.C.: Population Bulletin, Vol. 59, No. 2, June 2004).

87 Population Reference Bureau, "2004 World Population Data Sheet", accessed at http://www.prb.org/Template.cfm?Section=PRB&template=/Content/ContentGroups/Datasheets/2004_World_Population_Data_Sheet.htm%20%20.

The decline in mortality (or more positively the increase in life expectancy) is largely a consequence of improvements in public health and medical knowledge and technology. Life expectancy does vary by country and even within countries as well as in terms of socio-economic factors such as gender or income. Globally, life expectancy for males is 65 years and for females, 69. It is higher in the developed world at 72 and 80, respectively. In the developing world (including China), males can expect to live on average for 63 years and females for 67. Japan is the country with the highest life expectancy: 78 for males and 85 for females.[88]

Migration refers to the movement of people both between countries (international) and within countries (intra-national). The international flow of people is the key to increasing a country's population through migration (movement within a country changes population at a regional level). About 175 million people or three percent of world population are international migrants. The migrant pool is augmented by an estimated 5 million to 10 million people each year. A large majority of international migrants are from less developed countries (where about 80 percent of world population lives) and most move from one less developed country to another.

Until recently, the focus on population size and growth has largely ignored a critical demographic variable: the age structure of the population, i.e., the way the population is distributed across different age groups. Since individual and household economic behavior varies at different stages of life, changes in age structure can significantly affect national economic performance.[89] Globally, 30 percent of the population is under the age of 15 and 7 percent, 65 or older. However, there is a real contrast between the developed and developing world. In the former, 17 percent are under 15 and 15 percent are 65-plus. In the latter (excluding China), the shares are 36 and 4 percent, respectively.[90] Looking ahead, both the differential in population growth and age structure will impact the global political and economic balance of power.

With a current population of approximately 1.3 billion, China is the world's most populated country. This fact in combination with its growing economic might necessitates a more detailed look at its demographic situation. Some of the trends and issues that should be highlighted are: [91]

- China's mortality has declined dramatically over the past 50 years, from 14 deaths per 1,000 people in 1953 to below 7 by 2000.

- China's TFR has fallen from 6.2 in 1950 to 1.7 in 2003. A 2001 survey showed that the TFR in urban areas was 1.22 children per woman, significantly lower than the rural TFR of 1.98. This fertility decline has been supported by some of the world's most restrictive national birth planning policies, most notably the "one-child campaign" started in 1979. China's birth

88 Population Reference Bureau, "2004 World Population Data Sheet".

89 See, for example, David K. Foot with Daniel Stoffman, Boom, Bust & Echo: Profiting From the Demographic Shift in the 21st Century (Toronto: Stoddart Publishing Co. Ltd., 2000).

90 Population Reference Bureau, "2004 World Population Data Sheet".

91 Nancy E. Riley, China's Population: New Trends and Challenges.

planning policies have tempered the impacts of the factors normally considered to affect fertility such as the woman's education or family income. The policies have also created the problem of the "missing girls". The estimated sex ratio (i.e., the number of males per 100 females) for all births in 2000 was 120, the highest in the world.

- In 1980, life expectancy at birth for both sexes was 64.0 years; by 2001, it had risen to 71.8 years. Mortality rates are notably higher (and in some instances increasing) in rural areas and among the poor, ethnic minorities, and women.

- China's population is aging because of the dramatic fertility declines. The proportion of the population age 60 or older increased from just over 7 percent in 1953 to more than 10 percent in 2000. The elderly share is projected to reach 27 percent in 2050.

- China's government recognizes 56 official "nationalities" representing 9 percent of the country's total population (about 105 million people). The remainder of the population is Han Chinese.

- Between 30 million and 100 million Chinese from rural areas were living in cities by the mid-1990s. An agricultural census during this period estimated there were 56 million rural workers engaged in non-agricultural work in urban areas in one year alone. Economic expansion and reforms have also brought inequality between rural and urban residents. An estimated 170 million rural residents still live in poverty.

Canada

A snapshot of Canada's demographic situation currently and in the recent past can be obtained by reference to the Statistics Canada publication Annual Demographic Statistics 2004:[92]

- On July 1, 2004, Canada's population was estimated at 31,946,300, an increase of 285,900 since July 1, 2003. The growth rate for the 2003/04 period (9.0 per 1,000) was among the lowest since 1971. For the second consecutive year, the growth rate was below 10.0 per 1,000.

- Canada's population growth is characterized by a continuing decline in natural increase (births minus deaths). In 2003/04, the estimated rate of natural increase dropped to 3.1 per 1,000, the lowest rate on record. At 10.4 per 1,000, the birth rate continued its downward trend while the death rate (7.3 per 1,000) remained stable, with an improvement in life expectancy compensating for the aging of the population.

- Gains through international migration continued to be the main factor in the growth of Canada's population. While net migration accounted for 44.4% of total population growth in the early 1970's (from 1971 to 1974), it was 66.3% from 2001 to 2004.

92 Statistics Canada, Annual Demographic Statistics 2004 (Ottawa: Ministry of Industry, March 2005), pages 1-10.

- As an indicator of Canada's aging population, the median age is now 38.3 years, whereas in 1984 it was 30.6. In 2004, 24.6% of the population was in the age group 0-19, down from 29.7 in 1984. Over the same period, the 65+ age group increased to 13.0%, from 10.0% in 1984.

- Alberta (13.6 per 1,000), Ontario (11.0 per 1,000) and British Columbia (10.6 per 1,000) were the only provinces with population growth rates above that of the national average.

- [On July 1, 2004, Alberta's population was 3,201,895, 10 percent of Canada's.] Since 1997/98, the pace of growth in Alberta has declined and its gains over the last 2 years (43,300 in 2003/04 and 42,300 in 2002/03) were the lowest since 1995/96…. The demographic situation in 2003/04 in the provinces and territories has been influenced by recent changes to interprovincial migration trends. For the past 2 years, population losses in Newfoundland and Labrador through migration to other regions …were the lowest since 1991/92. Moreover, with net interprovincial migration in Ontario decreasing since 1999/00, the net became negative in 2003/04 for the first time since 1995/96. Alberta has continued to maintain its positive growth (10,900), albeit the lowest since 1995/96.

- All the provinces east of Ontario had median ages higher than the national average (38.3 years) in 2003/04. Among provinces west of Quebec, the median age in British Columbia (39.2 years) was the oldest and Alberta's (35.3 years) remained the youngest. In the latter case, a contributing factor was gains through interprovincial migration which helped the population age less rapidly.

- More and more Canadians live in census metropolitan areas (CMA's). In 2004, almost 20,754,800 (65%) Canadians resided in a metropolitan area and, of those, more than half were living in Toronto (5,203,600), Montréal (3,607,200) and Vancouver (2,160,000).

- As natural increase continues to spiral downwards, migratory exchanges continue to play an increasingly important role with regard to the pace at which metropolitan areas grow. The Toronto CMA continues to maintain its first place status with the highest population gain…. With a net gain of 4,400 persons, the Calgary CMA posted the highest population increase due mainly to large gains through provincial exchanges…. CMA's have a particularly strong attraction for persons aged 18 to 29 years old. The phenomenon was especially evident for the CMA's of Toronto, Montréal and Vancouver.

- …[T]he CMA's of Saskatoon and Calgary had the youngest population, with median ages being 34.7 years and 35.1 years, respectively.

At the start of the 21st century, Canada was typical of a country that has made the demographic transition. Its TFR was 1.49 in 2000, and life expectancy for males was 76.7 and for females, 82.0 years.[93] Another factor is that population growth nationally is driven primarily by

93 Alain Bélanger, editor, Report on the Demographic Situation in Canada 2002: Current Demographic Analysis (Ottawa: Ministry of Industry, Statistics Canada, December 2003, pages 14-17.

international migration as net natural increase declines. International migration is increasing the ethnic/racial diversity of the population. Statistics Canada in its reference scenario projects a 76.3 percent increase in the "visible minority" population by 2017 (from 4,037,500 in 2001 to 7,116,200 in 2017). This compares with an increase of 3.3 percent in the non visible minority population.[94]

Alberta's population growth during the last quarter of the 20th century was primarily driven by interprovincial migration. In addition, about two-thirds (64 percent) of its population in 2004 was resident in either the Edmonton (1,001,636) or Calgary (1,037,136) CMA's.[95] Alberta also reflected the demographic transition with a TFR of 1.64 and life expectancy values of 77.1 (male) and 82.0 (female) in 2000.[96]

2.4.2 Projected Trends

The World

In early December 2003, a unique report was released by the United Nations (U.N.). The report contained the United Nations' population projections to the year 2300. It was unique in two respects. The first was the timeline. Previous projections had extended no further than 2150. The second unique aspect was that the projections were made not only for continents but also for countries. The projections were produced by the Population Division of the Department of Economic and Social Affairs of the United Nations and vetted by an Expert Group of population scientists from universities and other relevant organizations (for example, the U.S. Census Bureau) in the United States, United Kingdom, Germany, France, Brazil, Chile, and Mexico.[97]

Key assumptions and findings of the report include:[98]

94 A. Bélanger and É. Caron Malenfant with the collaboration of L. Martel, Y. Carrière, C. Hicks and G. Rowe, Population Projections of Visible Minority Groups, Canada, Provinces and Regions: 2001-2017 (Ottawa: Ministry of Industry, Statistics Canada, 2005), page 11.

95 Statistics Canada, Annual Demographic Statistics 2004 (Ottawa: Ministry of Industry, March 2005), calculated from data in Table 1. Annual population estimates by age, sex and census metropolitan area for July 1, 2001 to 2004, Canada

96 A. Bélanger and É. Caron Malenfant with the collaboration of L. Martel, Y. Carrière, C. Hicks and G. Rowe, ibid.

97 Population Division, Department of Economic and Social Affairs, World Population in 2300: Proceedings of the United Nations Expert Meeting on World Population in 2300, United Nations Headquarters, New York (New York: United Nations, 2004), pages 33-36.

98 Ibid., pages 7-13. More detailed findings including data tables are contained in the final report: Population Division, Department of Economic and Social Affairs, World Population in 2300 (New York: United Nations, 2004), accessed at http://www.un.org/esa/population/publications/longrange2/WorldPop2300final.pdf.

- The projections are grounded in five scenarios with different assumptions about fertility. According to the medium scenario, in which world fertility for every country averages around replacement level, world population would rise from today's 6.3 billion persons to around 9 billion persons in 2300. Altering fertility by one-quarter of a child under replacement, or one-quarter of a child above replacement, results in world population ranging from 2.3 billion (low variant) to 36.4 billion (high variant) in 2300. In the constant fertility scenario, leaving fertility at 1995-2000 levels produces a world population of 244 billion persons in 2150 and an unsustainable 134 trillion in 2300. The zero-growth scenario, where births and deaths are balanced after a certain point, results in a population of 8.3 billion in 2300.

- All projection scenarios assume zero migration and decreasing mortality (increasing life expectancy) after 2050. No limit is set on the increase in life expectancy. As a result some countries reach very high levels of survivorship by 2300. The highest projected life expectancies are in Japan: females are projected to have a life expectancy of 108 years and males, 104 years. The lowest for Liberia and Mali (88 for females and 87 for males) are greater than current levels in Japan.

- Much of the demographic change up to 2050 will take place in the less developed regions. Collectively, these regions will grow 58 per cent over 50 years, as opposed to 2 per cent for more developed regions. Less developed regions will account for 99 per cent of the expected increment to world population in this period. However, population growth in the less developed regions is expected to slow down in the future. Due to falling fertility, the current annual growth rate of 1.6 per cent (for 1995-2000) will be halved in a little over 25 years and will be roughly halved again by mid-century.[99]

- All scenarios result in major shifts in the regional distribution of the world's population. According to the medium scenario, Africa's share of the world population would double, from 13 percent of the world population in 2003 to 24 percent in 2300. Europe's share would be halved, from 12 percent today to 7 percent in 2300.

- India, China and the United States will continue to be the most populous countries in the world (see Table 2). By 2200, only six developed countries (as currently defined) will be among the countries that comprise 75 percent of the world's population. Canada, with a projected population of approximately 38.5 million under the medium scenario, does not qualify for membership in this group.

- The world population will continue to age rapidly with the median age rising from 26 years today to nearly 50 years in 2300. According to the medium scenario, the global share of persons aged 0-14 declines from 30 per cent in 2000 to 16 per cent in 2300, and the number of persons aged 60 years or over rises from 10 percent to 38 percent (41 percent in more developed and 37 percent in less developed regions). The percentage aged 80 or over will rise from just 1 percent today to 17 percent in 2300.

99 World Population in 2300, page 4.

- The new long-range population projections show a smaller future population size (9 billion persons) than previous United Nations long-range projections (10-12 billion). This is primarily due to the recent fertility declines occurring throughout the developing world and expectations that future fertility trends in the developing countries will follow the path experienced by the developed countries.

Table 2. Countries Comprising 75 percent of Global Population in 2200 (medium scenario)[100]

Country	Population in 2200 (millions)	Cumulative %
India	1,305	15.4%
China	1,201	29.5%
United States	470	35.0%
Pakistan	343	39.0%
Nigeria	268	42.2%
Indonesia	263	45.3%
Bangladesh	232	48.0%
Brazil	209	50.5%
Ethiopia	197	52.8%
Congo	173	54.8%
Uganda	149	56.6%
Yemen	127	58.1%
Mexico	121	59.5%
Philippines	119	60.9%
Egypt	118	62.3%
Viet Nam	108	63.5%
Iran	95	64.7%
Japan	95	65.8%
Niger	91	66.8%
Turkey	87	67.9%
Russia	87	68.9%
Germany	79	69.8%
Thailand	72	70.7%
Afghanistan	70	71.5%
United Kingdom	69	72.3%
Tanzania	68	73.1%
France	64	73.9%
Mali	61	74.6%
Iraq	60	75.3%

Canada

Government agencies such as Statistics Canada typically do not develop population projections beyond a 25-30 year period. The most recent projections prepared by Statistics Canada are for

100 Calculated from data downloaded from http://www.un.org/esa/population/unpop.htm.

the 2000-2026 period.[101] However, the national projection is extended to 2051 by holding the assumptions about fertility, mortality, and migration constant at the 2026 levels.

Statistics Canada puts forward four projections – low (projection 1), medium (projection 2), high-west (projection 3), and high-central (projection 4) – that produce a population range of 34.2 to 38.6 million for Canada in 2026. The medium projection (projection 2) calls for a population of 36.2 million. Its underlying assumptions include a TFR of 1.48, male life expectancy of 80 years, female life expectancy of 84 years, and international migration of 225,000 annually.[102] Extending the medium projection to 2051, Canada's population is just less than 36.9 million.[103]

The results for Alberta under the medium scenario register a population of 3,576,600 in 2026. This result assumes a declining birth rate and increasing death rate, annual international migration of 14,000, and a precipitous drop in inter-provincial migration by 2026.[104] The 2026 population results for Alberta from the other projections are:

- Low (projection 1): 3,402,300[105]
- High-west (projection 3): 4,016,400[106]
- High-central (projection 4): 3,504,300[107]

Projections that only go as far as 2051 at the national level are insufficient as a guide to constructing our population projections for the area containing Millar Western's FMA. Therefore, it is useful to consult the data on Canada in the projections to 2300 developed by the United Nations. The results for Canada under all five scenarios developed by the United Nations are depicted in Table 3.

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101 M.V. George, Shirley Loh, Ravi V.P. Verma, and Y. Edward Shin, Population Projections for Canada, Provinces and Territories: 2000-2026 (Ottawa: Ministry of Industry, Statistics Canada, Demography Division, March 2001).

102 Ibid., Chart IV, page 57.

103 Ibid., Table A1, page 118.

104 Population Projections for Canada, Provinces and Territories: 2000-2026, Table A1, page 123.

105 Ibid., page 115.

106 Ibid., page 131. This projection assumes higher international and inter-provincial migration levels for Alberta than in the medium scenario.

107 Ibid., page 139.

Table 3. Canada's Population Under Different Scenarios[108]

Scenario	Population in Thousands				
	Year 2000	Year 2050	Year 2100	Year 2200	Year 2300
Zero growth	30,769	39,085	37,281	37,281	37,281
High	30,769	42,566	49,391	81,358	132,743
Medium	30,769	39,085	36,234	38,539	40,876
Low	30,769	35,858	26,598	19,707	15,112
Constant fertility	30,769				5,038

Looking at the results for 2050 in Table 3, the projections by the United Nations are all higher than the corresponding projections (for 2051) by Statistics Canada. The projection level that is closest between the two organizations is the high projection level. The projections for both organizations are compared in Table 4 (excluding the United Nations' constant fertility and zero growth scenarios).

Table 4. Population Projections for Canada: United Nations versus Statistics Canada

United Nations (Year 2050)		Statistics Canada (Year 2051)	
Scenario	Population (000's)	Scenario	Population (000's)
High	42,566	High (projection 4)	43,000
Medium	39,085	Medium	36,900
Low	35,858	Low	32,300

Dissecting further the assumptions and findings for Canada within the United Nations' medium projection yields the following observations:[109]

- The average annual rate of population growth will decline from 0.48 percent in the 2000-2050 period to 0.05 percent by the 2250-2300 period. It will reach its lowest level (-0.15 percent) during the last 50 years of this century.

- The average annual population change will reach a maximum of 241,000 between 2000 and 2005 and a minimum of -77,000 between 2050 and 2055. By 2300, the annual increase is projected at 21,000.

- The TFR climbs from its current level of 1.48 to 1.85 by 2050 and 2.06 (replacement level) by 2100. The TFR is at replacement level (2.06) in 2300.

108 World Population in 2300, Annex Tables.

109 World Population in 2300, Annex Tables.

- Male life expectancy rises substantially attaining 85 years by 2100, 93 years by 2200, and 99 years by 2300.

- Female life expectancy rises substantially reaching 90 years by 2100, 97 years by 2200, and 102 years by 2300.

- The median age of the population is projected at 46 years in 2050 (from 37 in 2000). By 2100, it is 44; by 2200, 47; and by 2300, 50.

2.5 Driving Forces: Summary

A useful way to summarize our analysis of the driving forces of energy, technology, economics, and demographics is to return to Schwartz's distinction between predetermined elements and critical uncertainties:

2.5.1 Predetermined Elements

- The primacy of fossil fuels as an energy source across the globe appears assured until at least the middle of the 21st century and perhaps somewhat beyond that point. Therefore, Alberta's economy should continue to prosper during this period on the basis of developing its conventional and non-conventional energy resources.

- The ICT sector of the economy in developed nations will attain maturation in the next 10 years or so.

- In the developed countries, the use of robots in industrial production will continue to expand, thereby alleviating some of the pressures associated with the aging of their labour forces. The application of robotics to tasks in the service sector is currently at a rudimentary level and likely cannot be counted on over the next 20 years to provide a solution to the problems of labour force aging.

- Nanotechnology will reach its initial stage of development (i.e., making existing products better and creating new products) within the next 10 to 15 years. This trend will not alter the current manufacturing paradigm.

- Advances in genetics will be a critical factor in the trend towards increasing life expectancy.

- Over the course of this century, significant advancements in economic prosperity and medical well-being will occur as a result of the convergence of ICT, robotics, nanotechnology, and genetics.

- Economic globalization will be the dominant trend for the foreseeable future. However, trade patterns between the developed and developing world for both material and intellectual resources will continue to shift. Canada is well-positioned to meet the demand of the developing world for natural resources and will likely lessen somewhat its trade dependence on the United States.

- The United States will remain a growing market and a significant trade partner for Canada.

- The "demographic transition" is the global paradigm for future demographic change.

- Population aging will impact both developed and developing countries over the next two hundred years.

- During this century, most of the global population growth will occur in the developing world.

2.5.2 Critical Uncertainties

- Environmental impacts may hasten the transition to alternative energy sources. However, certain alternative energy sources, especially hydrogen, face substantial technical and financial challenges before they are sustainable in both economic and environmental terms.

- Will the Alberta and Canadian economies make a successful transition to a world powered by alternative energy sources and rapidly changing, converging technologies?

- When will robots play a role in the service sector comparable to their current role in the goods production sector? Will the productivity gains attributable to the application of robotics to services be a reality by 2050 or before?

- Will nanotechnology evolve to the point where it will create a "post-manufacturing economy"? If a "post-manufacturing economy" creates widespread prosperity, will leisure be valued more highly both socially and economically?

- Can the United States maintain its global economic supremacy or will its economy ultimately be eclipsed by the emerging Asian giants, China and India? Will Alberta and Canada make the transition to a world economic order not dominated by the United States?

- If the full evolution of nanotechnology and the end of the fossil fuel era threaten Alberta's traditional economy, will the province be able to compete in the realm of the new technologies or possibly a new "leisure economy"?

- What factors might tip the fertility rate above replacement level in the developed nations such as Canada? Could the co-existence of economic prosperity and a highly technological lifestyle create a movement that places higher value on family and interpersonal relationships? Alternatively, will prosperity and technology propel us towards a "post-human" state where the emphasis will be more on the "quality" of human reproduction than the "quantity"?

3. Economic and Demographic Projections

3.1 Overview

Against the backdrop of the trends in the driving forces, this part of the report describes the model and assumptions we have used to develop plausible alternative population projections for Alberta, the Edmonton Census Metropolitan Area (CMA), Census Division (CD) 4811, and CD 4813 (which contains the Town of Whitecourt and the Millar Western FMA).

We begin by noting that if encroachment on Millar Western's FMA is to occur over the next two hundreds years, it is likely to do so by means of one or more of five potential threats:

- The population, households, and places of employment of the Edmonton Census Metropolitan Area could expand beyond current boundaries to reach the Whitecourt area and Millar Western's FMA;

- The population, households, and places of employment of the Whitecourt area itself could expand into the FMA;

- Agriculture activities could migrate in a northerly direction within the province, ultimately encroaching on Whitecourt and the FMA;

- The number of visitors to the area (tourists) could increase to the point where the future existence of the FMA is undermined; or

- Coalbed methane deposits in the vicinity of the FMA could be developed as part of the increased global demand for fossil fuels from non-conventional sources.

The first two threats – encroachment by the expanding populations of Edmonton and Whitecourt, respectively - are addressed using a set of population projections that we have developed for each of Alberta, Edmonton, CD 4811, and CD 4813. The projections are first constructed to illustrate the impacts of different economic and demographic assumptions on future population growth. Next, we develop projections that we consider to be the most plausible for Alberta, Edmonton, CD 4811, and CD 4813 as the basis for our conclusions regarding the threat of population expansion into the FMA.

These projections result from an economic-demographic model developed by the Centre for Spatial Economics for the purpose of assessing the impacts of potential regional economic growth on regional populations. The model in various customized forms has been used extensively by the Centre on behalf of other clients. Its use on behalf of Millar Western is described in the next section.

The third threat - agriculture encroachment - is addressed through an assessment of the current spatial distribution within Alberta of agriculture production against a backdrop of the potential for world-wide growth in the demand for Alberta-produced agricultural products.

The fourth threat - tourism encroachment - is addressed through an assessment of the current spatial distribution within Alberta of tourism activities against a backdrop of the potential for growth in tourism demand within Alberta, the rest of Canada, the United States, and the rest of the world.

The fifth threat – encroachment related to the extraction/production of coalbed methane gas – is addressed through an assessment of the probable future spatial distribution of CBM activities in the province against a backdrop of the potential for continued world-wide, especially North American, growth in the demand for energy.

Our analysis on the first four fronts leads us to conclude that it is highly unlikely that Millar Western's FMA will be threatened by human encroachment from any of these threats over the next two hundred years. Our analysis with respect to CBM suggests that its development will continue to migrate north within the province over the next two centuries and that future CBM development poses a credible threat to Millar Western's FMA within that time frame.

3.2 Economic-Demographic Model

3.2.1 Backgrounder on Population Settlement Patterns

The first census in Canada was taken in 1665-1666 and it was determined that the population of New France totaled 3,215 people (excluding aboriginal people and royal troops). The first decennial census was taken in 1851 and it revealed a total population of 2.5 million people. Since 1851, Canada's population has grown by an average of 1.9 million people per decade (or by 15 percent) reaching a total of 31.0 million as of 2001 (and an estimated 32.5 million as of 2006).

Population growth from one census to the next over that century and a half period varied significantly. For example, it grew by close to 25 percent between 1851 and 1861, 1901 and 1911, and 1951 and 1961, all of which were decades of economic prosperity that attracted massive flows of immigration. In contrast, it grew by less than 10 percent between 1931 and 1941 during the Great Depression, and again by less than 10 percent between 1991 and 2001 when the economy slowed as Canada tightened its belt to reduce government deficits and debt.[110]

The distribution of growth across the country varied significantly over that period as well. Settlement of the west, driven by natural resource extraction and agriculture, dominated the first half of that period supplanted since the Great Depression by growth in central Canada driven by industrialization and trade with the United States. Migration flows again explain the differences in population growth from one part of the country to another.

Canada's population growth has now slowed to a pace of about 10 percent each decade. Because of low fertility rates over the last three decades, the natural rate of growth of Canada's population is rapidly approaching zero. An increase in net immigration will be required in the next few decades if a 10 percent per decade pace is to continue. Canada's future population growth, like that of the past, will depend on how well the economy performs.

Over the last decade, the only provinces witnessing population gains exceeding 10 percent were Alberta (19 percent, driven by energy sector expansion and trade with the United States), Ontario (14 percent, driven by broad-based economic expansion stemming from trade with the United States.), and British Columbia (11 percent, driven by tourism and natural resources fostered by trade with Asia). In all cases, the growth is fuelled by international trade patterns. The populations of the remaining provinces are either not growing hardly at all, or they are declining (as in Newfoundland and Saskatchewan) because their economies are not generating new jobs.

All of Canada's provinces, even those that are growing, are witnessing declines in the populations of their rural areas. The major economic activities in these areas historically have related to mining, forestry, and associated manufacturing processes. While mining, forestry, and related manufacturing processes as industries are still growing, they are not growing as quickly as in the past, and they are becoming more and more productive with the application of new technologies. Thus, the number of people needed to get the job done in these sectors is in decline. As a result, most rural communities face gradual declines in their population base in the decades ahead.

110 Note that during the 1990's births held steady while deaths gradually increased due to an aging population, not higher mortality rates. As a result, the net natural change in population gradually declined each year during the 1990's, thus contributing to a slower pace of population growth unrelated to the state of the economy. However, net international migration also slowed from the high levels of the late 1980's as a result of the slower economy. These two sources together – demographic and economic – resulted in the overall slowing of population growth in Canada in the 1990's. The point is that, in the presence of a strong economy, net international migration would have been greater and population growth would not have slowed despite the demographic changes underway.

3.2.2 Economic Base and Community Base Industries

Communities exist because there is an economic reason for their existence: as a mining site, a manufacturing centre, a transportation hub, or a tourism attractor. Industries providing products or services to businesses or people outside a community are said to be export-based. Traditionally the primary (agriculture, forestry, fishing and mining) and manufacturing sectors have been seen as the export-based engines of economic growth for communities.

Increasingly, however, many services are serving non-local markets. Exported services account for a growing share of the economic base of a number of communities. Numerous examples of exported services can be found: legal, accounting, architectural, engineering, software development, and consulting firms serving national or international markets; call centers, data processing centers, head offices, back offices, and warehouses serving non-local businesses; universities and hospitals serving sizable non-local populations; and attractions, hotels, restaurants, and retail outlets serving tourists from other communities or other countries.

In sharp contrast to the export-based industries, most activity within a community serves the needs only of those living in that community. While exceptions exist, in most communities, much of the activity in construction, education, health care and social assistance, other services, and public administration, is driven by the needs of the local community. These industries would not exist in any community in the absence of some form of an export base.

Thus, the economic potential of a community depends on the economic base already established and on the potential for growth in employment in that base in the years ahead. Generally speaking, the population and household base of a community will increase in the future only if growth in employment in the economic base of the community occurs.

The economic-demographic model described in the following section and used to develop the various projections for Alberta contained in this report captures the interrelatedness of export and community base development described above. A schematic diagram of the model used in developing our projections is contained in Figure 1. The model includes two distinct blocks, a demographic block (coded in the diagram in yellow) and an economic block (blue), linked through a third block that includes aspects of both the demographic and economic blocks which together define the labour market (gray).

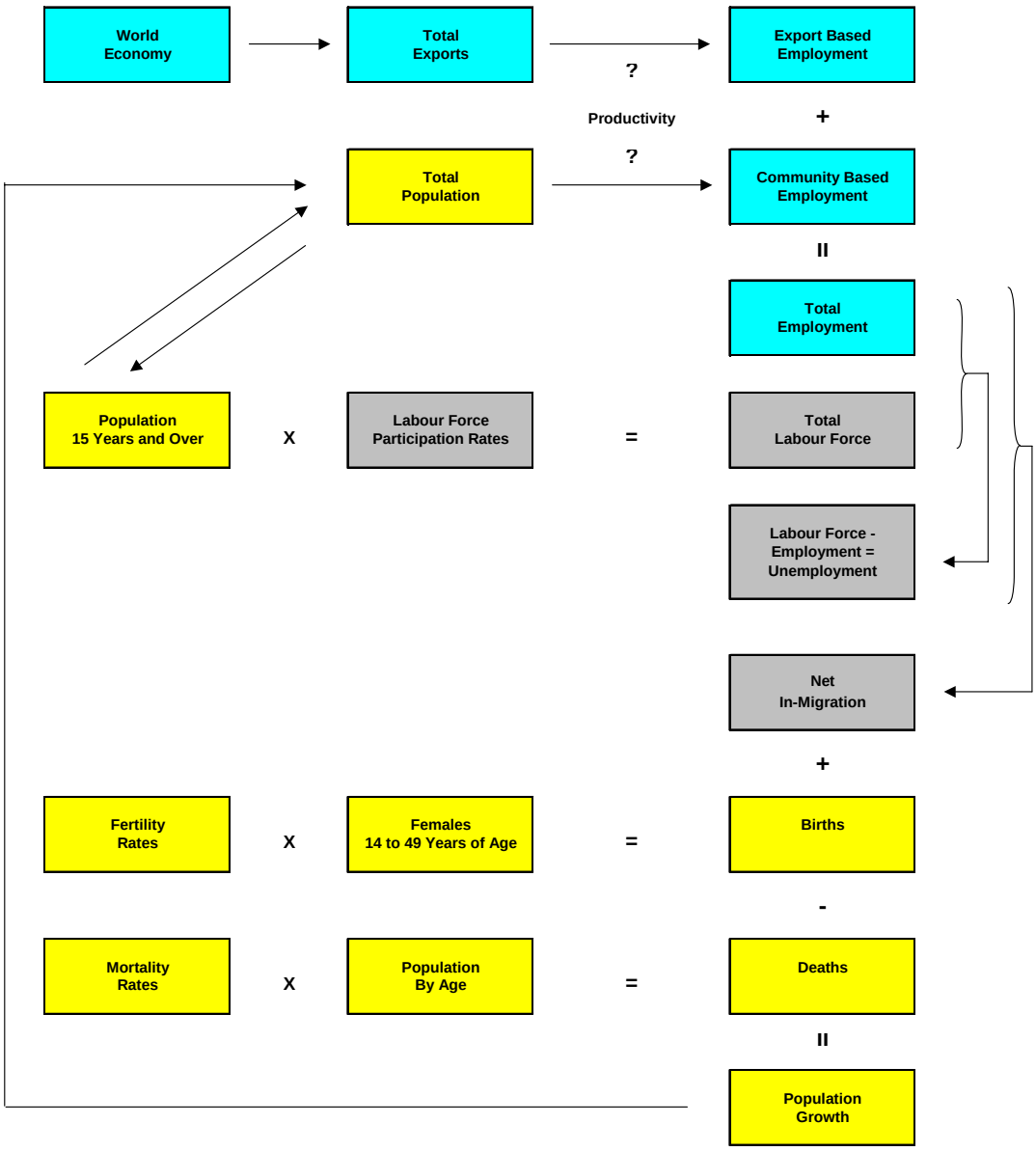

Figure 1. Economic-Demographic Model

3.2.3 How the Model Works

The economic block of the model projects Alberta's gross domestic product (GDP) in constant dollar terms by breaking the economy into two key industrial groups: those that produce goods and services that are primarily consumed by people and businesses outside Alberta (the export base industries) and those that produce goods and services that are primarily consumed by people and businesses in Alberta (the community base industries).

For example, Alberta's exports in the model are determined by growth in the economies of Canada, the United States, and the rest of the world (the World Economy box in the diagram).

Employment in the export base industries is determined by the levels of production of Alberta's export base industries taking into account expectations regarding the future rates of growth in output per worker (productivity) in the export base industries.

Community base industry growth is determined by the needs of the population in general (for example, the need for education and health services). The faster the population grows, the faster the growth for community base services. The growth rate in community base services, in turn, determines the growth rate in community base employment, again taking into account expectations regarding the future rates of productivity growth in those industries. Total employment in Alberta's export base industries plus total employment in its community base industries equals total employment across Alberta as a whole.

The demographic block of the model consists of a traditional age cohort population model. This block builds on a base of known information regarding the age and gender distribution of the population of Alberta as of 2004 (according to Statistics Canada's post censal estimates of the population) and on expected future fertility rates by age of mother and mortality rates by age and gender. The model predicts the population of Alberta in single year age and gender categories over time by aging the people in each cohort by one year each year and adjusting the number in each cohort according to assumed changes over time in fertility rates and mortality rates. The model allows for changes in the assumptions regarding future fertility and mortality rates.

The economic and demographic blocks are linked through the labour market. The demographic block provides detailed information regarding the number of persons potentially available for labour market activity (traditionally viewed as all persons 15 years of age and over not in an institution or on a First Nations reserve).[111] The proportion of the population actually available for labour market activities (the labour force or the supply of labour) is determined by assuming rates of labour market participation among persons of various ages and genders based on historical and expected trends. If the level of economic activity (determined by the economic block) generates a level of employment (the demand for labour) exceeding the labour supply (determined by the demographic block) – thus driving the number of unemployed persons and the unemployment rate down to levels that are unsustainable – the model generates a net positive inflow of migrants to clear the labour market. If, on the other hand, the level of economic activity generates a demand for labour that falls short of the supply (increasing the number of unemployed and the rate of unemployment), the model generates a net positive outflow of migrants to clear the labour market.

Economic and demographic changes happen simultaneously in the real world. The model accounts for these various changes across the future with the labour market establishing the equilibrium between economic and demographic changes. In this model, migration flows are determined endogenously by economic need, not exogenously as in most other population models (including those developed by the United Nations and Statistics Canada described earlier in this report). Although it is true that the level of immigration is controlled by federal government policies, it is also true that immigration targets in the past have been established

[111] Statistics Canada, Labour Force Historical Review 2004.

based on a consideration of the nation's labour market requirements.[112] Thus, the endogenous determination of net-migration in the model is simply a reflection of reality.

The model also allows for the allocation of total population growth within the province to each of the CMA's of Edmonton and Calgary, to CD 4811 and CD 4813, and to the rest of Alberta based on expected shares.

To develop any projection using the economic-demographic model, assumptions need to be made regarding:

- The annual rate of growth in real output of each of Alberta's export based industries.[113] These include all of agriculture; all of forestry, mining, and oil and gas; utilities; all of manufacturing (which in Alberta is mostly petroleum refining and chemical products); a portion of professional, scientific, and technical services; a portion of business, building, and other support services; and a portion of food and accommodation (the tourism supported portion). Over the last twenty years, the export base industries of Alberta have collectively grown at an average annual rate of just under 3 percent.

- An economy-wide rate of productivity growth.[114] Over the last twenty years, economy-wide productivity in Alberta has averaged 1.2 percent per year.

- The total fertility rate.[115] The rate in Alberta in recent years has averaged 1.7. It has persisted at a level well below the replacement rate of 2.1 since the early 1970's.[116]

- The average age of life expectancy for males and females at birth.[117] At this time in Alberta, males at birth can expect to live just over 77 years and females just over 82 years.[118]

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112 Strategic Projections Inc., GTA Population and Employment Projections (Toronto: January 2000).

113 In the model a single rate of growth for overall exports is assumed. The model calculates a rate for each export base industry based on the overall rate and on a relative rate (which can be individually adjusted if desired) reflecting historical trends.

114 This economy wide rate is used to drive individual industry productivity growth rates based on historical relative trends and on our judgment regarding future relative trends by industry.

115 The total fertility rate reflects the number of children each female of child bearing age would have based on currently prevailing rates of fertility at each age level from 14 to 49 years of age. In the model, a scale factor is applied to each rate by age across time which allows for raising or lowering the individual rates, thus affecting the resulting total fertility rate.

116 Statistics Canada, CANSIM Table 102-4505 (May 2005).

117 In the model, a scale factor is applied to individual age and gender mortality rates over time to achieve the desired age of life expectancies.

118 Statistics Canada, Life expectancy – abridged life table, at birth and confidence interval, by sex, Canada, provinces and territories, 2002 (September 2004).

Before developing plausible population projections for Alberta, Edmonton, and the two census divisions, we first construct several projections for Alberta alone, simply to illustrate how the various assumptions identified above relate to each other and to the population potential of the province as a whole. Next, we draw attention to the three projections that are the most plausible for Alberta over the next two centuries.

3.2.4 Alternative Export Growth Scenarios and Projections

It is our contention that the size of Alberta's population over time will largely be determined by the size of its economy. Therefore, we begin by describing three scenarios differing from each other only in the rates we assume regarding the future growth of Alberta's export base industries. In these three scenarios, we assume that the overall rate of productivity growth in the future will be about the same as it has been in the past and that fertility rates and mortality rates will hold constant at current rates. We vary the future rates of export growth as follows:

- As a starting point, we assume that between now and 2051 the export base industries of Alberta will grow at an average annual rate of about 2.3 percent. We assume that by 2101 the rate will have fallen to about 1.8 percent and that by 2201 it will have fallen to 1.4 percent. These trends are in line with projections regarding expected rates of growth in the rest of Canada and in the United States.[119] We call this the Exports Moderate (EM) scenario.

- As alternatives, we assume that Alberta's export base industries will grow at an average annual rate over the entire projection period by an amount 0.5 percentage points higher (the Exports Strong scenario, ES) or 0.5 percentage points lower (the Exports Weak scenario, EW) than the Exports Moderate scenario.

The projections of GDP, employment, and population emanating from the three scenarios are summarized in Table 5.

119 The Centre for Spatial Economics typically develops long-term projections for Canada through to the year 2031. The growth rates assumed for the United States over this period are drawn from a number of sources, the most relevant being, over the next decade, from our partner organization in the United States, Macroeconomic Advisers, LLC in St. Louis, and beyond ten years out, from various publications produced by the United States Bureau of the Census and by the United States Congressional Budget Office. Projected growth rates for Canada and the United States beyond 2031 through to 2201are as assumed by the Centre for Spatial Economics based on long term population projections from the United Nations.

Table 5. Comparison of Alternative Export Growth Scenarios: Projections of Real Gross Domestic Product, Employment, and Total Population

	Year								
Scenario	**2005**	**2026**	**2051**	**2076**	**2101**	**2126**	**2151**	**2176**	**2201**
Gross Domestic Product ($97 Billions)									
Exports Moderate	133	207	360	576	894	1,282	1,848	2,554	3,426
Exports Strong	134	233	477	877	1,558	2,490	4,004	6,090	8,898
Exports Weak	132	183	275	384	526	679	880	1,107	1,364
Employment (Millions of Persons)									
Exports Moderate	1.8	2.2	2.8	3.4	4.0	4.4	4.9	5.3	5.6
Exports Strong	1.8	2.5	3.7	5.2	7.0	8.6	10.7	12.7	14.6
Exports Weak	1.8	1.9	2.1	2.3	2.3	2.3	2.3	2.3	2.2
Total Population (Millions of Persons)									
Exports Moderate	3.2	4.0	5.2	6.3	7.4	8.2	9.0	9.8	10.3
Exports Strong	3.2	4.5	6.8	9.5	12.7	15.6	19.3	22.9	26.4
Exports Weak	3.2	3.6	4.0	4.3	4.4	4.4	4.4	4.4	4.3

Source: Centre for Spatial Economics.

Projections under the Exports Moderate scenario represent, for the most part, a continuation of the status quo in terms of export growth, productivity growth, fertility rates, and mortality rates. Under this scenario, a total population for Alberta of 5.1 million persons is attained in 2051. Base case provincial projections prepared for other clients of the Center for Spatial Economics that extend only as far as 2051 also call for a total population for Alberta in that year of just over 5 million.

The projections in Table 5 reveal how dramatically different the future of Alberta would be if export base industries grow only a bit faster or a bit slower than assumed in the Exports Moderate scenario. By 2051 the economy (measured by real GDP, total employment, and total population) in the Exports Strong scenario is a third larger than in the Exports Moderate scenario. By 2101 it is almost 75 percent larger and by 2201 it is more than two and one-half times the size of the Exports Moderate scenario. In contrast, in the Exports Weak scenario, by 2051 the economy is about three-quarters the size of the Exports Moderate scenario, falling to less than 60 percent by 2101 and to less than 40 percent by 2201. It should be noted that Alberta's combined forestry, oil and gas, and mining industries would have to generate output in 2201 almost ten times that generated today for the Exports Strong scenario to be attained. The industries would have to generate output in 2201 about four times that generated today for the Exports Weak scenario to be attained.

Figure 2 compares the projection for the total population of Alberta for each of these three scenarios. It shows that in the Exports Weak scenario the population of Alberta reaches a peak around 2026 of less than 5 million and gradually declines thereafter. In sharp contrast the population of Alberta climbs across the entire projection horizon in both the Exports Moderate and Exports Strong scenarios, ultimately reaching levels of more than 10 million in the former case and more than 26 million in the latter case.

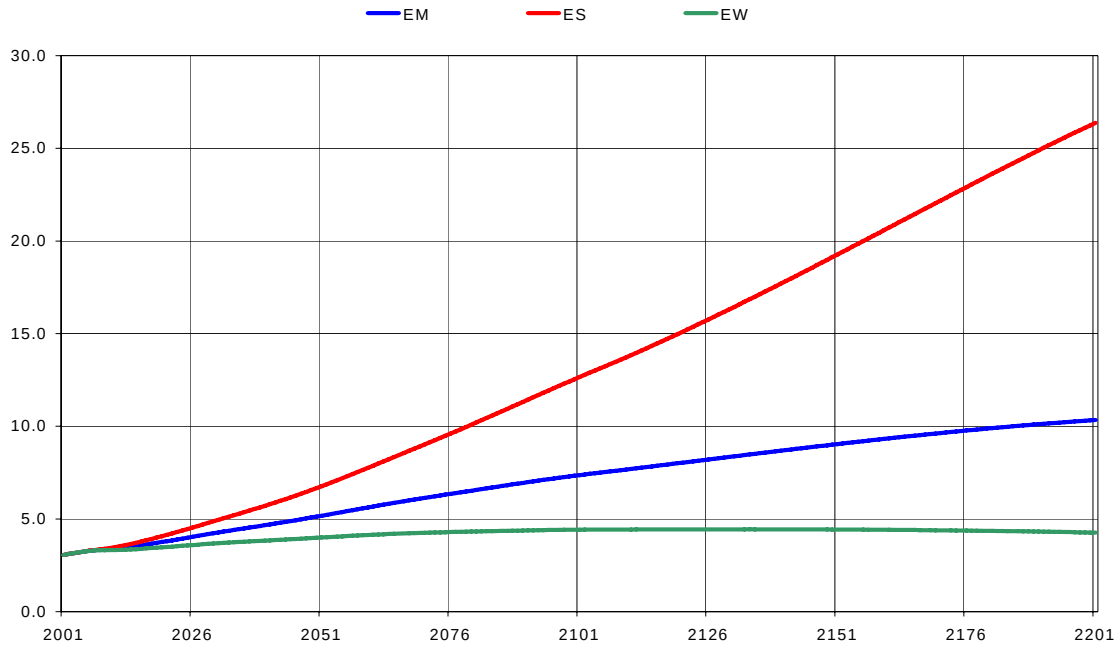

Figure 2. Export Growth Scenarios: Total Population Projections

Source: Centre for Spatial Economics.

Our analysis of the driving forces might furnish the plausible conditions for the levels of economic growth attained in the Exports Strong and Exports Moderate scenarios, respectively. By 2051 the larger economy in the Exports Strong scenario (compared to the Exports Moderate scenario) could reflect a world in which fossil fuels are still a major component of the total energy supply, a trend we categorized earlier as a "predetermined element". In particular, the demand generated by matured economies in Asia might be substantial. Alberta's strategic role in this future scenario could be sustained by the development of its non-conventional sources of supply. This outcome (at least, up to around 2050) is in line with the projections done by the Bureau of Economic Policy Analysis in the Netherlands. Continued expansion of the Alberta economy beyond 2051 under the Exports Strong scenario might reflect a successful transition to the production of non-fossil fuels or an economy focused on nano-manufacturing and other new technologies, trends we categorized earlier as "critical uncertainties". Economic decline under the Exports Moderate scenario could be a sign that alternative fuels have come to the fore earlier than currently anticipated either due to environmental or economic considerations and that Alberta and possibly North America have not made a successful transition to an economy based on new technologies and dominated by Asia's largest countries such as China and India (trends that also fall within the realm of critical uncertainties).

3.2.5 Alternative Productivity Growth Scenarios and Projections

Most economists would agree that productivity growth in the future is likely to at least match the pace achieved in the past.[120] Hence, our assumption in the three scenarios described above that the productivity growth in the future will match that of the past.

However, due to the recent surge in overall productivity growth in the United States,[121] and in view of the emerging and powerful technologies described elsewhere in this report, we have prepared two alternative scenarios based on the assumption that productivity will grow 0.5 percentage points per year faster in the future than assumed in the above three scenarios. This assumption implies that the rate of technological change in the future will be greater than that of the past by a factor of about one-half. In other words, we are assuming a major acceleration in the rate of technological advancement.

We developed two scenarios involving this assumption, one based on the Exports Moderate scenario, the other on the Exports Strong scenario. Higher productivity growth in the future means the same level of output can be achieved with fewer workers. Thus, the level of employment (and hence the associated level of total population) in each of these new scenarios is significantly lower than it is with the Exports Moderate and Exports Strong scenarios. We call these two scenario alternatives Exports Moderate, Higher Productivity Growth (EMHP) and Exports Strong, Higher Productivity Growth (ESHP). Figure 3 compares the total population projections associated with each of the scenarios.

120 Andrew Sharpe, "Symposium on Future Productivity Growth in Canada: An Introduction", International Productivity Monitor (Centre for the Study of Living Standards, Fall 2003), page 45.

121 Centre for the Study of Living Standards, Aggregate Income and Productivity Tables for Canada and the United States, (accessed at http://www.csls.ca/data/ipt11.pdf), Chart 9 on page 36.

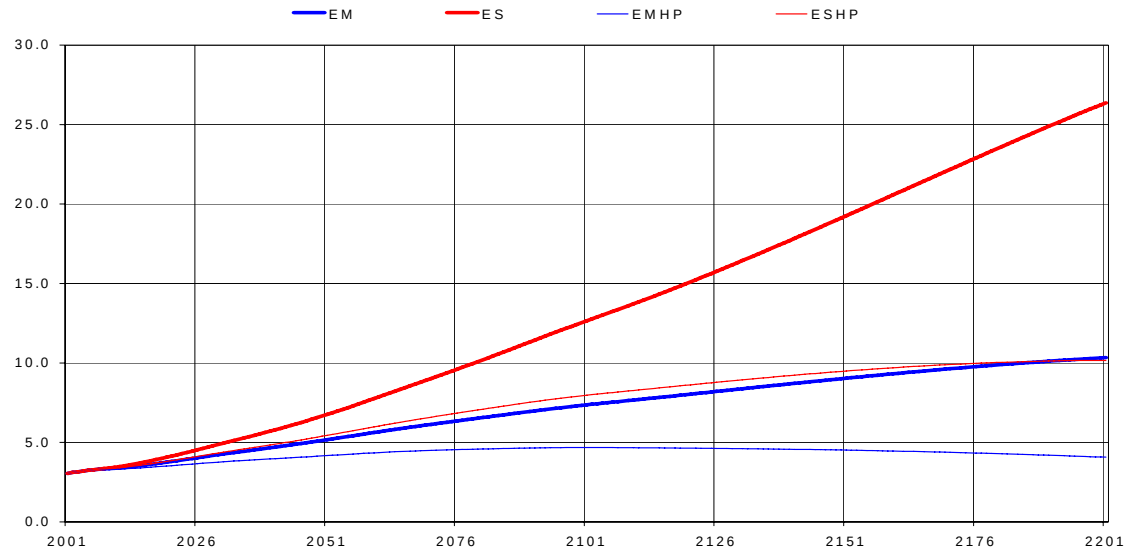

Figure 3. Export and Productivity Growth Scenarios: Total Population Projections

Source: Centre for Spatial Economics.

Several observations can be made about the projections in Figure 3. If productivity grows 0.5 percent faster in the future than assumed in the Exports Strong (ES) scenario, the population associated with the Exports Strong, Higher Productivity (ESHP) scenario is about the same as that associated with the Exports Moderate (EM) scenario. When higher productivity growth is assumed for the future in conjunction with the Exports Moderate scenario (Exports Moderate Higher Productivity, EMHP), the total population of Alberta reaches a peak between 2101 and 2126 at less than 5 million people, then falls thereafter (a path similar to that of the Exports Weak population projection).

The enhanced productivity growth is achieved in these new scenarios through the adoption of new technologies resulting in the replacement of workers with equipment. Less net in-migration is therefore required in these simulations, so the population associated with this more capital intensive world is smaller.

3.2.6 Alternative Fertility Rate Scenarios and Projections

To this point we have prepared all scenarios on the assumption that neither fertility nor mortality rates will change in the future. The total fertility rate in Canada and Alberta has persisted at a level well below the replacement rate of 2.1 since the early 1970's. The current rate in Alberta (1.7) is a bit higher than that for Canada as a whole (1.5).122 As shown in our discussion of demographic trends, factors such as increasing real incomes lead to a decline in the total fertility rate. Furthermore, the general view underlying most of the U.N.'s population projections is that future total fertility rates will be lower throughout the world than they are today.

122 Statistics Canada, CANSIM Table 102-4505 (May 2005).

Mortality rates in Canada have been declining steadily. In the early 1920's, both males and females at birth could expect to live only about 60 years. Today, life expectancy among females is around 83 years and among males about 76 years.[123] It seems reasonable to expect that, in view of the projected path of technology described earlier in this report, life expectancy will continue to increase. Certainly, the U.N. makes this assumption in its projections.

To gauge the importance of such potential shifts on the total population, we prepared two alternative scenarios to the Exports Moderate scenario. For both scenarios, we assumed that mortality rates will drift downwards in the future to gradually increase life expectancy rates to 93 years for males and 97 years for females, in line with the projections prepared for Canada by the United Nations. In preparing the first scenario, we followed the U.N.'s assumption that fertility rates in Alberta will drift upwards gradually to reach the replacement rate by the end of the projection period. In the second scenario, we assume that fertility rates in Alberta will gradually drift downwards to reach 1.3 by the end of the projection period. We call these scenarios Exports Moderate, Higher Fertility (EMHF) and Exports Moderate, Lower Fertility (EMLF). Figure 4 compares the projected total population of these two scenarios to the projection in the Exports Moderate scenario.

123 Statistics Canada, Life expectancy – abridged life table, at birth and confidence interval, by sex, Canada, provinces and territories, 2002 (September 2004)

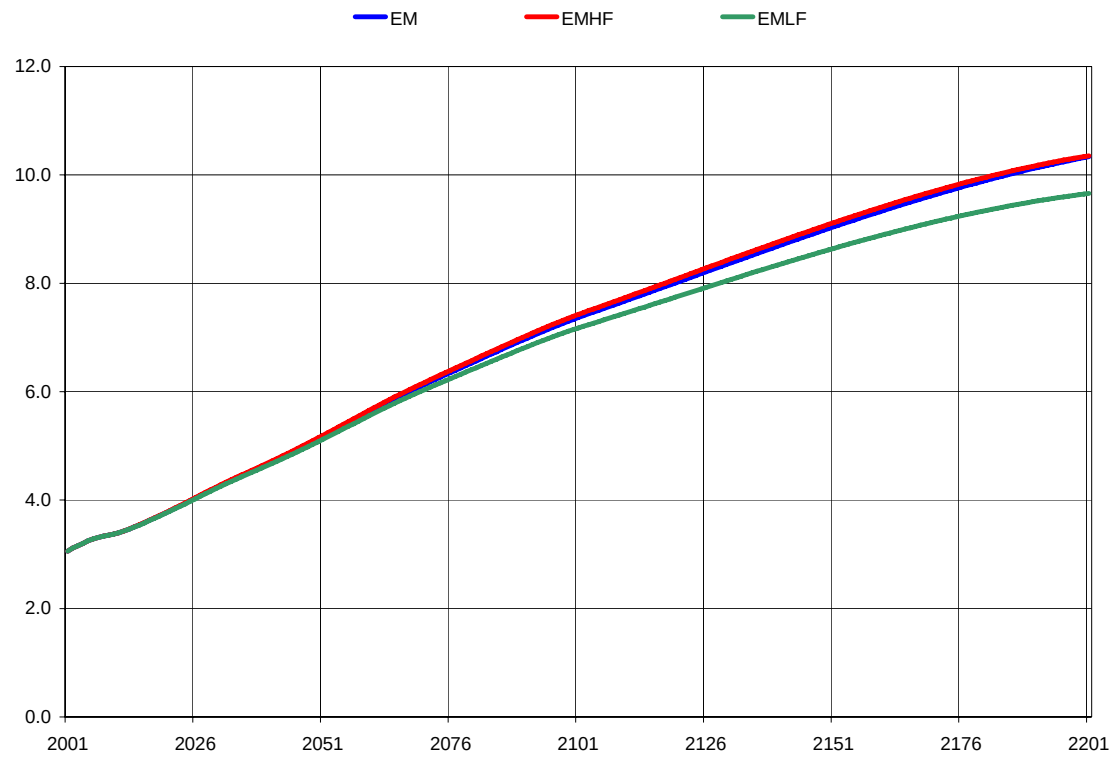

Figure 4. Fertility Rate Scenarios: Total Population Projections

Source: Centre for Spatial Economics

Not surprisingly, there is hardly any difference among the three projections with respect to total population because the population in our model is determined by the requirements of the economy, and our assumptions regarding the economy are the same in all three scenarios. The Exports Moderate scenario needs a certain number of workers without regard to their source.

The key difference among these three population projections is the *source* of future population growth. In the High Fertility projection, net natural population growth turns positive around 2051 and remains positive throughout the projection horizon. This results in considerably less net in-migration in the ensuing period compared with the other two projections. In the Low Fertility projection, net natural population growth is negative throughout the projection period. As a result, the amount of net in-migration required is significantly greater than in either of the other two projections. These trends are illustrated in Figure 5 and Figure 6.

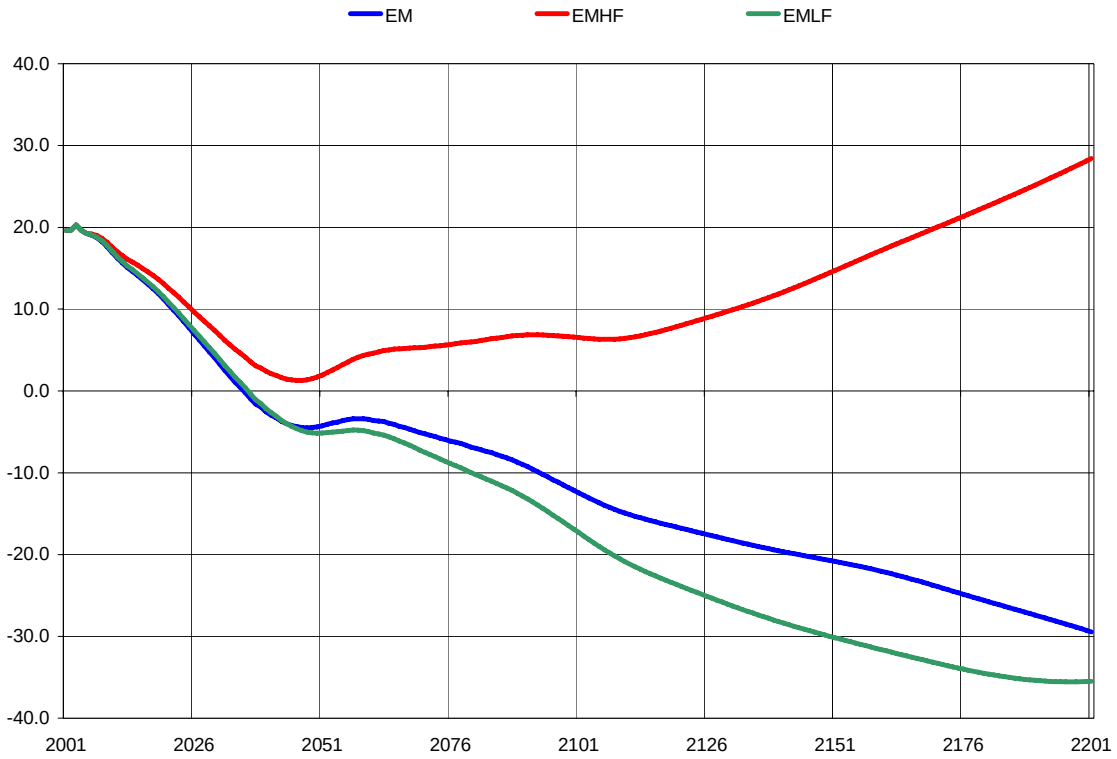

Figure 5. Fertility Rate Scenarios: Net Natural Change Projections

Source: Centre for Spatial Economics.

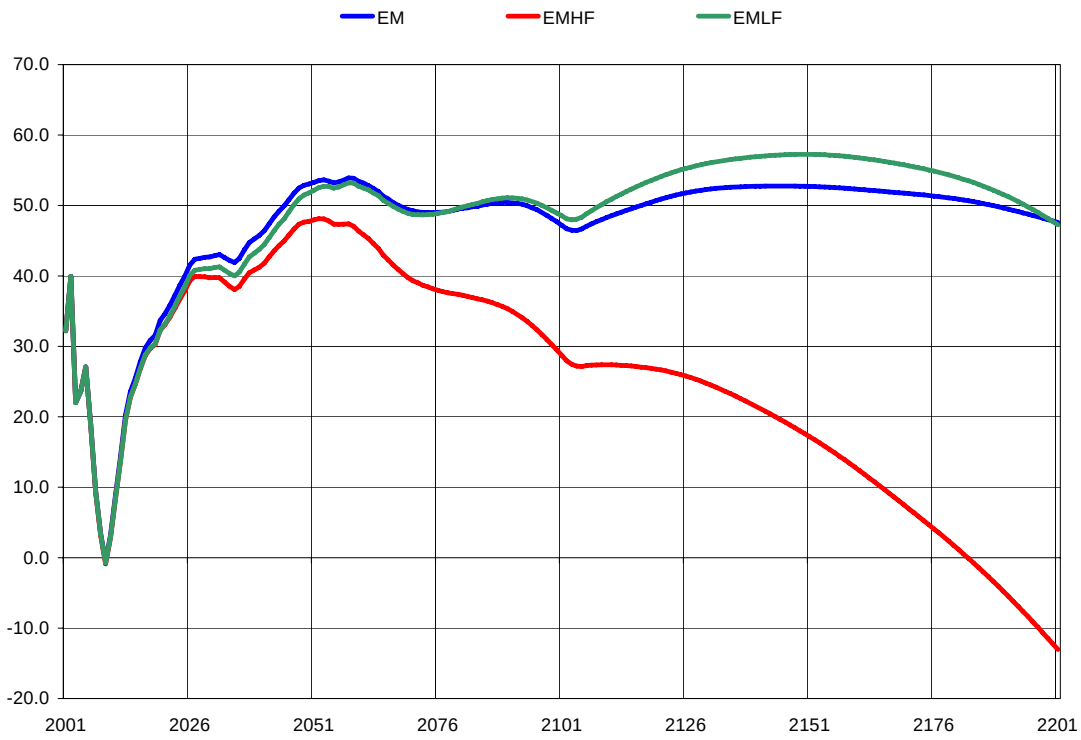

Figure 6. Fertility Rate Scenarios: Net Migration Projections

Source: Centre for Spatial Economics.

The results of the High and Low Fertility scenarios highlight the conceptual differences between projections generated from our economic-demographic model and those developed by the United Nations and Statistics Canada that are based solely on alternative demographic assumptions without regard to changes in key economic factors. Our "demographic scenarios" show clearly that changes in future fertility rates have a profound impact on the number of births occurring in Alberta over the projection horizon. However, our scenarios also clearly indicate that, so long as the economic environment is not changed, the population of Alberta – particularly of its working age population – must reach the same level in all three cases. As a result, if fertility rates increase, less net in-migration will be required. If fertility rates fall, more net in-migration will be required. In all three cases, the population of Alberta will be the same. Stated another way, the total population of Alberta depends on the size of its economy (export growth) and on the rate of technological change (productivity growth), not on the future rates of fertility that its inhabitants might achieve.

3.3 Projections for Alberta, Edmonton, and Census Divisions 4811 and 4813

The purpose of this report is to develop a two-hundred year "most plausible" base case projection of population, employment by detailed industry, and implied land use for the study area, Census Divisions 4811 and 4813 (refer to Figure 7). This base case projection is to be used

to inform Millar Western regarding the risks in terms of human encroachment over the next two centuries to its Forest Management Area (FMA).

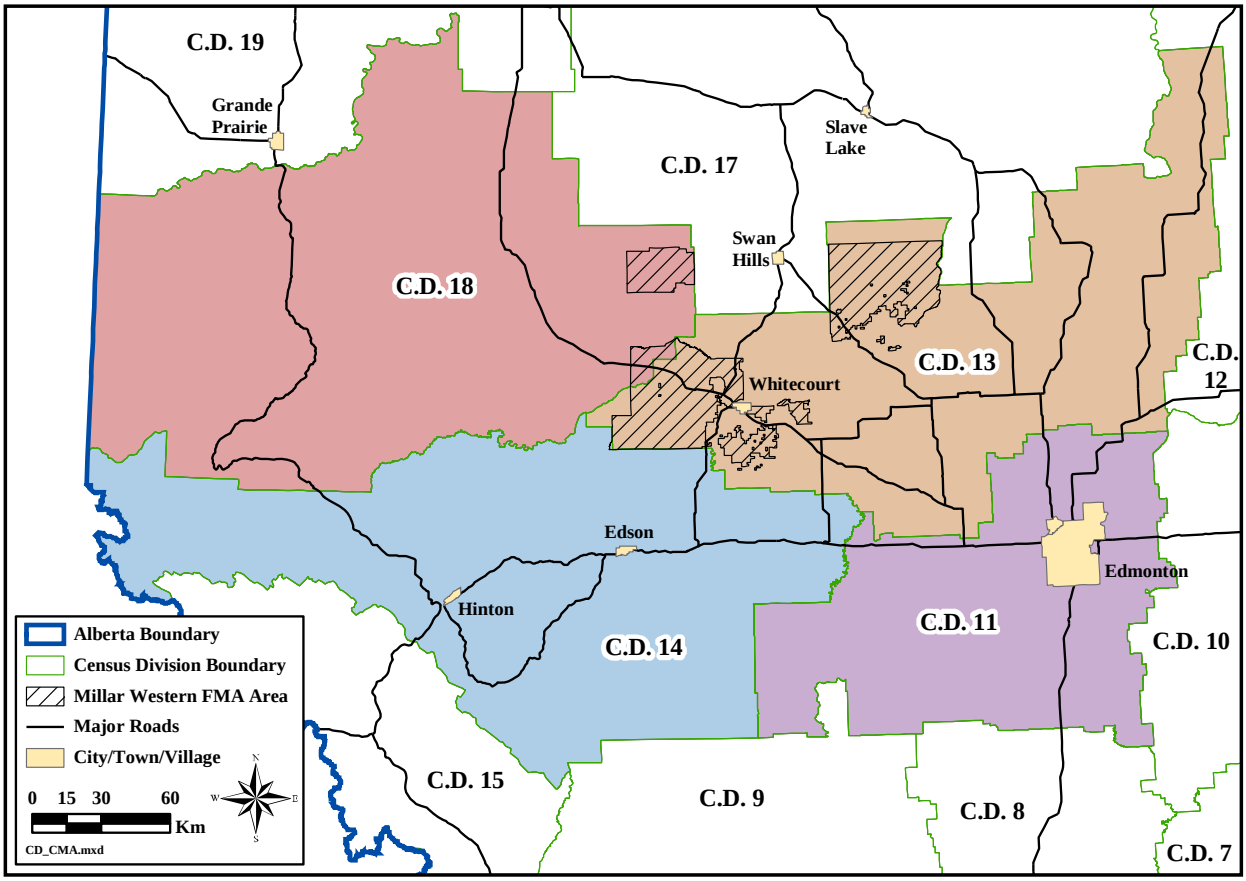

Figure 7. Location of Millar Western's FMA in relation to the Census Divisions (CD).

Since the future populations of CD 4811 and CD 4813 depend on the future demands placed on the Alberta economy as a whole, and on the spatial allocation of those demands within the province, we are particularly interested in projections that imply significant increases in population, household, and employment growth – or land use – in the province.

3.3.1 Recommended Population Projections for Alberta

We recommend that the population alternatives considered for Alberta should be based on assumptions regarding future export growth at least as strong as those used in developing the Exports Moderate scenario, and that the assumptions used in developing the Exports Strong scenario should also be considered. Recall that the Exports Moderate scenario assumes exports will continue to grow but at a declining rate of growth over time. This assumption is in keeping with the pace of growth implied by the population projections developed by the United Nations for the entire world that we consider to be the most plausible.

We also recommend that the population alternatives considered for Alberta should be based on assumptions regarding future productivity growth that at least matches that of the past, and

possibly exceeds that of the past. In view of the rate of technological change expected in the future, we consider it highly unlikely that the future rate of productivity growth will be lower than it has been in the past.

Finally, we recommend that the population alternatives considered for Alberta should be based on the assumption that life expectancy will increase in line with the assumptions made by the United Nations with respect to Canada, and on the assumption that the total fertility rate will continue to decline. Again, the changes in technology expected in the future are unlikely to reduce life expectancy, while the changes in real incomes per capita are unlikely to bring about a reversal of declining trends in fertility. Even if fertility rates were to increase in the future, reflecting perhaps some wealth induced preference for larger families, our projection alternatives above reveal that such a reversal would have no significant impact on the total population of Alberta, only on its source.

Therefore, we recommend the consideration of a base case projection for Alberta that assumes moderating growth rates for the province's exports, coupled with a sustained growth rate in underlying productivity, rising rates of life expectancy, and declining rates in fertility. We call this projection the Base Case alternative.

We also propose two alternative projections to the Base Case. The first alternative assumes stronger export growth, coupled with a sustained growth rate in underlying productivity, rising rates of life expectancy, and declining rates in fertility. We call this projection the Exports Strong alternative. This alternative reflects the very real possibility that the province's future exports of energy, petroleum, chemicals, and tourism activities will expand to meet the needs of nations other than Canada and the United States, most likely to meet the needs of those nations in Asia where future economic and population and growth rate potential is the greatest. We acknowledge, however, that the assumption of stronger export growth over a two-hundred year period is a critical uncertainty.

The second alternative to the Base Case enhances the stronger exports projection by adding stronger rates of productivity growth in conjunction with rising rates of life expectancy and declining rates of fertility. This alternative recognizes a highly plausible future that sees productivity growing at a rate higher than in the past, thereby reflecting the widespread and gradual absorption of the technological discoveries only just now emerging. We call this projection the Exports and Productivity Strong alternative.

Figure 8 depicts the path of Alberta's total population to 2201 according to the three projection alternatives and it reveals that there are really only two plausible population paths for Alberta, one that sees its population reaching 10 million people by 2201, the other that sees its population reaching 25 million. Therefore, we will refer to only two projections for Alberta, the 10 million and the 25 million alternatives.

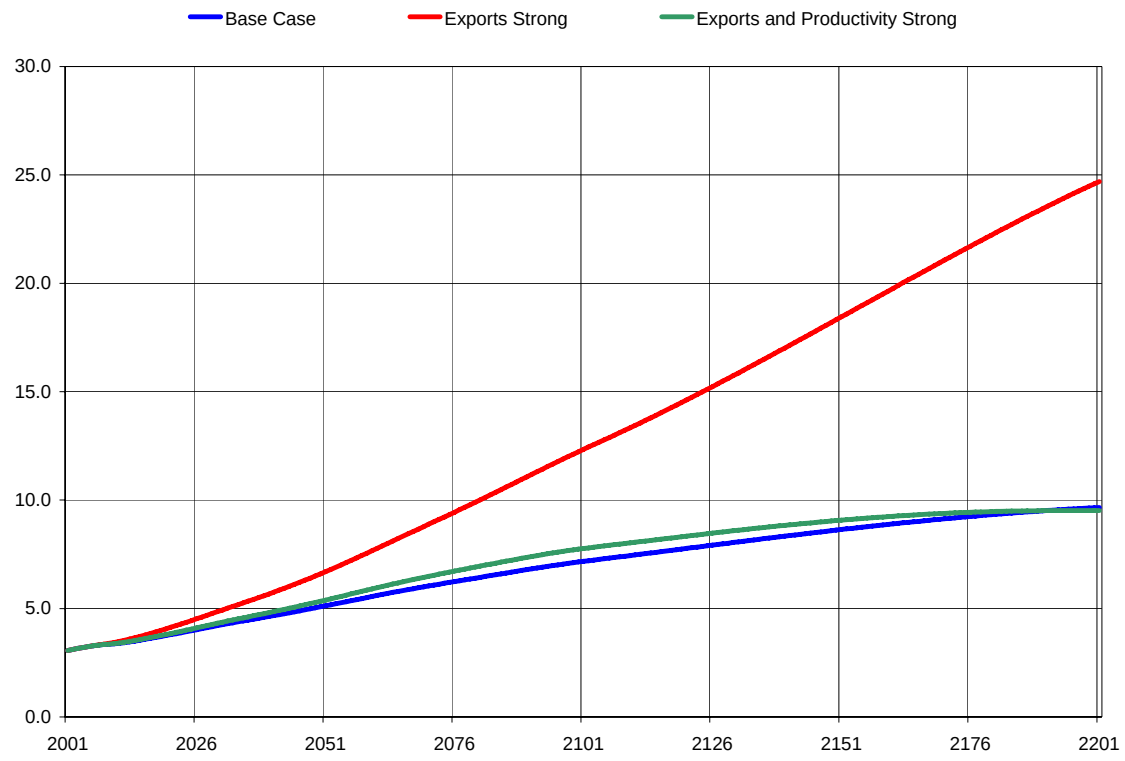

Figure 8. Recommended Alberta Total Population Projections

Source: Centre for Spatial Economics.

3.3.2 Spatial Implications of the Population Projections for Alberta

Census Division 4811

Over the last half century, Calgary and the rest of Alberta outside the Edmonton CMA have accounted for an increasing share of the population growth occurring in the province (see Table 6). Between 1951 and 2004, the total population of the province grew from 940,000 to 3.2 million. Between 1951 and 1971, Edmonton accounted for the lion's share of that growth (42.3 percent) with Calgary (36.5 percent) and the rest of the province (21.2 percent) both falling short of Edmonton's share. Between 1971 and 1991, however, Calgary (38.5 percent) pulled slightly ahead of Edmonton (37.8 percent) while the share accounted for by the rest of the province increased compared to the 1951 to 1971 period. Since 1991, Calgary has taken a commanding lead (44.4 percent). Even the share accounted for by the rest of the province (31.4 percent) exceeded that of the Edmonton area (24.2 percent) by a wide margin.[124]

124 Statistics Canada, Annual Demographic Statistics 2004, (Ottawa: Ministry of Industry, March 2005). Data prior to 1971 for Albert and prior to 1986 for Calgary, Edmonton, and the rest of Alberta are from various spreadsheets compiled over the years by the Centre for Spatial Economics drawn from various Statistics Canada publications no longer in our files.

All of the municipalities that make up the Edmonton CMA can be found in Census Division 4811. Over the period from 1991 to 2004, this CD accounted for 24.7 percent of Alberta's growth. In other words, outside the Edmonton CMA but within CD 4811, only 0.5 percent of Alberta's population growth occurred. Thus, the Edmonton CMA accounted for virtually all of the population growth occurring in CD 4811 between 1991 and 2004. CD 4813, situated to the north west of CD 4811 but adjacent to it, accounted for only 1.7 percent of Alberta's population growth over this period. Whitecourt and the Millar Western FMA are both found in CD 4813. Whitecourt itself accounted for 0.3 percent of Alberta's growth in population between 1991 and 2004, and it accounts for about 0.3 percent of its total population at this time.

Table 6. Population and Population Growth Distribution in Alberta: 1951 to 2004

	Period		
Location	**1951-1971**	**1971-1991**	**1991-2004**
Alberta	100	100	100
Edmonton	42.3	37.8	24.2
Calgary	36.5	38.5	44.4
Other Alberta	21.2	23.7	31.4
CD 4811	-	-	24.7
CD 4813	-	-	1.7
Whitecourt	-	-	0.3

Source: Statistics Canada (see footnote 126).

If we assume that over the next two centuries the Edmonton CMA is able to maintain a share of 24.2 percent of Alberta's projected population growth, and if the 10 million total population for Alberta projection was to prevail, then the Edmonton CMA's population would grow from just over 1.0 million people today to 2.6 million people in 2201. If the 25 million projection was to prevail, Edmonton's population would reach 6.2 million.

If we assume that within the next ten years the Edmonton CMA's dominant role within the province (reflecting the 1951 to 1971 period) was to reemerge, Edmonton could account for 45 percent of Alberta's population growth between 2025 and 2201. If so, its population would reach a total of 3.7 million in an Alberta of 10 million people and a total of 10.1 million in an Alberta of 25 million.

Census Division 4811 in Alberta covers an area totaling 15,755 square kilometers. Its total population in 2001 was 975,477 persons based on raw census counts not adjusted for the estimated undercount of the census. Thus, its population density was 62 persons per square kilometer in 2001. The Edmonton CMA covers a total of 9,419 square kilometers within CD 4811 (or about 60 percent of the CD's total area). The total population of the Edmonton CMA in 2001 was 937,845 (or 96 percent of the total population of CD 4811). Thus, the density of the CMA in 2001 was 100 persons per square kilometer. The CMA lies in the northern portion of CD 4811. The population of the rest of CD 4811 covers some 6,336 square kilometers and has a

relatively small population of 37,632 people, all found to the south of the CMA. The existing boundary of the Edmonton CMA could accommodate a population of 1.7 million people at the density of the Calgary CMA in 2001 (187 persons per square kilometer). It could accommodate 4.5 million at the density of the Hamilton CMA in 2001 (483 persons per square kilometer). It could accommodate 7.5 million people at the density of the Toronto CMA in 2001 (793 persons per square kilometer).

The south east portion of CD 4813 (about 6,000 square kilometers) could accommodate a total population of 600,000 at Edmonton's current density rate and populations of 1.1 million at Calgary's rate, 2.9 million at Hamilton's rate, and 4.8 million at Toronto's rate. Thus, the existing CMA plus the south east portion of CD 4813 could reach a total population of 1.5 million at Edmonton's current density rate, 2.9 million at Calgary's rate, 7.4 million at Hamilton's rate, or 12.7 million at Toronto's rate. If the rest of CD 4811, the 6,336 square kilometers to the south of the CMA, were also included in an expanded Edmonton CMA, then the larger Edmonton CMA could accommodate a total population of 2.2 million at its current density rate, 4.1 million at Calgary's rate, 10.5 million at Hamilton's rate, and 17.3 million at Toronto's rate.

All of these population levels could be achieved without any development encroachment into the Whitecourt area or into the Millar Western FMA. Our projections found that the Edmonton CMA's population at most would be just under 7.5 million by 2201. Thus, we conclude that Millar Western's FMA is not threatened by any conceivable expansion of the population of the Edmonton CMA over the next two centuries.

Table 7. Population Potential of an Expanded Edmonton CMA

		CMA Density			
		Edmonton	Calgary	Hamilton	Toronto
Location	Area (Km^2)	Now: 100/Km^2	Now: 187/Km^2	Now: 483/Km^2	Now: 793/Km^2
Edmonton CMA	9,419	941,900	1,761,353	4,549,377	7,469,267
SE portion of CD 4813	6,000	600,000	1,122,000	2,898,000	4,758,000
Total	15,419	1,541,900	2,883,353	7,447,377	12,227,267
Rest of CD 4811	6,336	633,600	1,184,832	3,060,288	5,024,448
Grand Total	21,755	2,175,500	4,068,185	10,507,665	17,251,715

Source: Centre for Spatial Economics.

Census Division 4813

Whitecourt is a community of just under 9,000 people whose municipal boundaries cover a total of 26.1 square kilometers. Whitecourt is found within Census Division 4813 which itself is populated by about 67,000 people who are widely dispersed across a vast area covering 24,385.2 square kilometers. In other words Whitecourt accounts for 13.4 percent of the total population of CD 4813 but for only 0.1 percent (that is, one one-thousandth) of CD 4813's land mass.

CD 4813 itself consists of some 40 individual Census Sub Divisions (towns, villages, counties surrounding them, etc.) only 10 of which have populations of 2,500 or more. Whitecourt is the second most populated community within CD 4813. The most populated community is Lac Ste. Anne County with just over 9,000 people. The next most populated communities after

Whitecourt are Athabasca County No. 12 at just under 8,000, Westlock County at just over 7,000, and Barrhead County at about 4,200. But these areas differ from Whitecourt in that they are not towns but, rather, large counties surrounding smaller concentrations of populations within. For example, Lac Ste. Anne covers 2,845.1 square kilometers, Westlock County covers 3.168.2 square kilometers, Athabasca County No. 12 covers 6,144.7 square kilometers, and Barrhead County covers 2,404.5 square kilometers. In contrast, Whitecourt is a separated town within Woodlands County which itself covers 7,668.1 square kilometers and itself has a widely dispersed population of about 3,700 people.

Within CD 4813 Whitecourt is the most populated town (or organized community). Its population density, at 319 persons per square kilometer in 2001, is lower than that of the Town of Barrhead (at 518 persons per square kilometer, one of the concentrated settlements in Barrhead County) and the Town of Westlock (at 500 per square kilometer, one of the concentrated settlements in Westlock County). The Town of Athabasca within Athabasca County No. 12 has a population of about 2,300 and a density of just 142 people per square kilometer.

As noted earlier, communities exist because there is an economic reason for their existence. For a community to grow from a population base of 9,000 to 30,000 the amount of employment supported by its economic base industries would have to triple in size. For a community to grow from 30,000 to 300,000, its economic base employment would have to grow tenfold.

If we assume that over the next two centuries CD 4813 is able to maintain a share of 1.7 percent of Alberta's projected population growth, and if the 10 million total population for Alberta projection was to prevail, then CD 4813's population would grow from just under 67,000 people today to just over 177,000 people in 2201. If the 25 million projection for Alberta was to prevail, CD 4813's population would reach about 437,000. Note that the economic base of CD 4813 would have to almost triple in size from its current level for its population to reach 177,000, and it would have to increase seven fold for its population to reach 437,000.

CD 4813 covers 24,385.2 square kilometers. Its density today is less than 3 persons per square kilometer. If its population in 2201 was to reach 177,000, its density would be just over 7 persons per square kilometer. If its population was to reach 437,000, its density would reach about 18 persons per square kilometer. Density levels of 7 and 18 persons per square kilometer are very low, reflecting relatively undeveloped, primarily rural areas. In other words, the projected population growth for CD 4813 is not significant enough to pose a threat to the Millar Western FMA.

If we assume that over the next two centuries Whitecourt itself, within CD 4813, is able to maintain a share of 0.3 percent of Alberta's projected population growth, and if the 10 million total population for Alberta projection was to prevail, then Whitecourt's population would grow from just under 9,000 people today to just over 30,000 people in 2201. If the 25 million projection for Alberta was to prevail, Whitecourt's population would reach about 80,000.

As noted above, the current boundary of Whitecourt covers an area totaling 26.1 square kilometers. Its current population density, therefore, is 340 persons per square kilometer. If Whitecourt's population was to reach 30,000, its density would increase to 1,150 persons per

square kilometer. The density of the City of Edmonton (not the CMA) at this time is 1,272 while that of the City of Calgary is 1,877. Thus, a population of 30,000 for Whitecourt could conceivably be accommodated within its existing boundary at densities approaching those of the cities of Edmonton and Calgary today. For example, the City of St. Thomas in Ontario today covers 32.2 square kilometers (and thus is a bit larger than Whitecourt) but its population is more than 33,000 and it is by no means fully developed.

If Whitecourt's population was to reach 80,000, its density would reach 3,050 per square kilometer. This total would generate a density exceeding that of the cities of Edmonton and Calgary today. It should be noted, however, that since the area surrounding Whitecourt is relatively unpopulated it is conceivable that the municipal boundary could be extended southward to accommodate an increase in its population to 80,000 persons.

Note that for Whitecourt's population to increase from 9,000 today to 30,000 in 2201 its economic base employment would have to more than triple in size. For its population to reach 80,000 its economic base employment would have to increase almost tenfold. Our earlier analysis pointed out that the populations of most of Canada's rural areas are currently in decline, and that that these declines are expected to occur well into the future because the industries that support such communities (mining, forestry, and related manufacturing processes as industries) are still growing, but not as quickly as in the past, and they are becoming more and more productive (and therefore less labour intensive) with the application of new technologies. Thus, the number of people needed to get the job done in these sectors is in decline. As a result, most rural communities face gradual declines in their population base in the decades ahead.

In other words, we conclude that it is highly unlikely Whitecourt will ever reach a total population of 80,000 between now and 2201, and not very likely it will ever reach a population of 30,000.

Table 8. Population Potential of an Expanded CD 4813 and Whitecourt

	Alberta Population and Year		
Location	3.2 Million Year 2005	10 Million Year 2201	25 Million Year 2201
CD 4813	66,515	175,500	431,200
Whitecourt	8,900	30,100	79,700

Source: Centre for Spatial Economics.

3.4 Potential Encroachment from Agricultural Expansion

Although the province of Alberta is recognized world-wide as a source of agricultural products, agriculture's size relative to oil and gas extraction and manufacturing in the province has always been relatively small. Over the last two decades, agriculture accounted for an average of just 2.5 percent of the province's total constant dollar Gross Domestic Product (GDP), dwarfed by the 19.7 percent accounted for by oil and gas extraction and the 9.0 percent accounted for by manufacturing. These three sectors together define the province's economic base and provide the economic support to the remaining 68.8 percent of mostly community base economic activity.

3.4.1 Recent Trends in Agriculture in Alberta

In 2003 (the latest year for which data are available) agriculture accounted for $2.6 billion of value added in Alberta, or 2.1 percent of the province's total Gross Domestic Product of $125.6 billion (all figures are in constant 1992 dollars). The share for agriculture in 2003 was lower than its long term average of 2.5 percent reflecting the impacts on production in recent years of both the BSE scare and droughts.

Agriculture's share of total GDP in Alberta has fluctuated since 1985, reaching as high as 3.0 percent in each of 1993 and 1995 and as low as 1.7 percent in 1985. Despite this variation, Figure 9 shows that its contribution to the Alberta economy has been more stable than that of either oil and gas extraction or manufacturing. Since the early 1990's, the contribution from oil and gas has fallen from well over 20 percent to only 15 percent, while that of manufacturing has increased steadily over the two decade period for which data are available, increasing from around 7.5 percent in the mid-1980's to more than 10 percent in recent years.[125]

Statistics Canada provides a breakdown of agricultural GDP only for the years since 1997. Over the period 1997 to 2003, crop production and support activities accounted for an average of 58.2 percent of all agricultural value added in the province, with animal production and support activities accounting for an average of 26.4 percent. The remaining 15.3 percent reflects other agricultural activities including greenhouse, nursery and floriculture activities, and animal aquaculture. Figure 10 reveals that even over that very short time period, the shares of these three major categories within agriculture shifted significantly with an apparent shift away from crops into animals and other activities interrupted by the impacts of droughts and the BSE scare.

125 Alberta's manufacturing industry accounted for 12.9 billion in constant 1992 dollar value added in 2003. The major manufacturing industries (accounting for more than 85 percent of all manufacturing value added) included chemicals (20.5 percent of the manufacturing total), food, beverages and tobacco (16.8 percent), primary and fabricated metals (13.9 percent), machinery (9.8 percent), wood products (9.6 percent), cement and concrete (5.1 percent), electronic equipment (4.4 percent), and pulp and paper (4.1 percent).

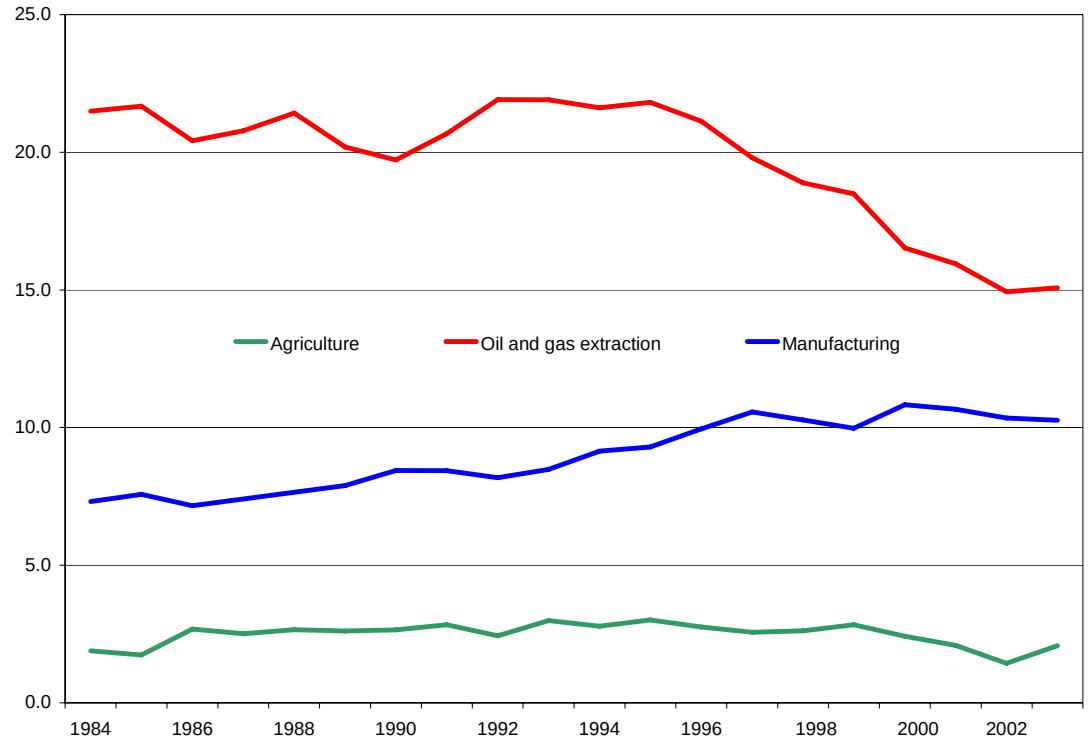

Figure 9. Agriculture, Oil and Gas Extraction, and Manufacturing as a Percent Share of Constant 1992 Dollar GDP in Alberta, 1984 to 2003

Source: Statistics Canada and the Centre for Spatial Economics.

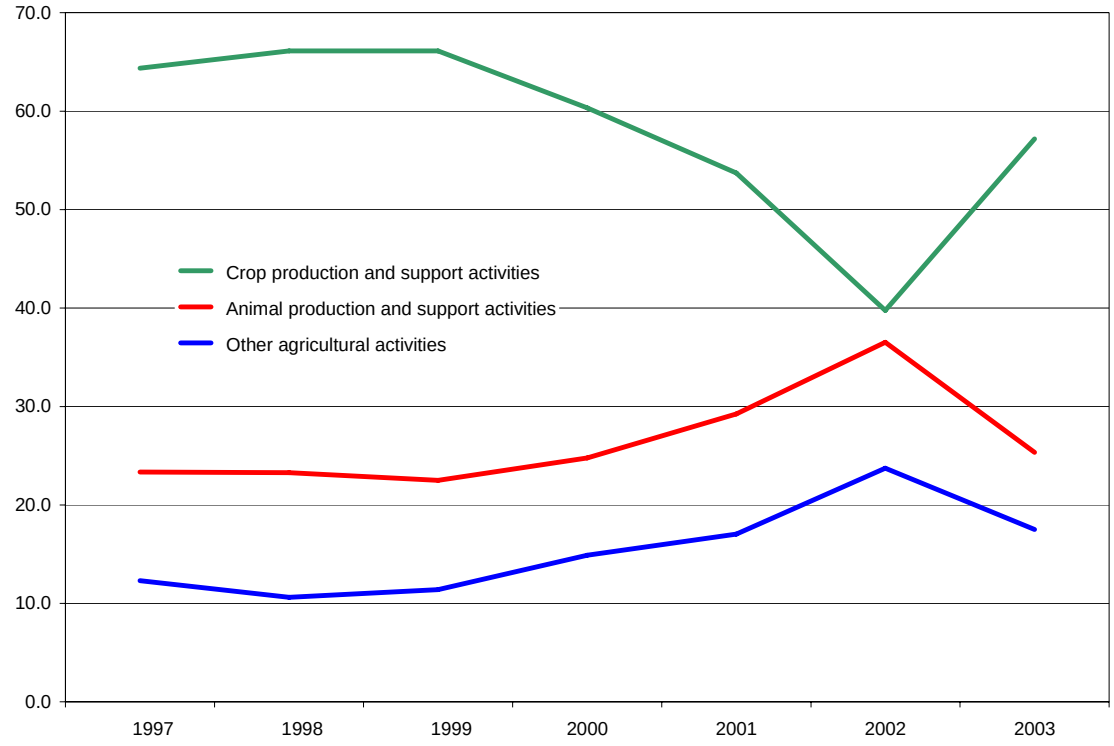

Figure 10. Agriculture Production by Major Activity as a Percent Share of Constant 1992 Dollar Total Agriculture GDP in Alberta, 1997 to 2003

Source: Statistics Canada and the Centre for Spatial Economics.

According to the Census of Agriculture,[126] farm numbers in Canada have been falling for the last five decades, reflecting rapid changes in technology and increasing productivity. The number of farms in Alberta fell by 9.1 percent between 1996 and 2001, from 59,007 to 53,652. Nationwide the decline in farms was 10.7 percent. Only Alberta and British Columbia (down 7.1 percent) witnessed rates of decline in farms slower than the national average. While the number of farms has declined over time, the average size of farms has been rising as have average gross farm receipts.

Though the number of farms in Alberta declined between 1996 and 2001, the province still has the second-highest number of census farms among the provinces.[127] The average farm size in Alberta increased 10.2 percent between 1996 and 2001, reaching 970 acres. Between 1996 and 2001 the total amount of agricultural land in Alberta increased slightly by 0.2 percent, reaching a total of 52.1 million acres. The area under crops increased 1.9 percent over that same period to reach 24.0 million, to account for 46 percent of all agricultural land use in the province.

126 Accessed at http:/www.statcan.ca/English/agcensus2001/first/farmop/01front.htm

127 Accessed at http:/www.statcan.ca/English/agcensus2001/first/regions/farmab.htm

Gross farm receipts in 2000 totaled $9.9 billion in Alberta, up from $7.9 billion in 1995. However, agricultural product prices fell over that period in general while input costs increased. Thus, the percentage share of operating expenses in gross farm receipts increased from 84 percent to 90 between 1995 and 2000 (that is, net incomes fell from 16 percent to 10 percent of gross farm receipts). The number of farms with less than $250,000 of gross farm receipts fell by 13.4 percent between the two censuses while the number with receipts greater than $250,000 increased by 35.6 percent. Gross receipts per farm in Alberta averaged about $185,000 in 2000.

Cattle farms are the most common type of farm in Alberta accounting for 44 percent of all the farms in the province. Wheat, grains, and oilseeds account for 25 percent. These shares did not change much between 1996 and 2001.

The Census enumerated 6.6 million cattle in Alberta in 2001, up 11.3 percent from 1996. The total number of pigs increased 17.2 percent to 2 million in Alberta, while the number of sheep and lambs increased 18.3 percent to 307,302. Non-traditional operations grew quickly in Alberta as well between 1996 and 2001. For example, the number of bison tripled to 79,731 while the number of llamas and alpacas more than quadrupled to 12,894.

Agricultural activities are spread out across the southern portion of the province, not concentrated in any one particular area. Census data regarding agricultural industry employment indicate that of the nearly 90,000 persons employed in agriculture in the province in 2001, 11,605 were employed in Census Division 4811, the CD that includes the Edmonton metropolitan area. CD 4811 accounts for the largest number of agricultural employed among the 19 census divisions in the province. The census divisions with the next largest numbers of people employed in agriculture were CD 4806 (which includes the Calgary metropolitan area, 9,375), CD 4802 (which includes Lethbridge, 8,835), CD 4810 (which includes Camrose, 8,430), and CD 4808 (which includes Red Deer, 7,485). These five census divisions collectively accounted for half of the province's agriculture employment in 2001. There were 6,030 persons employed in agriculture in CD 4813 in 2001, the CD that includes Whitecourt. CD 4813 accounts for the next highest number of agriculture industry employed persons in Alberta after CD 4808. As of 2001, therefore, 6.8 percent of the people employed in agriculture in Alberta were located in CD 4813.

The geographic distribution of agricultural employment within Alberta is illustrated in Figure 11

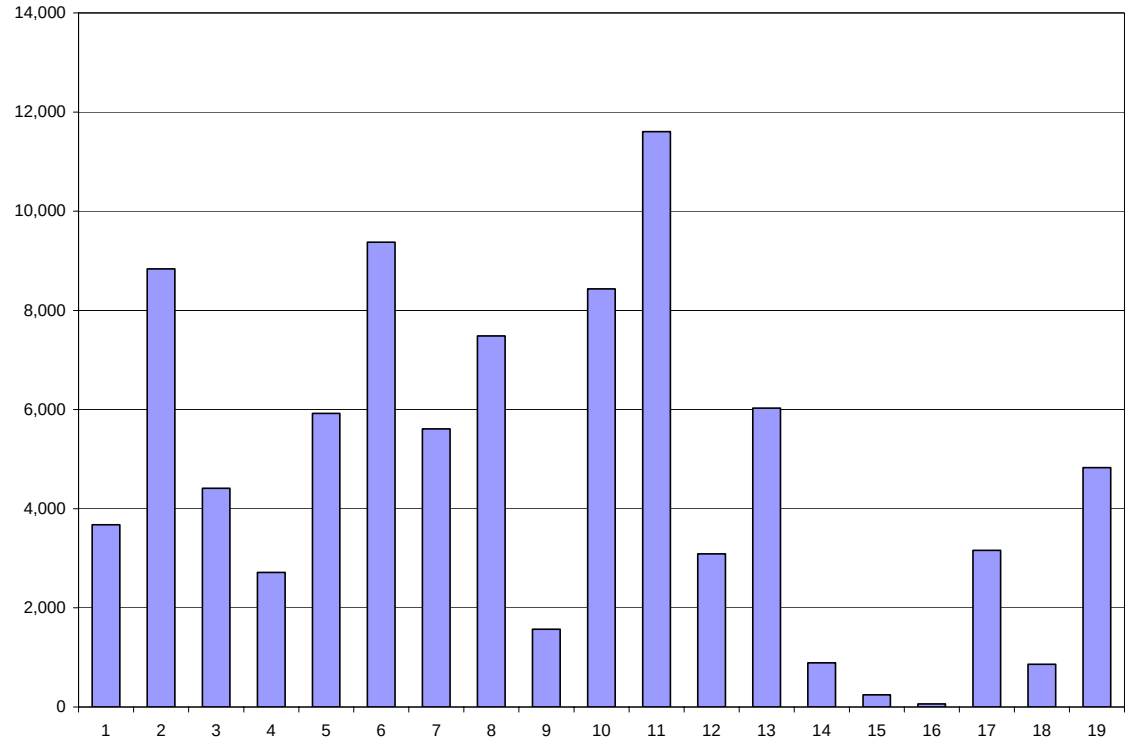

Figure 11. Agriculture Employment by Census Division in Alberta in 2001

Source: Statistics Canada.

3.4.2 Agriculture in the Whitecourt Area

CD 4813 covers 24,385.2 square kilometers. The boundary of the Town of Whitecourt itself accounts for only 26.1 square kilometers, or less than 0.1 percent (or one one-thousandth) of the total area of the census division.

Within CD 4813 farms account for 1,255,677 hectares – or 12,556.8 square kilometers[128] – of land use, or just over one half of all the land available in the census division. The total area of farms in CD 13 was equal to 6.0 percent of the provincial total in 2001.

In CD 4813 in 2001 there were 4,921 farms (9.2 percent of the provincial total) with gross farm receipts of $581 million (5.9 percent of the provincial total). Therefore, the average farm in the census division received about $118,000 in gross farm receipts, well below the provincial average of $185,000.

The top five crops in CD 4813 in 2001 were alfalfa, barley, all other tame hay and fodder crops, spring wheat (excluding durum), and oats. The number of cattle and calves totaled 489,389 (7.4

128 One square kilometre equals one hundred hectares.

percent of the provincial total) and the number of pigs totaled 149,504 (7.5 percent of the provincial total).

Of the 1,255,677 hectares of farm land in CD 4813, about one half was used for crop production. Natural land for pasture totaled 246,804 hectares, or almost one-fifth the total.

3.4.3 Future Trends in Agriculture in Alberta

According to the United Nations, the population of Alberta's major international trading partner, the United States (88 percent of Alberta's exports in 2004), could reach 470 million by 2200 compared to 285 million in 2000, an increase of 65 percent. China, Alberta's next largest trading partner but only accounting for 2.6 percent of exports, will see its population decrease from 1,275 to 1,201 million or 5.8 percent. India, not on the current list of Alberta's top ten trading partners, will experience a population increase of 288 million or 28 percent on a base of 1,017 million in the year 2000.

Our population projections for Alberta led us to conclude that Alberta's population itself could reach anywhere from 10 million to 25 million compared to just over 3 million currently. The projection of 10 million for Alberta is consistent with a population projection for all of Canada of almost 87 million people, or almost three times the population of Canada at this time. The projection of 25 million for Alberta is consistent with a population projection for all of Canada of at least 100 million plus people (if only Alberta grows within Canada) and upwards of 200 million plus (if the historical growth centers within Canada grow in tandem with Alberta).

If Alberta's agriculture production in the future keeps pace with the projected population increases in Canada and other major trading nations, agricultural land requirements in the province could conceivably increase significantly and possibly represent a serious threat to the Millar Western FMA. However, this risk of encroachment from agriculture is best identified as a critical uncertainty for at least two reasons:

- The rate of return on increased agricultural activity, more particularly in the animal slaughtering and processing sector, will have to be competitive with that for other land uses ranging from outdoor recreation to oil and gas production. If the land becomes more valued for grazing in the future, it may well look first at the conversion of hectares currently devoted to crops before it expands into forest land that may also have a new competitive value (outdoor recreation, for example).

- Alberta's agricultural commodities will need to respond to shifting consumer preferences and trading alliances. For example, China is a huge market for meat products but currently consumes more pork than beef, Alberta's premier commodity. Will the Chinese eventually consume more beef? Even if they do, they may well buy it from countries they are presently forging trade links with such as Brazil or Argentina.

3.5 Potential Encroachment from Tourism

Tourism is already a substantial economic sector in Alberta but in the future its importance may loom larger if the current mainstay of the economy, energy produced from fossil-fuels, wanes and the emerging trends world-wide for travel opportunities take hold.

3.5.1 Tourism and Tourists in Alberta Today

Tourism is currently a big business in the province of Alberta. Tourism revenues in 2004 totaled an estimated $4.7 billion. The province's Gross Domestic Product on an expenditure basis totaled about $180 billion in 2004; thus, tourism accounted for 2.6 percent of economy-wide expenditures.[129]

Tourism supported over 83,000 jobs in Alberta in 2004, half directly in the industry, the other half indirectly. Employment in Alberta in 2004 totaled 1.8 million; thus, tourism accounted for 4.7 percent of all the jobs in the province. By way of comparison, mining (including oil and gas) in 2004 accounted for 107,000 jobs directly, agriculture for 66,000 directly, and forestry for 5,000 directly.

Of the $4.7 billion spent on tourism in 2004, Alberta residents accounted for $2.1 billion, other Canadian residents for $1.0 billion, and international visitors for $1.2 billion, including almost $700 million from American visitors and almost $600 million from other international visitors.

Travel to Alberta in 2002 and 2003 was down from the peak levels of 2001 mirroring international trends in the aftermath of 911. Recent trends indicate that travel is recovering world wide. In 2003, person trips to Alberta totaled 17.9 million, down from a peak of 23.7 million in 2001. The breakdown of person trips in 2003 (see Figure 12) was as follows: 13.2 million by residents of Alberta, 3.0 million by residents of the rest of Canada, 962 thousand by American residents, and 613 thousand by residents of countries other than Canada and the United States.

129 All tourism figures for Alberta were obtained from the web site www.alberta-canada.com.

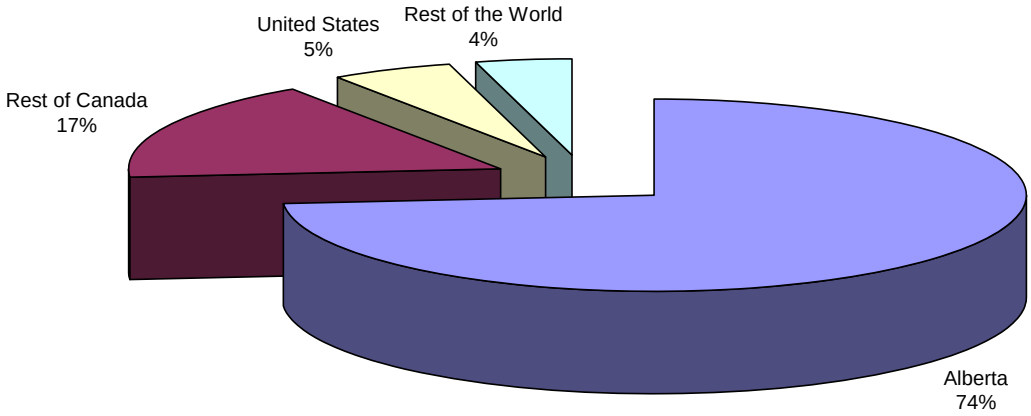

Figure 12. Alberta Travel Person Trips by Source in 2003

Source: Alberta Economic Development.

On a state by state basis, the nearly 1.1 million visitors to Alberta from the United States in 2002 broke down as follows: 112,000 from California, 104,000 from Washington, 99,000 from Montana, 58,000 from Texas, 42,000 from Oregon, 39,000 from Florida, 39,000 from Colorado, 39,000 from Minnesota, 32,000 from Ohio, and 30,000 from Illinois. These ten states collectively accounted for almost half of the total number of American visitors to Alberta in 2002.

International visitors were almost evenly split between Europe and Asia. There were 387,000 visitors to Alberta from Europe in 2002, including 188,000 from the United Kingdom, 69,000 from Germany, 33,000 from the Netherlands, and 97,000 from the rest of Europe. Visitors from Asia and other Pacific locations totaled 349,000 in 2002, including 135,000 from Japan, 56,000 from Australia-New Zealand, and 158,000 from other such locations.

About 57 percent of all visits in the province in 2002 included at least one overnight stop, yielding 12.5 million overnight person visits in 2002. Almost all overseas visitors (773,000) spent at least one night in Alberta, as was the case with most American visitors (1.07 million). Canadians were responsible for 85 percent of all overnight travel in Alberta, almost half of them (7.9 million overnight visits, or 63 percent of all overnight person visits) were residents of Alberta (see Figure 13).

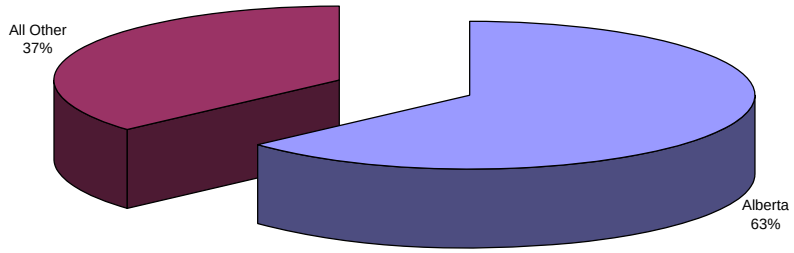

Figure 13. Aberta Overnight Person Visits by Source in 2002

Source: Alberta Economic Development.

The key sources of overnight inbound travel for Alberta outside Alberta itself including neighboring provinces, northwestern American states, and major European and Asian markets were (see Figure 14): British Columbia (1.0 million), Saskatchewan (887,000), Ontario (503,000), Manitoba (258,000), the United Kingdom (188,000), Japan (135,000), California (112,000), Washington (104,000), Montana (99,000), Germany (68,000), Texas (58,000), Taiwan (52,000), and Oregon (42,000). These thirteen provinces-states-countries accounted for 3.5 million overnight visits in Alberta in 2002, or 28 percent of the total. Thus, Alberta plus these 13 areas together accounted for 95 percent of the 12.5 million overnight person visits in Alberta in 2002.

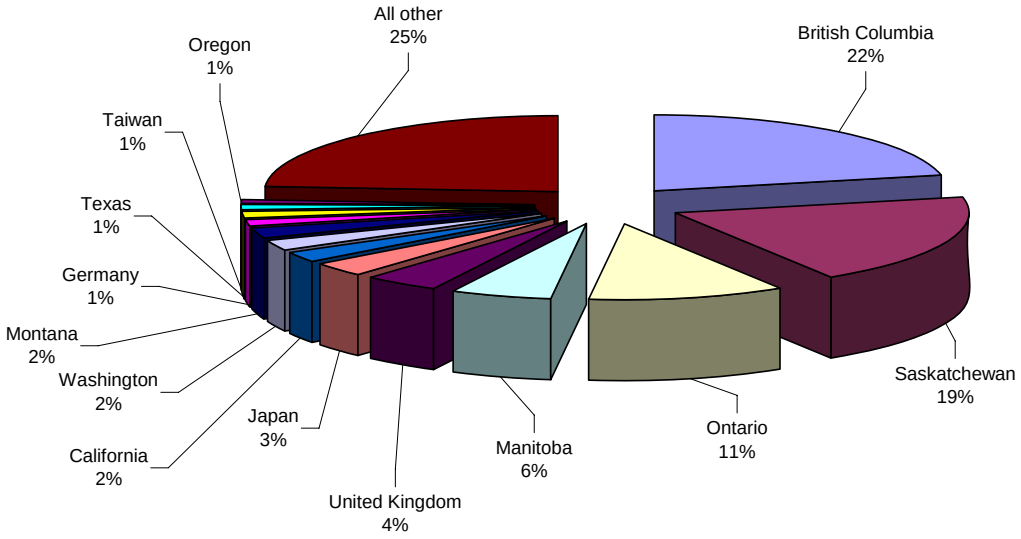

Figure 14. Alberta Overnight Person Trips by Source Other Than Alberta in 2002

Source: Alberta Economic Development.

Of the 12.5 million overnight visits in Alberta in 2002, 5.2 million (41 percent) were for pleasure and 4.5 million (36 percent) were motivated by visiting friends and relatives. Business travel accounted for 1.7 million overnight visits (13 percent) while the remaining 1.4 million (11 percent) were for other reasons.

Activities among the 12.5 million overnight visitors in Alberta in 2002 were diverse. Including multiple motivations, 7.8 million visited friends and relatives, 6.3 million went shopping, 4.7 million went sightseeing, 4.4 million participated in outdoor activities, 3.4 million visited parks and historic sights, 2.0 million participated in nightlife, 1.2 million attended a sporting event, 0.9 million attended theme parks, 0.7 million attended a festival, and 0.6 million participated in a cultural event.

The 12.5 million overnight visits in Alberta generated a total of 45.7 million person nights. Alberta Economic Development has designated six tourism areas within the province. The person nights in Alberta in 2002 broke down as follows:

- 11.1 million in Calgary and the Calgary area;
- 10.3 million in Edmonton and the Edmonton area;

- 8.3 million in the Central area;
- 7.7 million in the Rockies;
- 4.6 million in the South; and
- 2.9 million in the North.

Whitecourt is found in the northwest section of the Alberta Central Area. The Alberta Central Area currently generates the third highest number of visitor person nights in the province.

The major individual tourism attractors in Alberta include: West Edmonton Mall; Calgary Tower; Banff National Park (4.6 million annually); Jasper National park (1.9 million annually); and Waterton Lakes National Park (368,000 annually).

While summer was the most popular period in 2002 for overnight visitors (37 percent of the 12.5 million overnight visits in Alberta occurred during July, August, and September), other seasons were also popular. The spring months (April, May, and June) accounted for 23 percent, the fall months (October, November, and December) for 21 percent, and the winter months (January, February, and March) for 20 percent. Thus, Alberta is clearly a year-round tourism attractor.

No data are available on a census division basis regarding where visits to Alberta occur. In the absence of such information, we calculated a proxy using 2001 census data relating to employment in the food and accommodation industry. We began by calculating the number of jobs per capita in that industry for each census division using employment by place of work data. We found the minimum number of food and accommodation jobs per capita in Alberta in CD 4812 (the Cold Lake Area) at 22. Assuming that there is likely not much tourism traffic generated in CD 4812, we concluded that, at a minimum, a community requires at least 22 people per capita in the food and accommodation industry just to meet the local needs of the population. Assuming that in those census divisions where the number employed in that industry on a per capita basis exceeded 22 the excess number was meeting the needs of people visiting that census division, we concluded that the major tourism destinations within Alberta in 2001 were CD 4811 (Edmonton), CD 4806 (Calgary), and CD 4815 (Jasper and Banff). These three census divisions alone accounted for 75 percent of our estimate of tourism-based employment in the food and accommodation industry in Alberta. Our estimates, in turn, suggest that CD 4813, the location of Whitecourt and the Millar Western FMA, accounted for only 1.1 percent of all such employment in the province in 2001. Our estimate of tourism-based food and accommodation on a census division basis in Alberta in 2001 is illustrated in Figure 15.

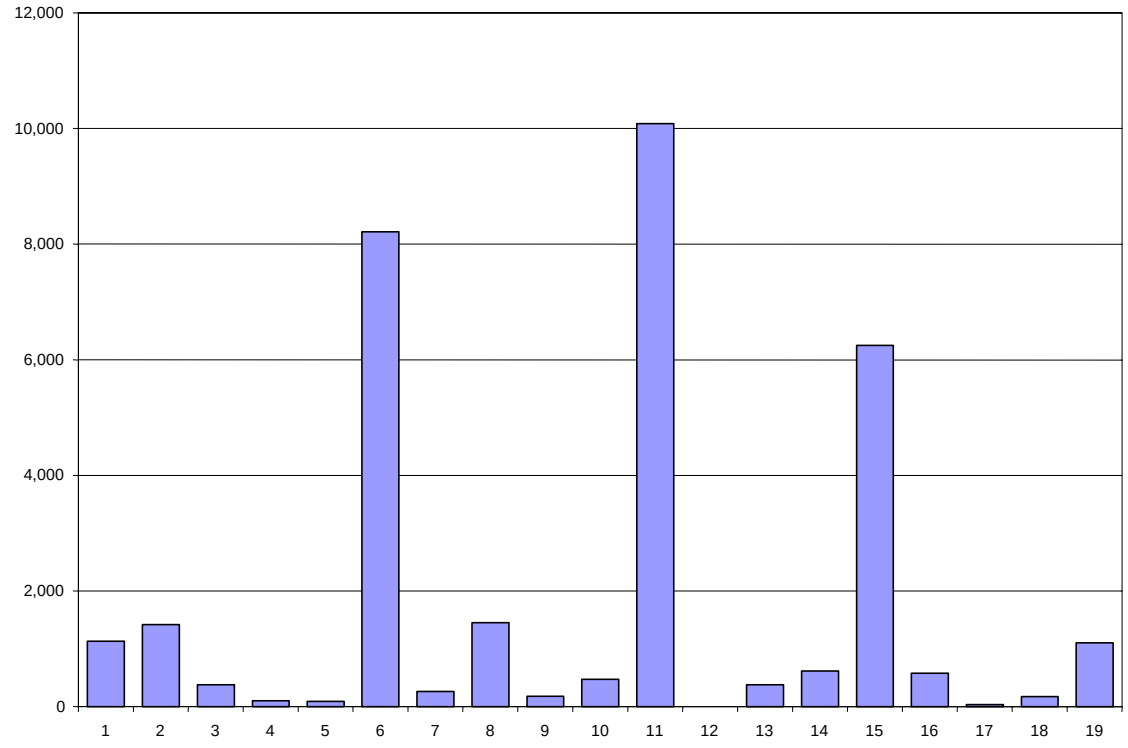

Figure 15. Alberta Employment in Tourism-Based Food and Accommodation by Census Division in 2001

Source: Estimated by the Centre for Spatial Economics

3.5.2 World Tourism Today

The World Tourism Organization (WTO/OMT) is a specialized agency of the United Nations. It is the leading international organization in the field of tourism and serves as a global forum for tourism policy issues and practical source of tourism know-how. According to the WTO, France maintains its leading position as the world's most visited destination with 75.1 million tourist arrivals in 2004. Spain ranks second with 53.6 million arrivals, followed by the United States (46.1 million), China (42 million), Italy (37.1 million), the United Kingdom (28 million), Hong Kong (22 million), Mexico (20.6 million), Germany (20.1 million), and Austria (19.4 million). As noted above, person trips in Alberta in 2003 totaled about 17.9 million, 13.2 million representing Albertans traveling within the province, 3.0 million by other Canadians, and the remaining 1.7 million from the United States and abroad.

Based on the views of the WTO and on research carried out by the Centre for Spatial Economics on behalf of a number of communities in Ontario,[130] we have concluded that world-wide tourism can be expected to grow significantly in the future. Future tourism growth will be propelled by

130 Including theTown of Fort Erie and the Regional Municipality of Niagara.

two key drivers: growth in the total population of the world and in the real per capita incomes of the world's population.

At this time, the major travelers in the world are those from the highest average income countries, trends reflected in the travel patterns of visitors to Alberta. Most such travelers, however, are from countries where future population growth is expected to be the slowest. The major gains in travel activity over the next two centuries can be expected to be sourced from among those living in the developing nations of the world. While the per capita real incomes of the average person in these countries pales in comparison to the averages prevailing among developed countries at this time, the growth in per capita incomes in many of these nations is rapid and the rates of population growth tend to exceed those prevailing throughout the developed countries (recall the U.N.'s population projections). These trends ensure that travel and tourism will remain one of the fastest growing industries world wide over the next two centuries.

3.5.3 Tourism in Alberta in 2201

The growth of tourism in Alberta over the next two centuries will depend on several key factors:

- The growth of population in the province itself;
- The growth of population in the states and provinces surrounding Alberta;
- The growth in population of the rest of Canada and the United States, especially in Ontario, California, Texas; and Florida;
- The growth of the population in Europe and Asia; and
- The growth of real per capita incomes in all of the above jurisdictions.

It is impossible to project with precision the impacts of these factors on the demand for tourism in Alberta or on the number of visitors to Alberta in the future. It is safe to say that the industry will bigger than it is today, probably much bigger. Under its medium projection, the U.N. sees the world's population increasing from 6.1 billion in 2000 to 8.5 billion in 2200, an increase of just over 39 percent or 0.2 percent per year. Among the "more developed" nations population is projected to remain stable at 1.2 billion. However, in the "less developed" nations population rises from 4.9 to 7.3 billion (49 percent) and in the "least developed" nations it goes from 0.7 to 1.9 billion (171 percent). Our recommended projections for Alberta's population identify a level ranging from 10 million to 25 million by 2201. These trends suggest that by 2201 tourism trips in the province could increase substantially from the annual rates witnessed in recent years.

While the metropolitan areas of the province will remain major tourism attractors in the future (since visiting friends and relatives is a significant reason for tourist travel), outdoor activities and visiting parks and historic sights will no doubt continue to be activities pursued by travelers in the future, particularly if such activities come to be seen as a release from a highly technological world. This suggests that Alberta's non-metropolitan travel regions, including the

Central Area, all of which are well endowed with such attractors, could evolve into major tourism destinations for people from around the globe in the future.

We conclude that travel demand world-wide will grow faster than most other industries in the future. Alberta's tourism industry is likely to grow in tandem with this world-wide expansion. The extent to which tourism will encroach on Millar Western's Forest Management Area will be determined by the extent to which the Whitecourt area will be seen as a natural attractor and/or the extent to which either man-made attractors are permitted to develop in the area or, in a society dominated by high technology, "pastoral experiences" acquire an economic value well beyond competing economic uses. So long as the net present value of the land in the Whitecourt area remains high as a source of forest products, it is unlikely that any future provincial government would permit a change in its use. However, if the net present value of the area as a tourism destination was ever to reach or surpass its value as a provider of forest products, it is possible that some future provincial government would permit a change in its use. Encroachment from tourism presents a risk but it is one that remains a critical uncertainty.

3.6 Potential Encroachment from Coalbed Methane

Coalbed methane (CBM)[131] is natural gas contained in coal.

Natural gas is widely considered to be the almost-perfect fuel because it is clean, efficient, convenient, safe, abundant, and economical. Natural gas heats half of Canada's homes and provides about 45 percent of the energy used by manufacturers.[132]

CBM is commonly referred to as an "unconventional" form of natural gas because the coal acts as both the source of the gas and the storage reservoir. Pressure from overlying rock and water within the natural fracture system of the coal seam keeps the methane gas bound to the coal. In contrast, "conventional" natural gas is trapped in the pore space of the rock. Coalbed methane gas is produced by reducing the pressure in the coal seam by pumping groundwater out. This allows the natural gas to flow through the fracture in the coal into the well bore which carriers it to the surface. If few natural fractures exist, producers may use hydraulic fracturing to create channels in the coal. When the natural gas reaches the surface, it is compressed and transported through natural gas pipelines.[133]

For many years the methane gas trapped in coal was a liability, frequently the cause of deadly underground mine explosions. Miners typically vented the gas out of the mine shafts as a safety

131 Alberta Energy uses the term natural gas in coal (NGC) because coalbed methane is the same as natural gas and all laws and regulations in place for natural gas relate to gas from coal, sand, shale and any other type of rock. Throughout this note we use the more common term coalbed methane gas (CBM).

132 Alberta Energy, Frequently Asked Questions about Natural Gas in Coal, accessed at www.rnergy.gov.ab.ca/364.asp?print=1.

133 Ibid.

precaution. It was only in the past two decades that geologists, looking for new sources of natural gas, perceived that the methane in the coal could be extracted and added to the nation's natural gas supply.[134]

Because the coal beds from which the methane is taken lie anywhere from 5,000 to 10,000 feet closer to the surface than is the case with conventional natural gas, an average CBM well costs only about $150,000 to drill versus the $1 million or more for a well drilled to a deeper conventional natural gas reservoir. CBM has the same fuel quality as the conventional gas taken from the deeper reservoirs. It can be put in the same pipelines, run through the same processors, and burned in the same generators and home furnaces and cooking stoves as conventional natural gas.[135]

3.6.1 The Spatial Dimensions of CBM

Most of the current CBM production in the United States (about 8 percent of all American natural gas production at this time) comes from the San Juan Basin in Northern New Mexico and southern Colorado, as well as from fields in northern Wyoming and into Montana. The United States Geological Survey says that up to 90 percent of the undiscovered natural gas in the continental United States is likely to be in the form of methane derived from coal. Most of that gas is in the western and Rocky Mountain states and in another large coal bed field in Alabama.[136]

Extracting CBM in Canada is a relatively new idea but it has a 20 year history of success in the United States. As a result firms are lined up ready to take a chance on Alberta.[137]

According to a study by the Alberta Geological Survey, the province's coalbed resource could contain approximately 500 trillion cubic feet (tcf) of natural gas. There is not enough information available at this time to provide a meaningful estimate of how much of the 500 tcf in Alberta is recoverable. By way of comparison, the province's reserves of recoverable conventional natural gas reserves total 39 tcf. As of the end of 2004, over 3,500 CBM wells had been drilled in Alberta of which more than 1,700 had resulted in production. The first commercial CBM project was announced in 2002. So far about 90 percent of Alberta's CBM wells have targeted the middle Horseshoe Canyon and Belly River coal zones in the Calgary-Red Deer corridor (refer to Figure 16). This is so because development in that area is less costly

134 Alexander's Gas and Oil Connections Company News, "Coal bed methane emerges as a natural gas source" (Volume 8, Issue #15, August 8, 2003), accessed at www.gasandoil.com/goc/company/cmn33266.htm.

135 Ibid.

136 Ibid.

137 Alberta Chamber of Resources, Black Gold: Coal Bed Methane The Energy Industry's Next Big Play (2003), accessed at www.acr-alberta.com/Featured/Black_Gold.htm.

because the coal there is drier leading to no water handling costs. About 7 percent of the province's CBM activity is in the deeper Manville zone in north-central Alberta. The deep coals (over 1,000 meters) there tend to produce highly saline formation water, similar to conventional oil and gas wells at that depth. A small number of CBM wells are spread across a broad area of west-central and south-west Alberta. Some CBM has been produced in the shallower Scollard (Ardley) area with limited amounts of water that varies in quality. An even smaller number of test wells have focused on the Kootenay coals in the Foothills region.[138]

138 Alberta Energy, op. cit.

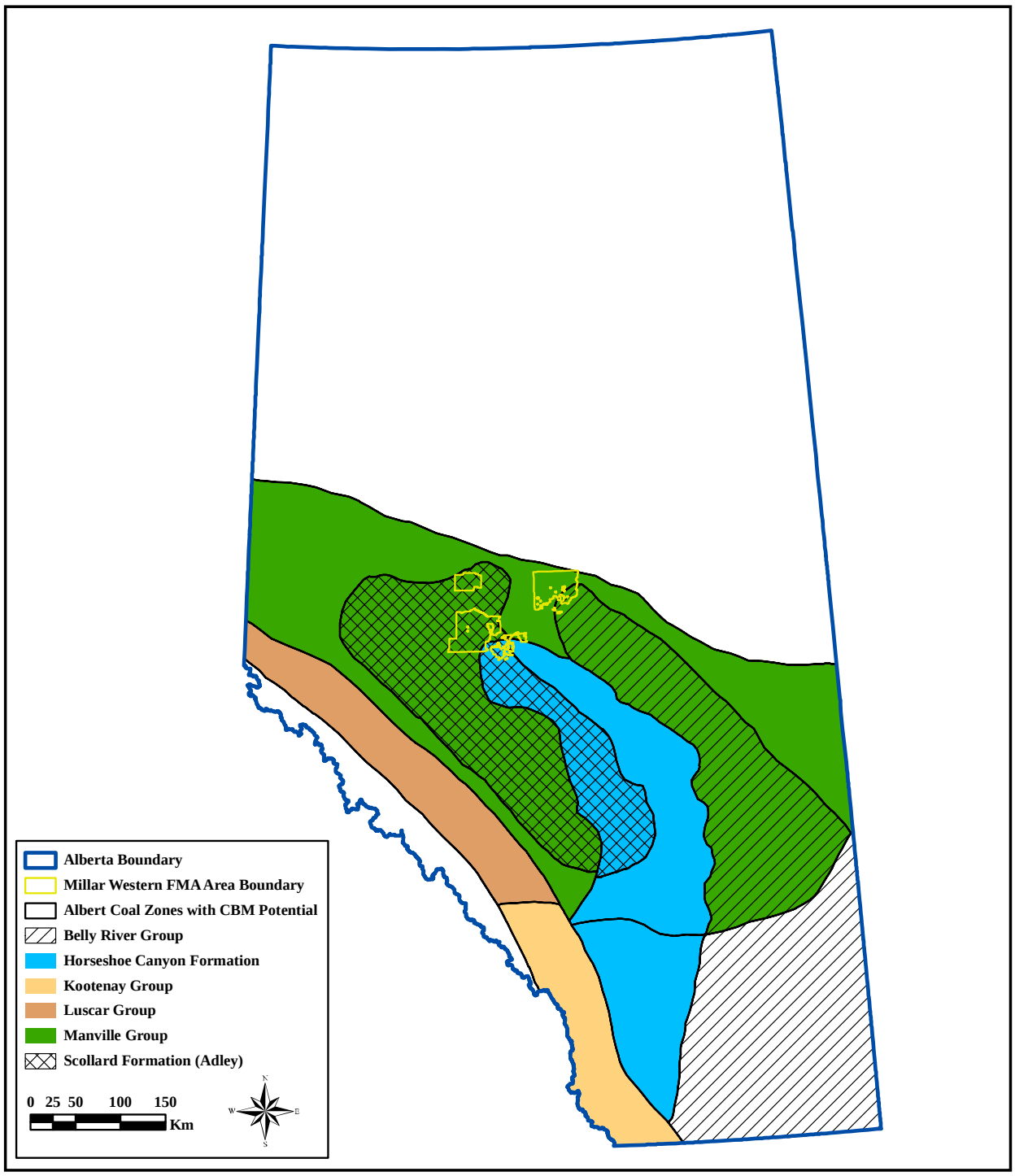

Figure 16. Identified coalbed methane deposits in southern Alberta.

Canada is the world's 12th largest coal producer and has huge coal reserves in British Columbia, Alberta and Nova Scotia. According to the Canadian Gas Potential Committee, estimates of the CBM gas resource nationwide range anywhere between 187 tcf to 460 tcf. The Alberta Energy and Utilities Board (EUB) estimates Alberta's reserves at 135 tcf to 410 tcf. Only 20 tcf of CBM

will supply American gas needs for one year.[139] These estimates suggest that Alberta accounts for 70 to 90 percent of the nation's supply of CBM.

3.6.2 Issues Related to the CBM Extraction Process

CBM cannot be produced until the water that permeates the coal beds is pumped off. This dewatering process often means pumping 12 to 15 gallons of water a minute from each well, a process that must continue for a year or so before maximum methane production kicks in. The question related to this process is, what to do with the water. The water pumped out of the methane-rich Powder River Basin of Wyoming is enough to supply the needs of thousands of people each day. The water quality ranges from fresh to brackish, and most of it is simply spilled on the ground. Ranchers throughout the state claim CBM development is jeopardizing thousands of square miles of aquifers that feed from the headwaters of the region's rivers and streams. Association spokesmen say that water resources are at risk that could be damaged for 200 to 1,000 years.[140]

Canada's regulatory framework is stronger than that in the United States, and in Alberta the ground disposal of any kind of oilfield water is governed by the EUB. Surface water handling – unless it is stored in tanks – falls under the jurisdiction of Alberta Environment. Under the status quo, CBM developments would require a combination of permits from both authorities to proceed. But special circumstances unique to CBM production also require outright rule changes.[141]

The Alberta Research Council has been working with the Canadian, American, and other governments since the late 1990's to enhance methane recovery by injecting carbon dioxide from large producers of greenhouse gases into coal beds. This process has helped increase recovery from the San Juan coal beds mentioned earlier, but research in Alberta is still inconclusive. In this process carbon dioxide is injected and is absorbed by the coal and stored in the pore mix of the coal seams, releasing the trapped methane. Two or three molecules of carbon dioxide are absorbed for each molecule of methane released. In this closed process the carbon-dioxide produced by coal-burning or methane-burning power plants is injected into the CBM reservoirs to produce more methane, and the cycle continues.[142]

Future work in this area could lead to the design of efficient zero-emission power plants that are fuelled either by mineable coal or by the methane released from the deep coal reservoirs.[143] Needless to say, that would be a welcomed breakthrough.

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139 Alberta Chamber of Resources, op. cit.

140 Ibid.

141 Ibid.

142 Ibid.

143 Alberta Research Council, Alberta Field Pilot Study to Test CO2 Enhanced Coalbed Methane Recovery (2005) (found at www.arc.ab.ca/Index.aspx/ARC/2629).

3.6.3 Land Impacts of CBM Extraction

The Sierra Club of Canada, Prairie Chapter, points out that unconventional resource development can result in greater environmental impacts due to the more complicated methods of production and the greater number of steps required in the refining process. CBM operations require a greater number of wells per section (8 per section/sq mile) than conventional oil and gas wells, resulting in a greater disturbance on the landscape.[144]

In that regard the Alberta EUB notes that resources are typically developed beginning with the highest quality reserves and working progressively towards the lower quality portions of the resource. Natural gas development is no different. As lower quality gas reservoirs are developed, higher well densities are generally required to optimize gas recovery. CBM continues the trend toward closer spacing of gas wells. Standard gas well spacing for much of Alberta results in one producing well per section per pool. Parts of the province in shallower gas development areas have a common spacing of two to four wells per section per pool. To reduce the spacing from these set standards, EUB regulations require that industry file an application which includes the need to notify all landowners and occupants in the area proposed for reduced well spacing, including full disclosure of the projects details, impacts and benefits. The EUB processes hundreds of special oil and gas spacing applications annually with few public concerns being raised.[145]

In areas already producing conventional oil and gas, new CBM development may be able to take advantage of existing infrastructure to minimize the surface impacts. Good land-use practices, such as drilling multiple wells from a single surface location ands alignment of roads or pipelines along natural field breaks, can reduce surface disturbances while allowing the necessary number of subsurface well penetrations of the coal seam for optimum recovery.[146]

3.6.4 Other CBM Considerations

Many stakeholders in the United States are concerned with CBM trends underway there. For example, the current high oil and natural gas prices on world markets have provoked a major boom in CBM exploration in the Denver-Greeley area of Colorado. Two engines of growth – population in the metropolitan area and energy growth in the form of both oil and natural gas – are colliding in Greeley, and similar clashes are occurring from Montana through to New Mexico. Land previously set aside for urban development is now being sought by CBM producers. There is a general feeling that the boom is in for an extended run, though some

144 Sierra Club of Canada, Coal Bed Methane (found at www.sierraclub.ca/prairie/Sierra911/cbm.html).

145 Alberta Energy and Utilities Board (EUB), EnerFAQs No. 10, Coalbed Methane (January 2004) (found on the EUB web-site at www.eub.gov.ab.ca/BBS/public/EnerFAQs/EnerFAQs10.htm).

146 Ibid.

caution that those predicting a long run are those that predicted a long run for high tech before the bubble burst, so the clash is likely to continue for some time.[147]

The concerns about CBM production are not limited to urban areas. The Coalition for the Valle Vidal in New Mexico covers a range of interests, from ranchers to hunters to hikers, who are concerned about plans to allow CBM development in the Valle Vidal. The Valle area ranges in elevation from 7,700 to 12,584 feet and undulates across the alpine meadows and conifer forests of the Sangre de Cristo Mountains in the Southern Rockies. Several Rio Grande and Canadian River tributaries begin there and the area is known for its rich wildlife. The area is also home to the largest herd of elk in New Mexico and thus attracts hunters from across the United States. Oil company Pennzoil donated the Valle to the U.S. Forest Service in 1982 retaining its rights to develop coal resources in the area. The Forest Service at the time said it would manage the new "multiple use area" primarily for wildlife. The Coalition for the Valle Vidal contends that drilling for CBM would compromise that objective. El Paso Corp., which hopes to lease land on the east side of the Valle for drilling purposes, points to its project in neighboring Vermejo Park Ranch as evidence that energy development and environmental protection are not mutually exclusive. Critics contend the wells and roads and pipelines would irrevocably change the Valle. The Forest Service is expected to release a paper in April 2006 on whether CBM development is compatible with the other uses in the Valle Vidal.[148]

As in Canada (see next section), American projections suggest that CBM will account for a growing share of national gas production in the United States. By 2020, the United States will need about 50 percent more natural gas to meet growing demand. With only 10 to 20 percent of American conventional natural gas remaining untapped, the supply gap will have to be made up through CBM production.[149]

Recognizing the clash that already exists within Alberta for various population, energy, forestry, and agricultural land uses – and the reality that over the longer term agriculture is likely to lose out because of the higher economic value attached to population, forestry, and energy land uses – the Agriculture and Food Council of Alberta released a paper in June 2005 calling for cooperation among the province's forestry, energy, and agri-food industries to help sustain "the value of land as natural capital" and prevent the erosion of agricultural lands which "are in heavy competition with 'higher value' permanent uses in near urban and corridor areas". The paper offers a series of recommendations to establish a set of shared principles, to engage all stakeholders, to promote understanding among them, and to partner with governments.[150]

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147 Sandy Shore, "Gas powering a boom in the west" (Lexington Herald-Leader, March 4, 2006), accessed at www.kentucky.com/mld/hrealdleader/news/nation.

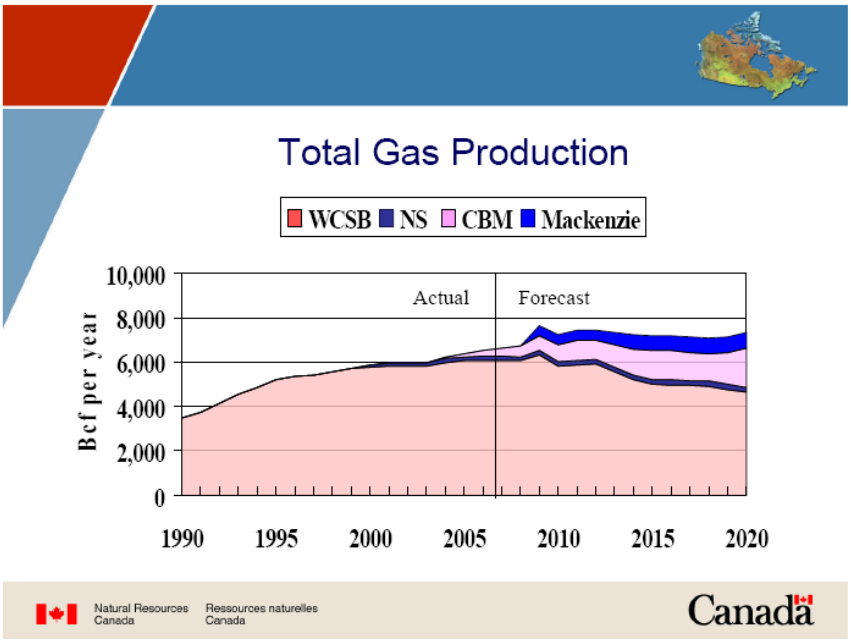
148 April Reese, "Drilling in New Mexico's Valle Vidal draws fire from coalition" (RED LODGE Clearing House New & Noteworthy, February 26, 2006), accessed at www.redlodgeclearinghouse.org/news.

149 Ibid.

150 Agriculture & Food Council, Land Use Policy and the Agri-Food Industry in Alberta (June 2005), accessed at http://www.agfoodcouncil.com/.

3.6.5 Future CBM Production in Canada

Recent (though preliminary) projections produced by Natural Resources Canada indicate that CBM can be expected to account for a growing share of the nation's production of natural gas.[151] The projections (see the chart below) suggest that within the next 15 years conventional natural gas production (from the Western Canadian Sedimentary Basin, or WCSB, which covers most of Alberta and the southern part of Saskatchewan) will fall from 6 tcf per year to just over 4 tcf per year, or by about one-third. In contrast, by 2020 CBM will account for about one-quarter of Canada's natural gas production.



3.6.6 Implications for Millar Western

The inevitable higher prices associated with dwindling conventional oil and natural gas will result in the conservation of these forms of energy, in an increased supply of their non-conventional forms, and in an increased supply other forms of energy. Given that abundant potential supplies of CBM are now being identified across Canada and the United States, it is likely that North Americans will continue to depend on natural gas as a major energy source for many decades ahead.

The recent run-up in oil and natural gas prices on world markets has once again driven home the critical role played by energy in the economic well being of the industrialized world. If oil and gas prices remain high in the future, conventional sources will not run out as quickly as had been

151 Natural Resources Canada, Canada's Energy and Emissions Outlook: Preliminary Results (November 21, 2005 Power Point Presentation to the Canadian Association of Business Economists)

expected just a few years ago. If oil and gas prices drop in the future, the need for unconventional sources will simply be delayed but will not disappear. Growing needs for energy on the part of rapidly industrializing nations like China and India ensure that the need for unconventional energy sources is unlikely to go away.

Thus, in the case of both Canada and the United States, CBM is destined to become a major source of natural gas in North America within just a decade or two.

In Canada most of the nation's CBM will be produced in Alberta. To date CBM development has occurred in the southern portion of the province due to relatively easier access and lower production costs. Over time, however, CBM exploration will increasingly migrate to other areas of the province. Though CBM production has been underway in the United States for two decades, this industry is still in its infancy in Alberta. As noted above, it is difficult to determine today the CBM potential of the various coal zones in Alberta as there is not yet enough data to identify which areas of the province are likely to provide the most effective yields.

The Millar Western FMA is very close to several of the major potential CBM sites in the province. Given that the demand for natural gas is likely to continue for some time in North America and that the potential for CBM production in North America is very high in Alberta [152], it seems reasonable to conclude that CBM development will continue to migrate north within the province over the next two centuries.

Based on the analysis here we conclude that future CBM development poses a credible threat to Millar Western's FMA within that time frame.

152 Jon Baker of Trident Exploration Corporation claimed in an April 2005 presentation entitled The Future Path of Coalbed Methane Production in Western Canada that the CBM potential of the WCSB is equal to the potential of CBM production of the entire western United States.

4. Conclusions

In Part 3, we developed economic and demographic scenarios for Alberta and Census Divisions 4811 (Edmonton) and 4813 (Whitecourt) using an economic and demographic model that relates population growth to the labour market requirements of the economy. Based on various scenarios that consider alternative assumptions regarding future fertility rates, mortality rates, export growth, and productivity growth, we concluded that the key determinants of population growth in Alberta in the future relate to its potential for economic growth.

The population projections prepared by the United Nations (and Statistics Canada) discussed in Part 2 of this report were prepared using models that only take into account changes in key demographic drivers (fertility, mortality, and migration). Indeed, the U.N. projections after 2050 ignore the possibility of international migration.

We consider the projections prepared by the U.N. for the non-industrialized nations based on a replacement rate of fertility and rising life expectancies to be the most plausible. These projections imply falling rates of fertility for such countries and improved living standards, shifts reflecting our view that increased international trade will gradually raise the undeveloped parts of the world out of poverty and set them onto tracks of gradually improving standards of living. In such a world the rate of growth of the populations of these countries will gradually slow down.

We consider the projections prepared by the U.N. for the industrialized nations based on lower than replacement fertility rates and rising life expectancies to be the most credible. These projections tend result in either slow rates of growth or stable levels of population in the industrialized countries.

On balance, the U.N. projections we consider the most relevant for the industrialized and non-industrialized world envisage a world in which trade continues to grow but at a diminishing rate.

Our assessment of the prospects for economic and population growth for the province of Alberta leads us to conclude that its population could grow from 3.2 million people currently to as many as 10 million people in 2201. This Base Case scenario rests on the assumption that the growth rate of Alberta's exports will moderate over time in line with our above described expectations regarding world-wide economic and population growth. This assumption is consistent with a view that would see Canada's population growing to between 80 and 100 million over that period fuelled primarily by net in-migration driven, in turn, by a strong rate of international trade supported economic growth.

We considered a scenario for Alberta that assumes a higher but still moderating rate of export growth over the projection horizon. We conclude that such a profile could generate a population for the province of as many as 25 million people in 2201. This Strong Exports scenario generates greater labour market requirements than the Base Case scenario resulting in significantly higher population growth.

We point out, however, that if productivity growth in the future exceeds that of the past – a view held by many economists – labour market requirements would not grow as much in the future as they have in the past for a given rate of economic growth. We describe, therefore, a Strong Exports and Productivity scenario which concludes that the coincidence of both strong export growth and strong productivity growth would result in a total population in Alberta in 2201 no greater than that foreseen in the Base Case scenario (about 10 million people).

Should Alberta's exports grow faster in the future than foreseen in our Base Case scenario we would expect that a combination of factors – including economies of scale and the need to remain competitive – would lead to a coincident increase in the underlying rate of productivity growth. As a result we reject the Export Strong scenario as a plausible outcome for the province and recommend that the Base Case scenario and the Strong Exports and Productivity scenario be considered as the most plausible alternative futures for Alberta. Since the total population projected for Alberta by these two scenarios is nearly identical we are, in effect, recommending only one projection for the province.

We tested the probable impacts of both the 10 million and the 25 million Alberta population scenarios for 2201 on the populations of Census Division 4811 (Edmonton) and 4813 (Whitecourt and the Millar Western FMA). We concluded that population encroachment on Millar Western's Forest management Area will not occur. We reached that conclusion even after considering the possibility of Alberta's population reaching 25 million (which we reject) and of Edmonton reasserting the dominant role it played in population growth within the province in the decades following World War II (which we also reject).

We also considered the potential for encroachment of agriculture and tourism activities on Millar Western's Forest Management Area. Given the existing spatial distribution of such activities in the province and the prospects for growth of each of these two industries for Alberta as a whole, we concluded that neither industry is likely to grow sufficiently in the area of the FMA to threaten its existence between now and 2201.

Finally, we considered the potential for encroachment of coalbed methane extraction/production on Millar Western's Forest management Area. The Millar Western FMA is very close to several

of the major potential CBM sites in the province. Given that the demand for natural gas is likely to continue for some time in North America and that the potential for CBM production in North America is very high in Alberta, it seems reasonable to conclude that CBM development will continue to migrate north within the province over the next two centuries. We concluded that future CBM development poses a credible threat to Millar Western's FMA within that time frame.

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6. Glossary

International migration: An international migrant is defined as any person who changes his or her country of usual residence. International migration has two components: immigration and emigration. An immigrant is a person who has been permitted by immigration authorities to live in Canada permanently. An emigrant is a person who leaves Canada to settle in another country.

Interprovincial migration: Movement from one province to another involving a permanent change in residence. A person who takes up residence in another province is an out-migrant with reference to the province of origin, and an in-migrant with reference to the province of destination.

Life expectancy: A statistical measure derived from the life table indicating the average number of years of life remaining for a person at a specific age, if that person would experience during his life the age-specific mortality rates observed a given year.

Median age: The median age is an age "x", such that exactly one half of the population is older than "x" and the other half is younger than "x".

Natural increase: Excess of births over deaths.

Net migration: Difference between immigration and emigration or in-migration and out-migration for a given area and period of time.

Replacement level: Mean number of births per woman necessary to assure the long-term replacement of a population for a given mortality level. Currently, the replacement level for Canadians is around 2.1 children per woman.

Total fertility rate: The sum of single year age-specific fertility rates during a given year. It indicates the average number of children that a woman would have if the current age-specific fertility rates prevail over her reproductive period.

Nanotechnology: Nanotechnology is the application of science and engineering at the atomic scale. It facilitates the construction of new materials and devices by manipulating individual atoms and molecules, the building blocks of nature. Nanotechnology enables the atom-by-atom design and fabrication of tiny structures that are very small, typically 1-100 nanometres, and which have new properties and powerful application in medicine and biotechnology, in energy and the environment, and in computing and telecommunications.

Somatic gene therapy: Attempts to transform selected genes in an existing organism (e.g., to cure or mitigate a disease). The modified genes are not passed on.

Germline genetic engineering: A technology that changes genes (requires cloning) and hence the traits of the new organism. The genes are passed on.

Gross Domestic Product (GDP): The GDP of a country is defined as the market value of all final goods and services produced within a country in a given period of time.

Demographic transition: The demographic transition refers to the shift over time in an area's population from high to low mortality and fertility.

Census Divisions: The term applied by Statistics Canada to areas established by provincial law that are intermediate geographic areas between the municipality and the province or territory level. Census divisions represent counties, regional districts, regional municipalities, and other types of provincially legislated areas.

Census Metropolitan Area (CMA) or Census Agglomeration (CA): A census metropolitan area or a census agglomeration is formed by one or more adjacent municipalities centred on a large urban area (known as the urban core). The census population count of the urban core is at least 10,000 to form a census agglomeration and at least 100,000 to form a census metropolitan area. To be included in the CMA or CA, other adjacent municipalities must have a high degree of integration with the central urban area, as measured by commuting flows derived from census place of work data.

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