



Commercialization of Net Feed Efficiency (NFE): Olds College NFE Test Facility - 2002 to 2005

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**Net feed Efficiency Bull Test Results Meeting
June 9, 2005, Olds College, Olds, Alberta, Canada**



**Western
Forage/Beef
Group**



**Agriculture and
Agri-Food Canada**

**Agriculture et
Agroalimentaire Canada**



Alberta

**AGRICULTURE, FOOD AND
RURAL DEVELOPMENT**

Commercialization of NFE Project: Accomplishments



Tested 221 industry bulls for NFE



Demonstrated an RFID-based feed intake measurement system (GrowSafe System) to industry and students



Introduced and explained the science of NFE



Generated the first North American EPDs for NFE

Feed Efficiency in Beef Cattle: Why?



Maintenance requirements of beef cattle is largely unchanged over last 100 years (*Johnson, Ferrell and Jenkins, 2003*)



>50% of total feed intake is used solely for body maintenance of adult and slaughter animals (*Dickerson 1970*)



65-75% of the total dietary energy cost in breeding cows is required for maintenance (*Ferrell & Jenkins 1985; NRC 1996*)



5% improvement in feed efficiency has an economic impact 4X greater than a 5% improvement in ADG
(*Gibb & McAllister 1999*)

Energetic Efficiency in growing beef cattle

1. **Feed Intake**

2. **Feed Conversion Ratio: DMI/ADG**

3. **Partial Efficiency of growth: $ADG / (\text{avg. DMI} - \text{expected DMI}_m)$**

efficiency of growth after removing FI for maintenance

4. **Relative Growth Rate: $100 \times [\log \text{ end wt} - \log \text{ start wt}] / \text{days on test}$**

Growth relative to instantaneous body size

5. **Kleiber Ratio: $ADG / \text{avg test period LWT}^{0.75}$**

weight gain per unit of metabolic body weight

**All measures are related to body size, growth
and composition of gain**

6. Net Feed Efficiency (NFE) or Residual Feed Intake (RFI)



regression of mid-test wt and ADG on FI which gives expected FI;
 $NFE = \text{actual FI} - \text{expected FI}$



is the difference between an animal's actual feed intake and its expected feed intake based on its size and growth over a specified test period.



it is moderately heritable ($h^2 = 0.29-0.46$) & may reflect an animal's energy requirement for maintenance.



is independent of body size and growth rate

Net Feed Efficiency Testing

- Can. Operators: Lacombe, Lethbridge, Kinsella, Olds College, Cattleland Feedyards
- Cost: Feed, yardage, wood chips, weighing, ultrasound, adm. plus \$1/hd/day for NFE
- Age criteria: contemporary group, age range=60 days
- Test length: 28 day adjustment period; 84-112 day test period, weigh every 14 days, UBF, UMAR, UREA, hip height & BCS every 28 days
- Diet: Fed ad libitum a diet containing 2.39-2.87 Mcal ME/kg DM
Example: 55% barley silage; 39% rolled barley, 6% beef supplement (DM basis); ME=2.65 Mcal/kg DM; 14.2% CP
- Info: ADG, HH, UBF, UMAR, UREA, NFE
Report monthly to seedstock producers/breed associations
Internet site
- Standards: Animal Behaviour & Feed Efficiency Network (AAFRD, AAFC, Univ. of Alberta, Univ. of Calgary, Olds College)
- Reliability:

Olds College NFE Test Facility

Three-year summary of on-test traits

Start of test Traits	British Bulls N = 98	Continental Bulls N = 123
Age, days	246 (26)	271 (17)
Weight, kg	336 (58)	384 (47)
Hip height, cm	118 (5.2)	124 (3.4)
Backfat thickness, mm	2.4 (1.0)	1.8 (0.7)
Scrotal cir., cm	22.6 (3.1)	24.1 (3.0)

- British bulls consisted of 18 Aberdeen Angus, 20 Red Angus, 36 Hereford and 24 Welsh Black
- Continental bulls consisted of 39 Charolais, 44 Limousin and 40 Simmental.

Olds College NFE Test Facility

Three-year summary of final traits

Start of test Traits	British Bulls N = 98	Continental Bulls N = 123
ADG, kg/day	1.50 (0.24)	1.47 (0.19)
DMI, kg/day	8.36 (1.28)	9.10 (1.19)
FCR, kg DMI/kg gain	5.64 (0.74)	6.25 (0.80)
Backfat thickness, mm	5.9 (1.8)	3.9 (1.1)
NFE, kg as fed/day	0.0 (1.3)	0.0 (1.7)
EPD-NFE ₂ , kg as fed/day	0.0 (0.13)	0.0 (0.17)

- British bulls consisted of 18 Aberdeen Angus, 20 Red Angus, 36 Hereford and 24 Welsh Black
- Continental bulls consisted of 39 Charolais, 44 Limousin and 40 Simmental.

Relationships between NFE and various on-test traits

Start of test Traits	British Bulls N = 98	Continental Bulls N = 123
Birth weight, kg	-0.22 *	-0.27 **
Start age, days	0.11	-0.03
Start weight, kg	0.01	0.00
Hip height, cm	-0.06	-0.05
Backfat thickness, mm	0.12	-0.04
Marbling score	0.16	-0.03
Ribeye area, cm ²	-0.06	-0.06

•*P<0.05, **P<0.01

- British bulls consisted of 18 Aberdeen Angus, 20 Red Angus, 36 Hereford and 24 Welsh Black
- Continental bulls consisted of 39 Charolais, 44 Limousin and 40 Simmental.

Relationships between NFE and various final traits

Start of test Traits	British Bulls N = 98	Continental Bulls N = 123
End weight, kg	-0.00	-0.05
Backfat thickness, mm	0.26*	0.15
Marbling score	0.25*	0.15
Ribeye area, cm ²	-0.01	-0.17
ADG, kg/day	0.00	0.00
DMI, kg/day	0.49***	0.66***
Feeding HD, min/day	0.47***	0.33***
Feeding duration, min/day	0.33***	0.32***
FCR, kg DMI/kg gain	0.53***	0.64***
EPD-NFE ₂ , kg as fed/day	0.90***	0.91***

•*P<0.05, **P<0.01, ***P<0.001

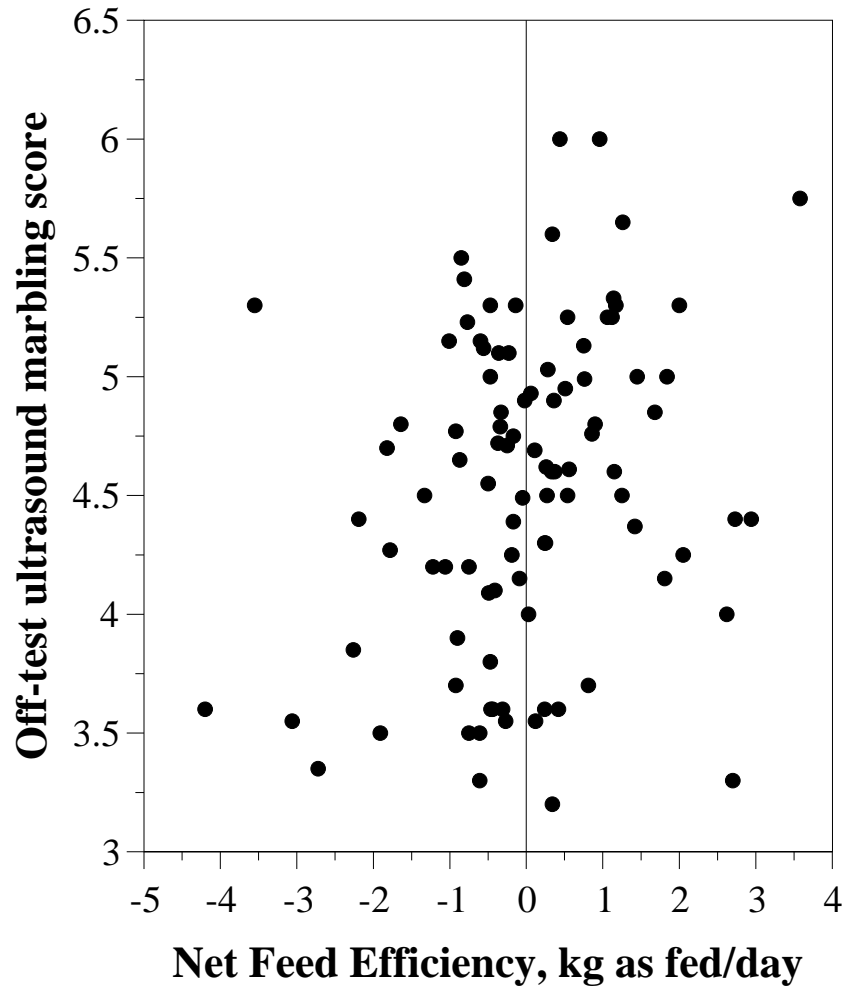
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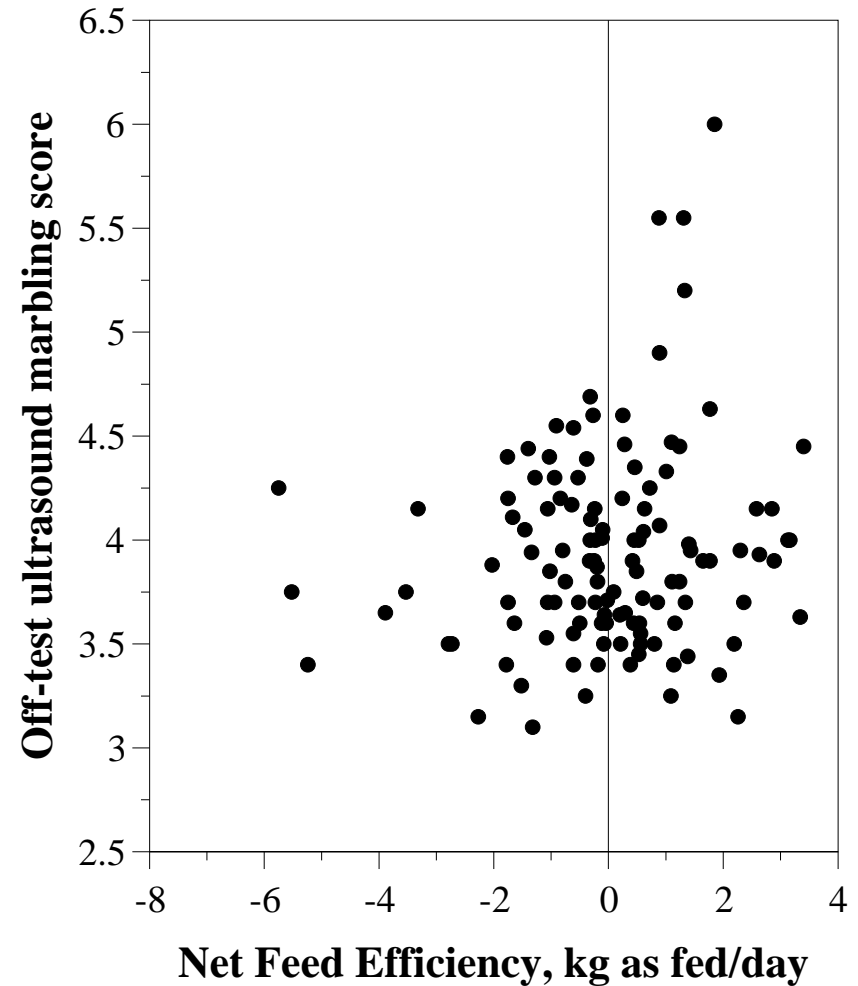
Olds College NFE Bull Test - 2002-03, 2003-04 & 2004-05

Relationship between NFE and off-test marbling score

British Bulls, n=96, $R_2 = 0.063$



Continental Bulls, n=123, $R_2 = 0.021$

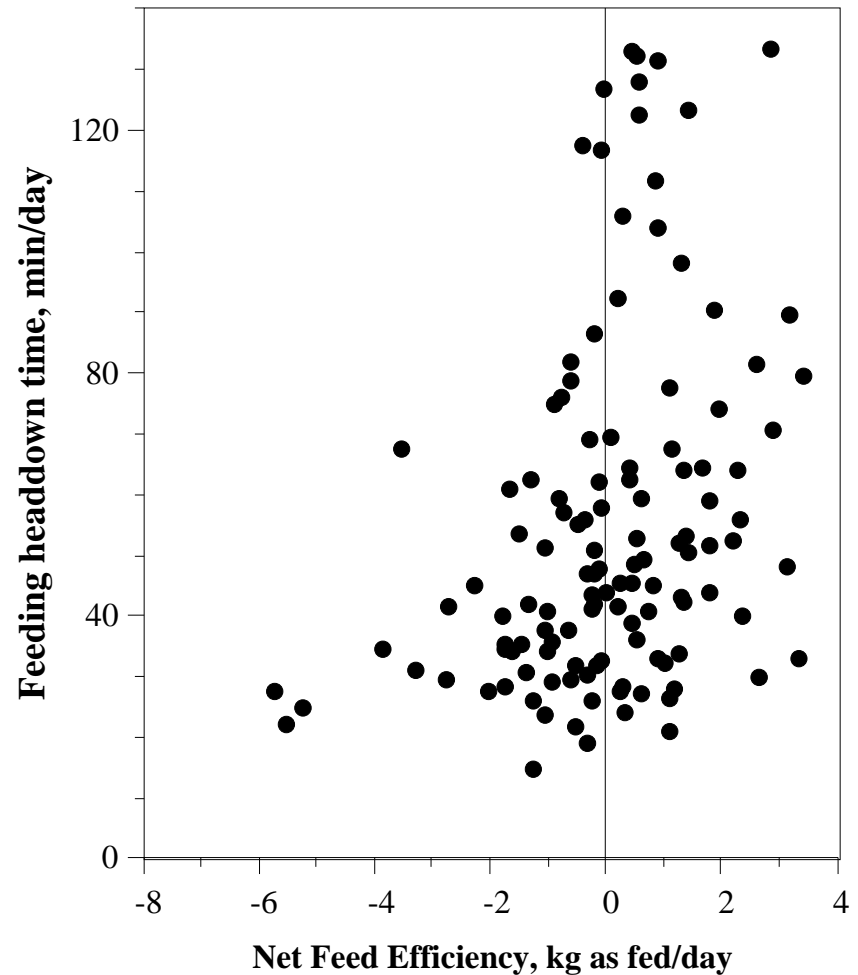
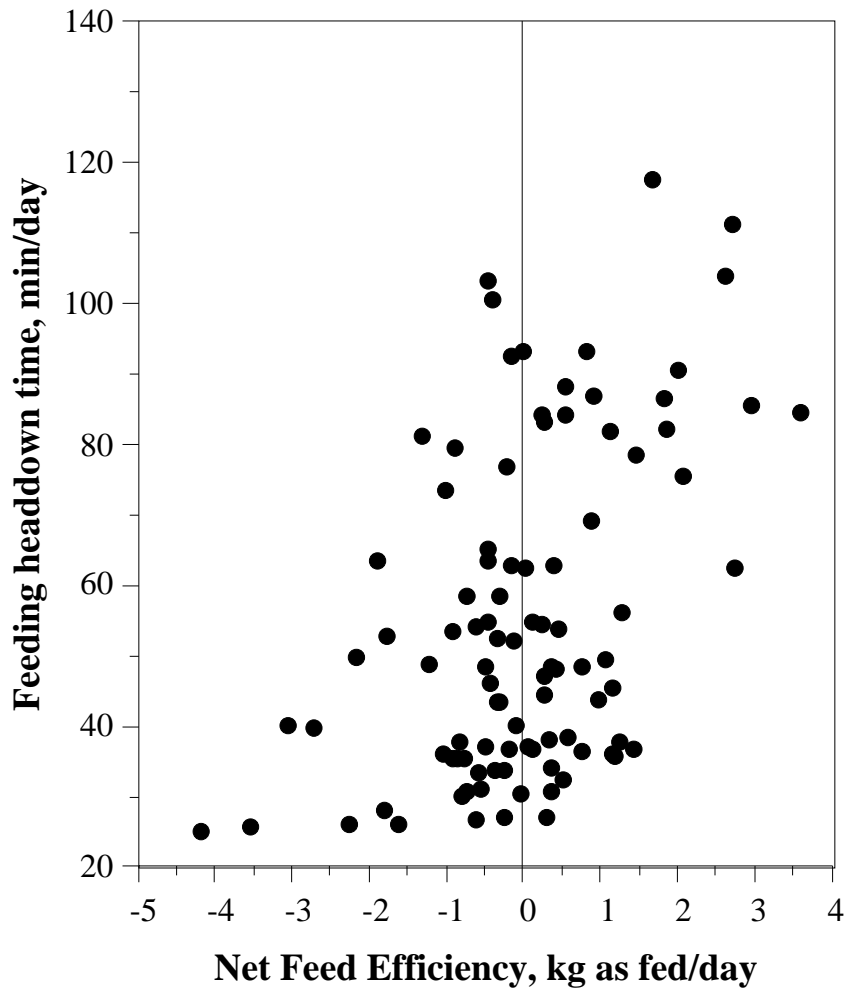


Olds College NFE Bull Test - 2002-03, 2003-04 & 2004-05

Relationship between NFE and feeding behaviour

British Bulls, n=96, $R_2 = 0.221$

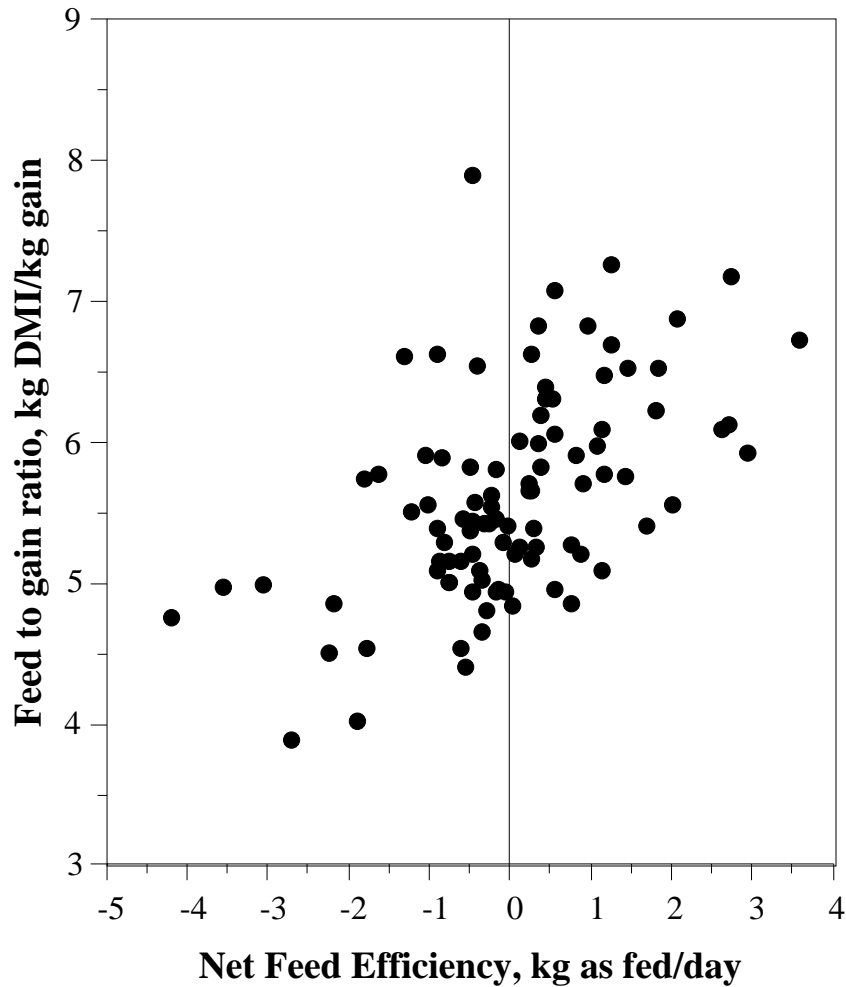
Continental Bulls, n=123, $R_2 = 0.106$



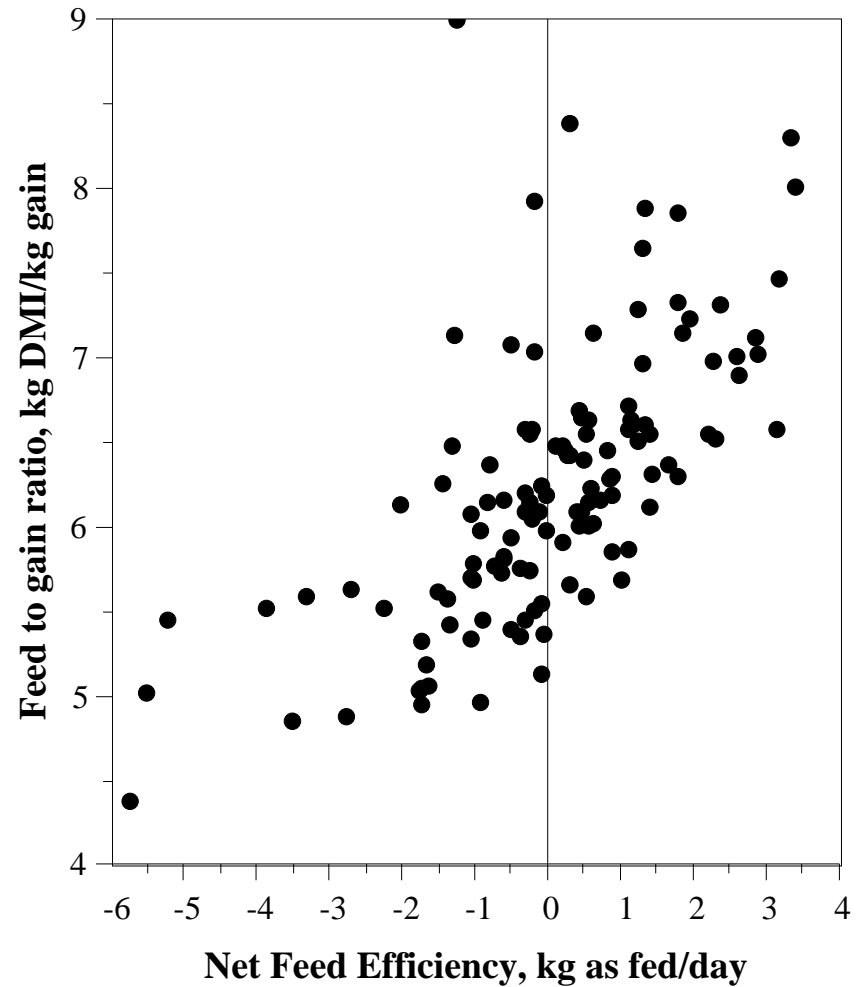
Olds College NFE Bull Test - 2002-03, 2003-04 & 2004-05

Relationship between NFE and feed to gain ratio

British Bulls, n=96, $R_2 = 0.280$



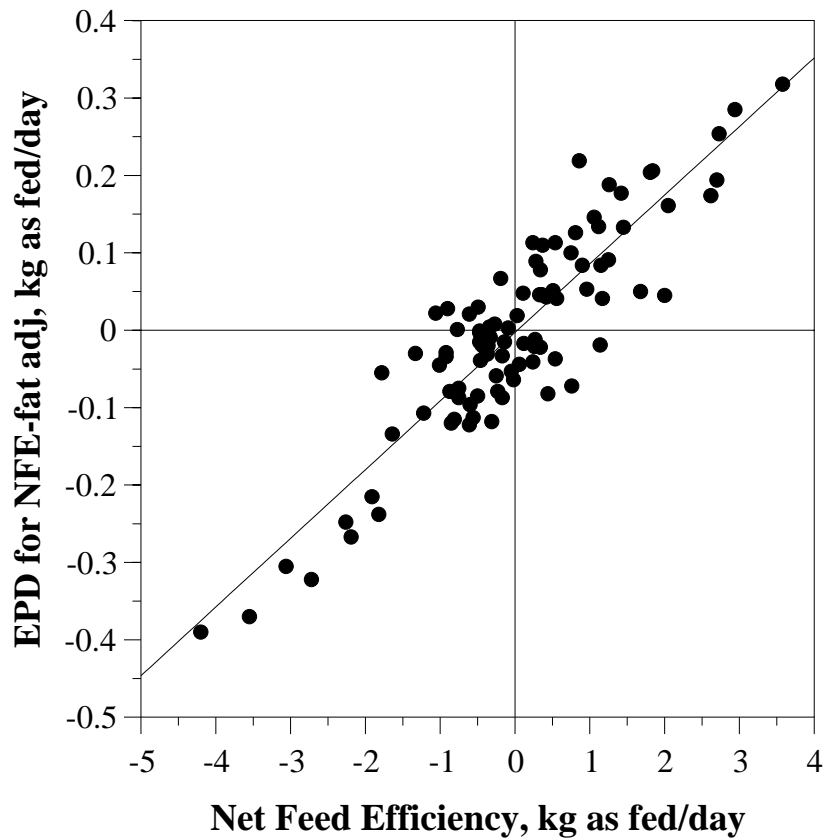
Continental Bulls, n=123, $R_2 = 0.413$



Olds College NFE Bull Test - 2002-03, 2003-04 & 2004-05

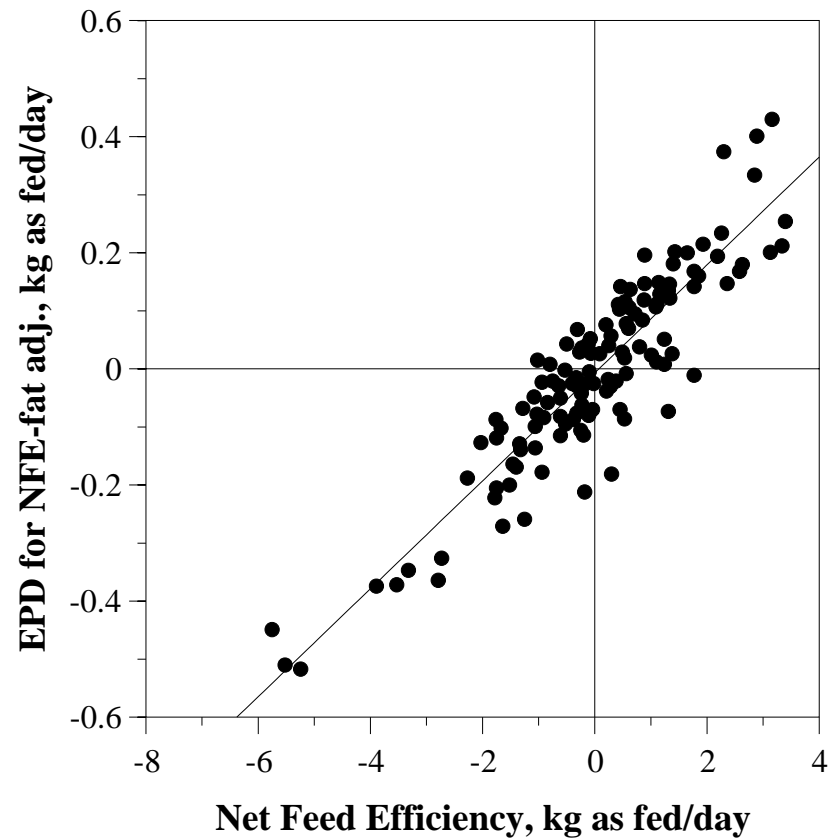
Relationship between phenotypic NFE and genotypic NFE

British Bulls, n=96



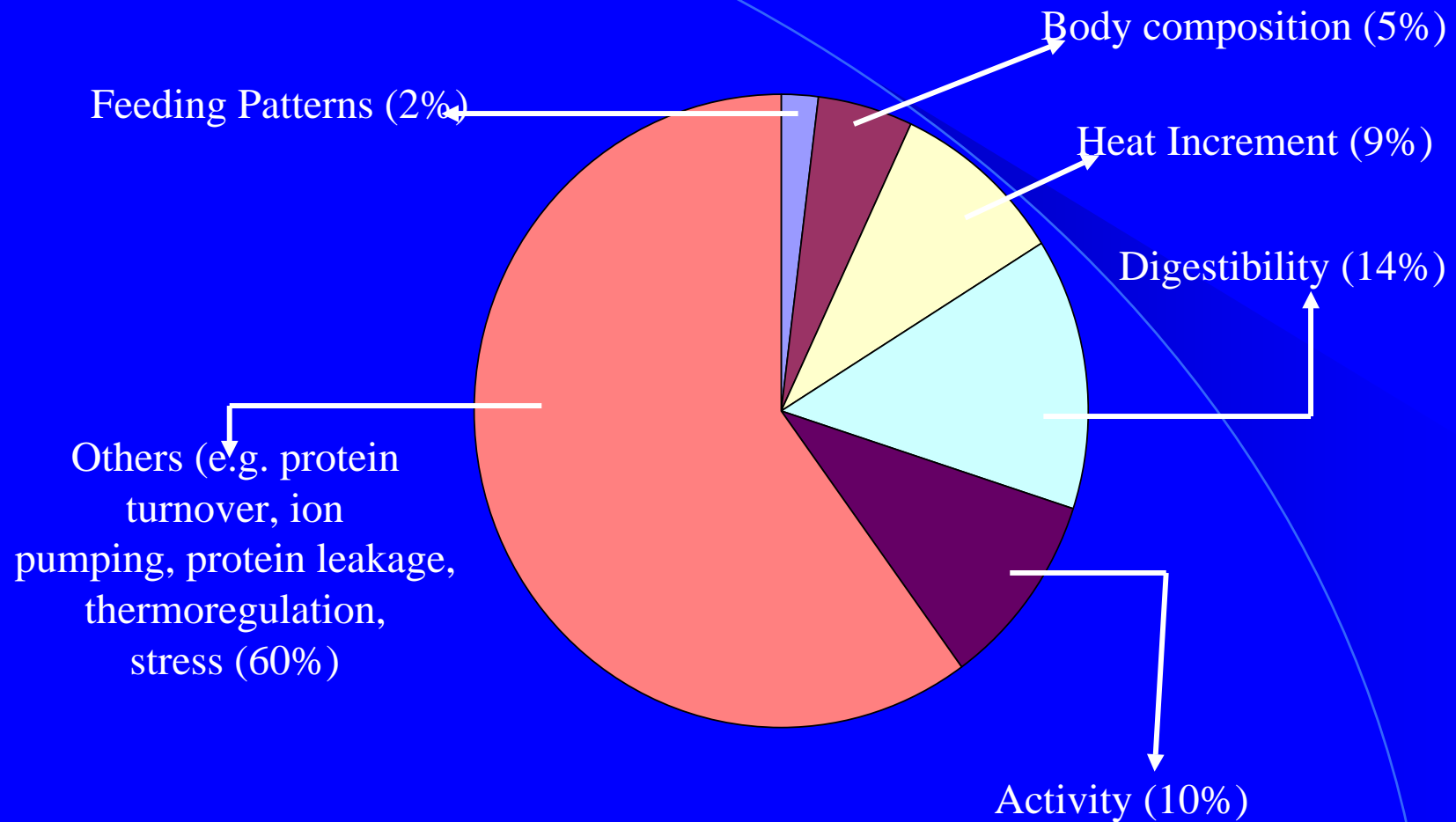
R-square = 0.801 # pts = 96
 $y = -0.00292 + 0.0887x$

Continental Bulls, n=123



R-square = 0.829 # pts = 123
 $y = -0.00693 + 0.093x$

Proposed contribution of different biological mechanisms to variation in NFE



Richardson and Herd, 2004
Herd et al., 2004

The selling price of bulls tested for NFE compared to the selling price of their untested half brothers

	Half Brothers Tested for NFE		Half Brothers Not tested for NFE		Diff. in favor of tested bulls
	Bulls	\$/bull	Bulls	\$/bull	
Owner A	4	\$5663	9	\$3156	\$2507
Owner B	4	\$3013	3	\$2167	\$ 846
Weighted mean	8	\$4338	12	\$2908	\$1430

Bulls tested for NFE at the Olds College NFE Test Facility, Alberta; Nov, 2004-Feb, 2005
 Bulls sold by Tom & Carol Handford, Handford Red Angus

The selling price of low versus high NFE half brothers

Traits	Half Brothers Low* NFE	Half Brothers High* NFE	Half Brothers Not tested For NFE
Number of bulls	3	5	12
NFE, kg as fed/day	-0.54	+1.77	unknown
Selling Price, \$/bull	\$6783	\$2870	\$2908

* Bulls tested for NFE at the Olds College NFE Test Facility, Alberta; Nov, 2004-Feb, 2005



Future:



Effects of NFE on cow lifetime productivity, milk yield, calving and weaning rates, replacement heifer & grazing ability



NFE on high concentrate vs. high roughage diets



Early indicators of NFE (physiological, genetic)



Underlying metabolic processes

Relationship of energy gain (EG) and metabolizable energy intake (MEI)

