Efficient Cows – More Money

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Tools for Building Better Cows
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Western Forage/Beef Group

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Building Better cows

- Optimize economic traits
- Replacement heifer development
- Match the cow type to resource
- Exploit individual cow variation

Relative Value of Beef Industry Traits

Production Traits	Trenkle & Willham, 1977	Melton, 1994	Barwick & Nicol, 1993
Reproduction	10	2	2
Growth Rate	2	1	1
Carcass Traits	1	>1	1

II. Harlan Ritchie at Michigan State University conducted a 20 year review on the "Optimum Cow" and on matching the cow to the available resources. He gave four examples:

British x smaller British crosses are optimal in a semi-arid climate with limited feed resources.

Cow: Chinese yellow x Limousin
Calf: Limousin sired

Cow: M3 (JE-TL-RP-SS)
Calf: Angus sired

Harlan Ritchie at Michigan State University conducted a 20 year review on the "Optimum Cow" and on matching the cow to the available resources. He gave four examples:

British x larger Continental crosses are optimal where precipitation is adequate and feed resources are abundant.

Cow: Charolais x Shorthorn
Calf: Simmental sired

Cow: Charolais x Angus
Calf: Chianina sired

Harlan Ritchie at Michigan State University conducted a 20 year review on the "Optimum Cow" and on matching the cow to the available resources. He gave four examples:

British x smaller Continental crosses are optimal in a semi-arid climate with medium feed resources.

Cow: Charolais x Hereford
calf: Limousin sired

Cow: Hereford x Angus
Calf: Limousin sired

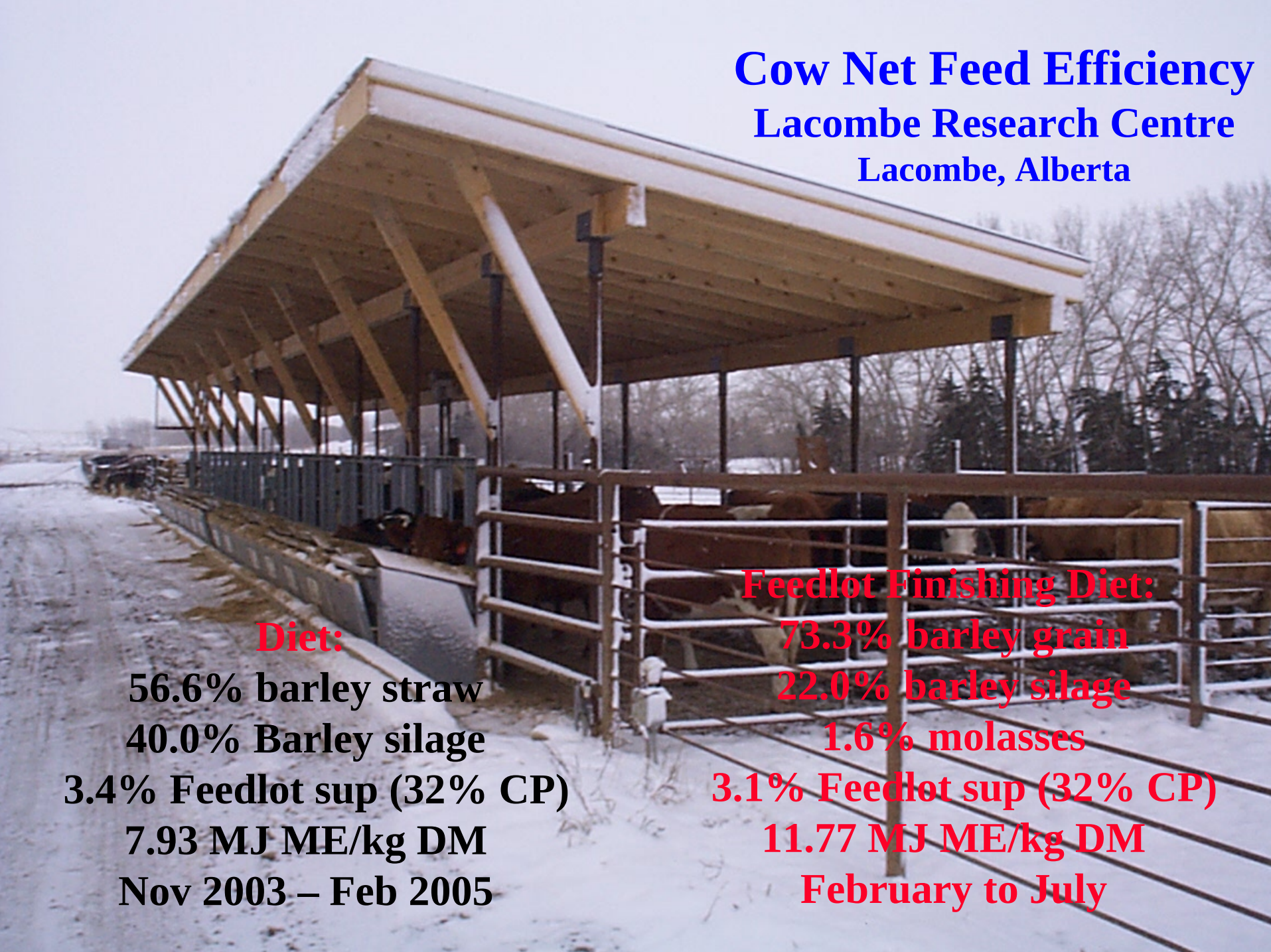
Net feed intake (residual feed intake):

- 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 and reflects an animal,s energy requirement for maintenance.
- is independent of body size and growth rate

Cow Net Feed Efficiency

Lacombe Research Centre

Lacombe, Alberta



Diet:

56.6% barley straw

40.0% Barley silage

3.4% Feedlot sup (32% CP)

7.93 MJ ME/kg DM

Nov 2003 – Feb 2005

Feedlot Finishing Diet:

73.3% barley grain

22.0% barley silage

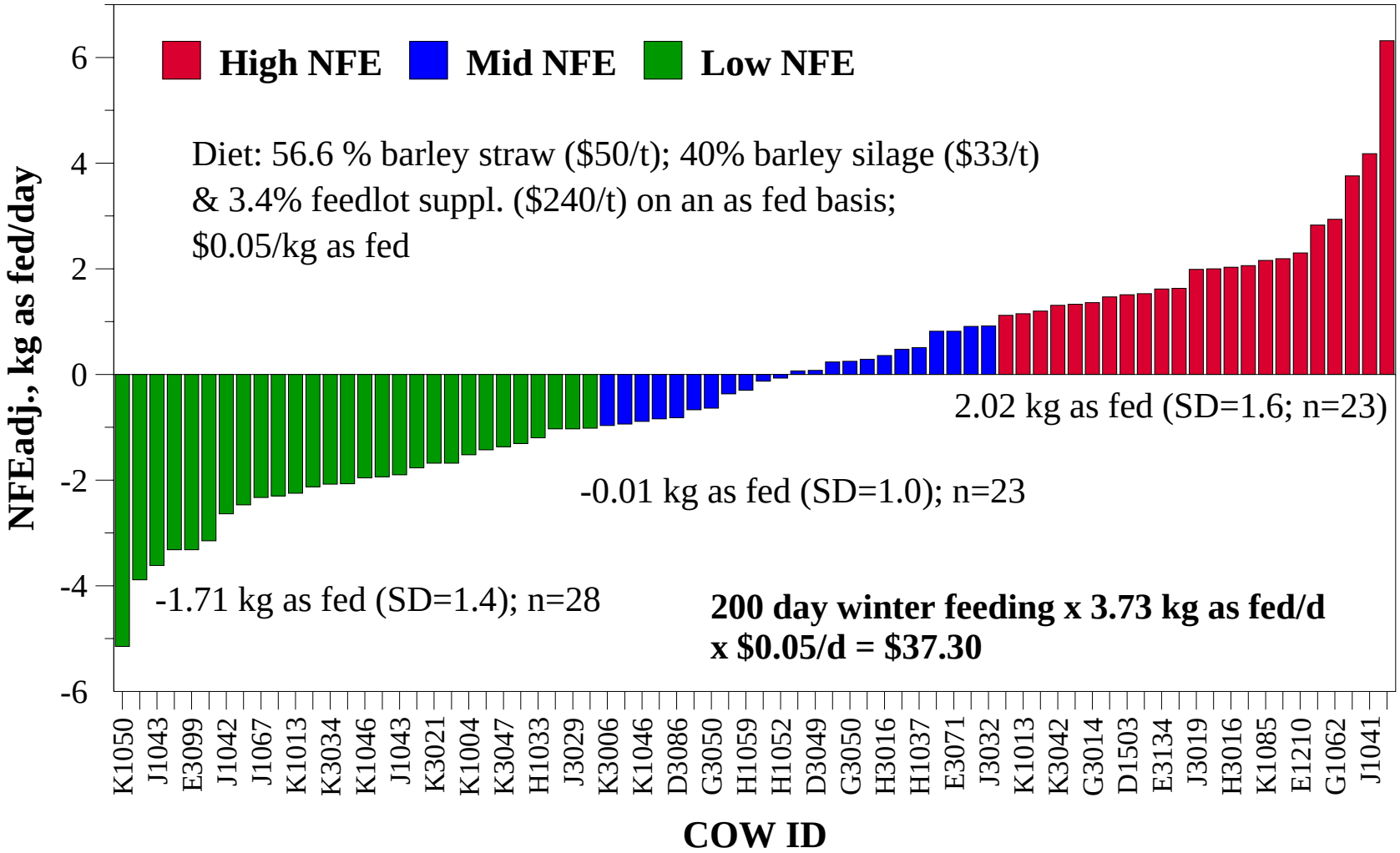
1.6% molasses

3.1% Feedlot sup (32% CP)

11.77 MJ ME/kg DM

February to July

Net Feed Efficiency in mature cows (LRC 2003-2005)



Expected feed intake was adjusted for mid-point metabolic weight, body fat (ultrasound rump fat gain) and feeding activity (duration & frequency). High NFE > +1 and Low NFE < -1

Feed intake, body weight, average daily gain and body condition score of HIGH, MID AND LOW NFE cows*

Trait	COW NFE Group			
	HIGH NFE	MID NFE	LOW NFE	Sign. level
Number of cows	21	19	30	
NFEadj, kg as fed/day	1.87a	-0.03b	-1.50c	<0.001
Feed Intake, kg DM/day	15.5a	14.5b	13.8c	0.047
ADG, kg/day**	0.15	0.15	0.10	NS
Body Condition score	3.1b	3.6a	3.6a	0.098
Backfat, mm	8.0b	10.0a	11.1a	0.010
Rump fat, mm	12.2b	18.4a	17.3a	0.009

* Expected feed intake was adjusted for mid-point metabolic weight, ultrasound rump fat gain and feeding duration and frequency

** ADG were adjusted for conceptus weight.

Production efficiency traits for of HIGH, MID AND LOW NFE cows*

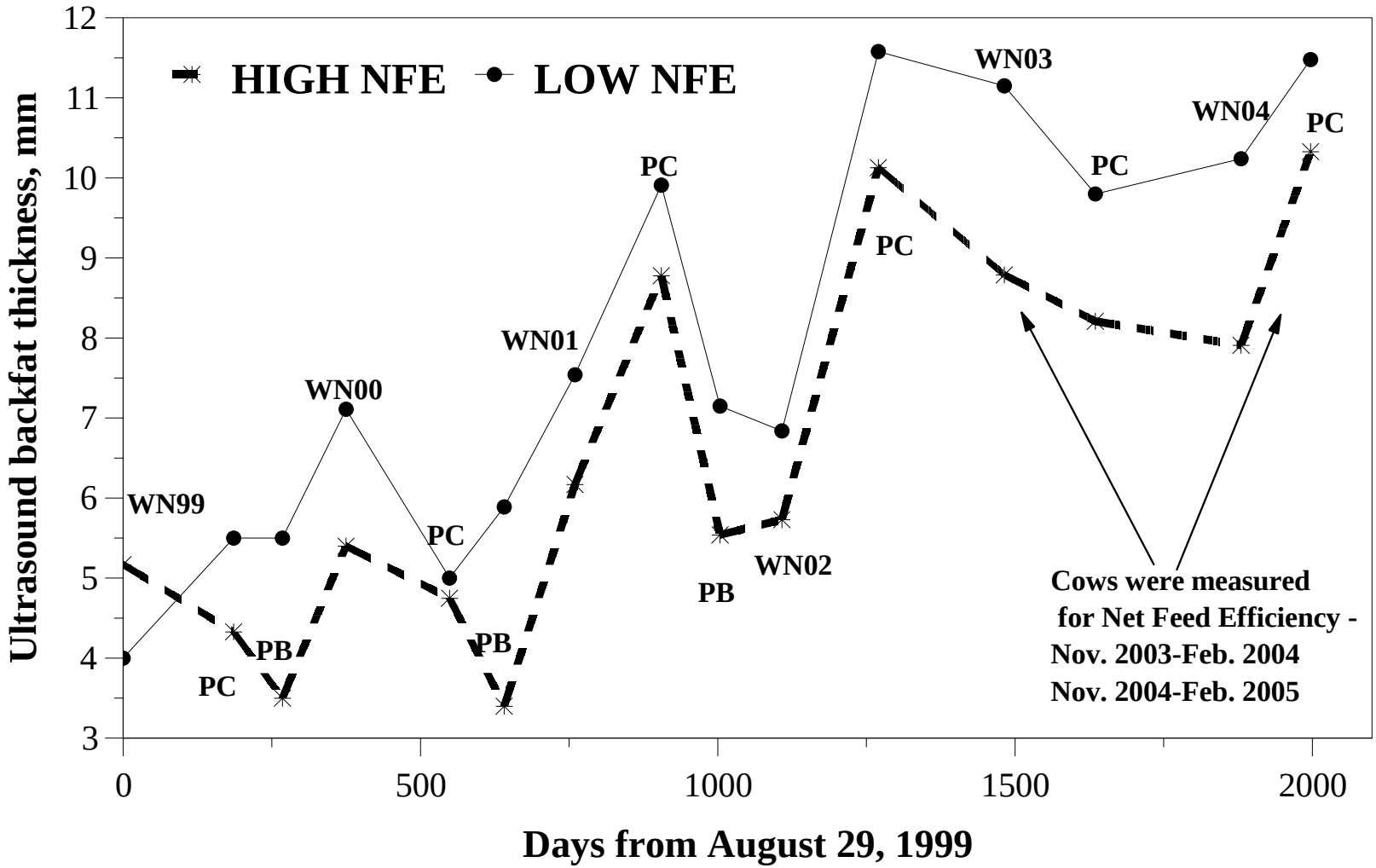
Trait	COW NFE Group			
	HIGH NFE	MID NFE	LOW NFE	Sign. level
Number of calvings	84	84	88	
Progeny ADG-200, kg/day	1.11	1.08	1.05	NS
Progeny 200-d wean wt, kg	271	268	260	NS
Dam's wt at weaning, kg	622b	667a	665a	0.033
Dam's BCS	2.98	3.13	3.35	0.094
PE adj BCS, kg calf/mating	43.7	40.9	40.1	0.097
Biol. Efficiency, adj BCS	1.50	1.64	1.54	NS

PE=(adj_wnwt/cw_wnwt)*100.
Body Condition Score adjustment; 40.2 kg/BCS for British and 23.4 kg/BCS for Continental cows
Adj.=cw_wnwt+(40.2*(3.0-cw_wnbc)).

LOW NFE cow J1042 (5 yr-old Hereford-Angus cow in the spring of 2004; NFE adj = -2.64 kg as fed/day; 2003 weight at weaning =787 kg).

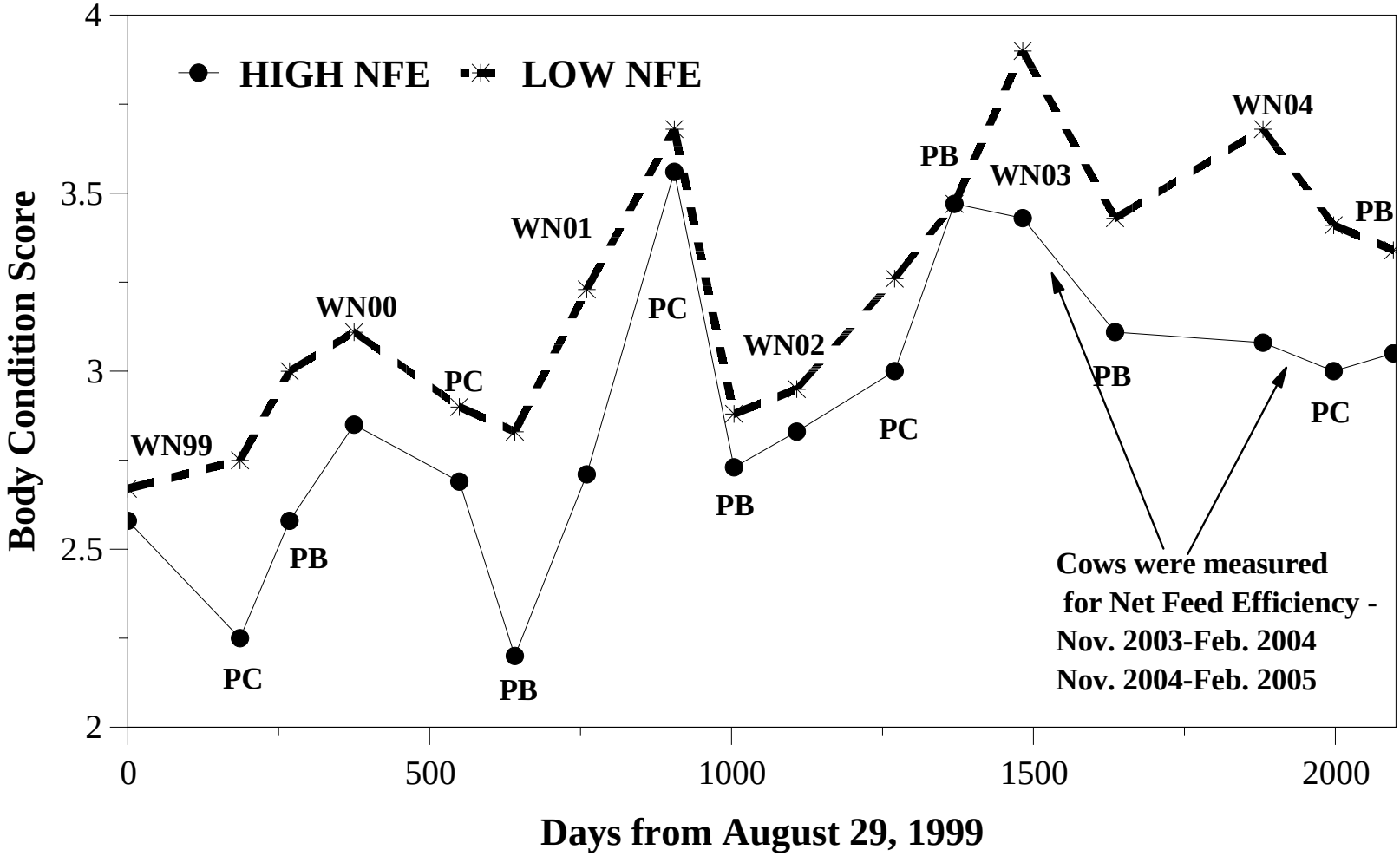
HIGH NFE cow E1245 (8 yr-old Hereford-Angus cow in the spring of 2004; NFE adj = 2.83 kg as fed/day; 2003 weight at weaning = 755 kg).

Backfat thickness changes in High and Low NFE cows at weaning (WN), pre-calving (PC) and pre-breeding (PB) from 1999 to 2005



Expected feed intake was adjusted for mid-point metabolic weight, body fat (ultrasound rump fat gain) and feeding activity (duration & frequency). High NFE > +1 and Low NFE < -1

Body condition score in High and Low NFE cows at weaning (WN), pre-calving (PC) and pre-breeding (PB) from 1999 to 2005



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Effect of cow NFE on their progeny's performance

Trait	COW NFE Group			
	HIGH NFE	LOW NFE	SE	Sign. level
Number of progeny	17	20		
Progeny NFE, kg as fed/day	1.28	0.24	0.30	<0.05
Progeny feed Intake, kg DM/day	9.1	8.3	0.3	<0.05
Progeny weight, kg	545	523	17	NS
Progeny ADG, kg/day	1.28	1.32	0.05	NS
Progeny backfat, mm	7.7	6.8	0.5	NS

Progeny test: Diet = 22% barley silage, 73.3% steam rolled barley; 1.6% molasses & 3.1% Beef supplement (32% CP), 11.97 MJ ME/kg DM; Test Period = 72 days.

Cows categorized as High or Low efficiency based on their progeny's NFE in 2003 and 2004

Trait	Progeny NFE			
	HIGH NFE	LOW NFE	SE	Sign. level
Number of calvings since 1997	206	185		
Calf birth weight, kg	42.4	41.9	0.8	NS
Calf pre-weaning ADG, kg/day	1.07	1.05	0.02	NS
200_day weaning weight, kg	266.5	260.8	3.5	NS
Prod. Eff., kg calf waned/cow exp.	40.3	40.9	0.7	NS
Prod. Eff, adjusted for BCS	40.5	41.1	0.7	NS

PE=(adj_wnwt/cw_wnwt)*100.
Body Condition Score adjustment; 37.5 kg/BCS for British and 22.0 kg/BCS for Continental cows
Adj.=cw_wnwt+(37.5*(3.0-cw_wnbc)).

Genetic Gain and Economic value

Selected heifer	= 0.0 kg as fed/day
Herd average	= 0.0 kg as fed/day
	0.0 kg as fed/day

Selected bull	= -2.00 kg as fed/day
Herd average	= 0.00 kg as fed/day
	= -2.00 kg as fed/day

Expected progeny performance=

0.40 x ((0.00 + -2.00)/2) = -0.4 kg as fed/day

Value in Progeny for slaughter & repl. heifers

Slaughter=-0.4 kg as fed/day x $0.10/kg as fed x 200 d = $8.00/hd

Repl.=-0.4 kg as fed/day x $0.05/kg as fed x 365 d = $7.30/hd

Genetic Gain and Economic value

Selected heifer	= -2.00 kg as fed/day
Herd average	= 0.00 kg as fed/day
	-2.00 kg as fed/day

Selected bull	= -2.00 kg as fed/day
Herd average	= 0.00 kg as fed/day
	= -2.00 kg as fed/day

Expected progeny performance=

0.40 x ((-2.00 + -2.00)/2) = -0.8 kg as fed/day

Value in Progeny for slaughter & repl. heifers

Slaughter=-0.8 kg as fed/day x $0.10/kg as fed x 200 d = $16.00/hd

Repl.=-0.8 kg as fed/day x $0.05/kg as fed x 365 d = $14.60/hd

Key points:

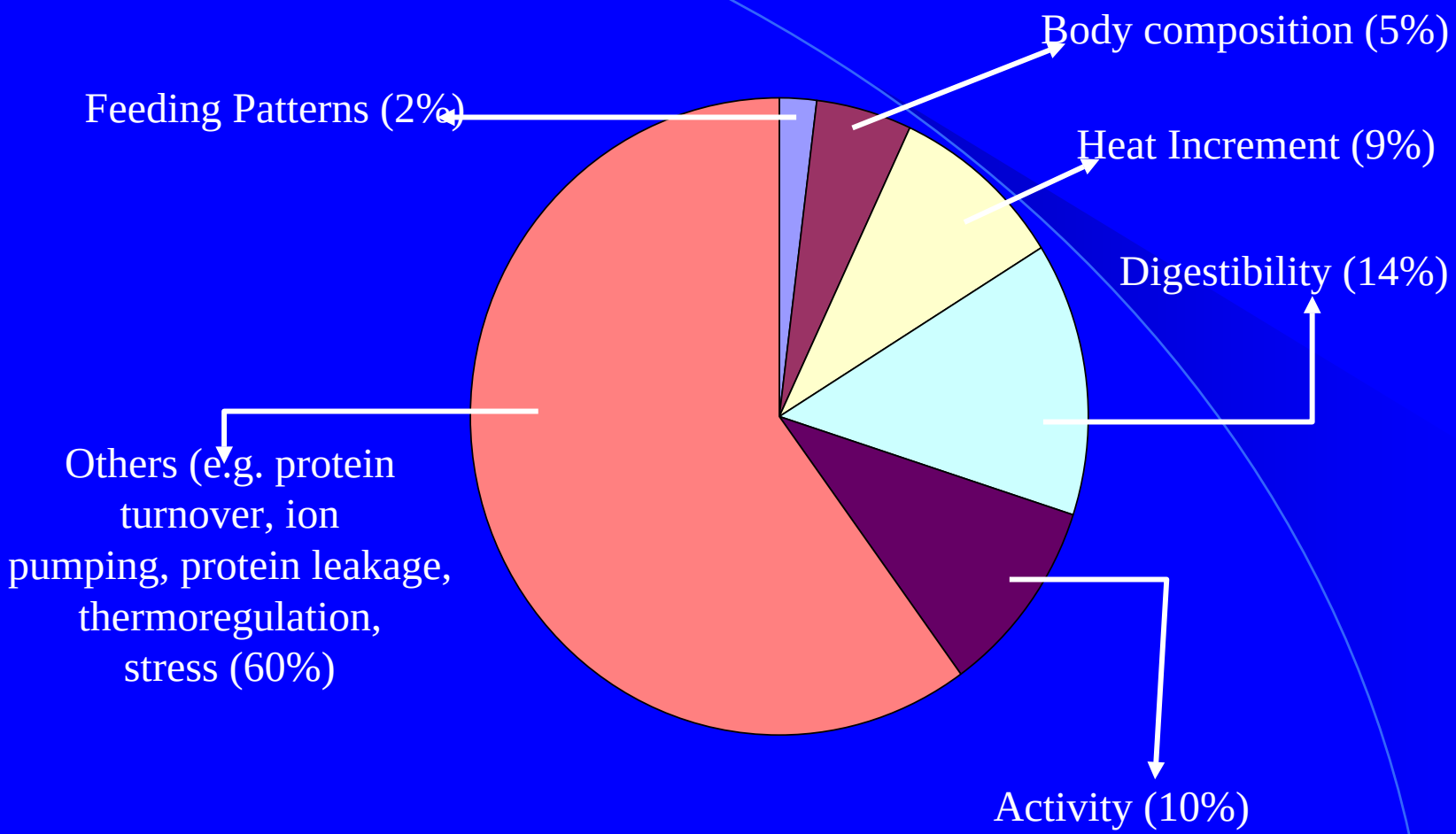
- **Large variation exists within breeds or biological types**
- **NFE is independent of body size and growth.**
- **NFE is moderately heritable & may reflect energy required for maintenance**
- **The advantage of NFE over FCR is that NFE allows breeders to place different emphasis on growth, size and feed efficiency**

Conclusion

- NFEadj in cows was related to measures of body fat
- NFEadj in cows was not related to progeny weaning weight or cow biological efficiency
- Only a small portion of the differences in NFE are due to differences in body composition. A larger portion was due to

i) differences in maintenance requirements & heat increment of feeding, and
ii) inherit differences in metabolic processes associated with protein turnover & ion transport

Proposed contribution of different biological mechanisms to variation in NFE



Richardson and Herd, 2004
Herd et al., 2004

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

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

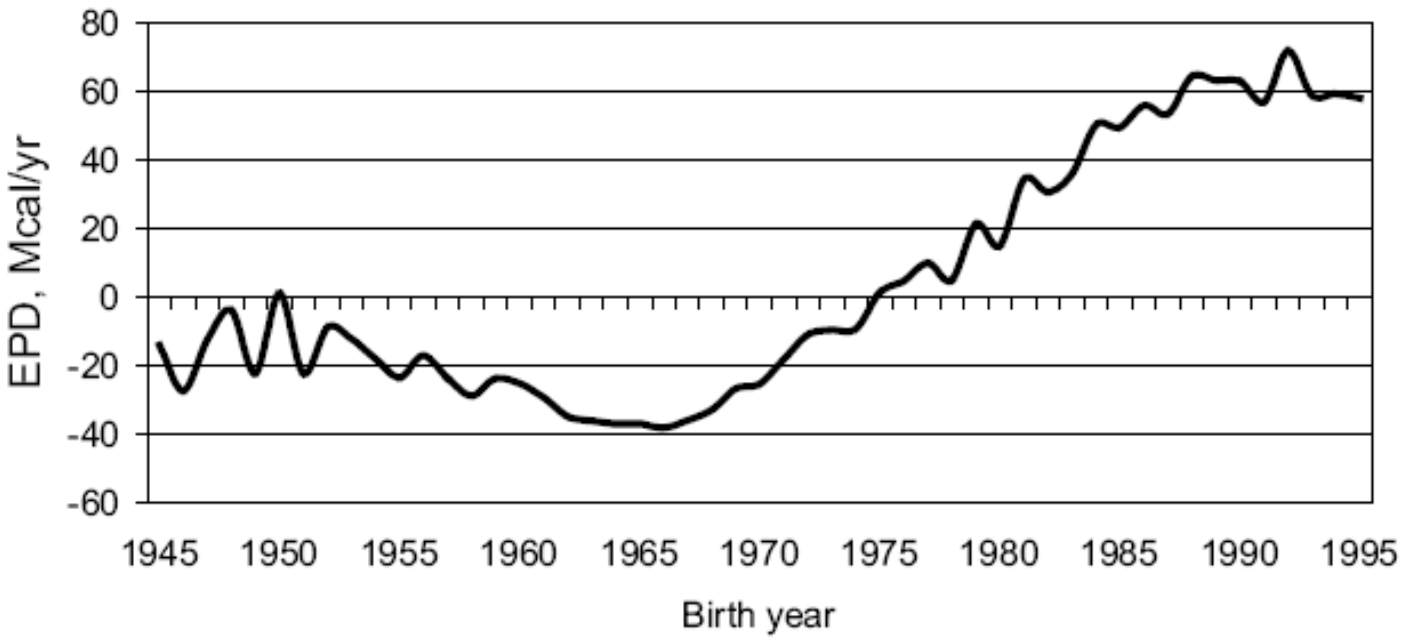


Figure 1. Average EPD (Mcal/yr) for mature cow maintenance energy requirements by birth year in Red Angus cattle (Evans et al., 2002).

Feed Efficiency in Beef Cattle: Why?

- **>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. **<u>Feed Conversion Ratio: DMI/ADG</u>**

3. **Partial Efficiency of growth: ADG/(avg. DMI-expected DMI_m)**

   efficiency of growth after removing FI for maintenance

4. **Relative Growth Rate: 100 x [log end wt – log start wt]/days on test**

   Growth relative to instantaneous body size

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

   weight gain per unit of metabolic body weight

kg calf/mating opportunity;
kg calf/Mcal energy intake

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

Effect of cow NFE on their progeny's carcass traits

Trait	Cow NFE Group			
	HIGH NFE	LOW NFE	SE	Sign. level
Number of progeny	17	20		
Carcass cutability, %	60.0	59.9	0.6	NS
Carcass grade fat, mm	11.4	10.0	0.9	NS
Yield grade	1.3	1.4	0.2	NS
Quality grade, A%	26.7	29.4		NS
AA%	60.0	52.9		NS
AAA%	6.7	11.8		NS
B4 %	6.6	5.9		NS

Predicted biological efficiency for 9 breeds (grams of calf weaned per kg of DM per cow exposed)		
Breed	DM intake 3500 kg/cow/yr	DM intake 7000 kg/cow/yr
Angus	39	17
Braunvieh	33	42
Charolais	27	45
Gelbvieh	29	36
Hereford	30	13
Limousin	33	42
Pinzgauer	38	44
Red Poll	47	24
Simmental	26	42