

Nutritional Effects of Frame Size on Efficiency and Longevity of Beef Cows

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Feed Efficiency

- Feed/pasture costs a significant portion of total production costs
 - $\approx 40 - 70\%$
- Feed costs volatile
- Advances in technology for selection?
- BIG QUESTION: What is efficiency and what measure of efficiency should we use?



Output (calf or carcass)

Efficiency =

Input (nutrients)





Feed Efficiency defined

Item	Definition
Gross efficiency Feed conversion ratio	feed:gain or gain:feed
Residual feed intake or Residual gain	Feed intake actual – feed intake predicted (after accounting for ADG and BW) or ADG actual – ADG predicted
Maintenance efficiency	BW/feed intake (at maintenance)
Partial efficiency of growth	Weight gain/feed intake (after accounting for maintenance)
Relative growth rate	Weight gain/instantaneous size
Kleiber ratio	Weight gain/metabolic BW
Cow/calf efficiency	Feed intake of cow and calf / weight of calf weaned
Weaning efficiency	lb calf/lb cow weight
Efficiency per acre	lb beef/acre
Economic efficiency	Net income



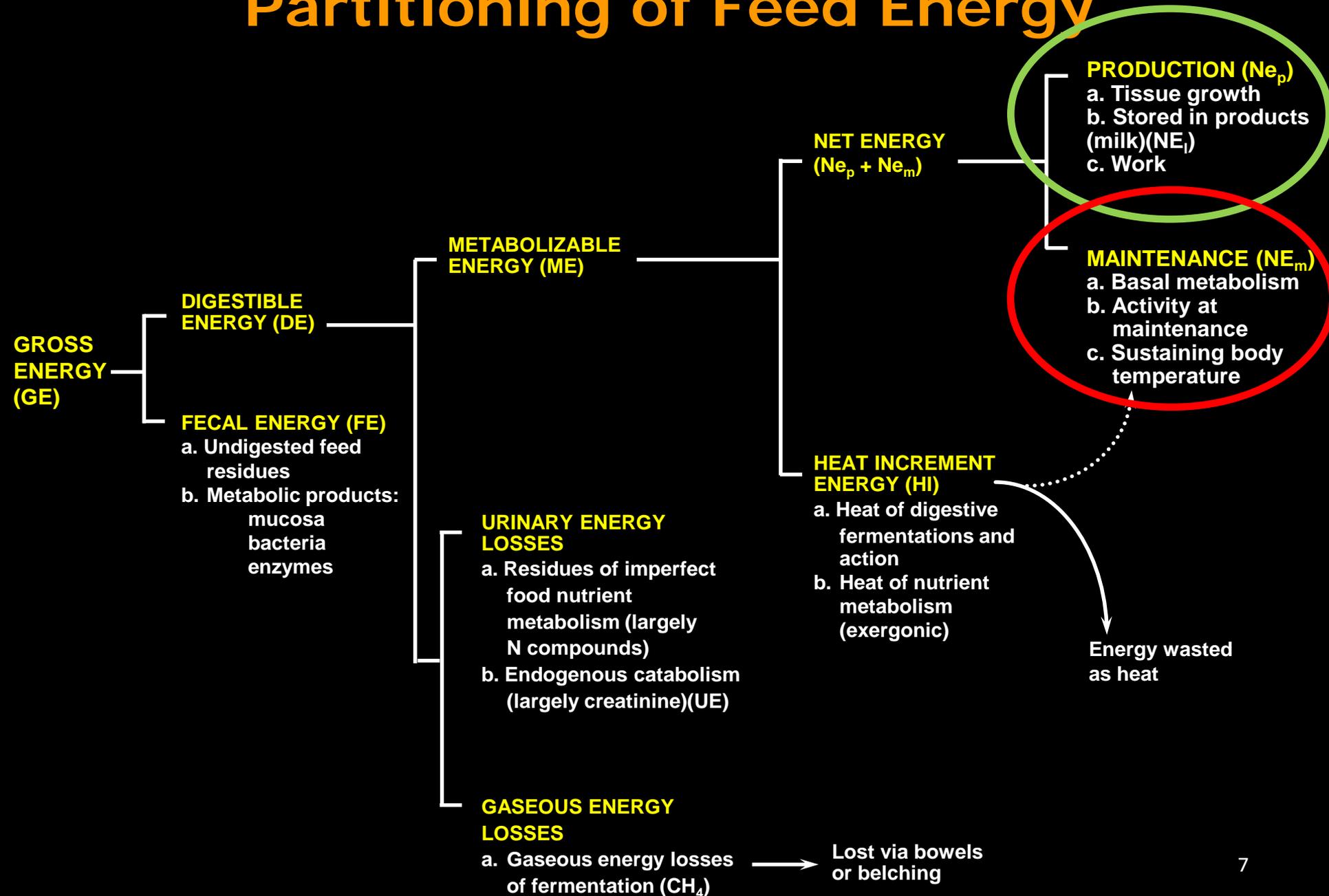
Longevity is an important factor (Lifetime efficiency)

- Weaned calf value: \$900
- Cost to produce calf: \$600
- Cull cow value: 1250 lb*\$0.80 = \$1,000
- Cost to purchase bred heifer: \$1,400
- So:
 - \$900 - \$600 * 1 = \$300 +1,000 - \$1,400 = -\$100
 - \$900 - \$600 * 2 = \$600 +1,000 - \$1,400 = +\$200
 - \$900 - \$600 * 3 = \$900 +1,000 - \$1,400 = +\$500
 - \$900 - \$600 * 4 = \$1,200 +1,000 - \$1,400 = +\$800

Reproductive Efficiency

- Pregnancy rate
- Rebreeding
- Calving distribution

Partitioning of Feed Energy



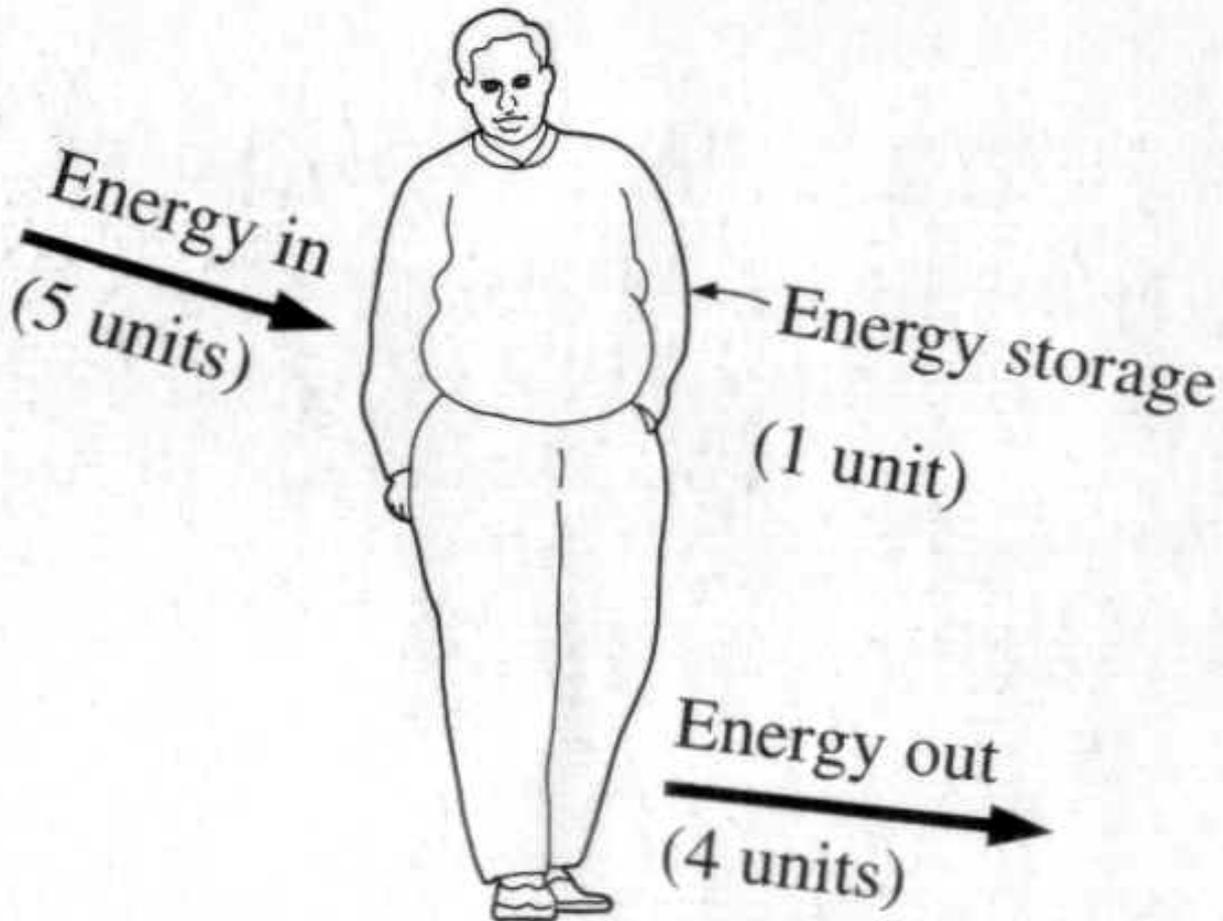
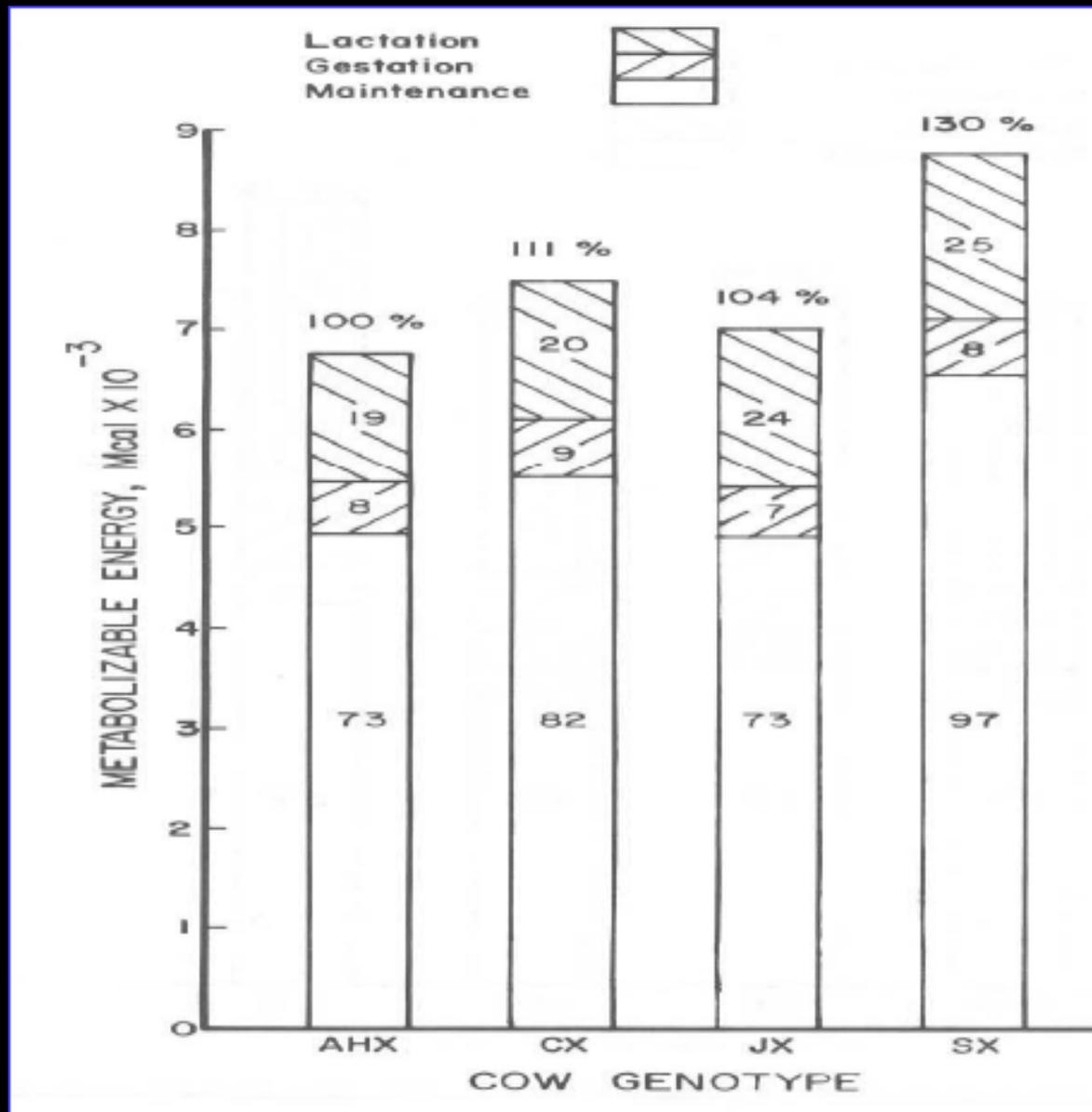


FIGURE 1-2

Conservation of energy principle for the human body.

Maintenance Costs are Significant



Ferrell and Jenkins 1985

What influences maintenance costs and feed efficiency

- Size
- Body composition
- Potential milking ability
- Visceral organ mass (cellular energy metabolism)
- Prior nutrition
- Environment (feed availability, weather, etc)
- Adaptability – Able to withstand feed restriction
- Hair coat, etc.
- Many more things

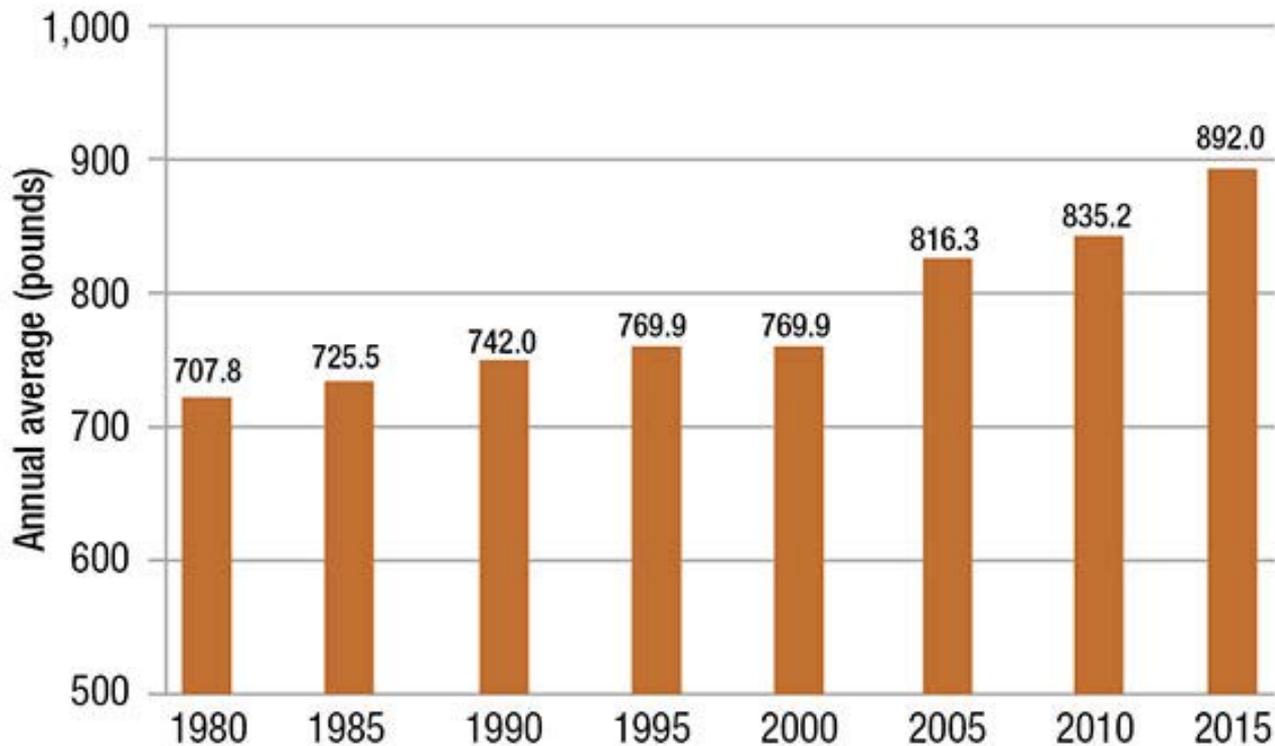
Finishing Cattle vs. Replacements or Mature Cows

- Finishing cattle
 - Output is gain or meat
 - Relatively easy to measure?
- Replacements or mature cows
 - Output is not the growth of that animal
 - Calf weaned or beef (over a lifetime)
 - Many, many factors influence the output
 - Also more difficult to measure inputs (feed intake)
 - Environment is critical
 - Forage availability, weather, etc.
 - Breeding programs much more difficult to design for selection of efficient cow/calf system that still fits into what is demanded by the finishing sector

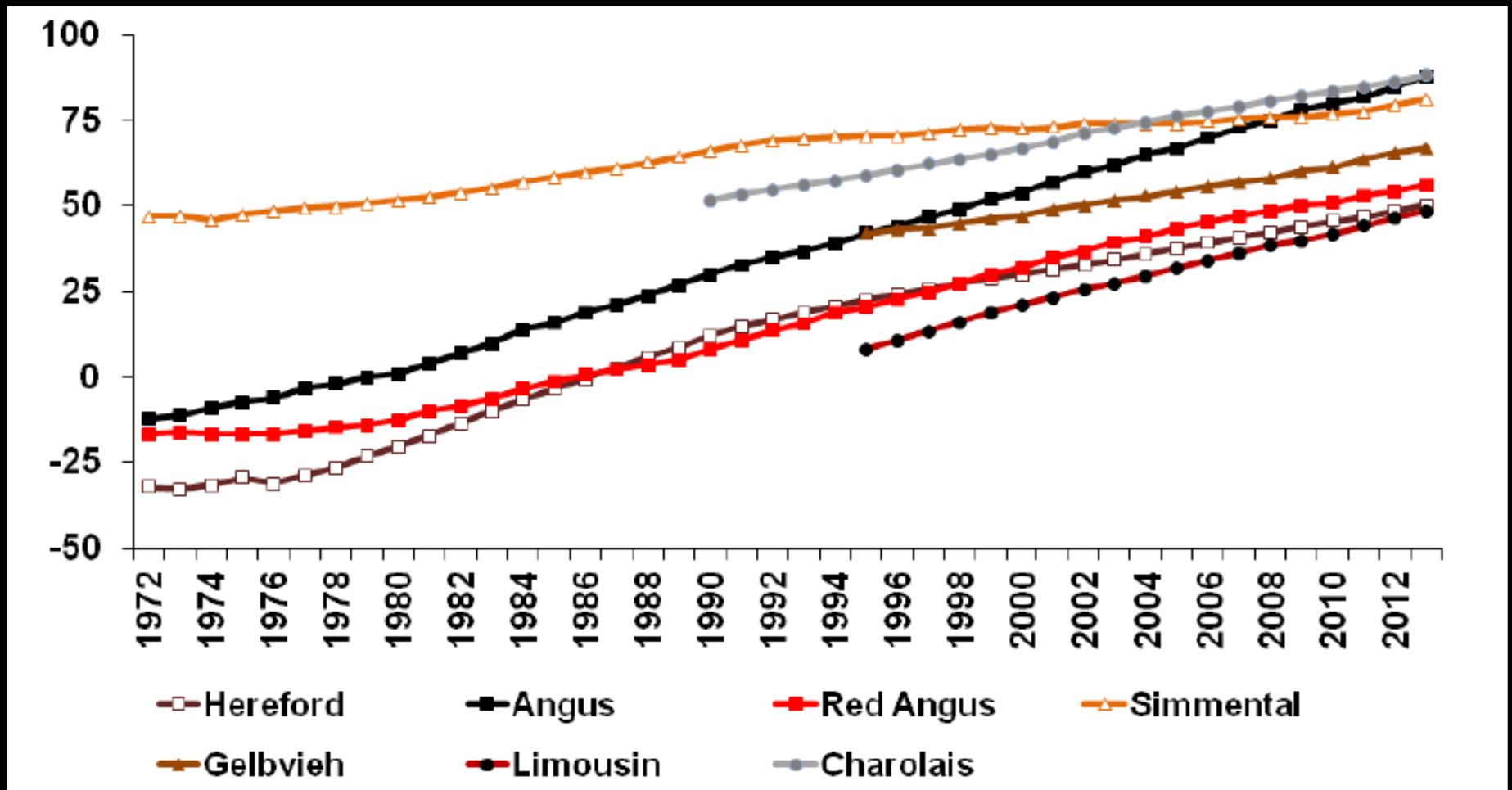
What happens if you select based on growth?

FIGURE 1

Steer carcass weights



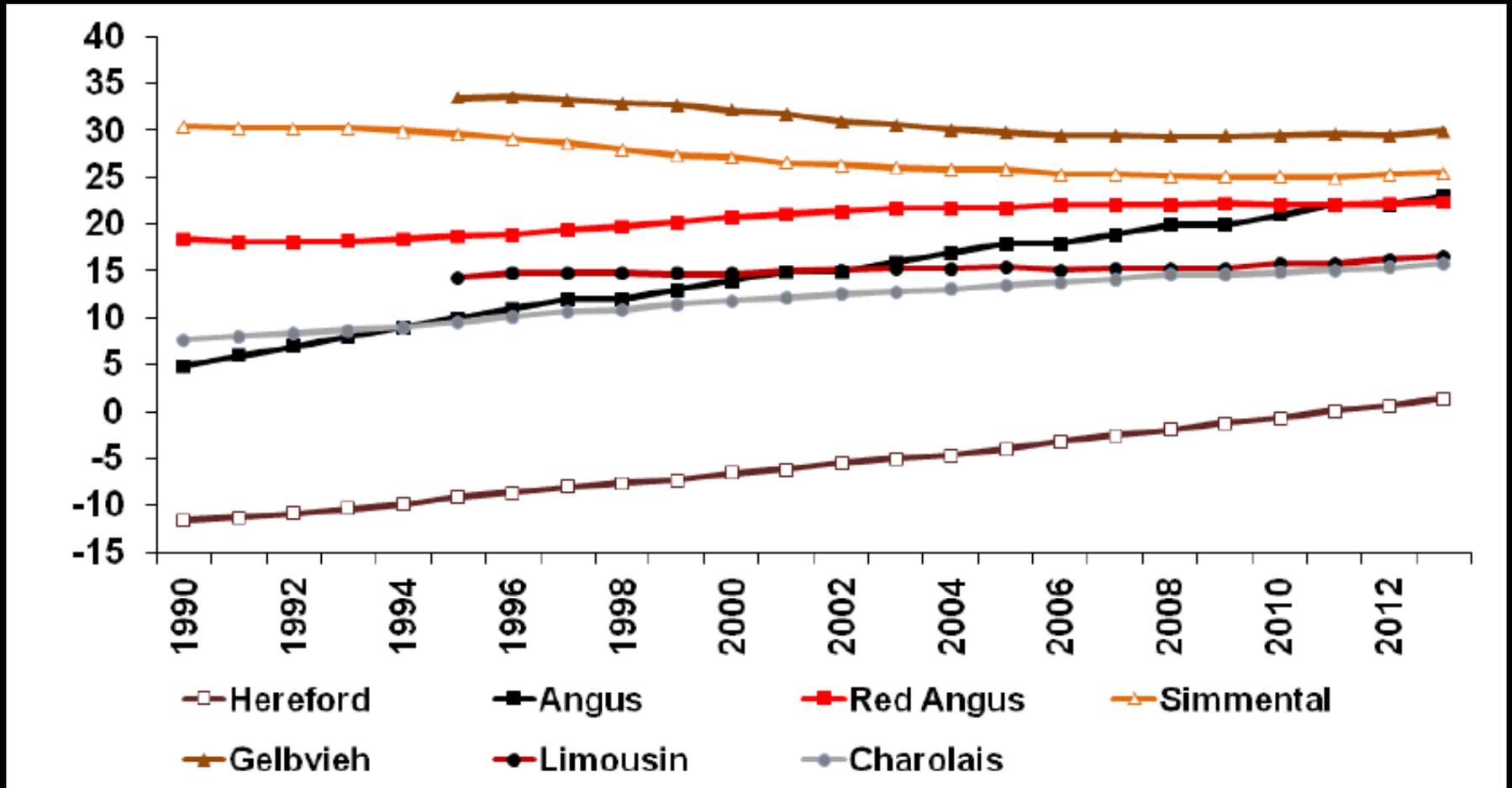
Relative Genetic Trends for Yearling Weight



Breed Differences in Mature Weight

Breed	5-year-old weight, lb
Hereford	1,419
Angus	1,410
Red Angus	1,409
Simmental	1,404
Gelbvieh	1,323
Limousin	1,391
Charolais	1,371

Relative Genetic Trends for Maternal Milk



Is this change in mature BW and maternal milk a good thing or a bad thing?

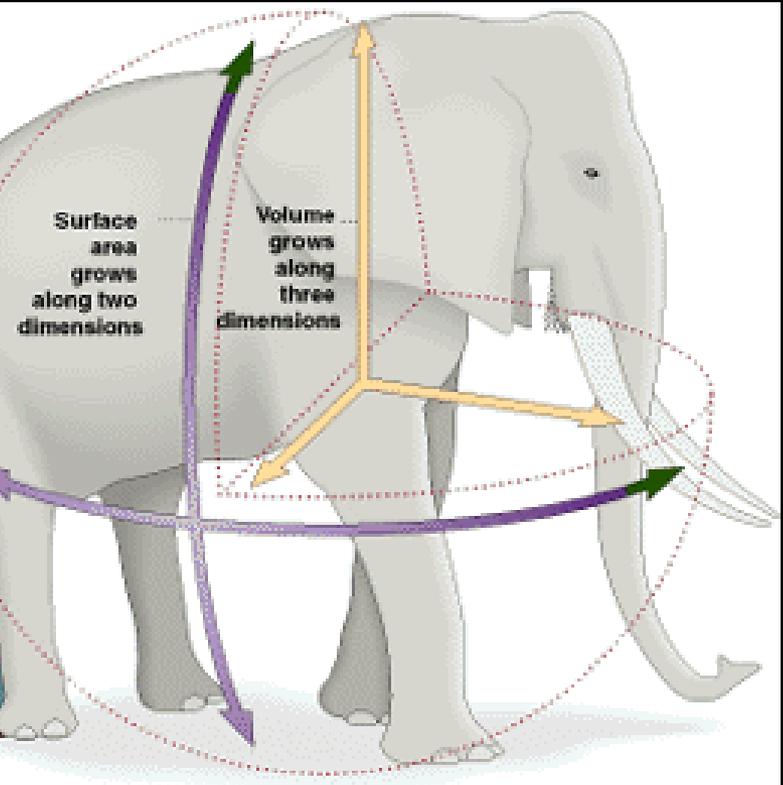
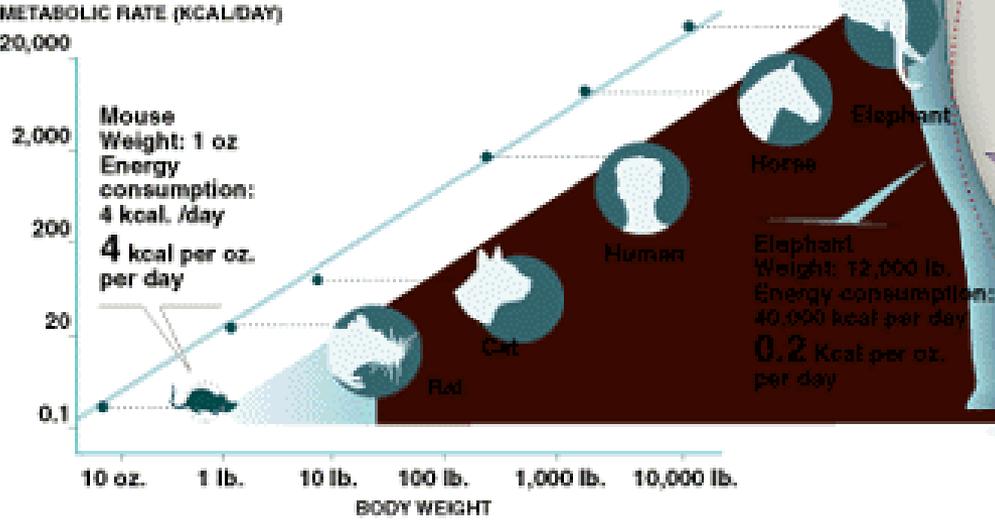
- More lb of beef per animal
 - Efficiency in feedlot
 - Efficiency at packing plant
- Effects on cow efficiency??????
 - Maintenance requirements – lower or higher

How does size/weight influence the maintenance requirement?

From the Small to the Huge

Three scientists have proposed a novel theory to explain how characteristics like body size and energy consumption differ from species to species along fixed scales. Their theory derives from analysis of the circulatory system.

An Example of Scaling: Metabolic Rate



Size and Efficiency

The average elephant weighs 220,000 times as much as the average mouse, but requires only about 10,000 times as much energy in the form of food calories to sustain itself. The

reason lies in the mathematical and geometric nature of networks that distribute nutrients and carry away wastes and heat. The bigger the animal, the more efficiently it uses energy.

$$\text{Metabolic BW} = \text{BW}^{0.75}$$

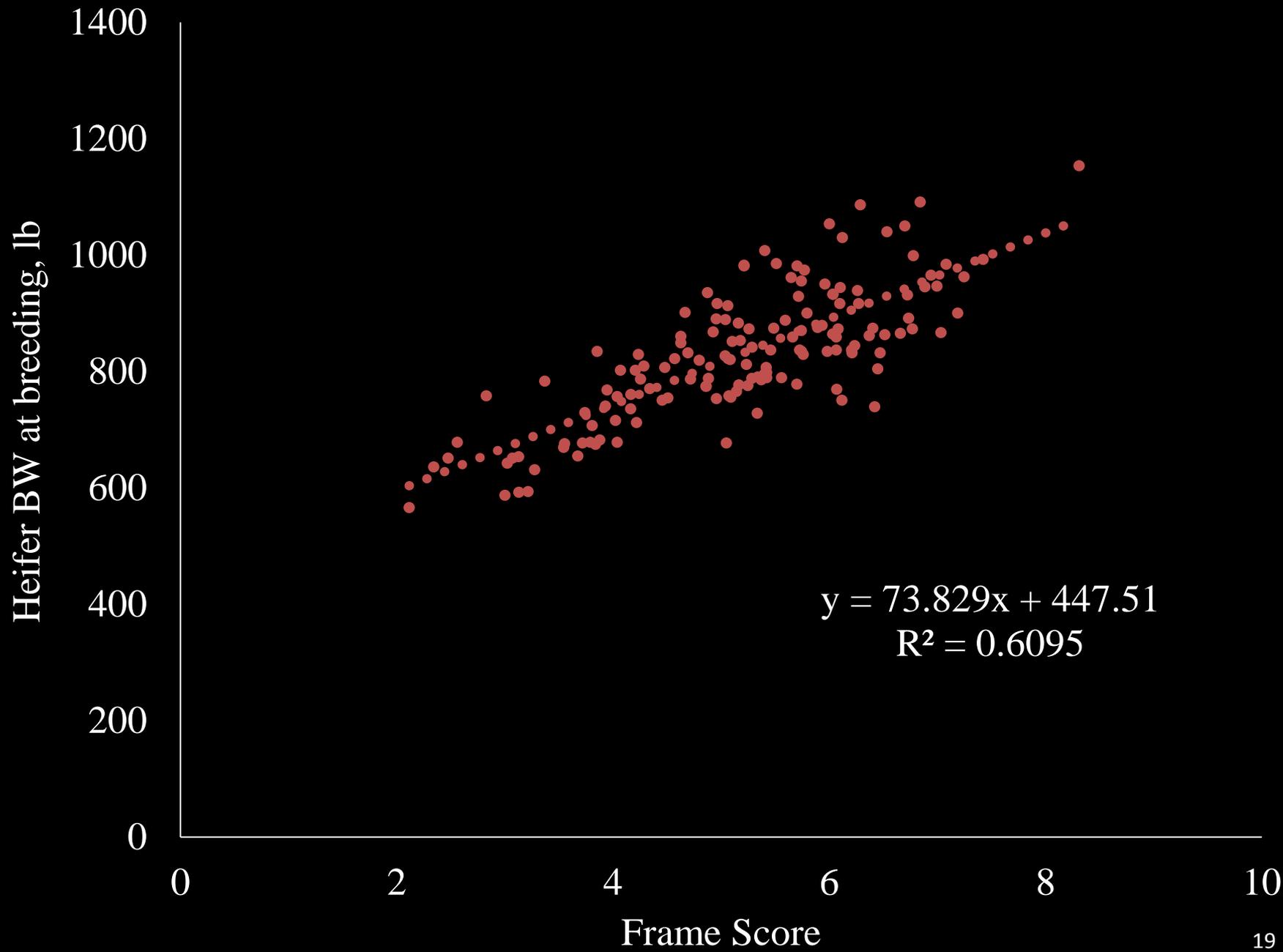


Dry Matter Intake, % of BW

3.0 – 3.5



2.0 – 2.5



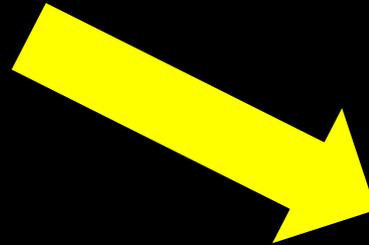
Body Weights of Heifers (2 years of data)

Frame Score

Item	3	4	5	6	7
BW at breeding, lb	669	743	817	890	964
BW at weaning of 1 st calf, lb	928	1025	1122	1219	1315

Measuring Feed intake

- Pen
- Individual
 - Individual pen, Calan gate, other electronic systems (Growsafe, **Insentec**, etc.)
- Markers
 - pasture
- Feeding behavior
- Predicting feed intake difficult
 - One of the biggest challenges
- Measuring BW



Growth Performance during Test (2 years of data)

Item	Frame Score				
	3	4	5	6	7
ADG, lb/d	1.0	1.2	1.4	1.6	1.8
DMI, lb/d	16.5	18.1	19.7	21.4	23.0
DMI, % of BW	2.46	2.44	2.42	2.40	2.39
Gain:Feed, lb/lb	0.064	0.068	0.073	0.077	0.082
Feed:Gain, lb/lb	15.7	14.6	13.7	12.9	12.2

Weaning Weight of Offspring (1 year of data)

Item	Frame Score				
	3	4	5	6	7
Weaning weight of heifer calves, lb	399	415	430	446	461
Weaning weight of steer calves, lb	444	448	452	456	460
Weaning weight of heifer calves, % of dam weight	48.3	45.7	43.2	40.6	38.0
Weaning weight of steer calves, % of dam weight	51.6	47.6	43.6	39.6	35.6

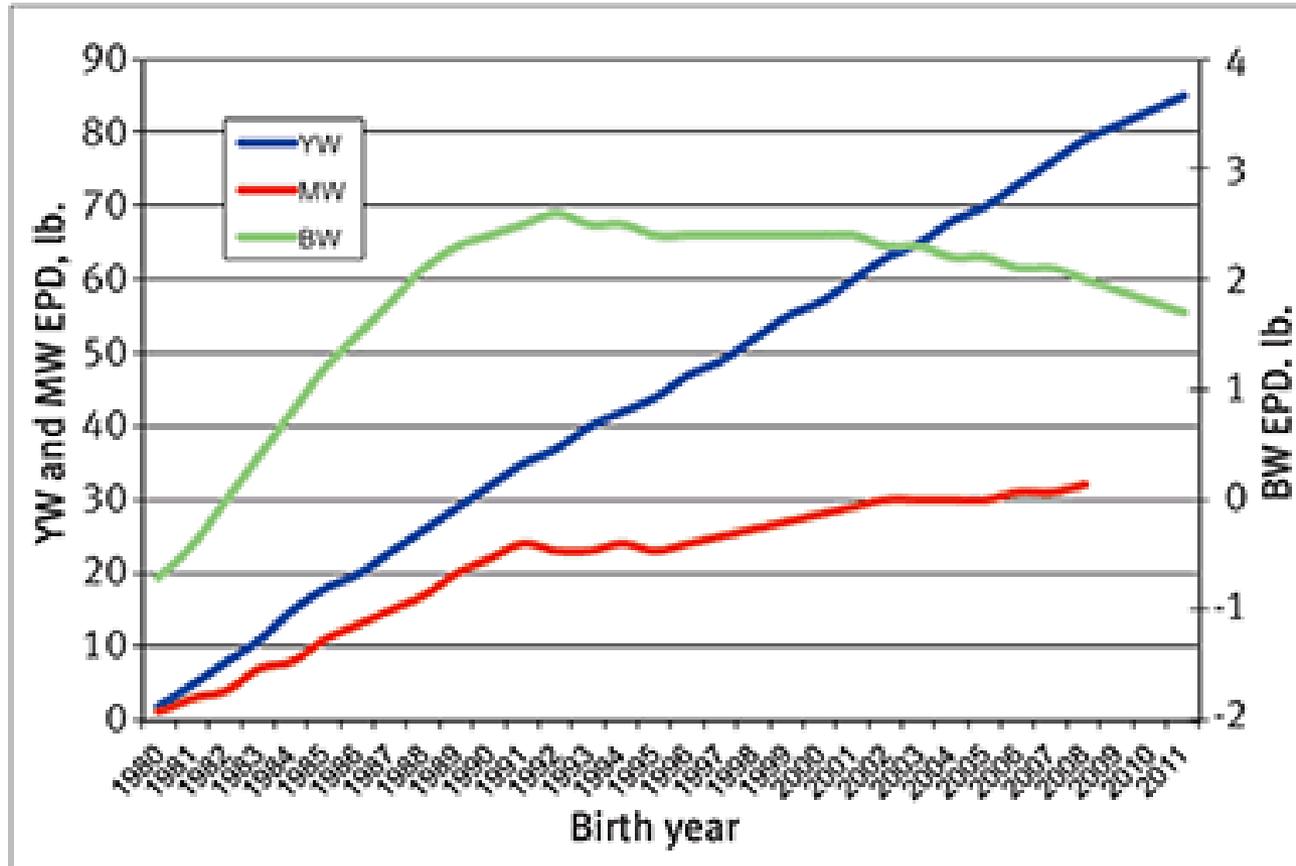
Average ribeye area of heifers during test (2 year of data)

Item	Frame Score				
	3	4	5	6	7
Ribeye area, inches ²	7.3	7.8	8.3	8.7	9.2
Ribeye area, inches ² /100 lb	1.09	1.05	1.02	0.98	0.95

Birth Weight of Offspring (1 year of data)

Item	Frame Score				
	3	4	5	6	7
Birth weight of heifer calves, lb	63.7	66.2	68.8	71.4	74.0
Birth weight of steer calves, lb	65.7	68.3	70.9	73.5	76.2
Birth weight of heifer calves, % of dam weight at breeding	9.3	9.0	8.6	8.3	8.0
Birth weight of steer calves, % of dam weight at breeding	10.0	9.5	9.0	8.5	8.0

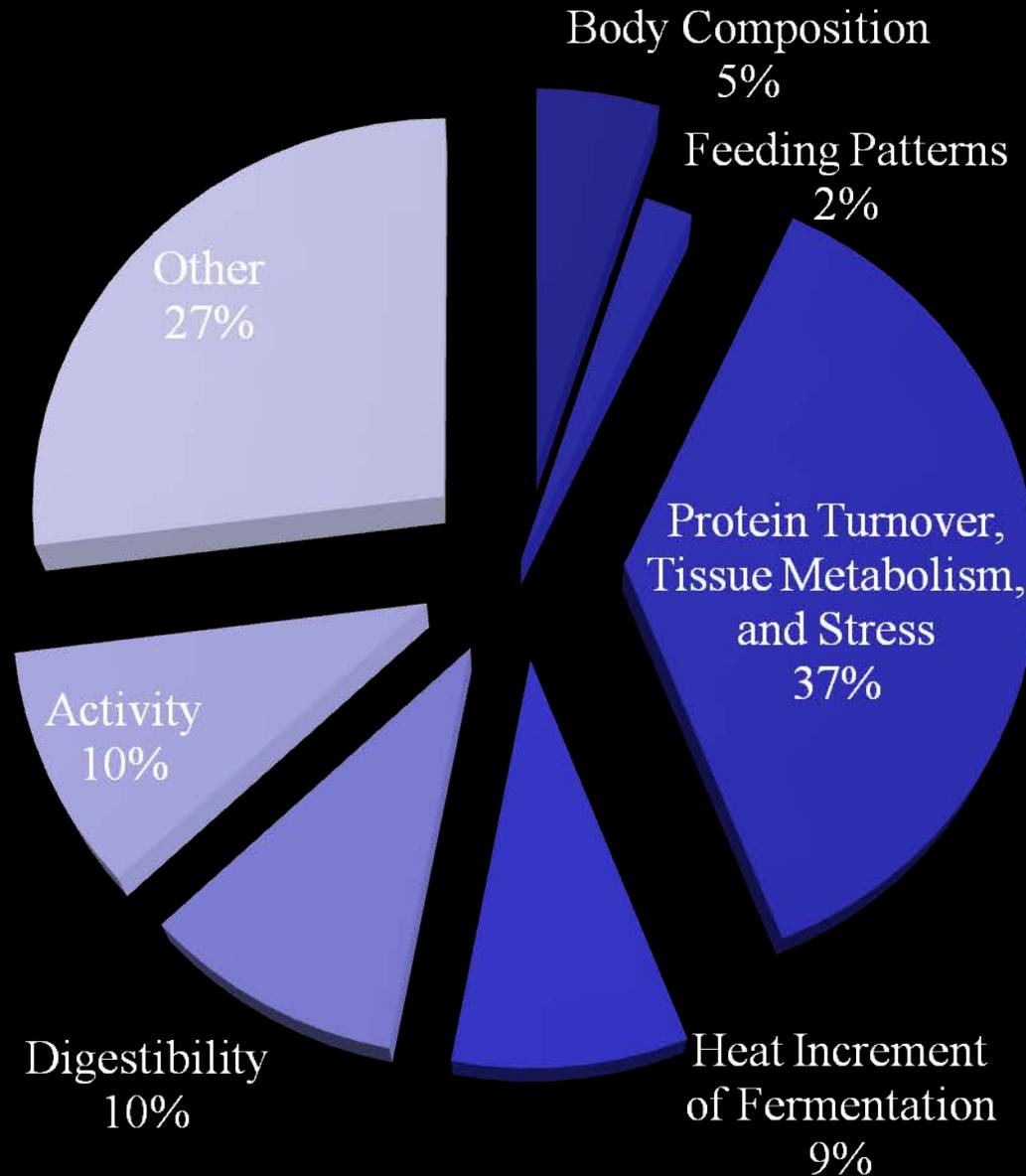
Fig. 3: Avg. genetic trend, by birth year, for birth weight (BW), yearling weight (YW) and mature weight (MW)



Source: American Angus Association database.

Select for gain:feed and % of calf weaned per cow BW while keeping birthweight stable?

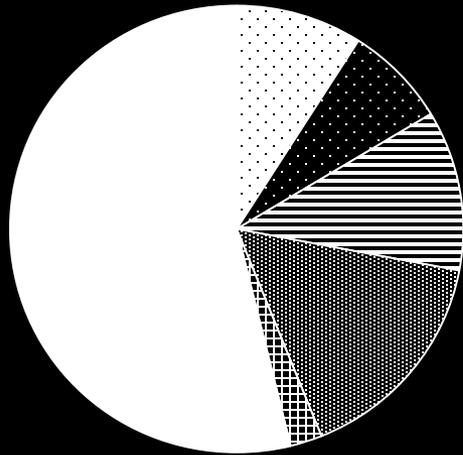
Factors Influencing Feed Efficiency?



•Much to be learned here!

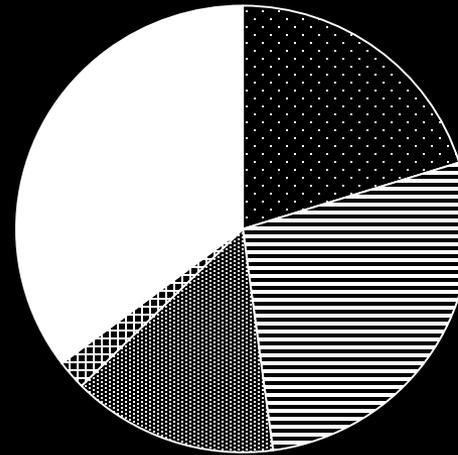
Summary of Findings: Gain to Feed

Heifers



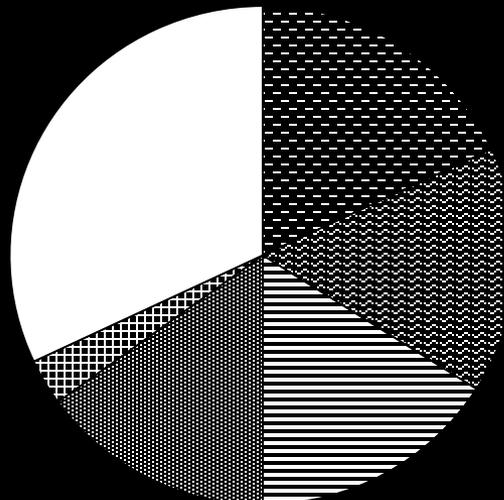
- Year, 9%
- Body composition, 7%
- ▨ Feeding behavior, 12%
- ▩ Animal size, 16%
- ▧ Blood metabolites, 2 %
- Other, 54%

Steers



- Body composition, 20%
- ▨ Feeding behavior, 28%
- ▩ Animal size, 15%
- ▧ Blood metabolites, 2 %
- Other, 35%

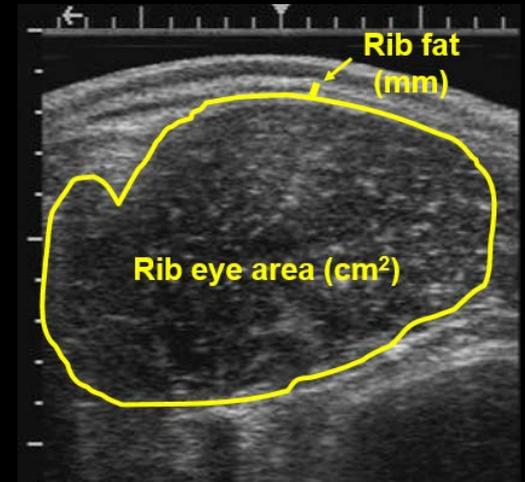
Cows



- ▩ Gestation length, 18%
- ▨ Calf parameters, 16%
- ▨ Feeding behavior, 16%
- ▩ Animal size, 15%
- ▧ Blood metabolites, 3%
- Other, 32%

What else are we measuring to better understand feed efficiency?

- Body measurements (hip height, girths, width)
- Body composition
- Feeding behavior
- Blood metabolites



- Examining many different measures of efficiency (including longevity measures)

Thanks!



Let food be thy medicine and thy medicine be thy food.
(Hippocrates)