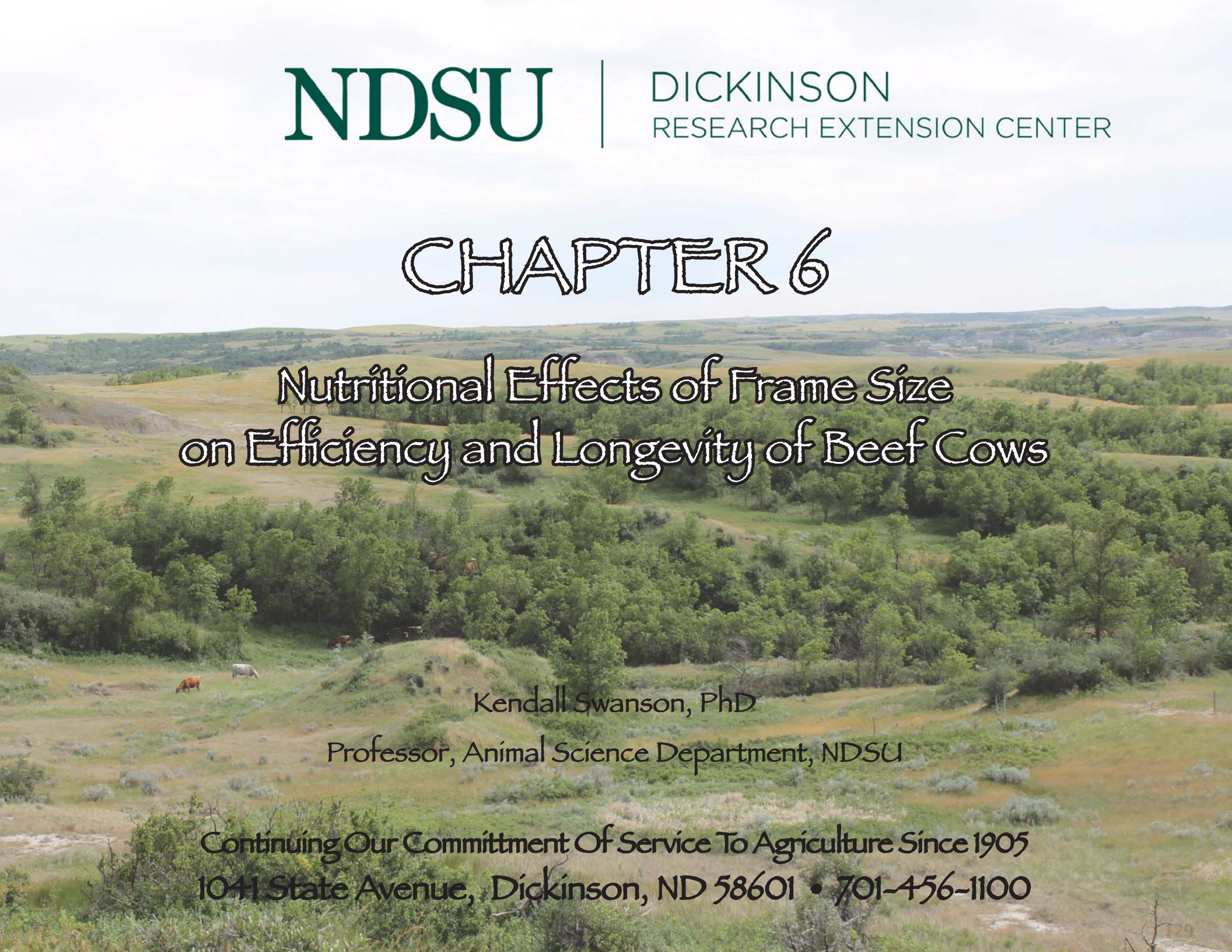

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# CHAPTER 6

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

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

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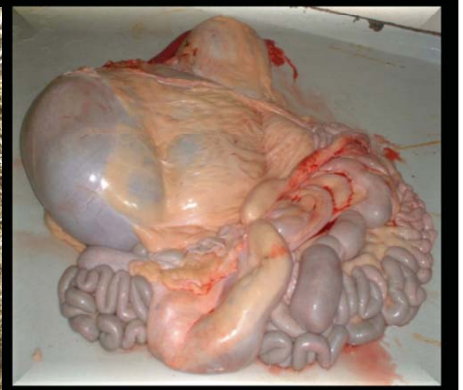
# Feed Efficiency

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

$$\text{Efficiency} = \frac{\text{Output (calf or carcass)}}{\text{Input (nutrients)}}$$



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# Feed Efficiency defined

| Item | Definition |
|---|---|
| Gross efficiency<br>Feed conversion ratio | feed:gain or gain:feed |
| Residual feed intake or<br>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 |


Swanson and Miller, 2008

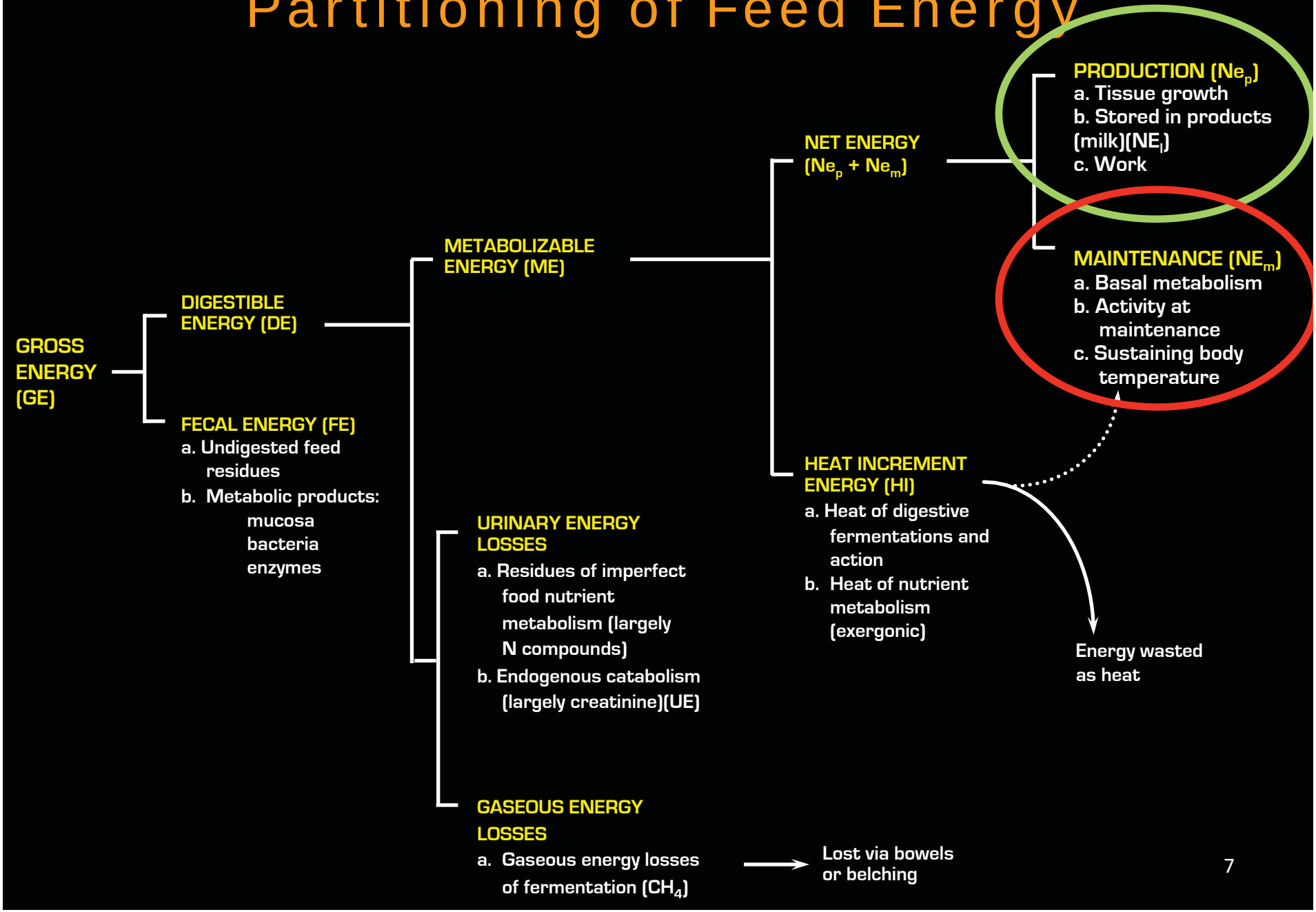
# Longevity is an important factor (Lifetime efficiency)

- 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

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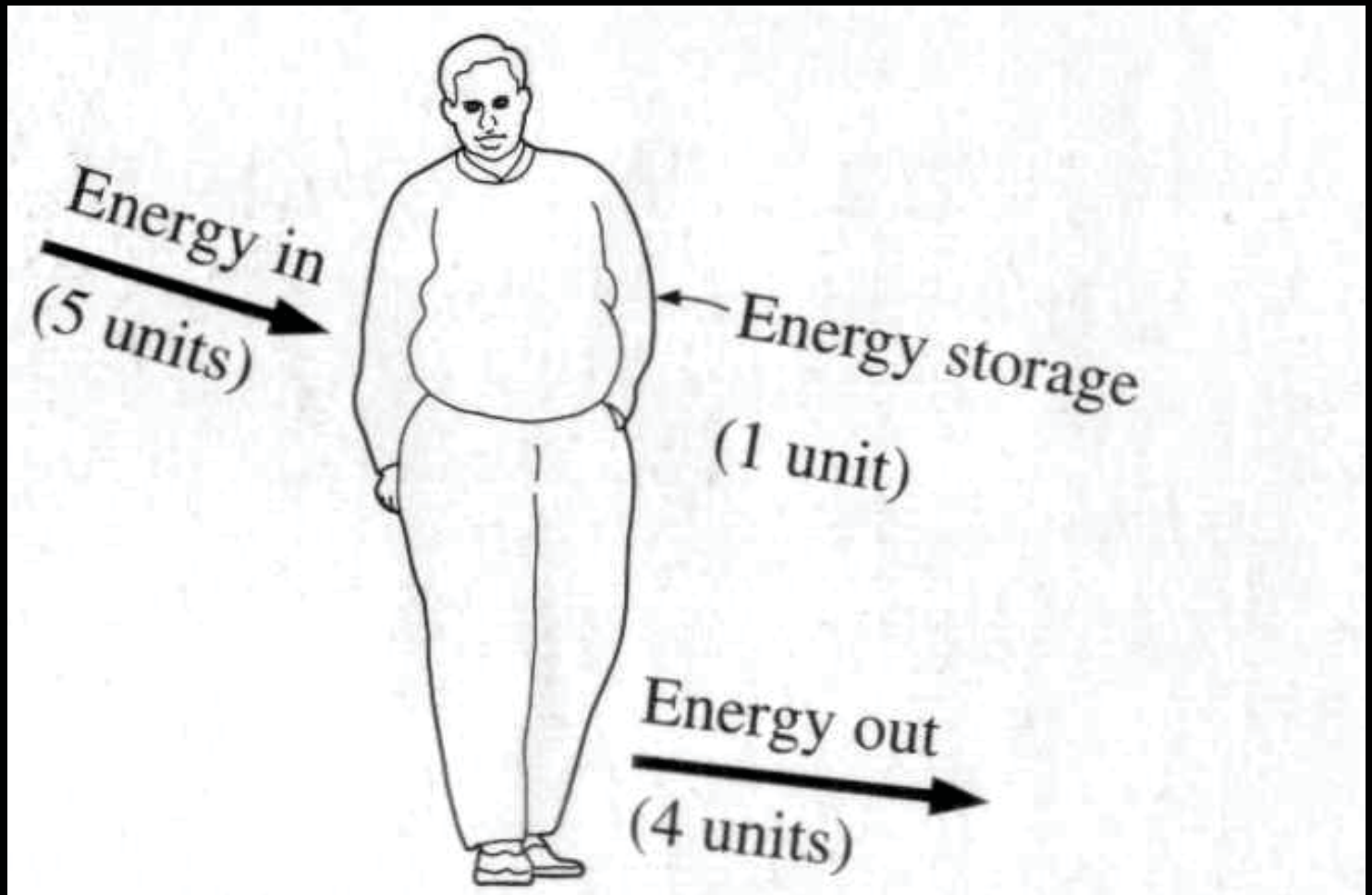
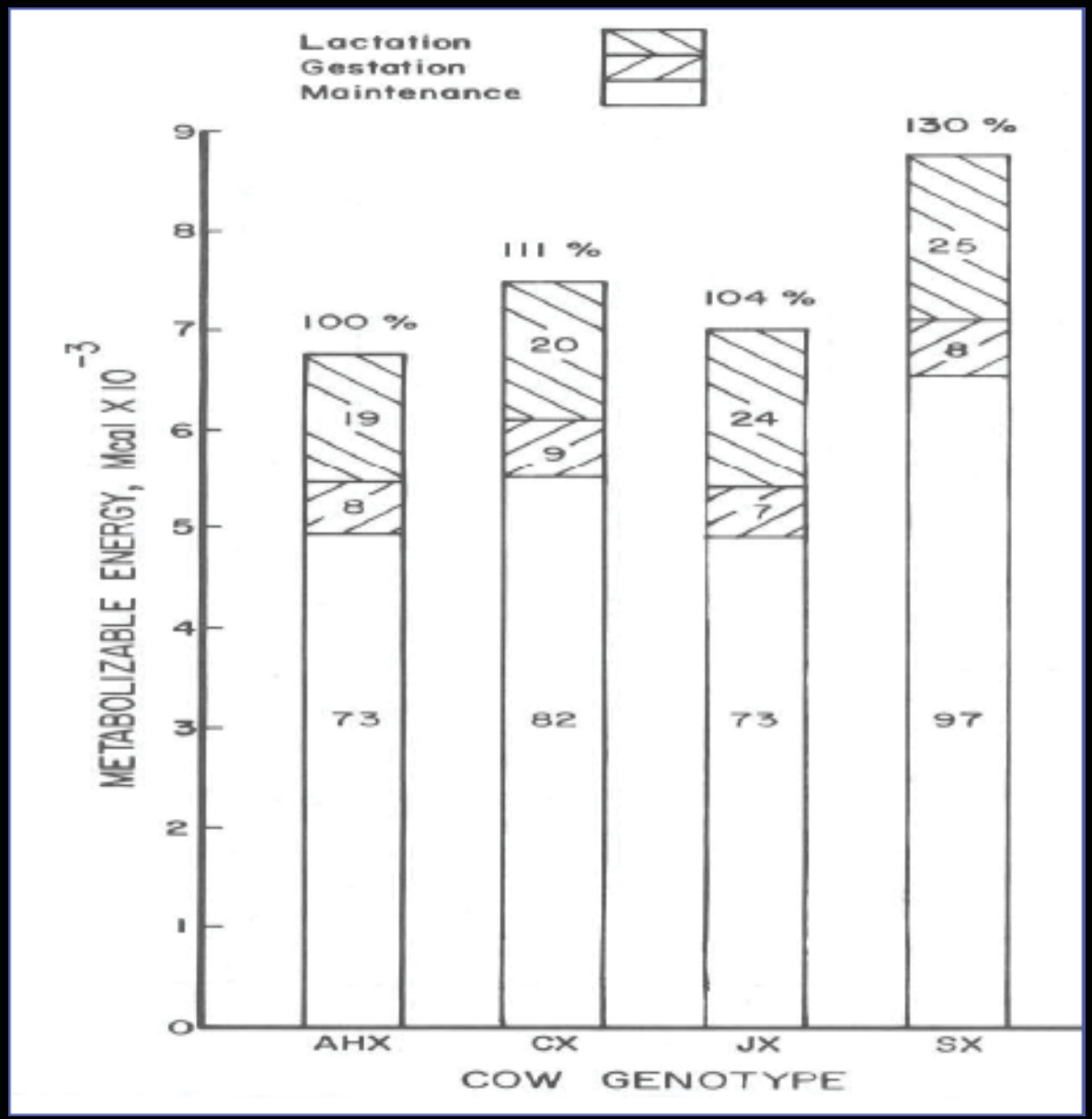



**FIGURE 1–2**
Conservation of energy principle for the human body.



http://theguycancook.com/blog/2010/06/16/everything-you-need-to-know-about-fat-burning-diets/

# Maintenance Costs are Significant




Ferrell and Jenkins 1985

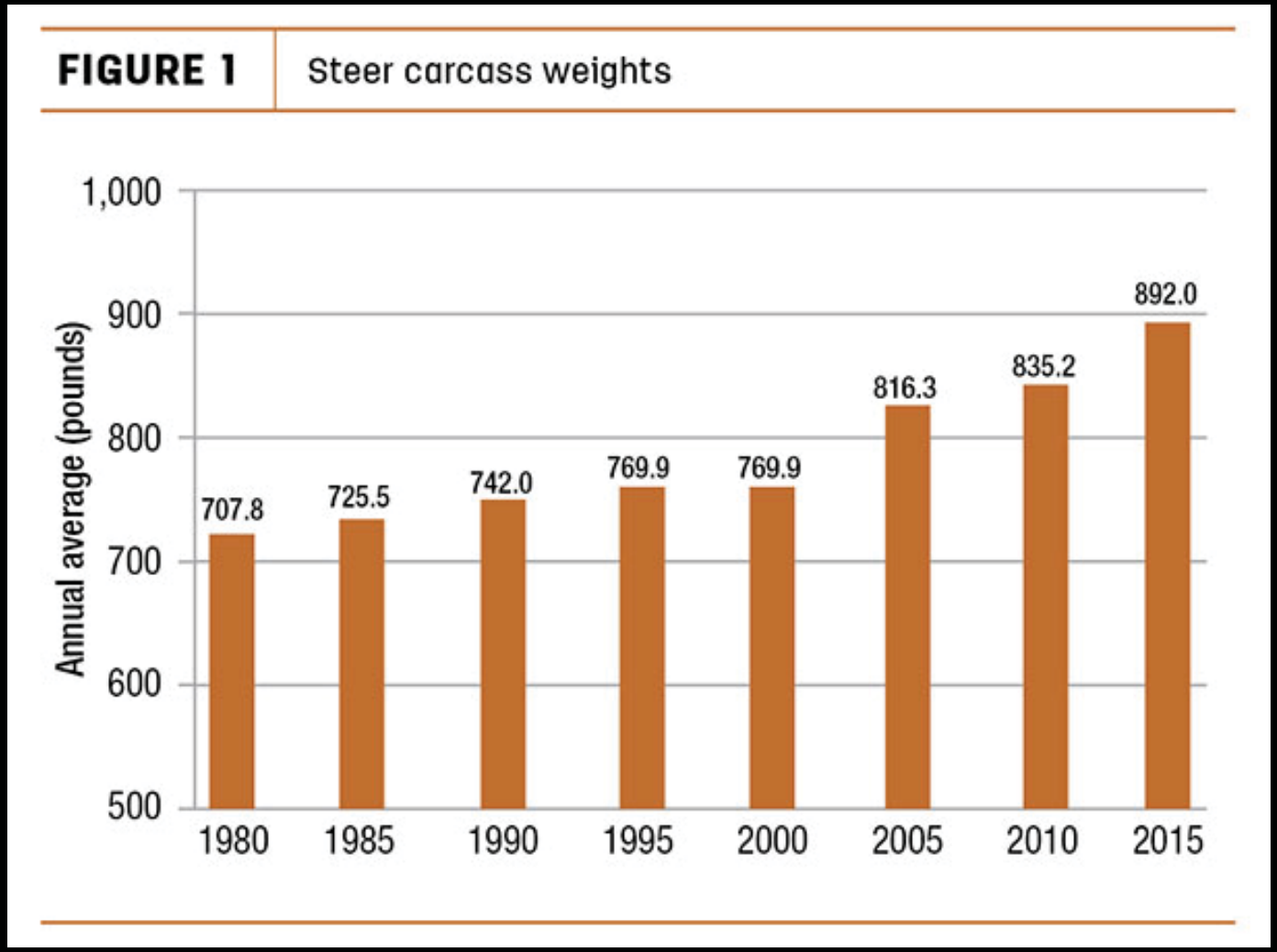
# What influences maintenance costs and feed efficiency

- 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

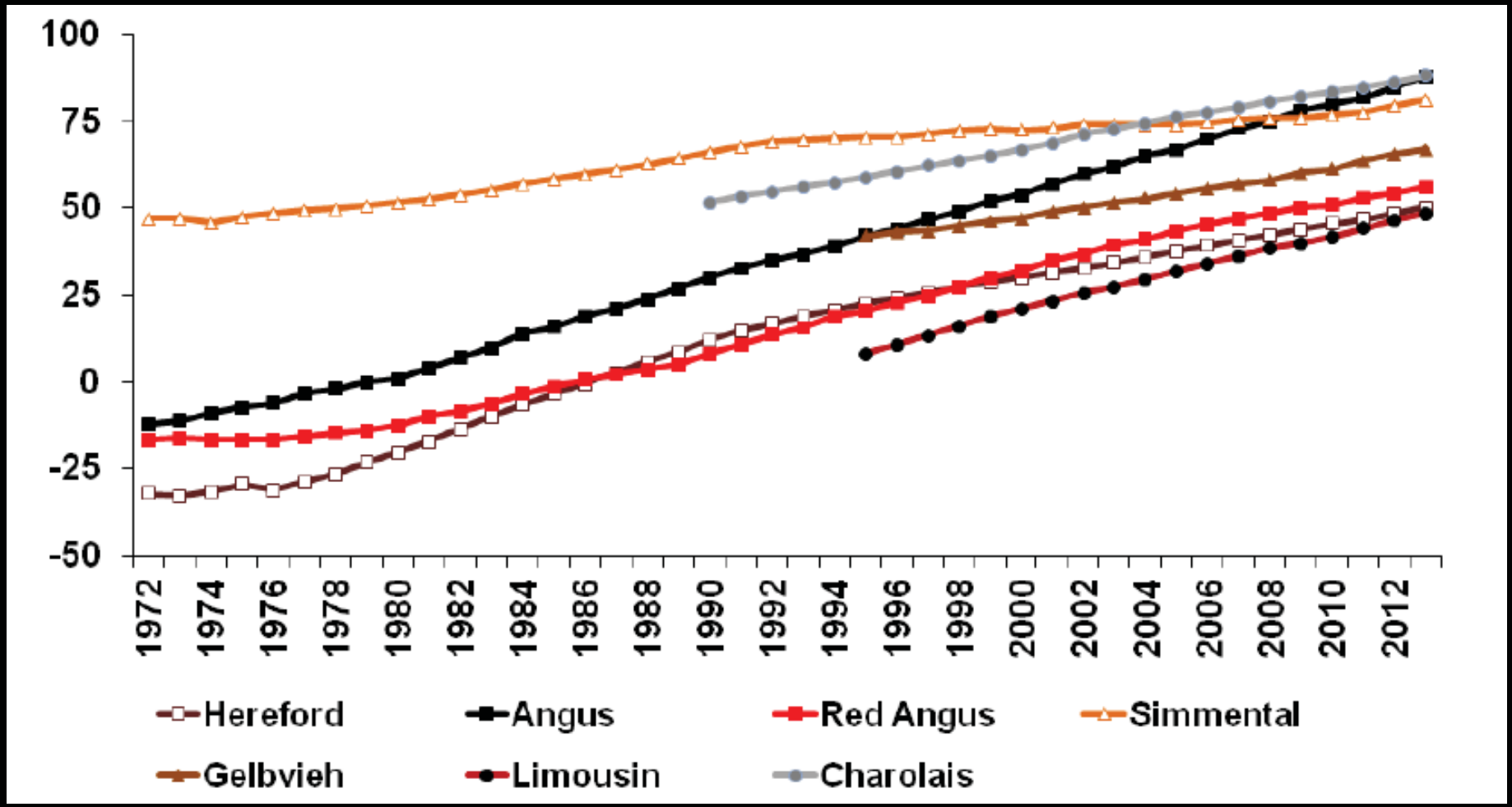
- Finishing cattle
  - Output is gain or meat
  - Relatively easy to measure?
- Replacements or mature cows
  - Output is not the growth of that animal
    - Calf weaned or beef (over a lifetime)
    - Many, many factors influence the output
    - Also more difficult to measure inputs (feed intake)
  - 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?




Hawley, 2016 Progressive Cattlemen

# Relative Genetic Trends for Yearling Weight




Kuehn and Thallman, 2015

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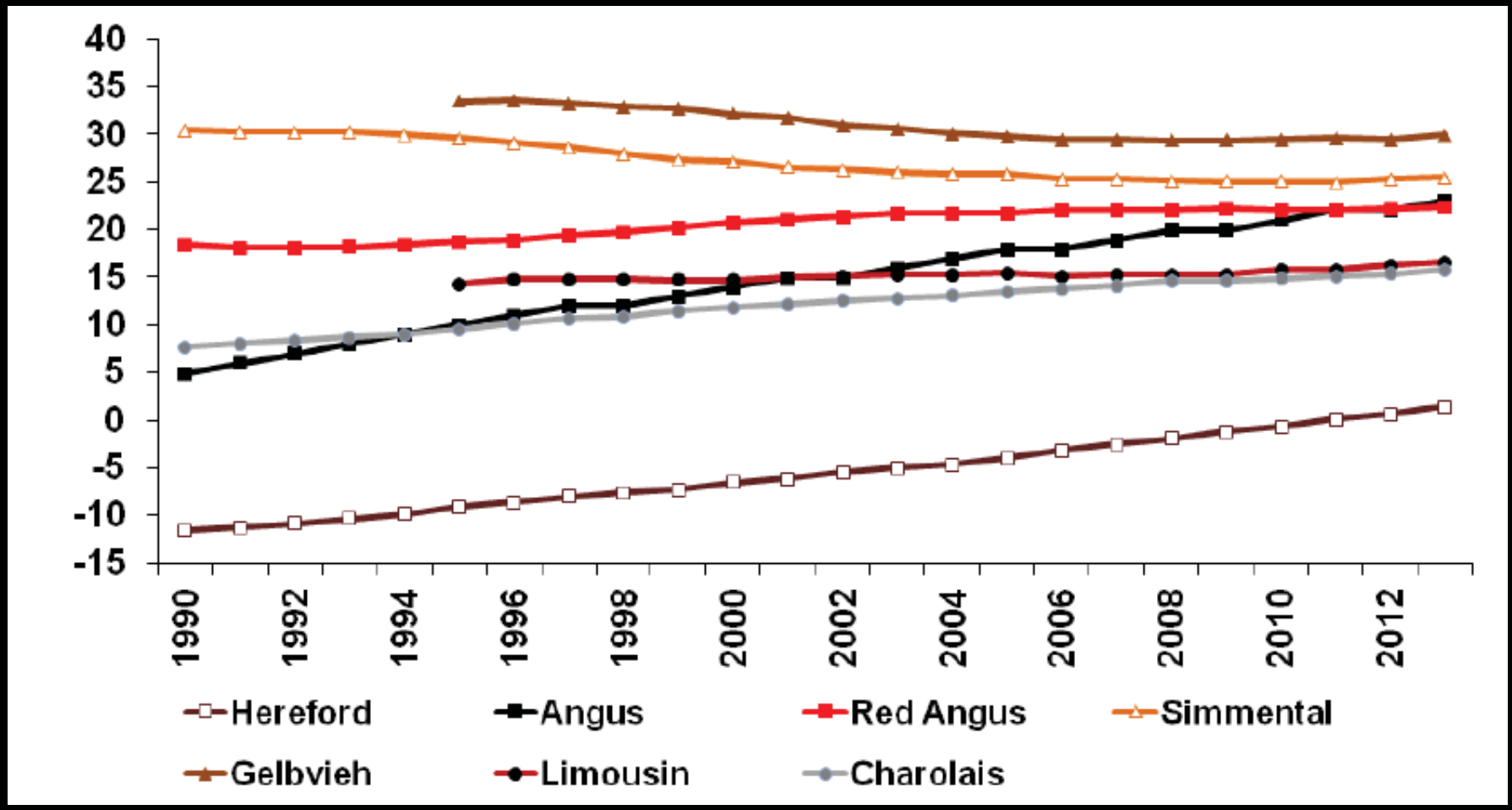
# Breed Differences in Mature Weight

| 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 |

USDA MARC data

# Relative Genetic Trends for Maternal Milk




Kuehn and Thallman, 2015 15

# 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

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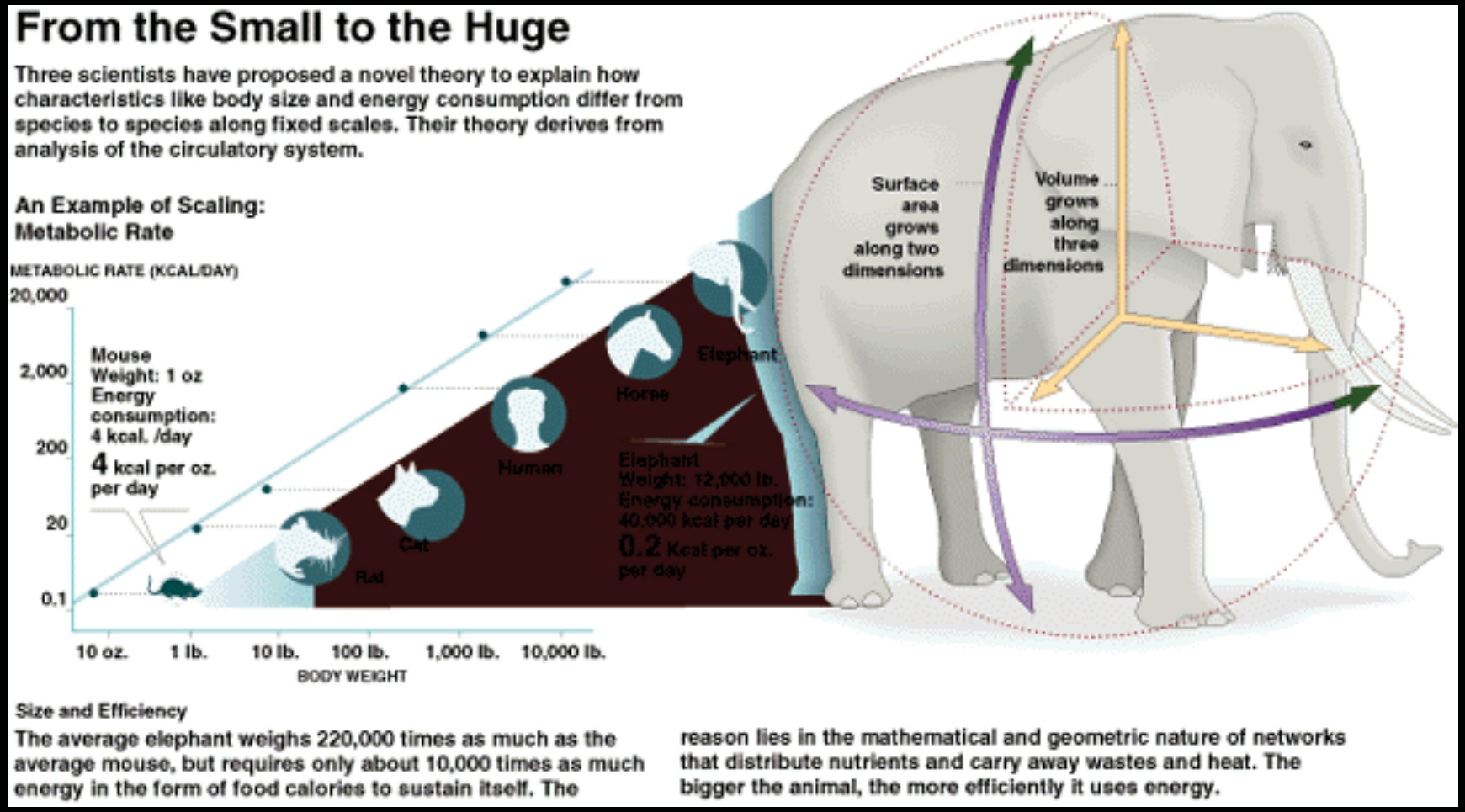
# How does size/weight influence the maintenance requirement?




Metabolic BW = $BW^{0.75}$

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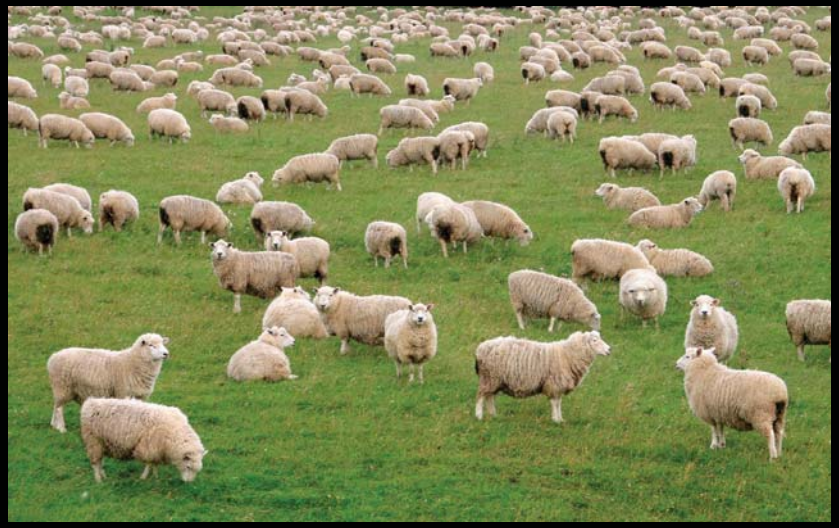
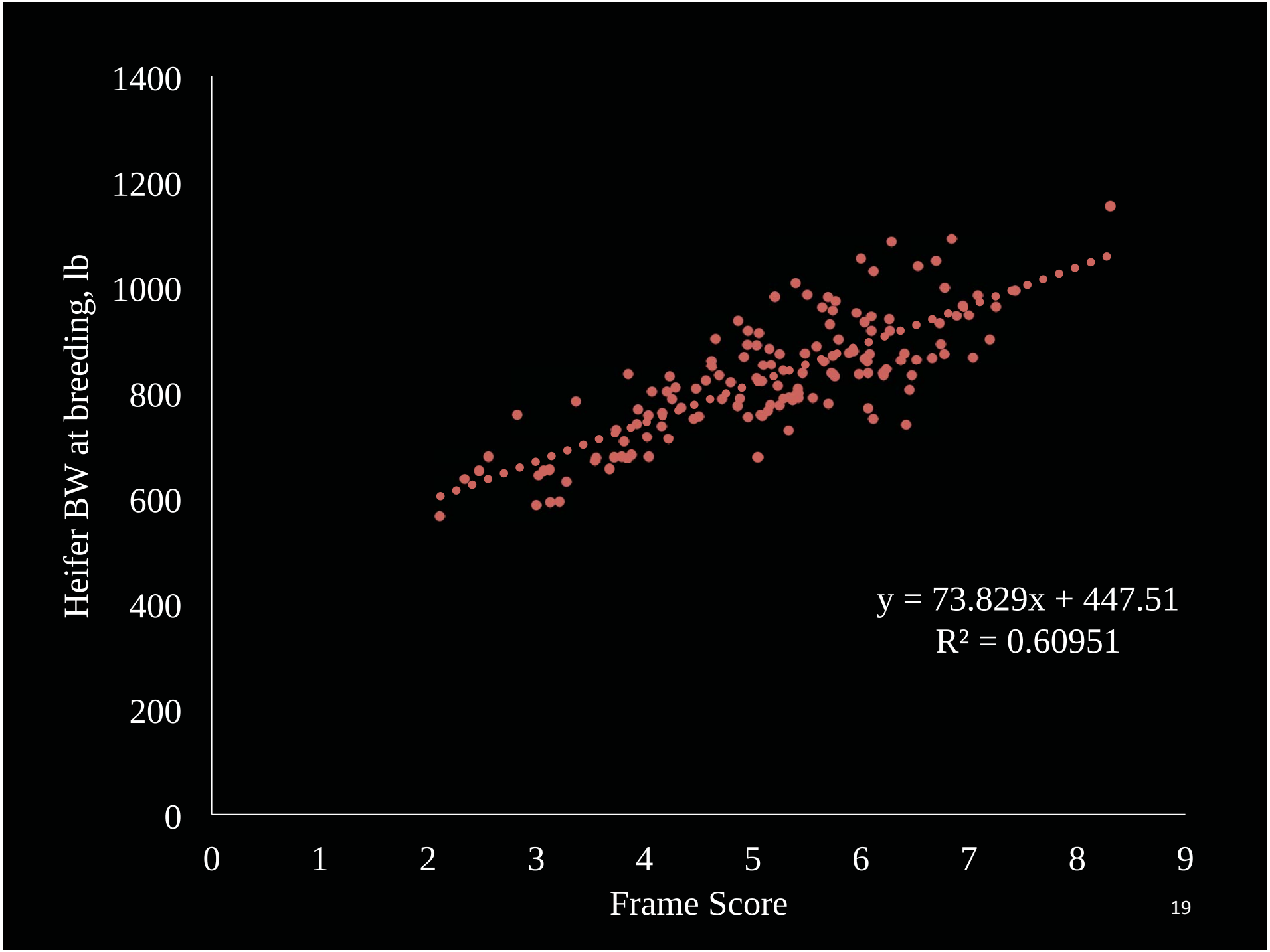


## Dry Matter Intake, % of BW

3 .0 – 3.5

2.0 – 2.5


1400
1200
1000
800
600
400
200
0
Heifer BW at breeding, lb
0
1
2
3
4
5
6
7
8
9
Frame Score
y = 73.829x + 447.51
R² = 0.60951
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# 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 1st 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

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# 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 |

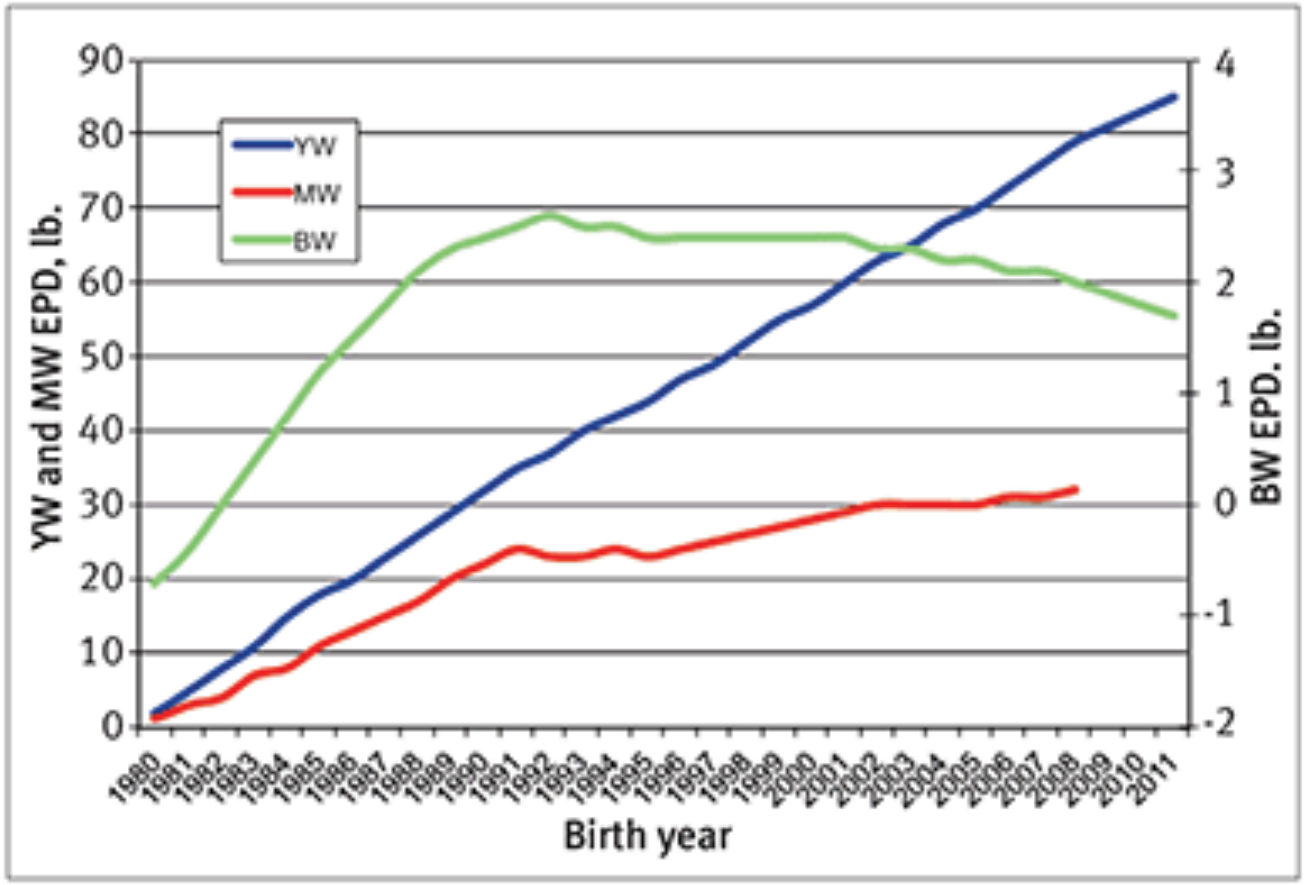
# Average ribeye area of heifers during test (2 year of data)

| 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)**

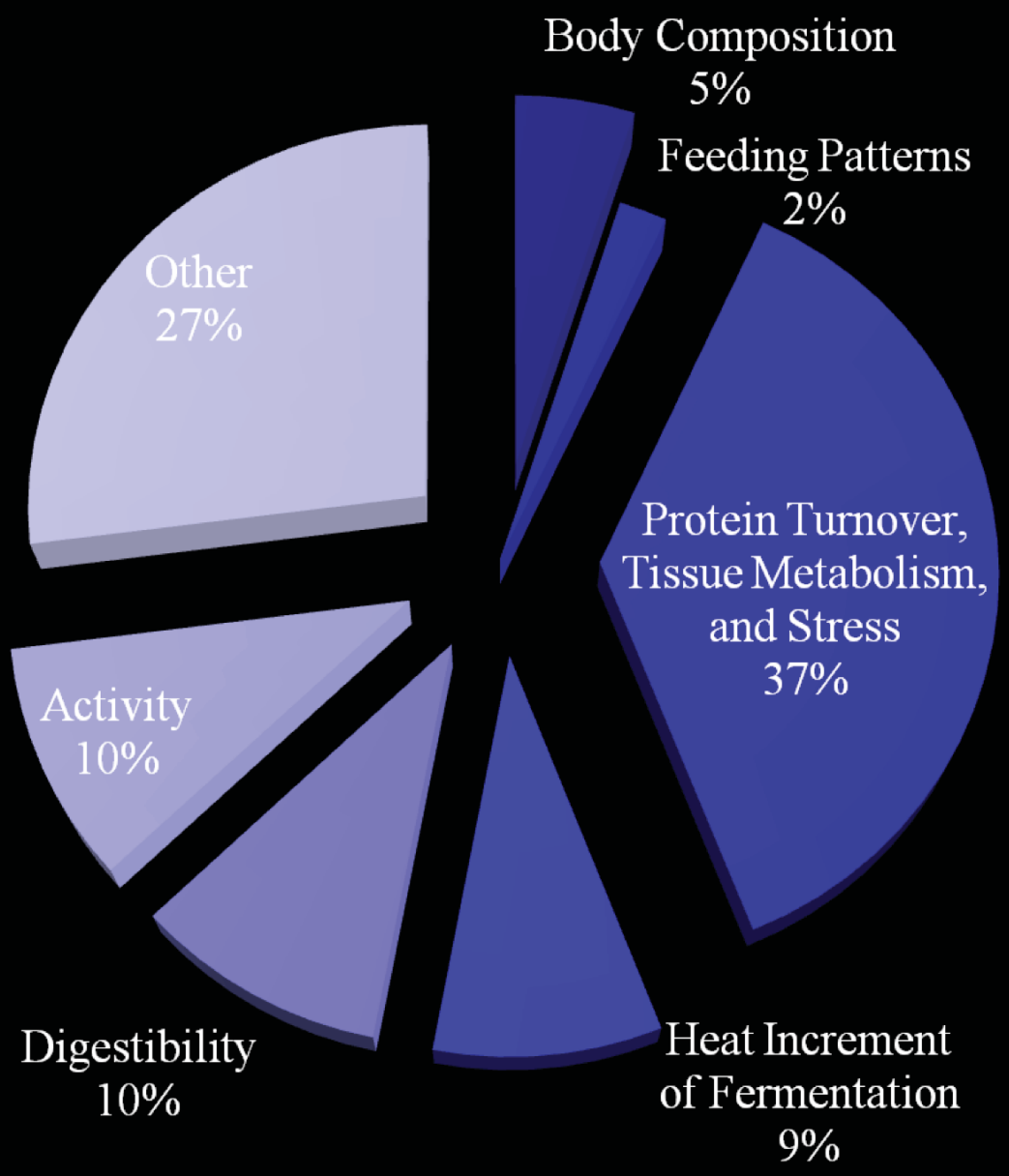



**Source:** American Angus Association database.

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

http://www.angusbeefbulletin.com/extra/2013/03mar13/0313fp_association_perspective.html#.WZX-kumQy70

# Factors Influencing Feed Efficiency?




- Much to be learned here!

Richardson & Herd, 2004

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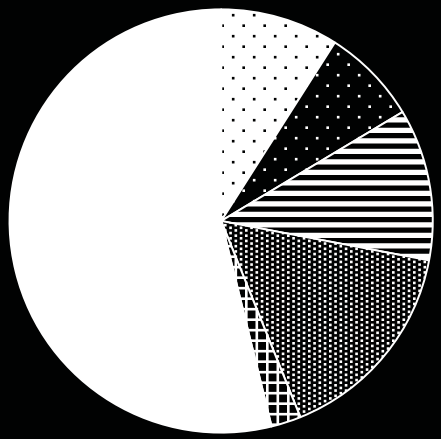
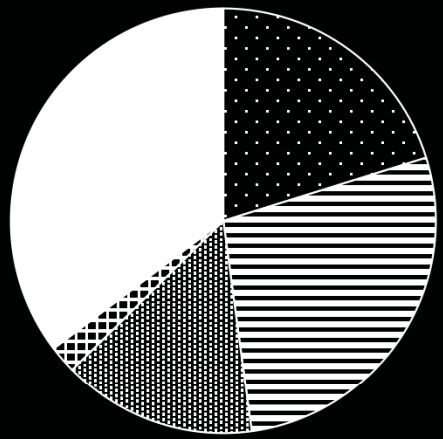
# Summary of Findings: **Gain to Feed**

**Heifers**



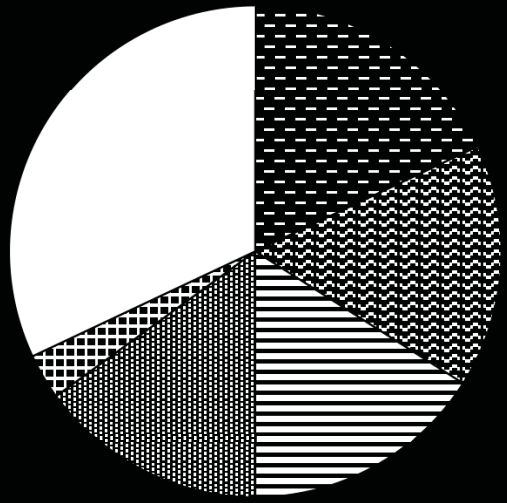
- Year, 9%
- Body composition, 7%
- Feeding behavior, 12%
- Animal size, 16%
- Blood metabolites, 2 %
- Other, 54%

**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%

Fontoura Thesis, 2017

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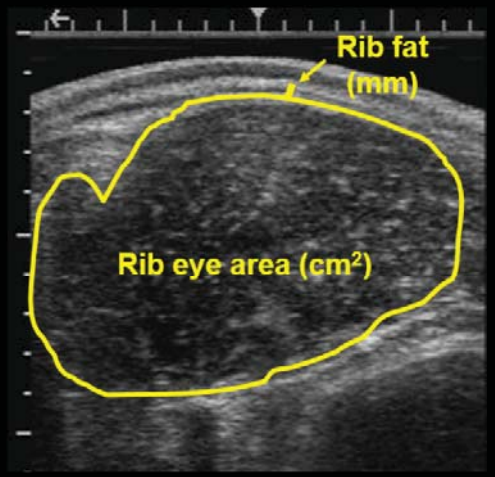
# What else are we measuring to better understand feed efficiency?

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






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

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# Thanks!


*Let food be thy medicine and thy medicine be thy food.*

(Hippocrates)