Full Picture of Cow Efficiency

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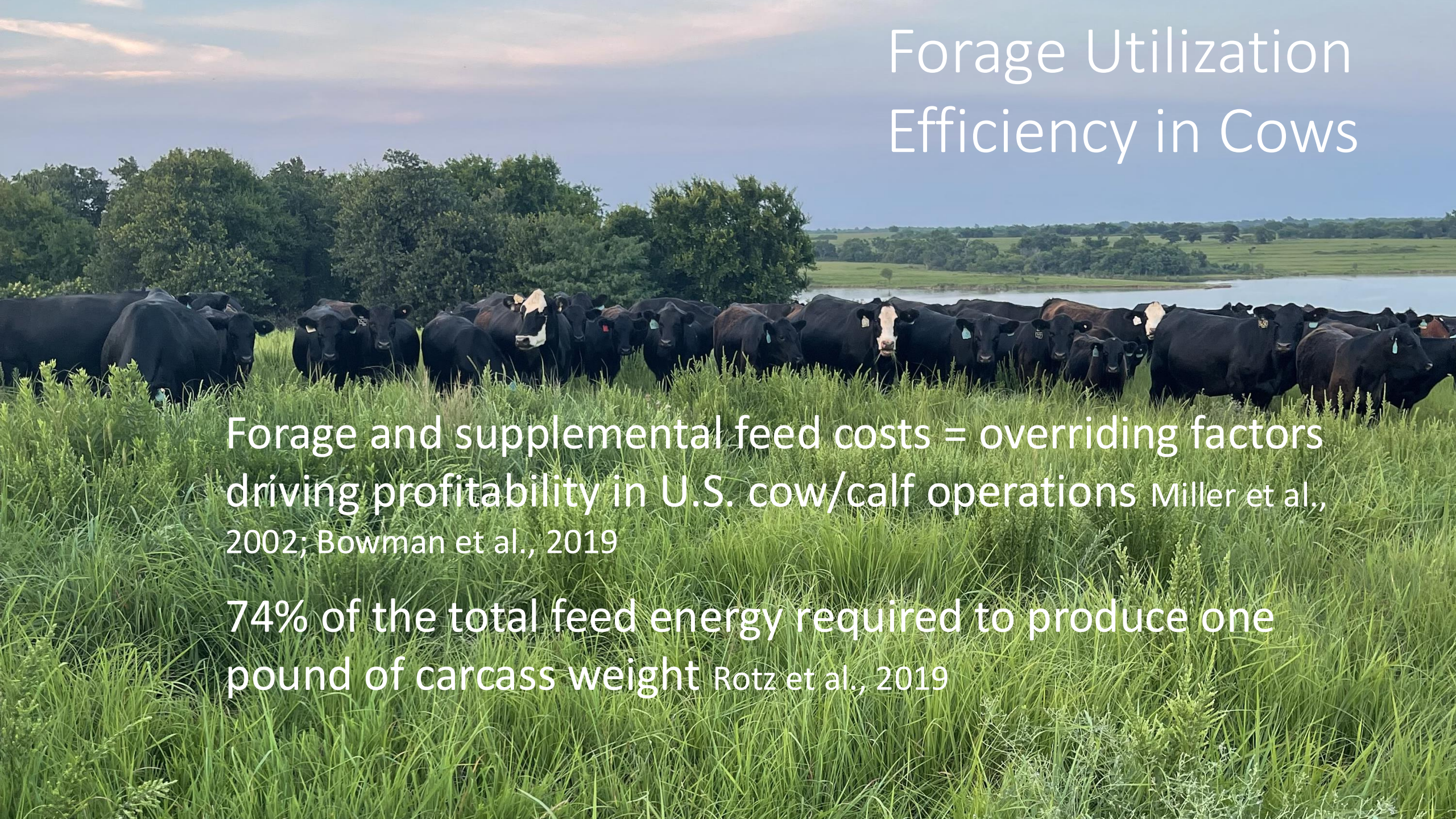
DEPARTMENT OF
ANIMAL AND
FOOD SCIENCE

Our advantage: Converting sunlight, carbon dioxide, and water into a nutritious, delicious, human food source



Forage Utilization Efficiency in Cows

Forage and supplemental feed costs = overriding factors driving profitability in U.S. cow/calf operations Miller et al., 2002; Bowman et al., 2019

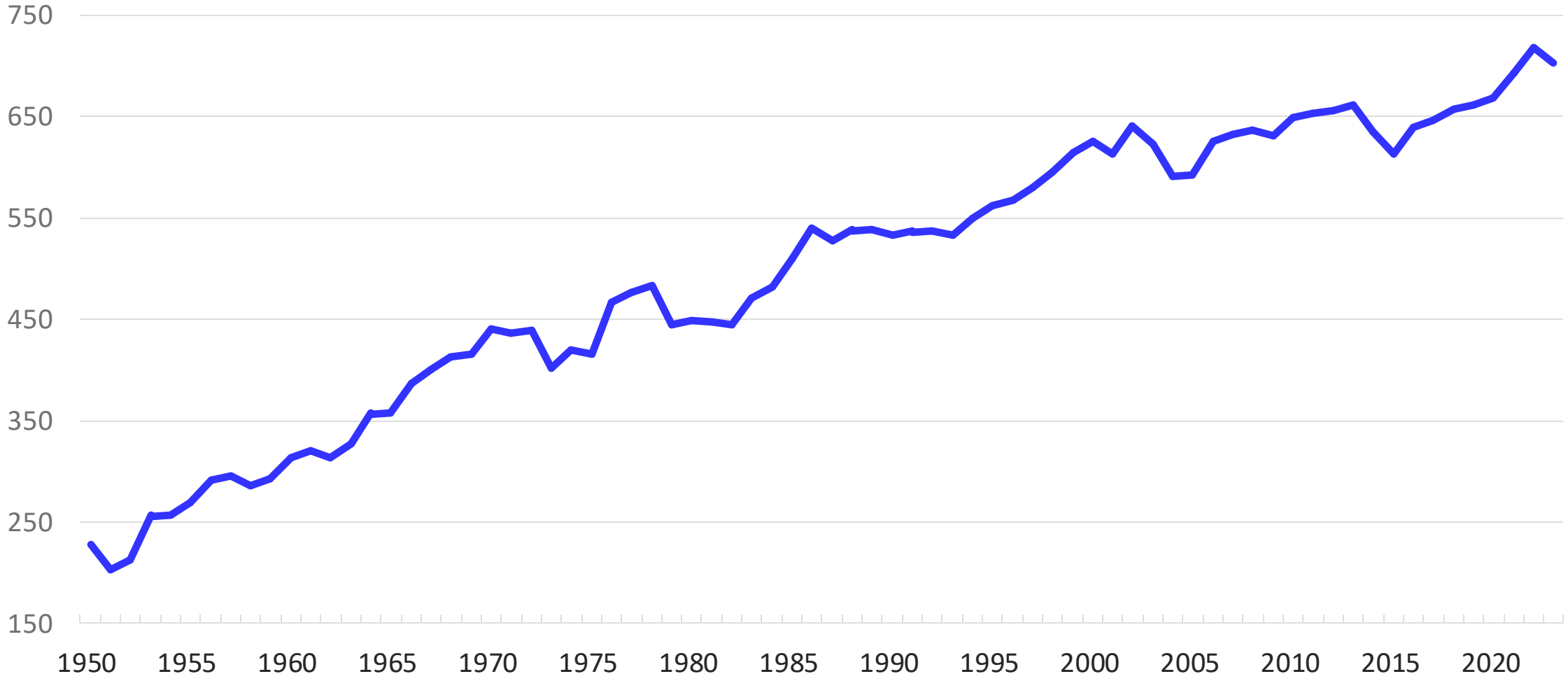
74% of the total feed energy required to produce one pound of carcass weight Rotz et al., 2019

Cow Efficiency

- Definition largely depends on market end point (system)
- System, herd, individual animal
- Biological vs economic
- Some version of “low level of inputs relative to outputs”

Beef Production Per Cow

Lbs. Commercial, 1950-2023



Inputs vs Outputs in a “Sell-at-Weaning” context

“61.7% of the average difference in net return to management ($460) between high-and low-profit farms is due to cost differences.

The other 38.3% is due to differences in gross income per cow, which is primarily because the high-profit farms sold a larger number of calves and sold slightly heavier calves at a slightly higher price.”

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Pendel and Herbel, 2021

Feed Costs and Profitability

Profitability Group	Feed Cost/Cow	Feed Cost/Cwt Calf Sold	Weaning Rate
Low 20%	$914	$165.28	80%
High 20%	$527	$88.85*	90%

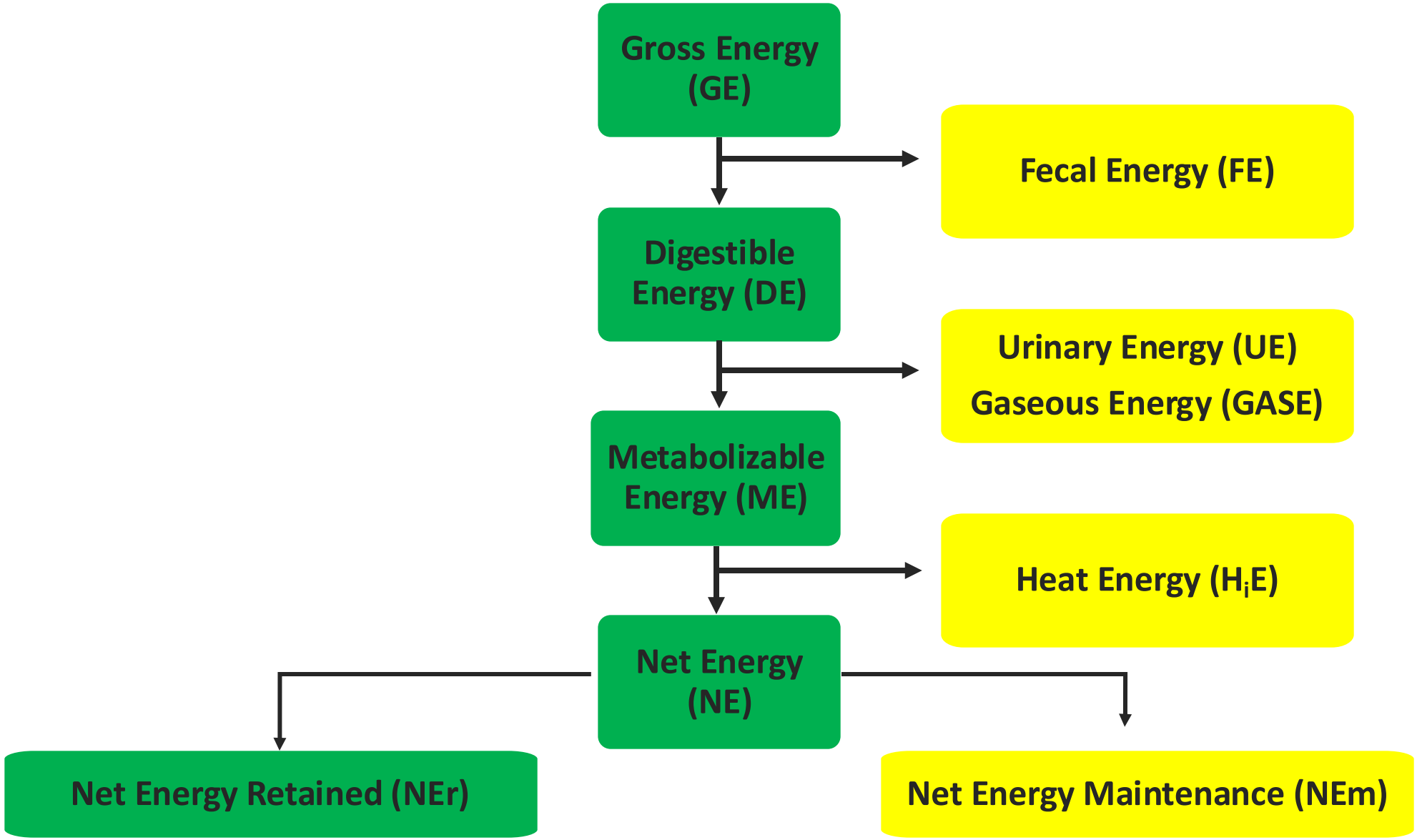
*Calves were 39 pounds heavier

Source: Center for Farm Financial Management

Whole-Farm Feed Efficiency in a Cow/Calf System

- Efficiency of forage production and utilization
- Reproductive efficiency
- Herd health
- Digestive and metabolic efficiency

Photo: Dr. Guillermo De Nava, Salto Uruguay


Gross Energy (GE)
Fecal Energy (FE)
Digestible Energy (DE)
Urinary Energy (UE)
Gaseous Energy (GASE)
Metabolizable Energy (ME)
Heat Energy (H_iE)
Net Energy (NE)
Net Energy Retained (NEr)
Net Energy Maintenance (NEm)

Post-Weaning Efficiency

The majority of feed efficiency work in beef cattle focused on growing animals consuming mixed diets

Archer et al., 1999

Arthur et al., 2004

Fitzsimons et al., 2017

Cantalapiedra-Hijar et al., 2018

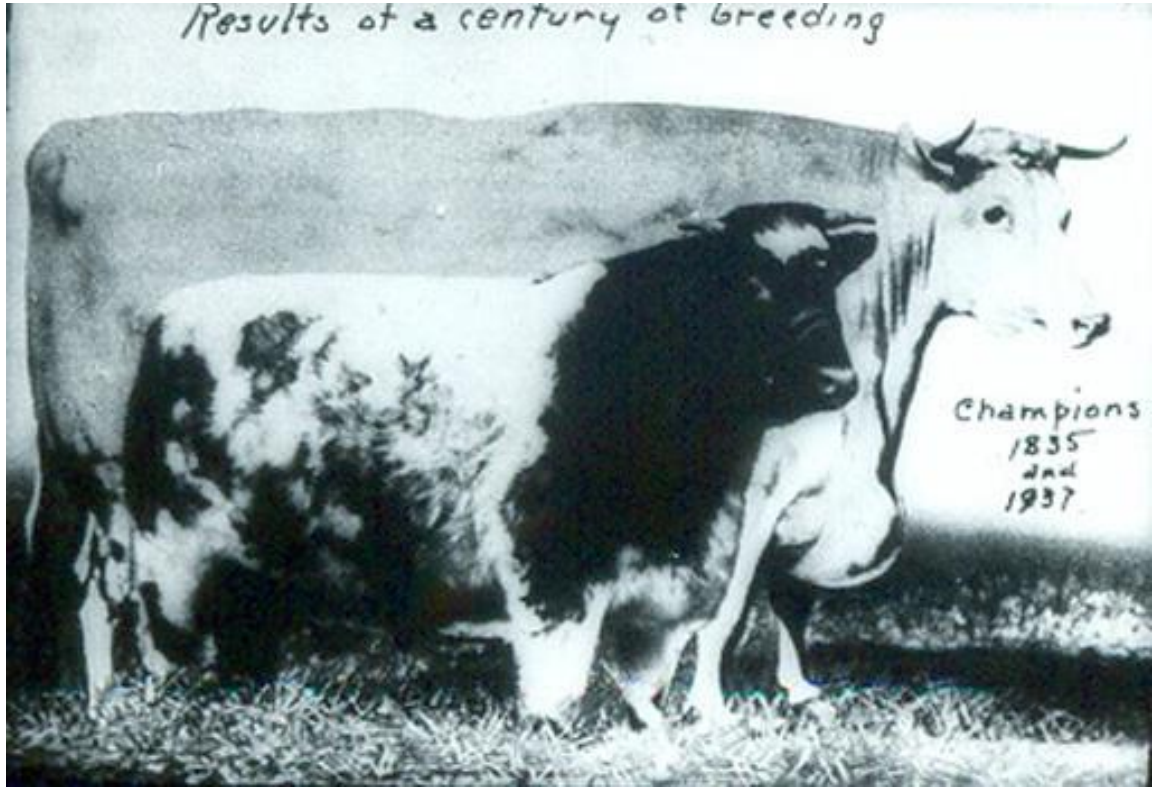
Kenny et al., 2018

Post-Weaning Efficiency

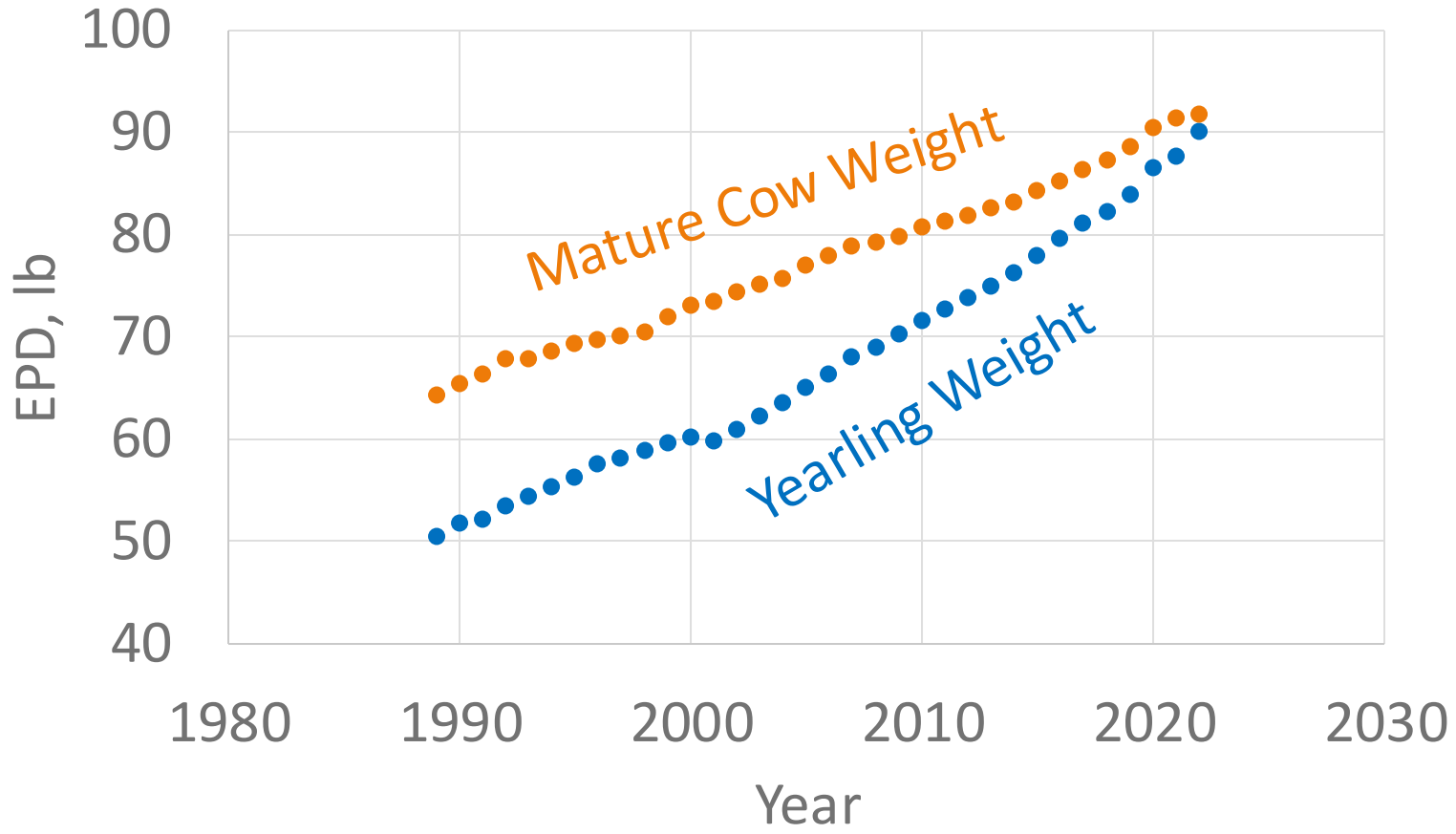
Genetic selection tools related to feed intake, performance, and feed efficiency are designed to improve production efficiency during the post-weaning phases of beef production

Cow Size Considerations

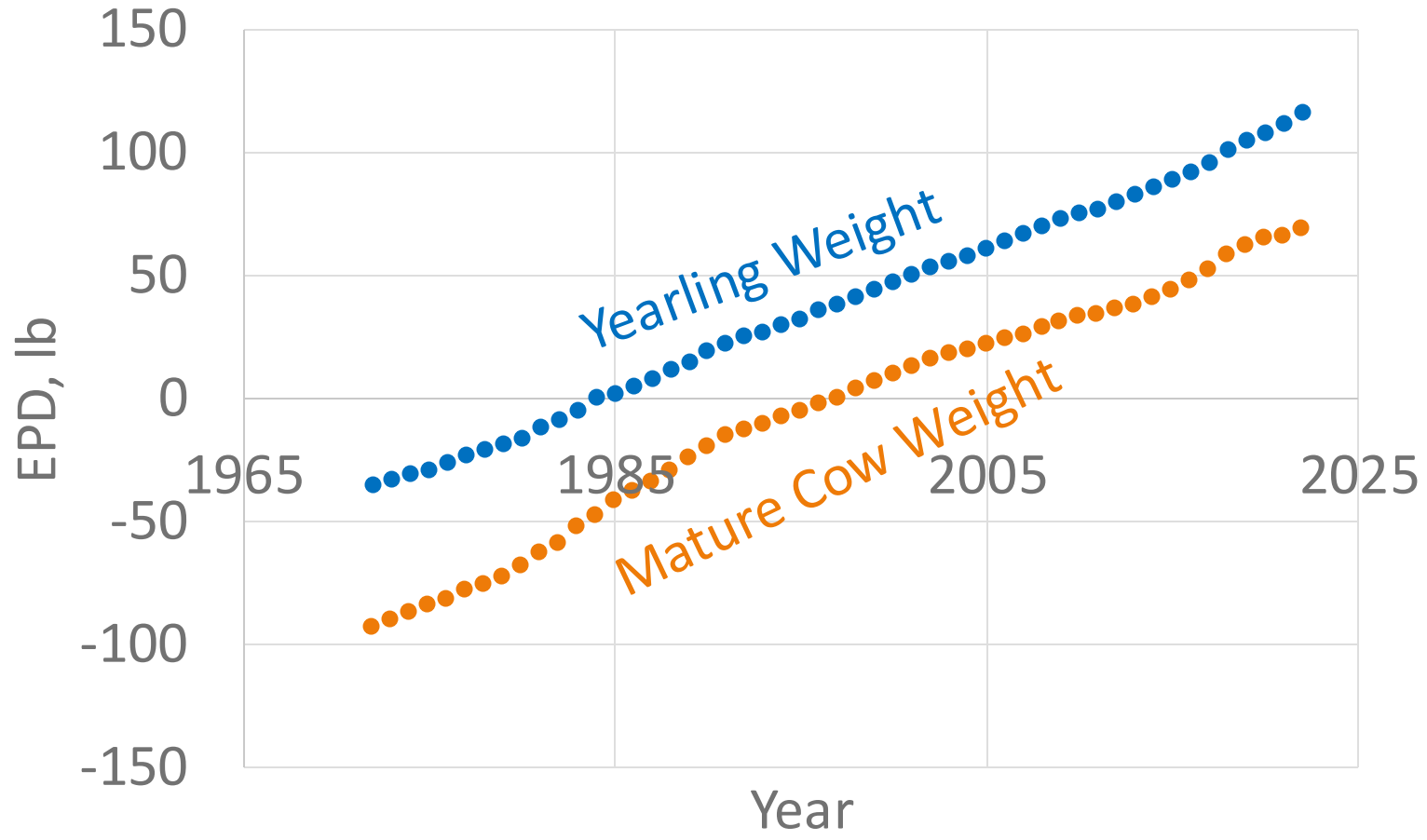
- A proxy for feed intake
- Cull cow market value
- Weaning weight
- Post-weaning growth
- Carcass weight

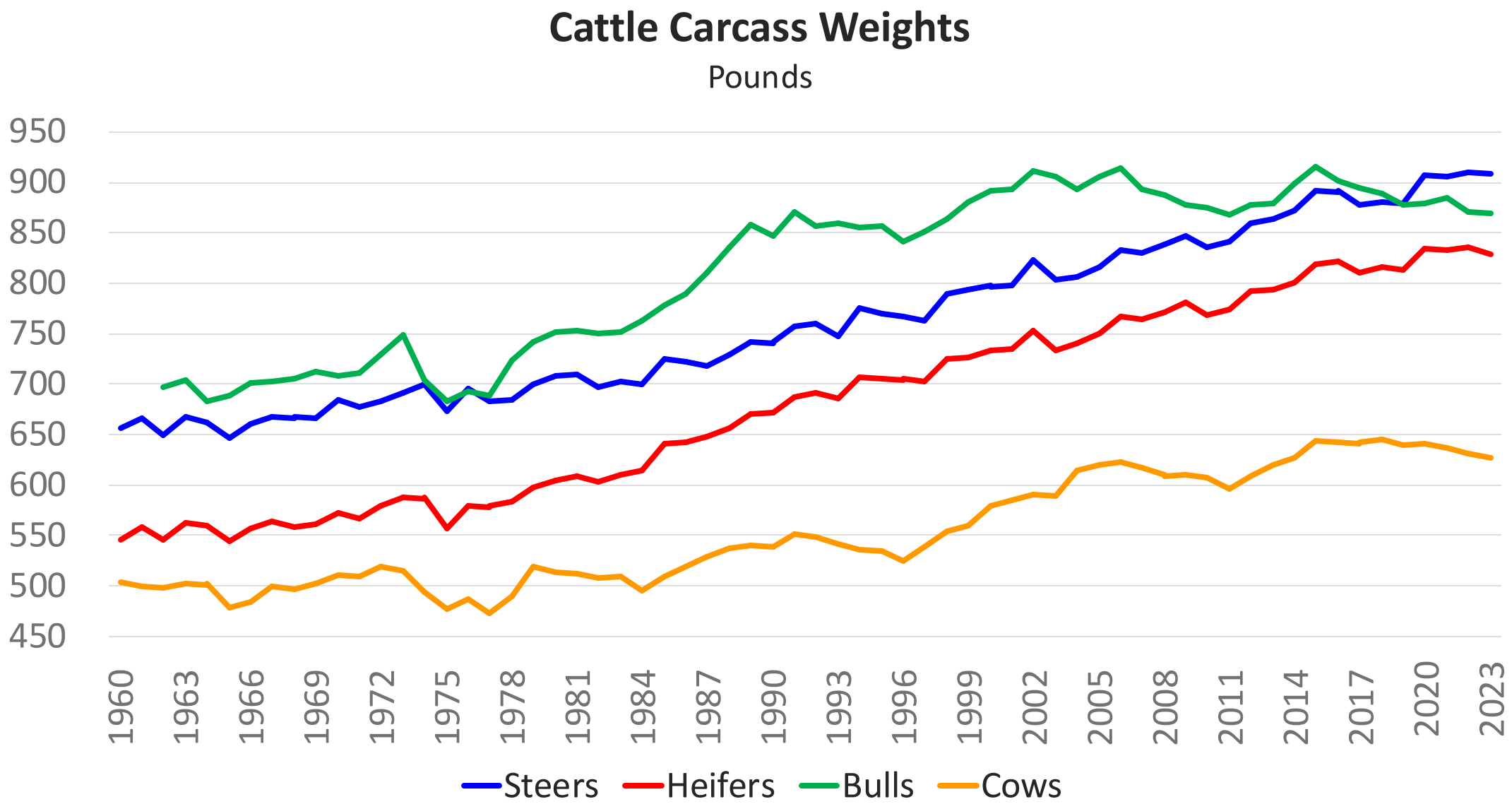


Genetic Trend
Weight: Hereford



Genetic Trend
Weight: Angus




Cattle Carcass Weights
Pounds
950
900
850
800
750
700
650
600
550
500
450
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2020
2023
Steers
Heifers
Bulls
Cows

Genetic Correlations

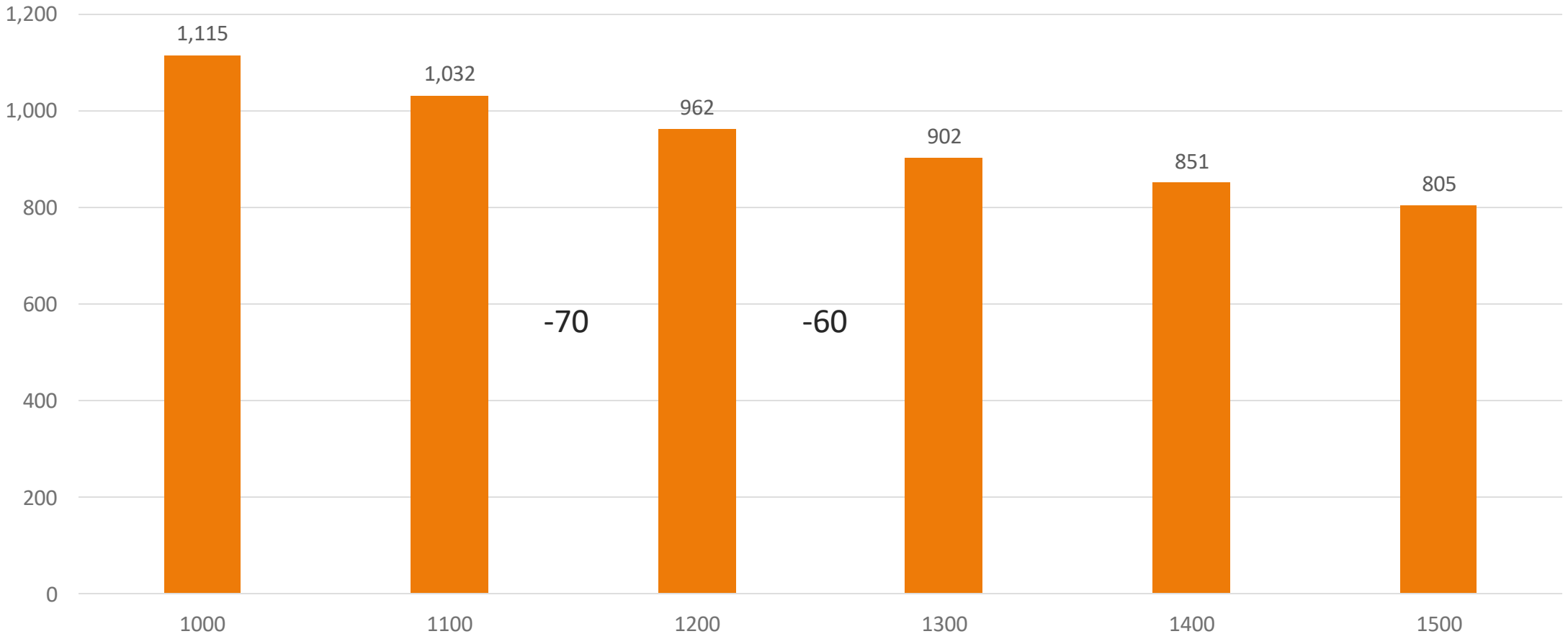
Angus

Weaning Weight ⟺ Feed Intake = 0.50

Post-Weaning Gain ⟺ Feed Intake = 0.61

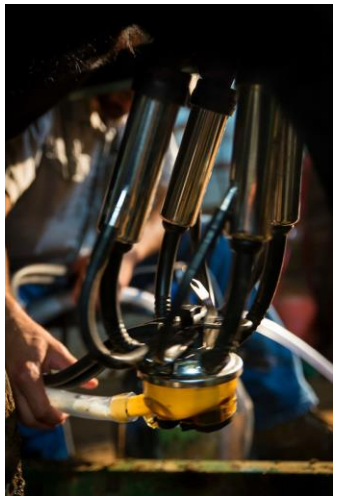
Mature Cow Weight ⟺ Weaning Weight = 0.44

Effect of cow size on stocking capacity: 10,000-acre ranch, North Central Oklahoma



Feed intake from Gross et al., 2024

Do Feed Intake EPD's Work for Cows?



Heritability and Genetic Correlations
Heifers vs Cows

- Heritability
  - Average daily DMI Heifers = 0.84 Cows = 0.53
  - Average daily gain Heifers = 0.53 Cows = 0.34
- Genetic correlations
  - Average daily DMI = 0.84
  - Average daily gain = 0.73

Freetly et al., 2020: Diet for both phases = 65% corn silage, 30% alfalfa hay, 5% other (dry matter basis)

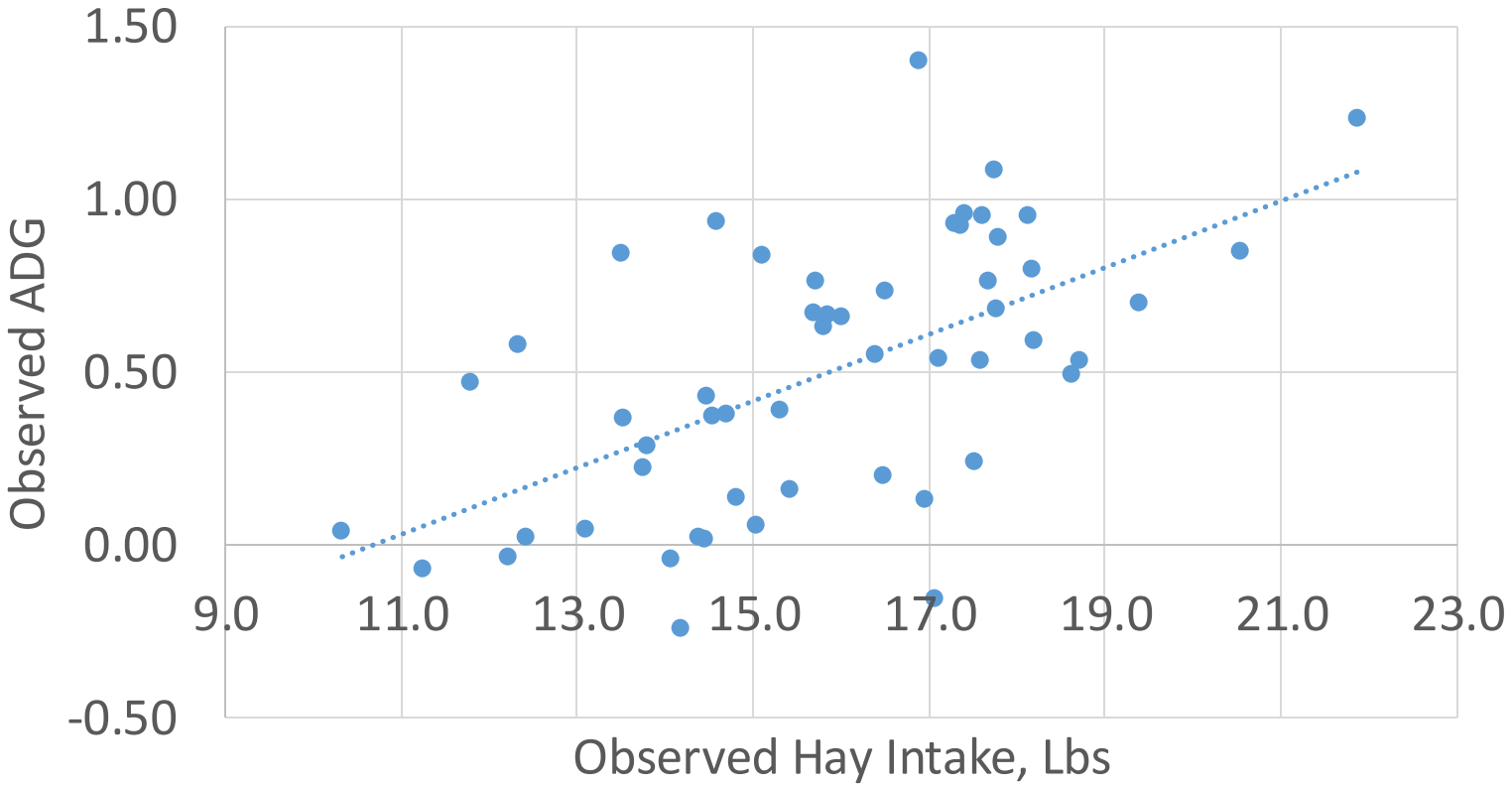

136
164
163

Phenotypic correlations for feed intake and gain for forage vs mixed diet

Reference	Class	Feed Intake	ADG
Cassady 2016	Crossbred hfrs	0.58*	-0.30*
Foote 2017	Crossbred strs and hfrs	0.51*	-0.09
Lahart 2020	Crossbred strs and hfrs	0.41*	0.03
Holder 2020	Angus cows	0.75*	-0.37*
Holder 2021	Angus cows	0.43*	-0.26
Briggs 2021	Angus heifers	0.48*	0.17
Briggs 2022	Angus heifers	0.48*	-0.16

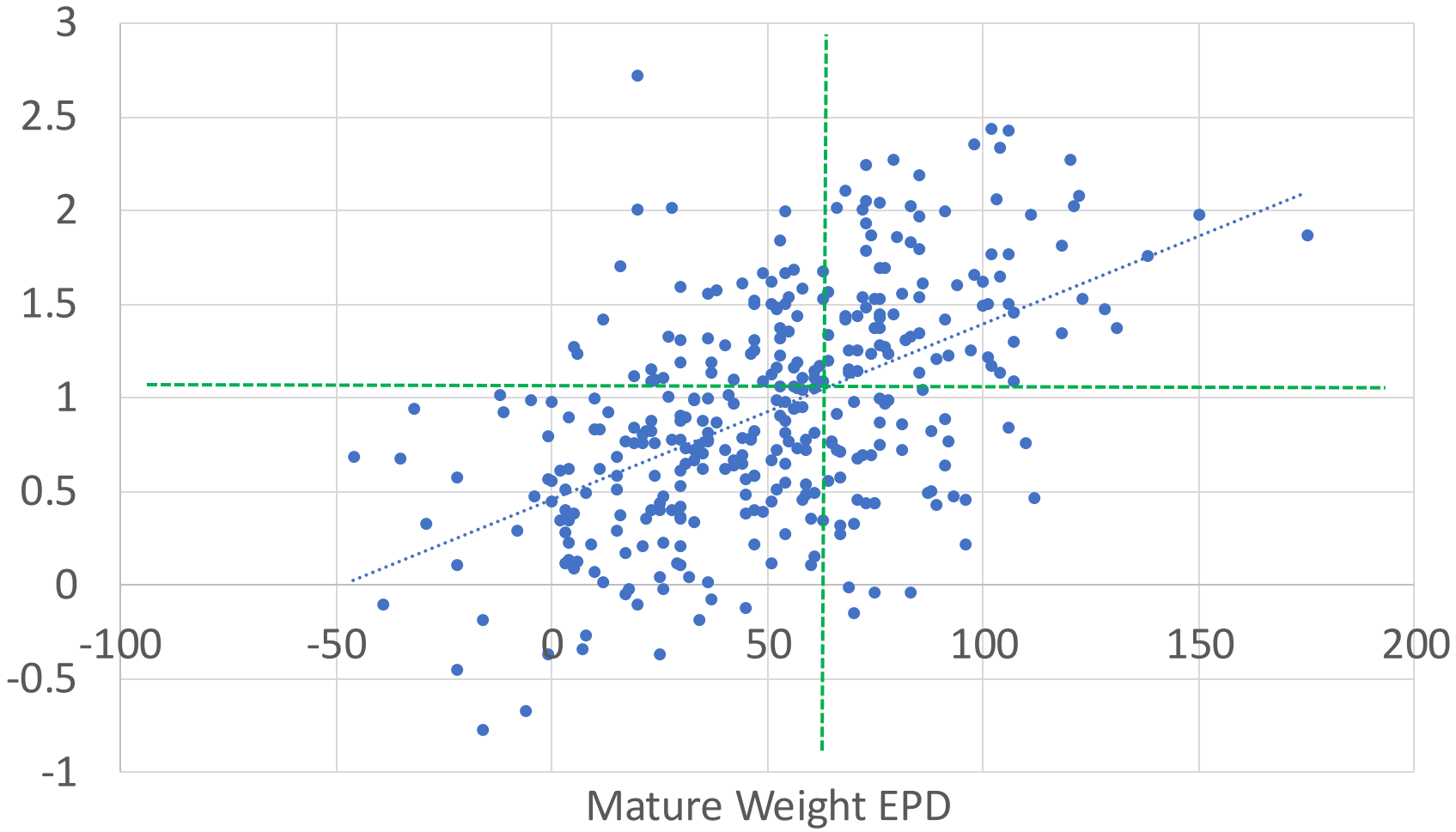
***correlation is significant P < 0.05**

Forage Utilization Efficiency Project
Replacement Heifers
Unprocessed Dry Grass Hay



Source: Briggs 2024

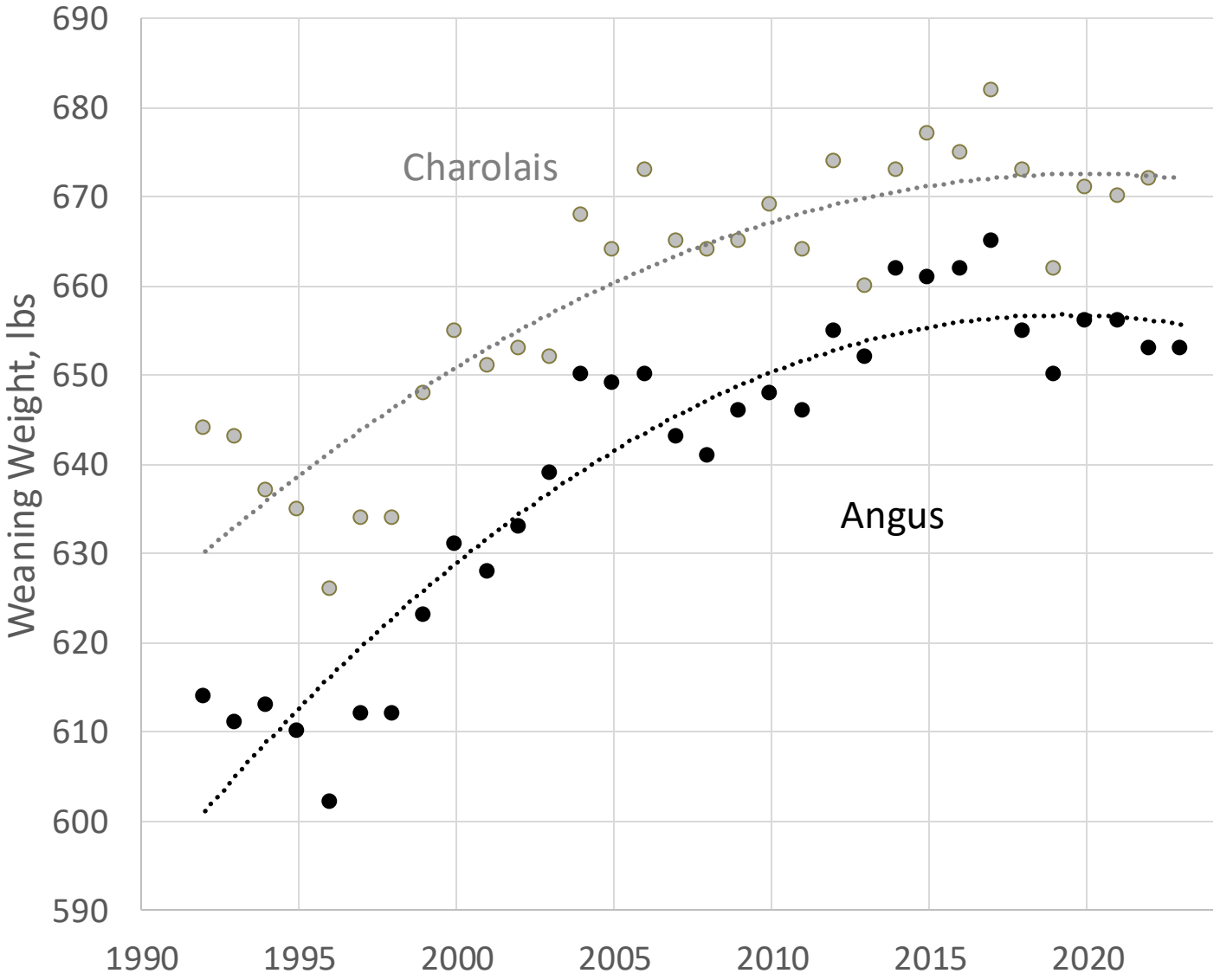
Genetics for Mature Weight vs Feed Intake



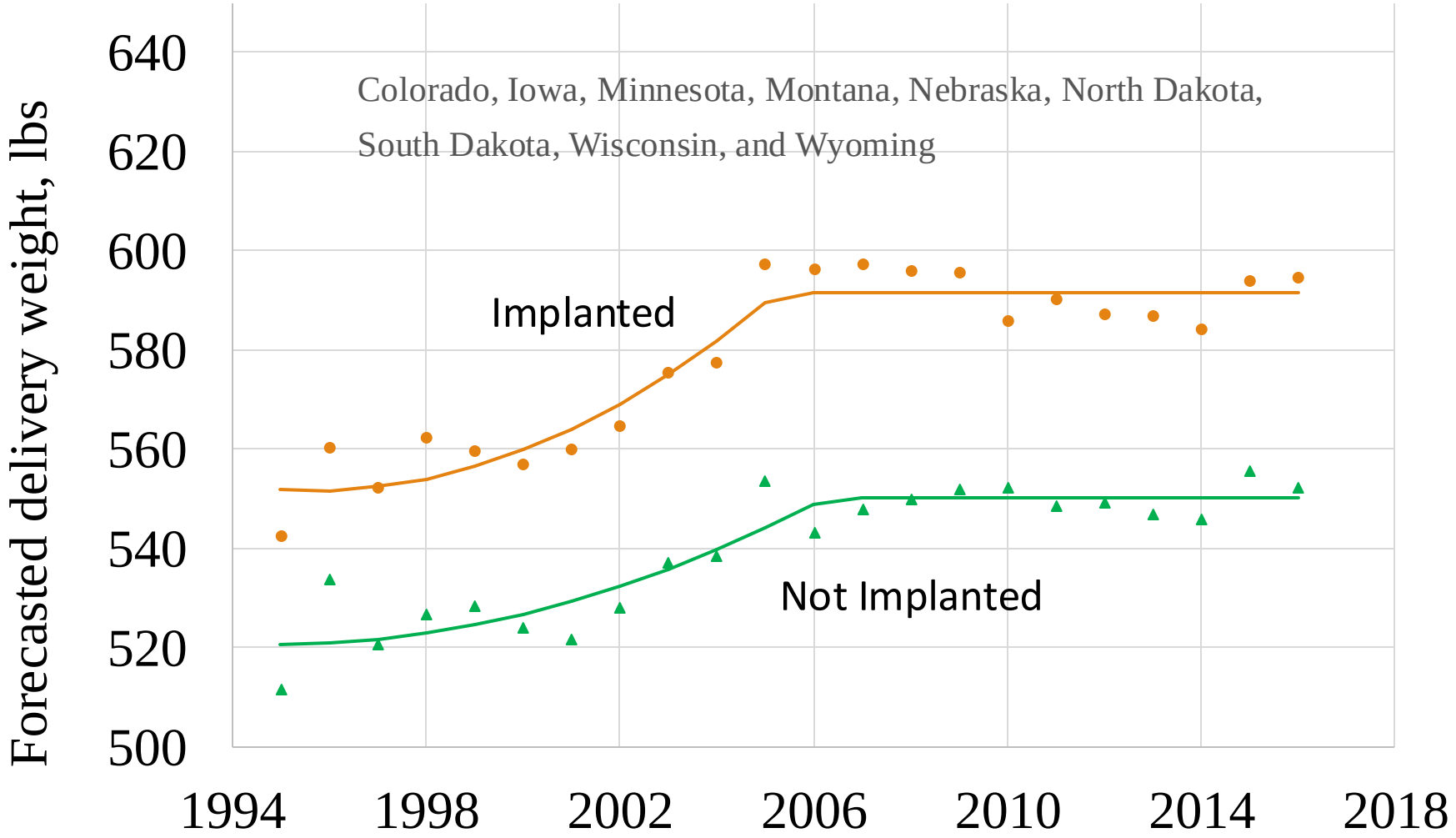
Source: American Angus Association

Weaning Weight Response in the Commercial Environment

Phenotypic Adj. Weaning Weight: Charolais and Angus Bulls



Superior Livestock Video Auction
Projected Delivery Weight



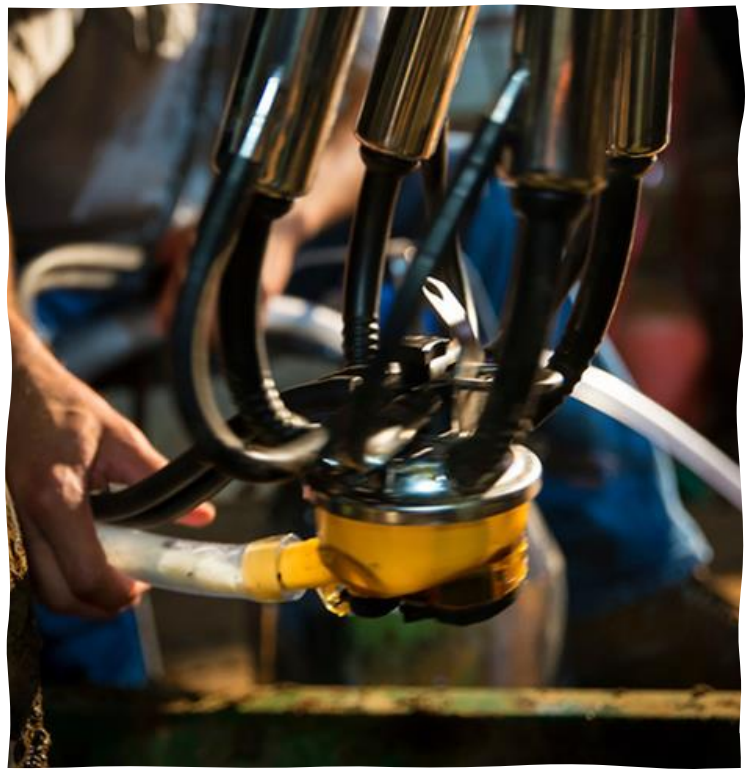
Cow Herd Appraisal Performance Software (CHAPS)
Five-Year Rolling Average

Trait	2000	2005	2010	2015	2020
Weaning %	88.6	90.3	91.1	90.4	91.3
Weaning weight, lbs.	542	558	565	555	562
Adj Weaning weight, lbs.	595	627	637	620	638
Lbs. Weaned/cow exposed	475	500	505	495	507

Source: Ramsay et al., 2021

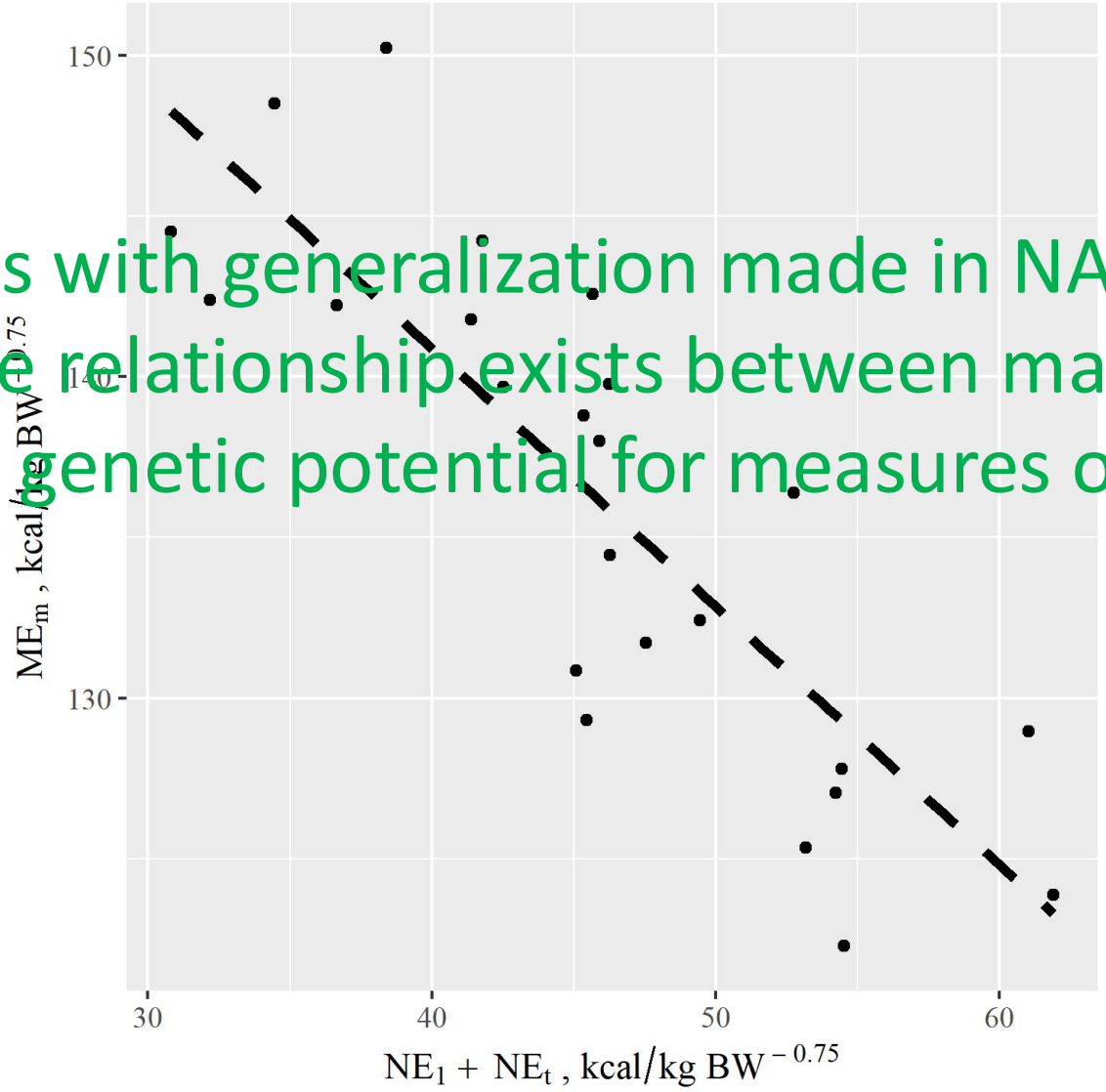
Take-Home

- Know what is going on at your place: weaning weight trend, mature cow weight, cost per unit of calf weaned
- Stocking rate should be adjusted according to mature cow size
- Assuming lack of progress in calf weight at weaning, focus on reducing cost of production and capturing value of genetic potential for superior postweaning performance



Milk

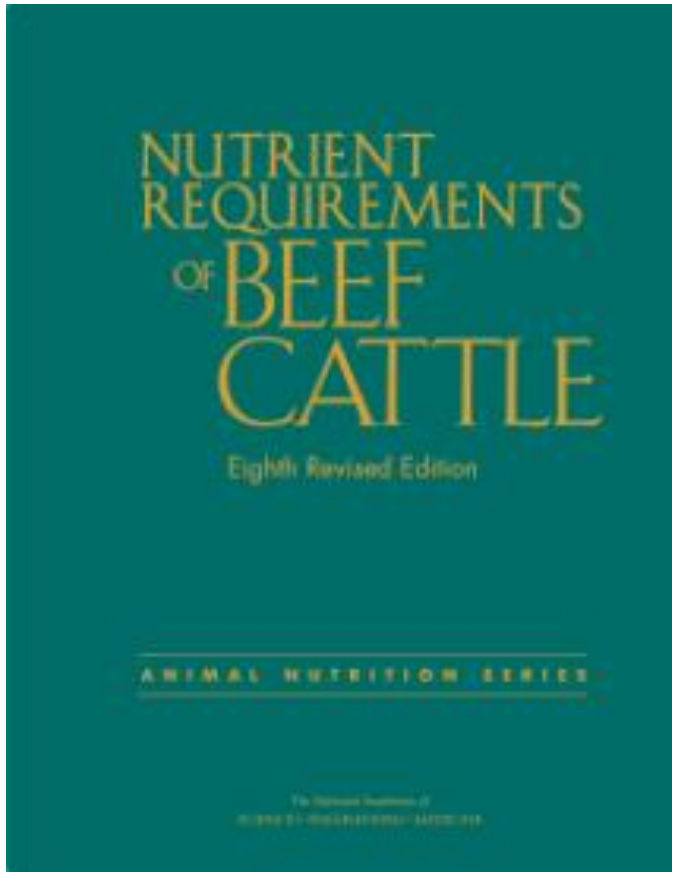
Increasing milk energy yield was associated with decreasing maintenance energy requirement.



This contrasts with generalization made in NASEM, 2016
"… a positive relationship exists between maintenance requirement and genetic potential for measures of productivity."

Briggs et al., 2022

How does milk yield influence feed intake?



NASEM 1984, 1996, and 2016

One unit milk = 0.2 units feed intake

Factors Affecting Forage Intake in Lactating Cows

DMI = -0.76

+ 0.023*BW, lbs

+ 4.39*ADG, lbs

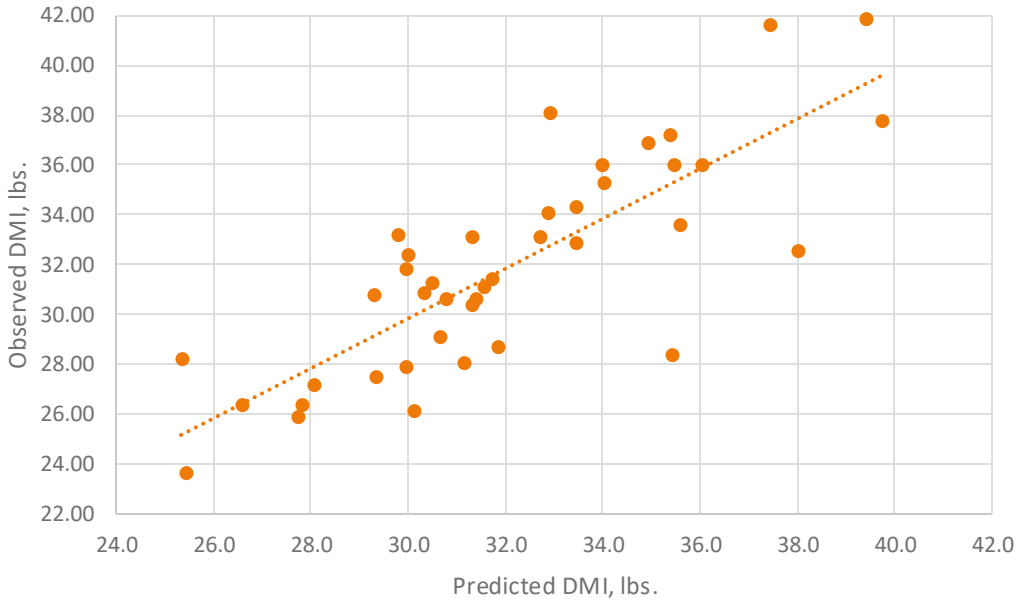
+ 0.51*Milk Yield, lbs

– 1.74*BCS

+ 9.73*REA/BW

$R^2 = 0.66$

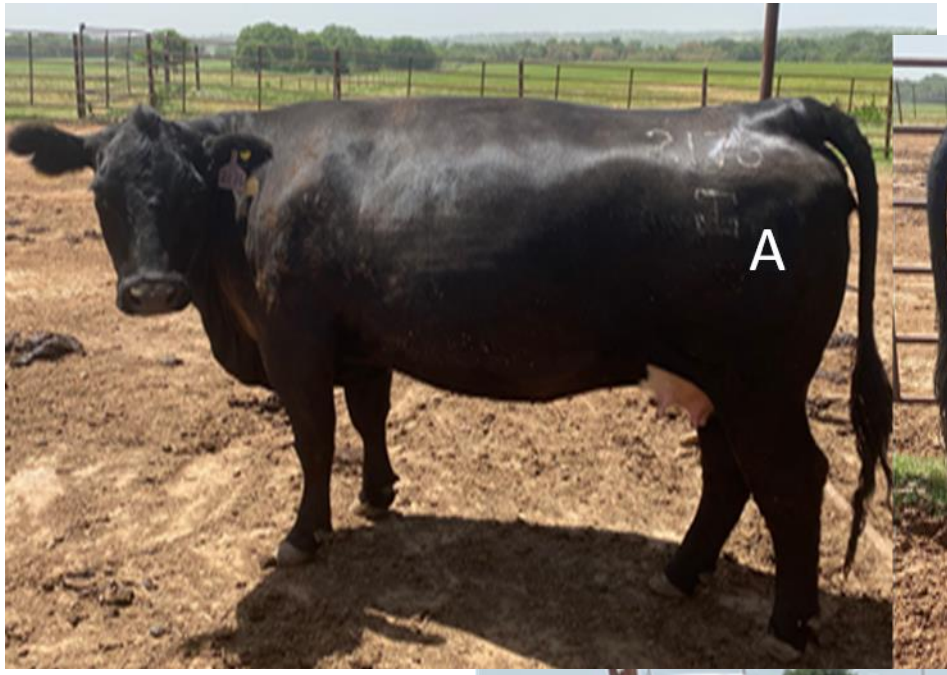
Talley, unpublished data



Talley, unpublished data

Feed intake response to increasing milk yield

Author	Feed Intake:Milk
Johnson et al., 2003	0.35
Moore et al., 2022	0.71
Gross et al., 2024	0.45
Talley 2024, unpublished	0.51


A


B


C

Fleshing Ability : Milk Yield : Forage Intake

Cow	Age	Cow Wt, lb	Peak Milk, lb	BCS	DMI, lb	Adj 205 Calf Wt
A	3	1390	16	5.8	20.2	547
B	3	1362	33	4.4	44.5	608
C	7	1465	31	5.5	23.8	601

Summary

- Continued aggressive selection for growth without control for mature cow size and feed intake will result in heavier mature weights, greater appetite, and less resilience (we already have the tools)
- Current NASEM model underestimates feed intake, especially in lactating cows
- “Productivity” does not seem to be detrimental to maintenance as previously thought

Estimating Cow Costs: Feed Intake

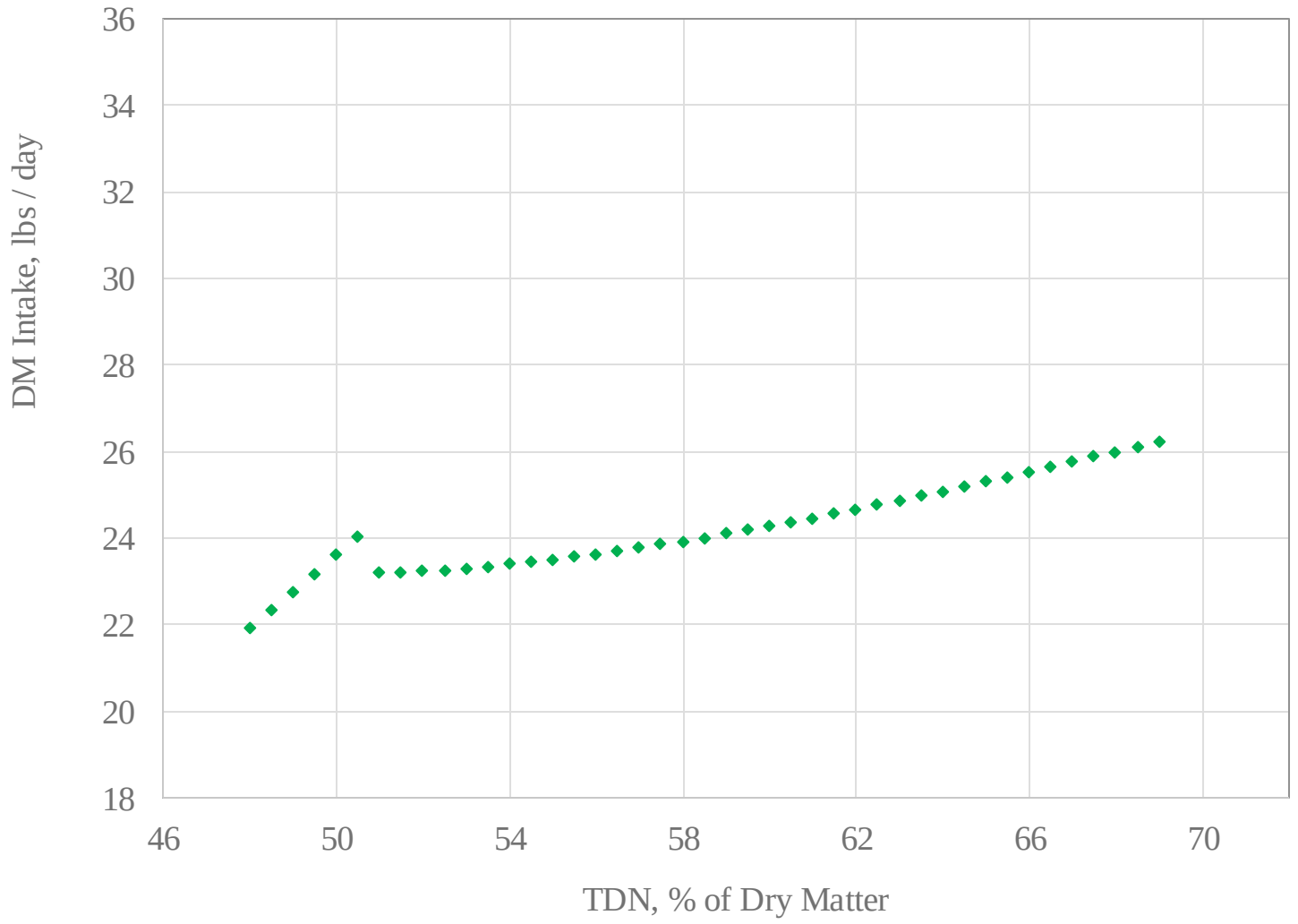
NASEM 1996 and 2016 Cow Feed Intake Equation

- Developed using data published between 1979 and 1993
- Contains substantial marker data; chromic oxide, alkanes, etc.
- Contains data from animals housed in metabolism or tie stalls
- Brief feed intake periods (4 to 6 days)

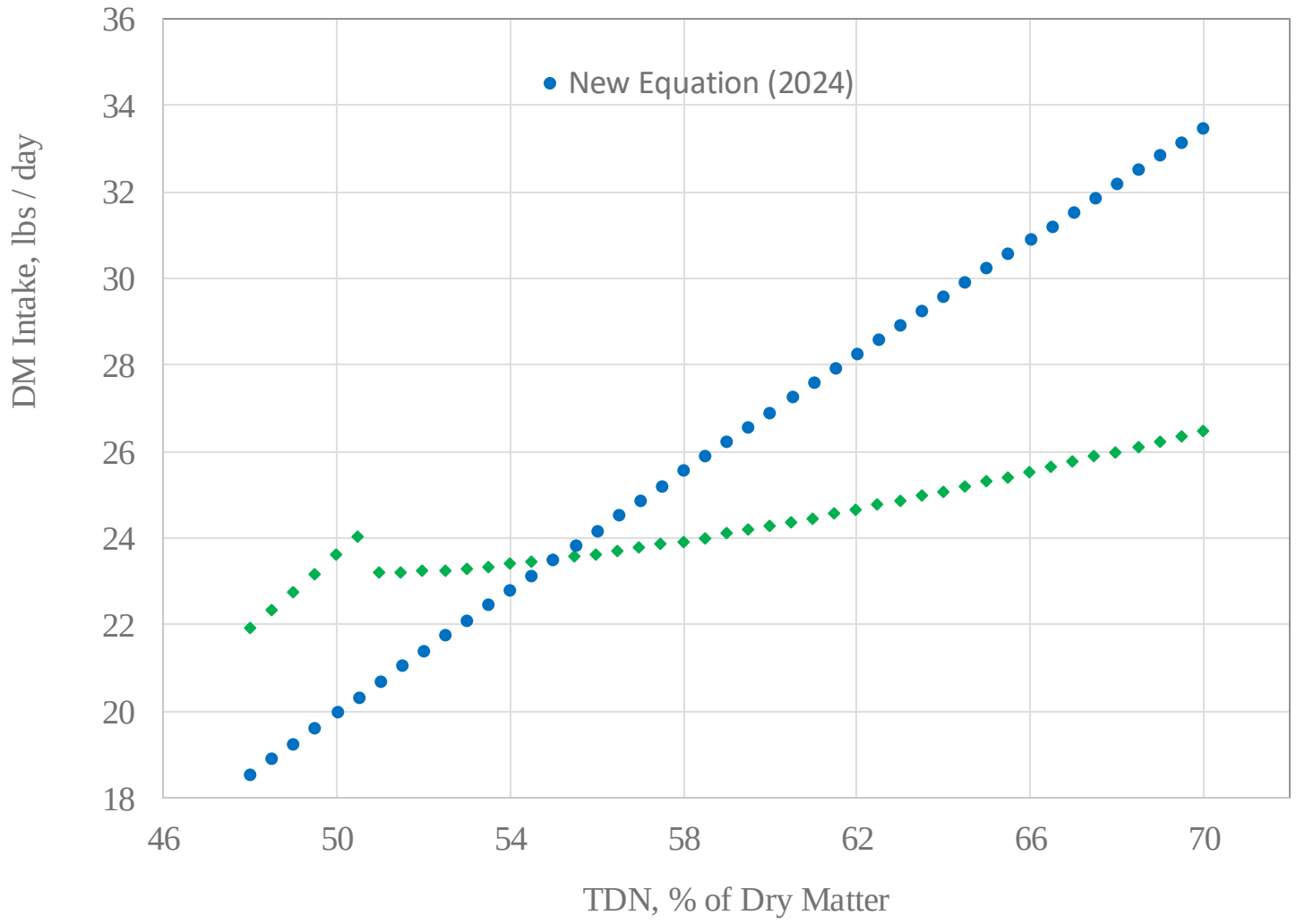
Evaluation of Intake Equations

- Current data set restricted to:
  - Voluntary ad libitum feed intake
  - Restricted to studies published or conducted between 2003 and 2022
  - No marker generated data
  - No metabolism or tie stall data
  - Studies with adequate dietary protein
- 85 observations/treatment means

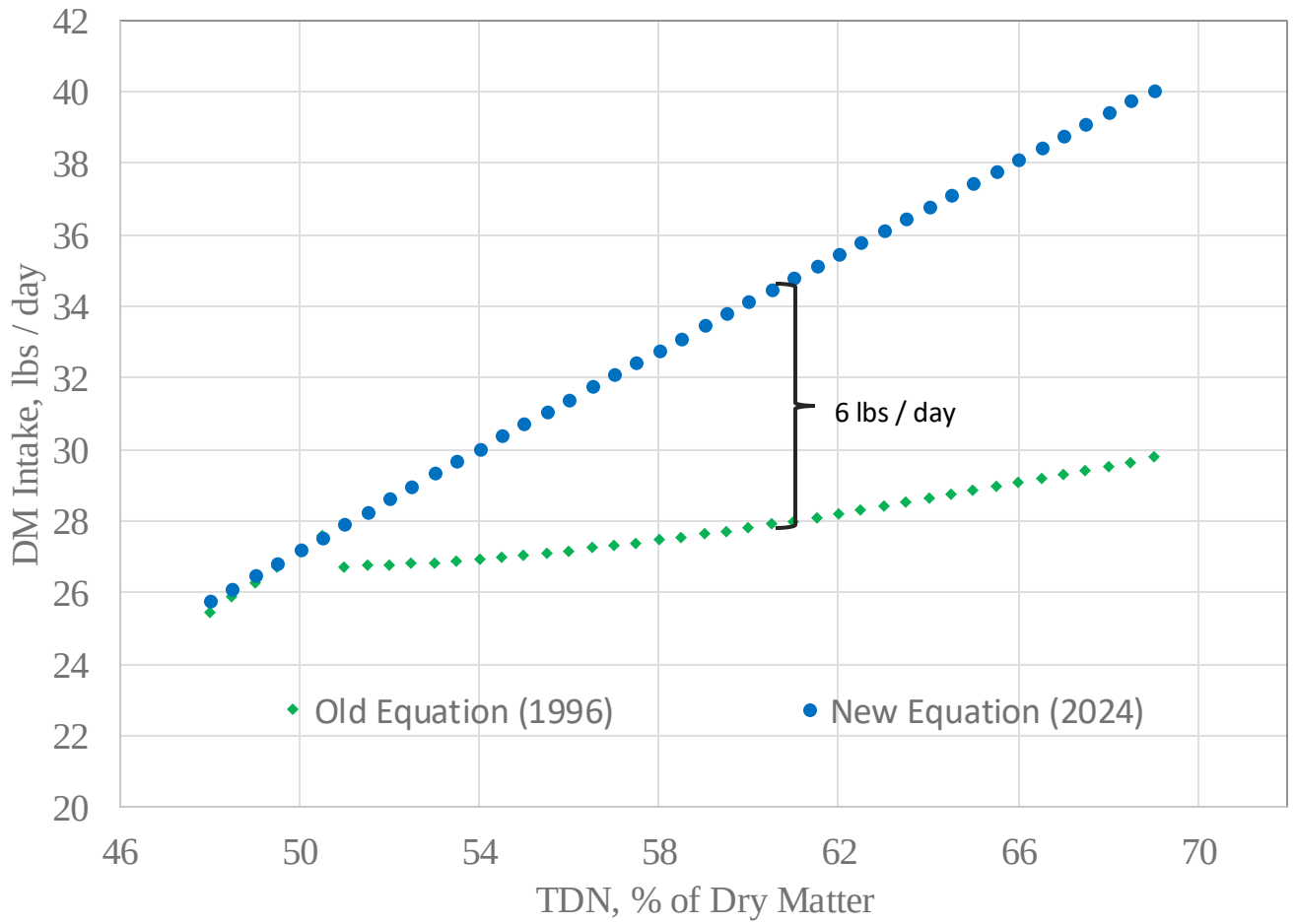
NASEM Feed Intake Equation Gestation



Feed Intake Equations; Gestation



Feed Intake Equations; Lactation



Impact of Forage Intake Equation

- 10,000-acre ranch: Tall and mid-grass prairie
- Forage production 3,500 lb
- Harvest efficiency 30%
- Mature cow weight 1,200 lb

Stocking Rate and Stocking Capacity

Model	Avg Annual DMI, lbs	Stocking Rate, Acres/Cow	Stocking Capacity
NASEM 1996	27.1	9.4	1063
Gross 2024	29.9	10.4	962
			+101

About 1 round bale more forage each year