Welcome to the 2018 PIC® Nutrition Seminar

August 23, 2018 | Des Moines, IA

WIFI: Hilton Honors Meeting
Promotional Code: des25

PIC®

Agenda	
10:00AM	Welcome
10:05AM – 10:35AM	Genetic Update
10:35AM – 12:35PM	Camborough Efficiency: • *Current Thoughts on Gilt Development* • *Body Condition Management* • *Update on Sow Feeding* • *Feeding Group-Housed Sows*
12:35PM – 1:35PM	Lunch + The Science Behind Carcass Value
1:35PM – 2:35PM	Maximizing Profit in Wean-to-Finish • *Formulating for Maximum Profit* • *W2F Management: Nutrient Availability and Implication*
2:35PM – 2:55PM	Break
2:55PM – 4:55PM	Workshop on Economic Calculators • *Nutrition Research Update* • *Lysine Economic Update* • *Energy Economic Calculator*
4:55PM – 5:00PM	Final Wrap-Up, Meeting Adjourned

PIC®

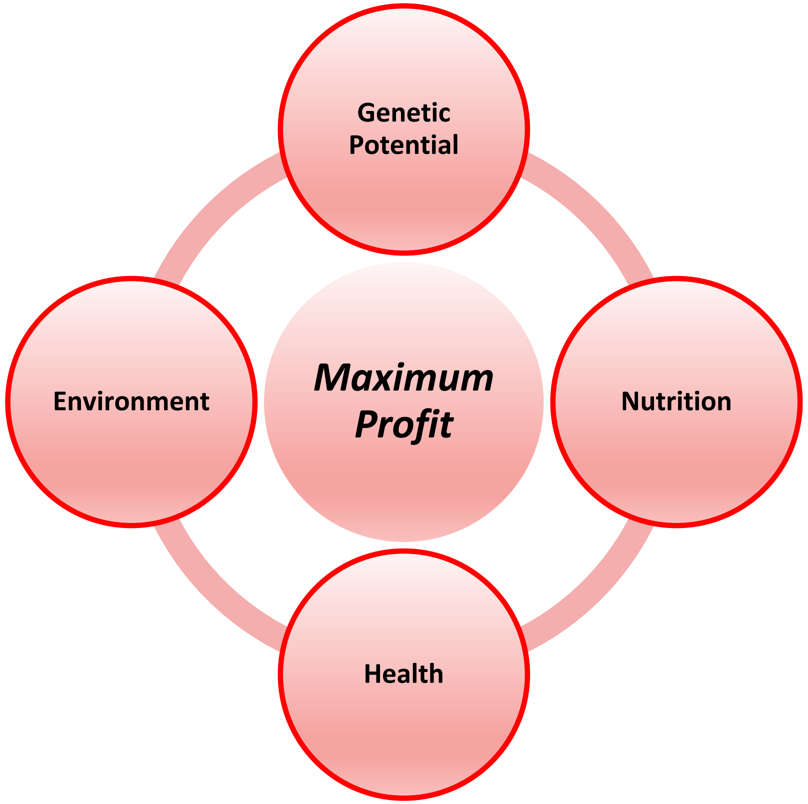
Never Stop Improving

Expecting More from the Evolution of Genetics and Nutrition

PIC

Never Stop Improving *Nutrition.*

Why Are We Here Today?



We believe that genetic improvement is accelerating and we can see the initial results…

We are excited about the opportunities that this provides for continued improvement…

We believe that nutrition is one of those essential items that allow potential to be realized…

PIC

Driving Selection Progress

4 Key Pillars Driving Accelerated Gain

Large populations driving selection intensity	Significant investments in population size and programs like Delta P	Populations are 2-3 times larger than 6 years ago
Meaningful data capture focused on what is important	Expansion of GNXbred program and inclusion of new traits	Doubling of GNX and inclusion of tenderness and primals
Using the best science possible to drive accuracy	Full implementation of RBGS and research on emerging science	Continued realization of > 35% increase in gain; PRRS gene edit project
Selecting for realizable commercial profit	Continued focus on bottom-line profit	Genetic trend increased by over 50%; significant changes on throughput

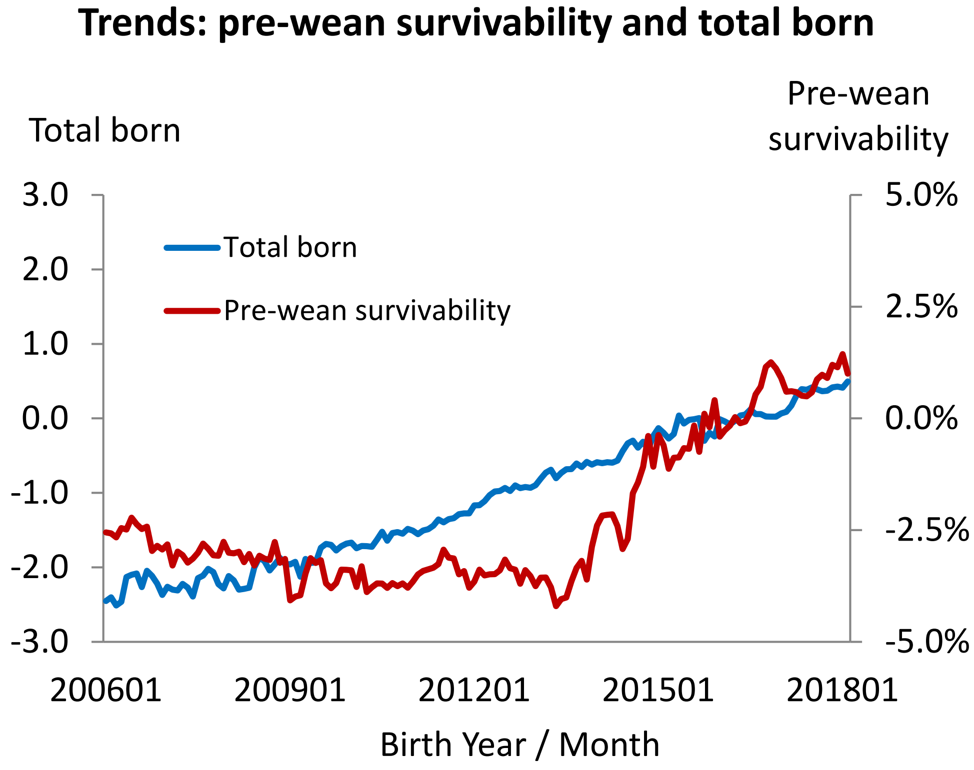
Never Stop Improving *Nutrition.*

PIC®

Increasing Quantity and Quality of Weaned Pigs

Never Stop Improving *Nutrition.*

A Few Examples of Impact



Individual piglet birth weight

- Measured for 10 years
- Utilized for 5 years

Today, with data and RBGS

- Acceleration for throughput (+.90 pigs/sow/year)
- Acceleration for quality / livability (+2% pre-wean mortality and .25 lbs / piglet birthweight)

PIC®

Never Stop Improving *Nutrition.*

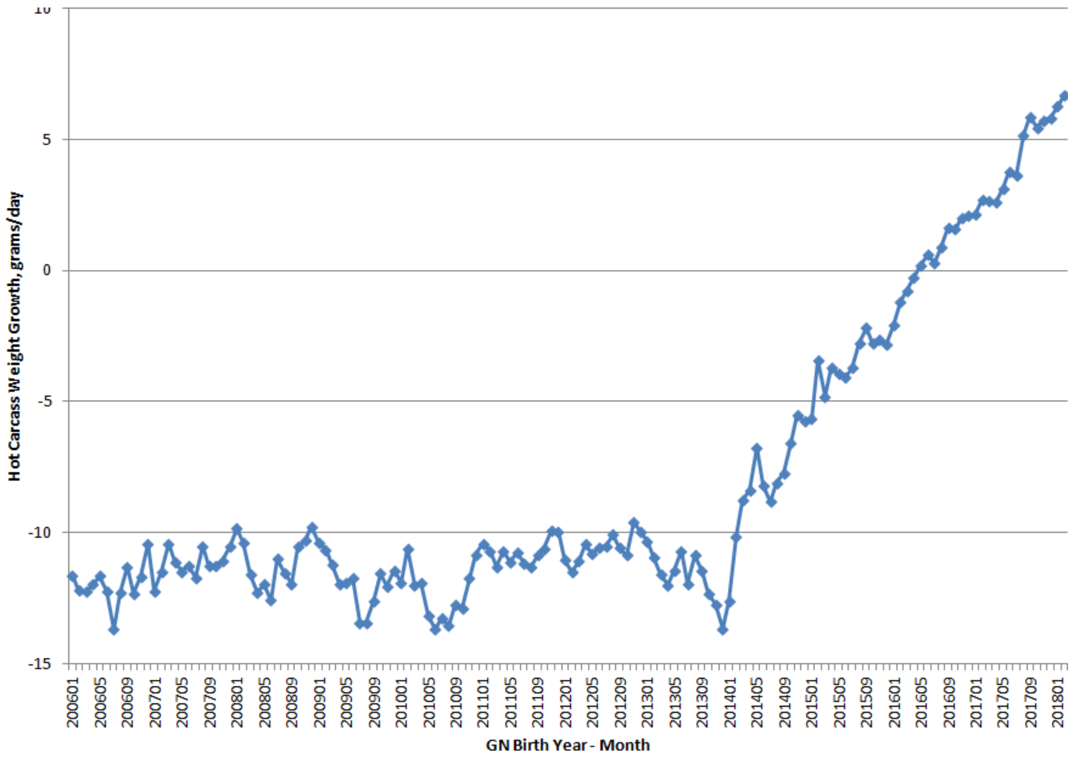
Increasing Post-Weaning Throughput

Dramatic acceleration in growth

Why?

- Fixed time vs fixed weight
- Capture joint added benefit of intensity and accuracy

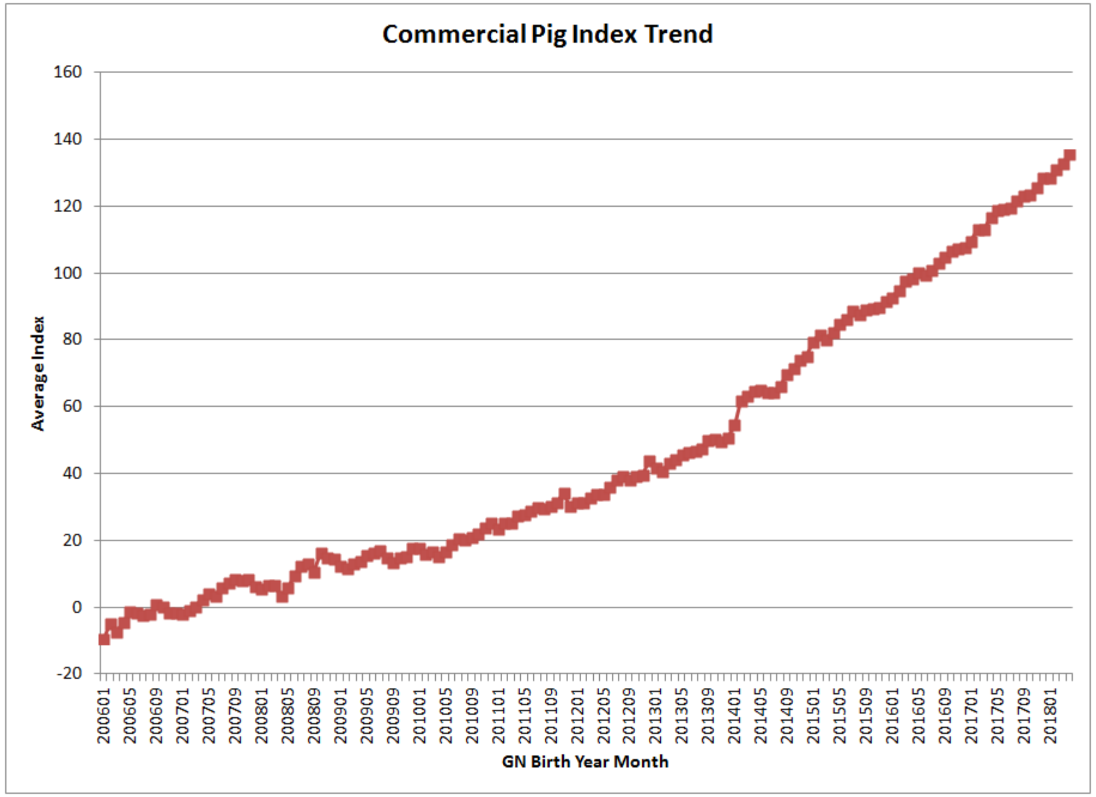
Currently, about 1/3 of way through the upward trend at the commercial level



PIC®

And, We Expect More to Come

Targeting the Future



	Today	Annual Change	2028
Pigs/Sow/Year	32.5	1.1	43.5
Weaned / Litter	13.3	.45	17.8
Kgs Weaned / Sow / Year	185.2	6.8	253.2
Pigs Weaned / Sow / Lifetime	60.0	1.3	73.0
Kgs Sold / Sow / Year	3,865	173	5,595
% Sold	93	.35	96.5
Avg Market Weight (kg)	130	1.3	143
Post-Wean Feed Efficiency	2.20	.03	1.90

Never Stop Improving *Nutrition.*

PIC®

And, We Expect More

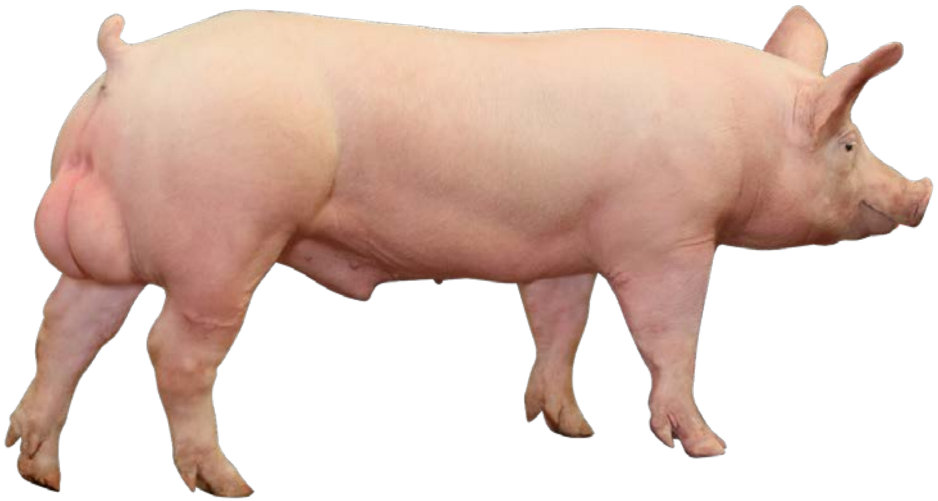
High Quality Throughput of Weaned Pigs

Top 10% for the last year

22.1 Total Born for the PIC L03

And, We Expect More

High Throughput Post-Weaning



Top 10% over the last year…

1.339 kg / day Test ADG

.976 kg / day Lifetime WDA

Never Stop Improving *Nutrition.*

PIC

And, We Expect More

Efficient Gain Post-Weaning

Top 10% for the last year

1.63 FCR for test period

Driving Selection Progress

4 Key Pillars Driving Accelerated Gain

Large populations driving selection intensity	Largest elite genetic system in the world with 2x the intensity of 5 years ago
Meaningful data capture focused on what is important	Triple the number of data points of 5 years ago and now including Tenderness
Using the best science possible to drive accuracy	Best implementation of genomic selection and genome sequence / gene edit R&D
Selecting for realizable commercial profit	Genetic trends increased by nearly 50% over last 5 years

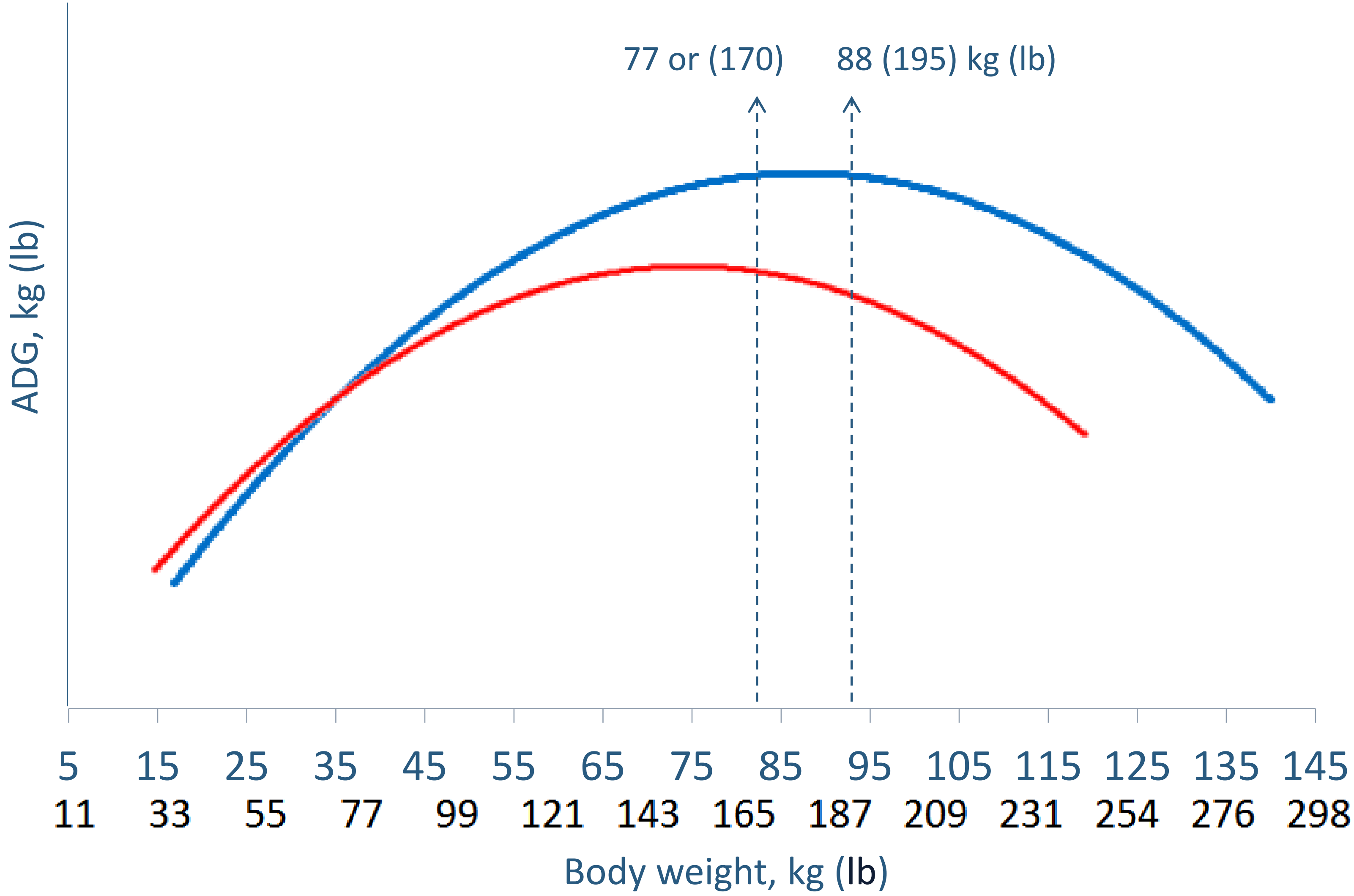
Never Stop Improving Nutrition.

PIC®

Capturing Increased Potential

Body Weight at Maximum Protein Deposition

Estimated based in the growth curves of 337 in 2007 and 2016

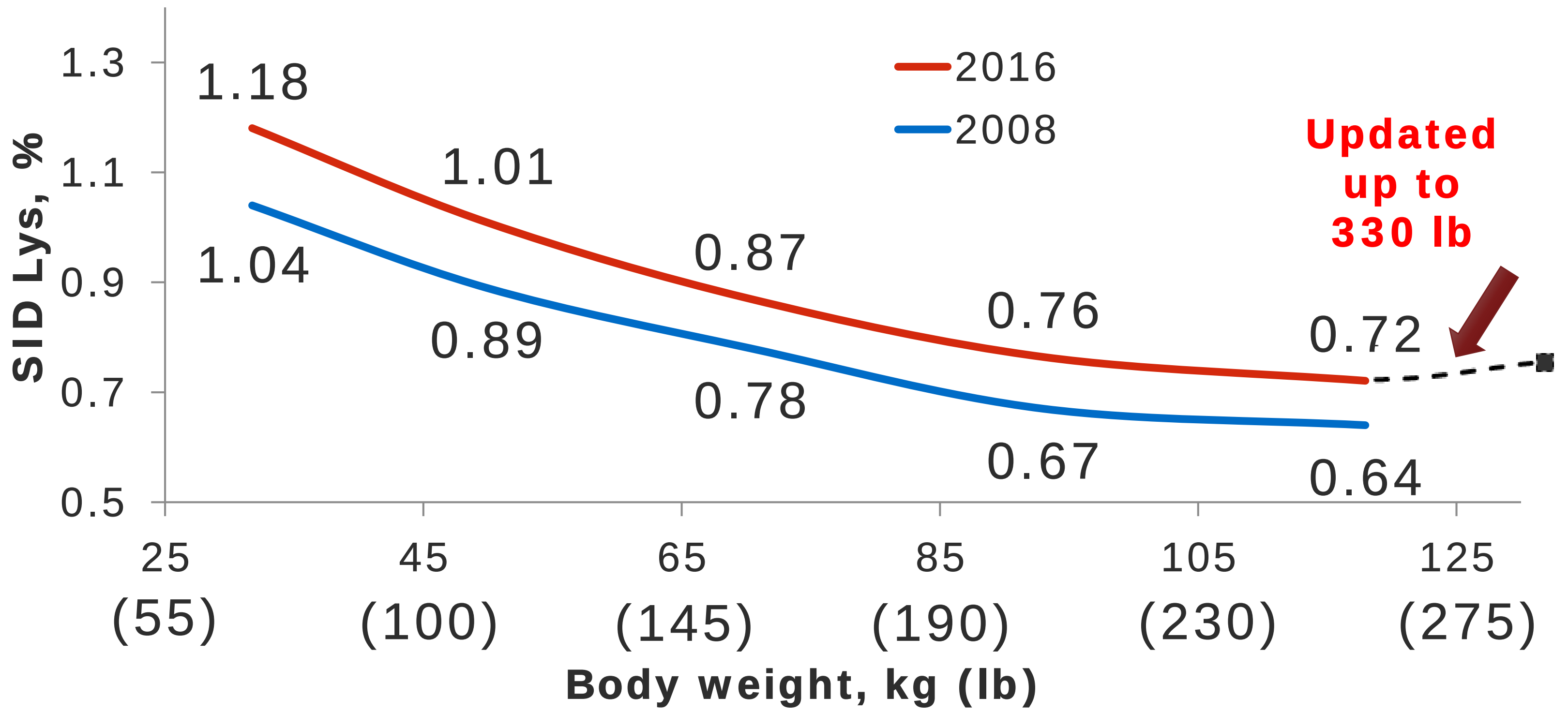


Never Stop Improving Nutrition.

PIC®

Amino Acid Requirements

2,440 kcal NE/kg (1,107 Kcal NE/lb)



A total of 28 commercial experiments were used in the meta-analysis with a total of 46,092 pigs.

Average of barrows and gilts, average of ADG and F/G.

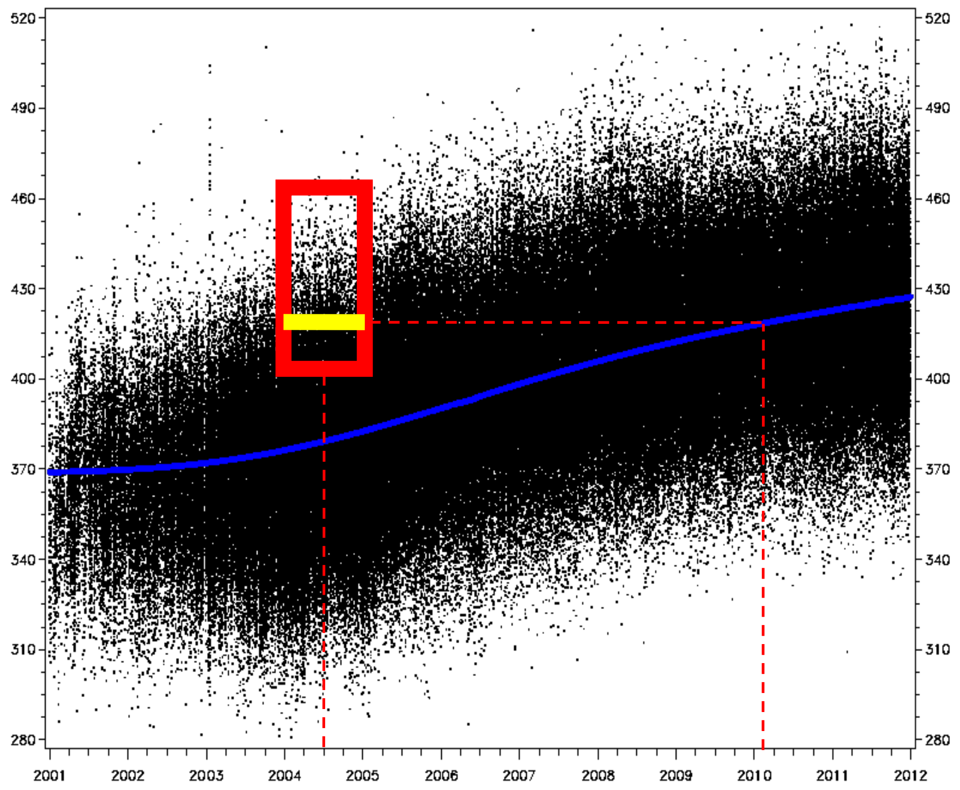
Assuming a corn-soybean meal diet. ADFI of 2.22 and 2.40 kg/d for gilts and barrows, respectively.

Unlocking Genetic Potential

Trends in EBVs for lean tissue growth rate (LTGR)

Progress continues forward

Over a roughly 6 year period the genetic merit of the most elite animals become the genetic merit of the average



Never Stop Improving Nutrition.

PIC®

Increasing the Realization of Success

Efficient Gain Post-Weaning

- Creating genetic potential

- Capturing genetic potential
    - Nutrition
    - Health
    - Environment
    - Best practices

Current Thoughts on Gilt Development

Current Scenario

It is not your father's gilt

- Improved feet and legs.
- Grow faster and leaner.
- Environment modifies performance and behavior.

Targets

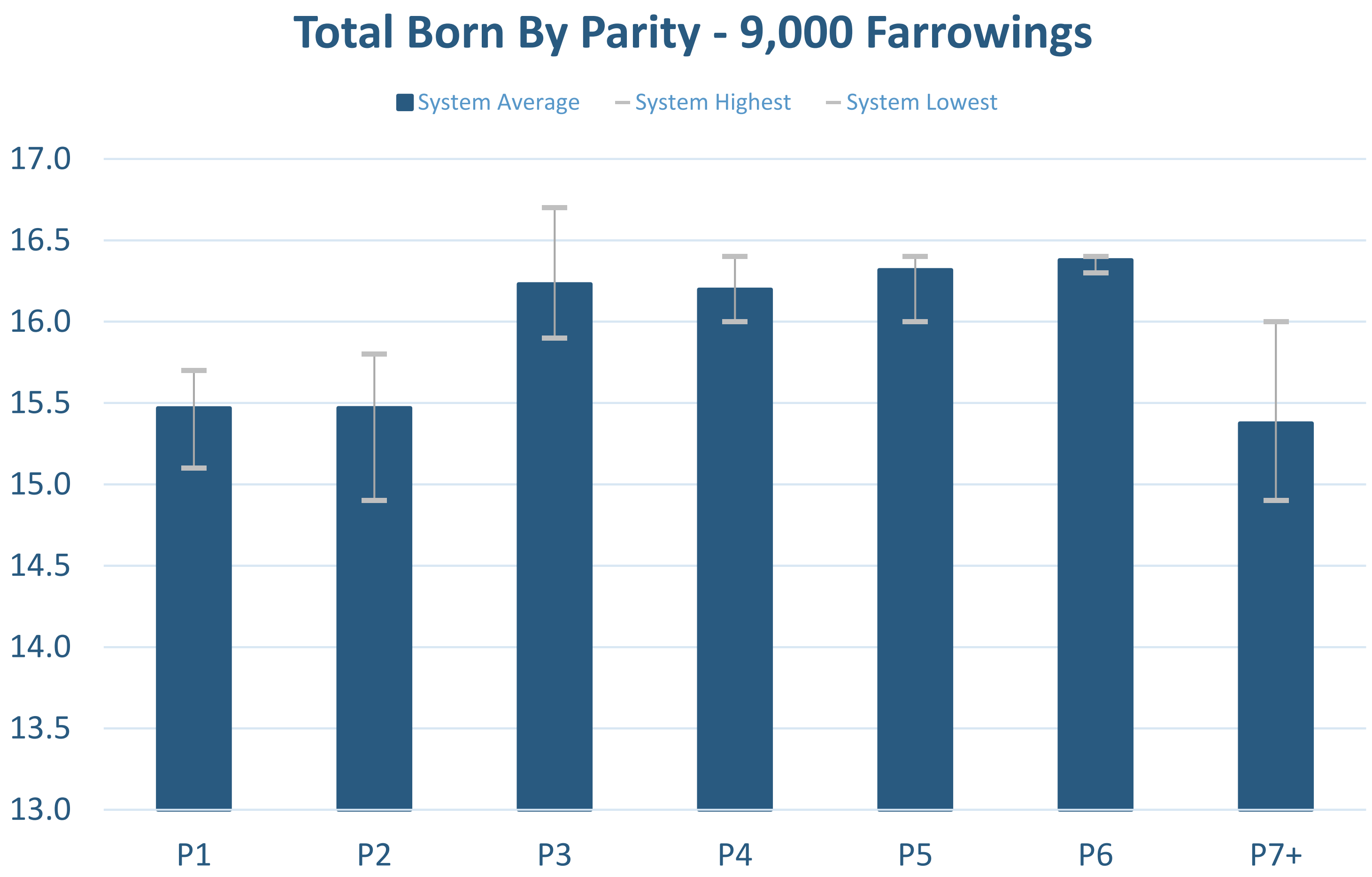
- Go beyond P1 litter size
- Different outcomes between and within systems.

However

- Some still breed them at the same age as your father used to do.

Performance Reliability

Gilts in 16.0 TB Farms



Performance Reliability

Gilts in 16.0 TB Farms

- **High performance** – At/around the farm litter size average.
- **>15.5 pigs at farrowing**
    - 30% litters ≥ 16.0 TB.
    - 45% of litters ≥ 15.0 TB.
    - 60% of litters ≥ 14.0 TB.
- **No dips** – P2 dip is absent or negligible.
- **Longevity** – If no management decision to cull young individuals, 75% of them should make it to P3 and 50% to P6.

Never Stop Improving Nutrition.

PIC®

Gilt Development Starts Early

- It is wrong to consider that reproductive management starts with the boar exposure.

Gestation
- Stress on pregnant dam
- Uterine capacity/placental efficiency and litter size

Birth-10 wks
- Ovaries and uterus grow proportionally to the gilts growth

11-20 wks
- Vesicular follicles appear
- Increased number of >3mm follicles after 15-16 wks

Prepuberty
- Number/size of follicles remains constant
- Ovaries and uterus weight stay unchanged until 1 week prior first estrus

Never Stop Improving Nutrition.

Gilt Development Starts Early

- It is wrong to consider that reproductive management starts with the boar exposure.

Gestation

Stress on pregnant dam

Uterine capacity/placental efficiency and litter size

Birth-10 wks

Ovaries and uterus grow proportionally to the gilts growth

11-20 wks

Vesicular follicles appear

Increased number of >3mm follicles after 15-16 wks

Prepuberty

Number/size of follicles remains constant

Ovaries and uterus weight stay unchanged until 1 week prior first estrus

---

Gestation:

1. Feed in early gestation
2. Movements in early gestation
3. Late gestation immunization

Birth-10 wks:

1. Scours control and treatment
2. Weaning older (?)/select suboptimal ones out.
3. Avoid overcrowding
4. Hooves integrity

11-20 wks:

1. Selection
2. Lameness treatment

Prepuberty:

1. Boar exposure and heat induction
2. Stall acclimation and full feed >15 d
3. 3 wks from last vaccine

PIC®

Anatomical Changes

- **Puberty** – It is the phase that starts with the first estrus. This occurs when gilts reach a certain stage of physiological maturation to support successful reproduction.

Category	Age(d)	Uterus weight (g)	Uterus eco area (cm2)
Infantile	181	46	3.5
Impubertal	182	121	13
Prepubertal	184	291	30
Puberty	185	359	41

- **Uterus weight and area** - Highly correlated (R2 = 0.92)

Common Gaps

Man-Power

- **Understaffing** - When understaffed, puberty management is, too often, the first casualty.
  - Do the farms know what are the man-hours needed to do a world-class job.
  - Work load in a stocking (5x).

- **Even if fully staffed** – Trained vs. untrained staff; motivated vs. unmotivated staff.

- **Weekends** – Still an opportunity in many places… if unable to do boar exposure, how feasible is to feed altrenogest individually?

Never Stop Improving *Nutrition.*

PIC®

Common Gaps

Man-Power

- **Understaffing** - When understaffed, puberty management is, too often, the first casualty.
  - Do the farms know what are the man-hours needed to do a world-class job.
  - Work load in a stocking (5x).

- **Even if fully staffed** – Trained vs. untrained staff; motivated vs. unmotivated staff.

- **Weekends** – Still an opportunity in many places… if unable to do boar exposure, how feasible is to feed altrenogest individually?

Common Gaps

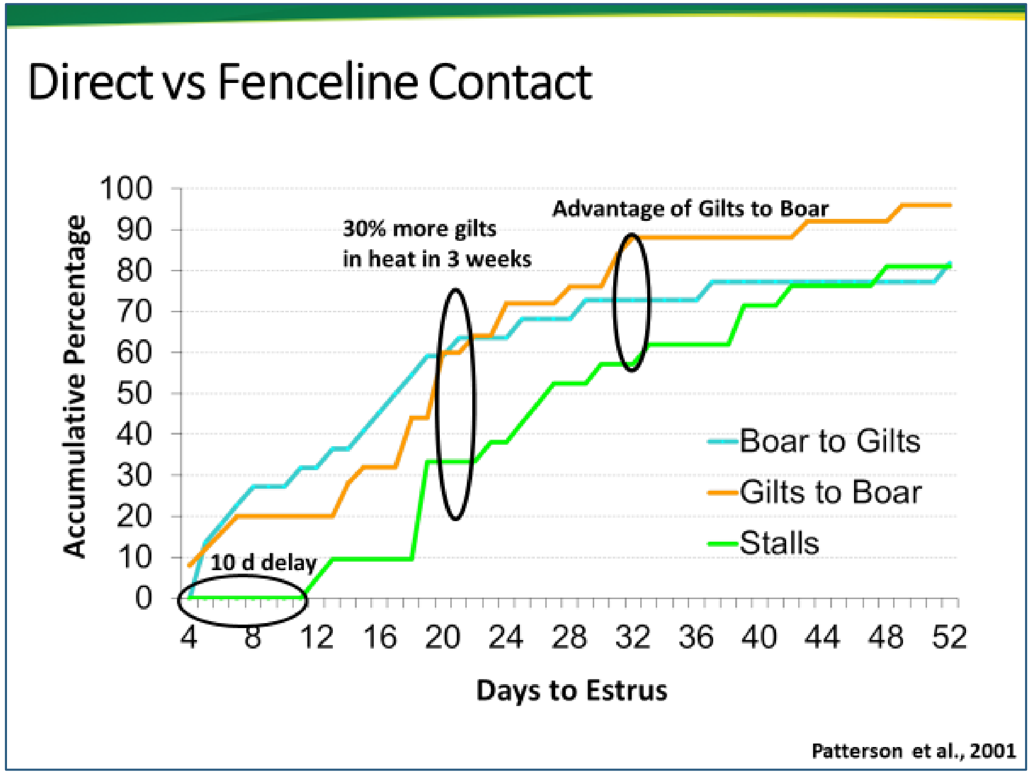
Boar-Power

- Check your heat checking boars.
  - Number of boars.
  - Age.
  - Body condition.
  - Feet status.
  - Libido.
- Fence-line boar exposure is not as effective as direct exposure (nose-to-nose contact inside the pen).
- Heat detecting boars replacement.

Common Gaps

People and Boars Interface

- **Good execution** – Based on 5 interlinked columns: Boar exposure, heat induction, heat detection and heat recording, 7 days a week.
  - Fence contact is not what it takes.



Common Gaps

Factors Explaining Variations in Gilt Response to Boars

Never Stop Improving *Nutrition.*

- **Stimulus value of the boar(s)** - Reciprocal response from gilts promotes boar courtship behavior and saliva production.
- **Amount of physical gilts to boar interaction** - Tactile, auditory, olfactory and even visual are additive/synergistic to pheromones.
- **Duration and frequency of boar exposure**

PIC®

Common Gaps

Bodyweight and Feed

Never Stop Improving Nutrition.

- **Current recommendation**
  - No individual gilts bred below 300 lbs.
  - >90% of gilts should be bred in the 300 to 350 lbs range.

- **PICpro100** - Proprietary information representing a 1.2m sow base and 480 farms.

  - Believe it o not - Feeding cost and feeding strategies repercussions are both poorly appreciated by production people.

  - Body weight (actual or estimated) - Essentially unknown.

PIC

For Your Consideration

Never
Stop
Improving
Nutrition.

- **GDU should be similar in status to farrowing and B&G**
  - The dilemma between urgent needs vs. important needs is alive and well.
  - It is hard to conceive a long term behavioral change when GDU is perceived, by many, as too simple and/or too mechanical.

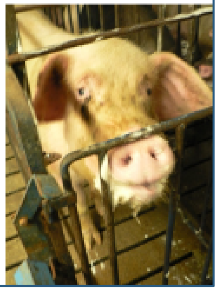
PIC®

For Your Consideration

- **Help the gilts to better express heat**
  - Provide direct boar exposure inside the pen instead of fence line exposure.

Key components of puberty stimulation

- **The Boar – The most potent stimulus of pubertal onset in gilts.**
  - Boar libido is a critical factor influencing puberty attainment in gilts.
  - Multiple, daily, exposures to a rotation of mature boars maximize the response to this component of the "boar effect".
- **Direct boar contact is better than fenceline contact**
- **Taking the gilts to the boars is more effective compared to taking the boar to the gilts pen**



Courtesy of Jennifer Patterson
University of Alberta

For Your Consideration

Never Stop Improving *Nutrition.*

- **Help the gilts to better express heat**
  - Minimize the prevalence of refractory gilts and maximize their response to the boar
  - A tough pill to swallow but worth the try:
    - Allocate man and boar-power to get the job done in 120 minutes or less, without compromising the time/gilt needed.

PIC®

For Your Consideration

Never Stop Improving *Nutrition.*

- **Help the boars to do their job**
  - Heat detecting boars should not work longer than continuous 60 minutes.
  - Keep boars in the thin side.
  - Maintain boar feet health.
  - Maintain their libido.

PIC®

For Your Consideration

Never
Stop
Improving
Nutrition.

- **Help the boars to do their job**
  - Support young boars effect: In stockings, perhaps the use of pheromones could help
  - Heat detecting boars replacement: Have a documented and known annual replacement plan.

PIC®

For Your Consideration

Never
Stop
Improving
Nutrition.

- **Help the boars to do their job**
  - Proactively estimate the boar needs. For instance, a 5.600 sow unit would require:
    - Stockings: Min 18
    - 65% RR: Min 4.
    - 45% RR: Min 3.

  - Size (volume) matters. A 1,200 sow unit need 1 boar per 80 gilts to expose vs. 1 to 120 in a 5,600 one.
    - Layout also can affect the ratio and the need to work with pen-mates boars.

PIC®

For Your Consideration

- **Know the actual weight at first breeding** – It will optimize gilt COP, allow feed adjustments and avoid long term detrimental consequences.

- It typically cost $15/year/inventoried sow to postpone first breeding by 21 days.

In Closing

- **Opportunity size** - Your current performance vs. 16 TB.
- **Resources needed** – People, boars, records.
- **Information** - True gilt weight at first breeding.
- **Feeding** - Strategy and opportunities.
- **Biology?** - Perhaps we have to break a paradigm.

Body condition management

2018 PIC Nutrition Seminar

August 21 & 23, 2018

Dr. Mark Knauer

NCSU Swine Extension Specialist

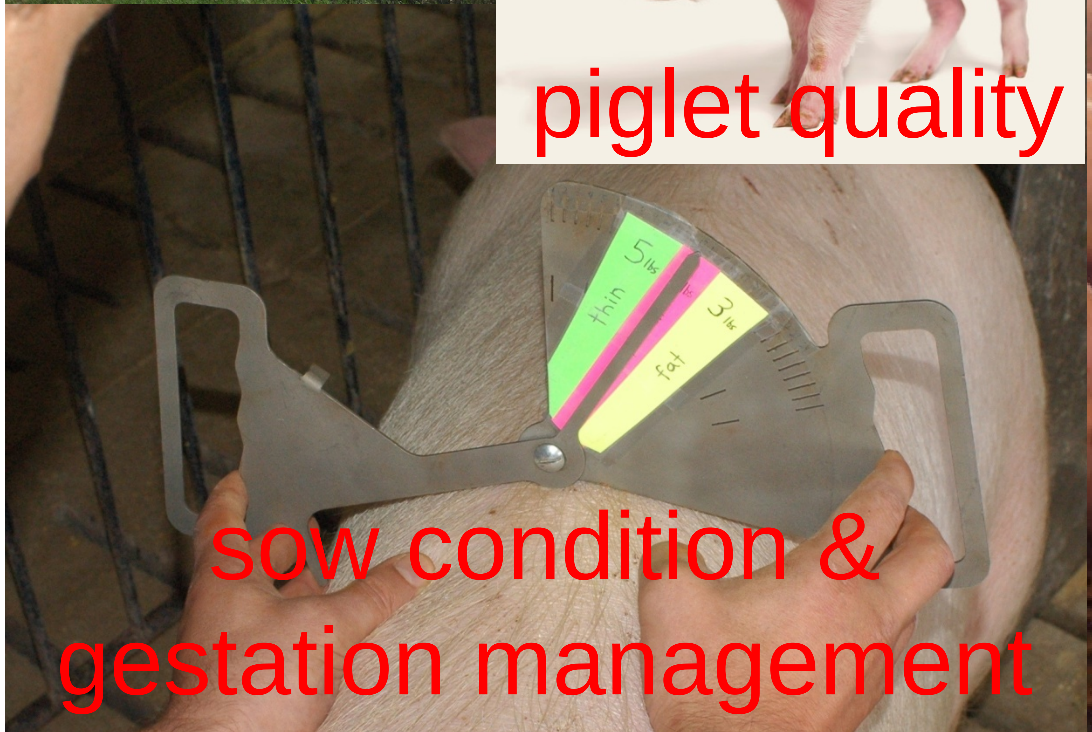
NC State Swine Extension

North Carolina State University - Swine Extension Specialist

- Focus
  - Swine genetics and production management
- Appointment
  - 70% extension
  - 30% research
- Start date – July 2011

Applied research

Basic research



New – Summer 2018

Outline

- Thin & fat sows reduce $
- Objective sow condition tools
- What is ideal sow body condition?
- Summary

Thin & fat sows reduce profit

Thin

Fat

Impaired reproduction

Well-being concerns

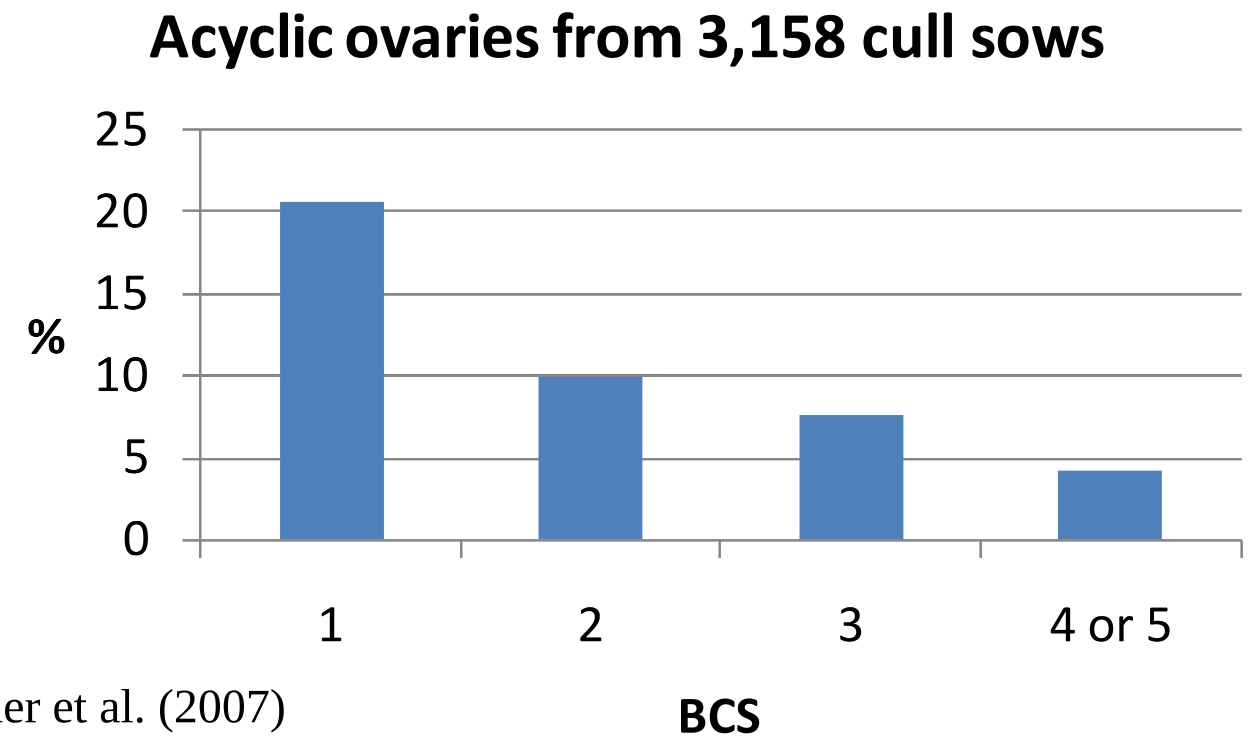
High feed costs

Farrowing problems

Increased preweaning mortality

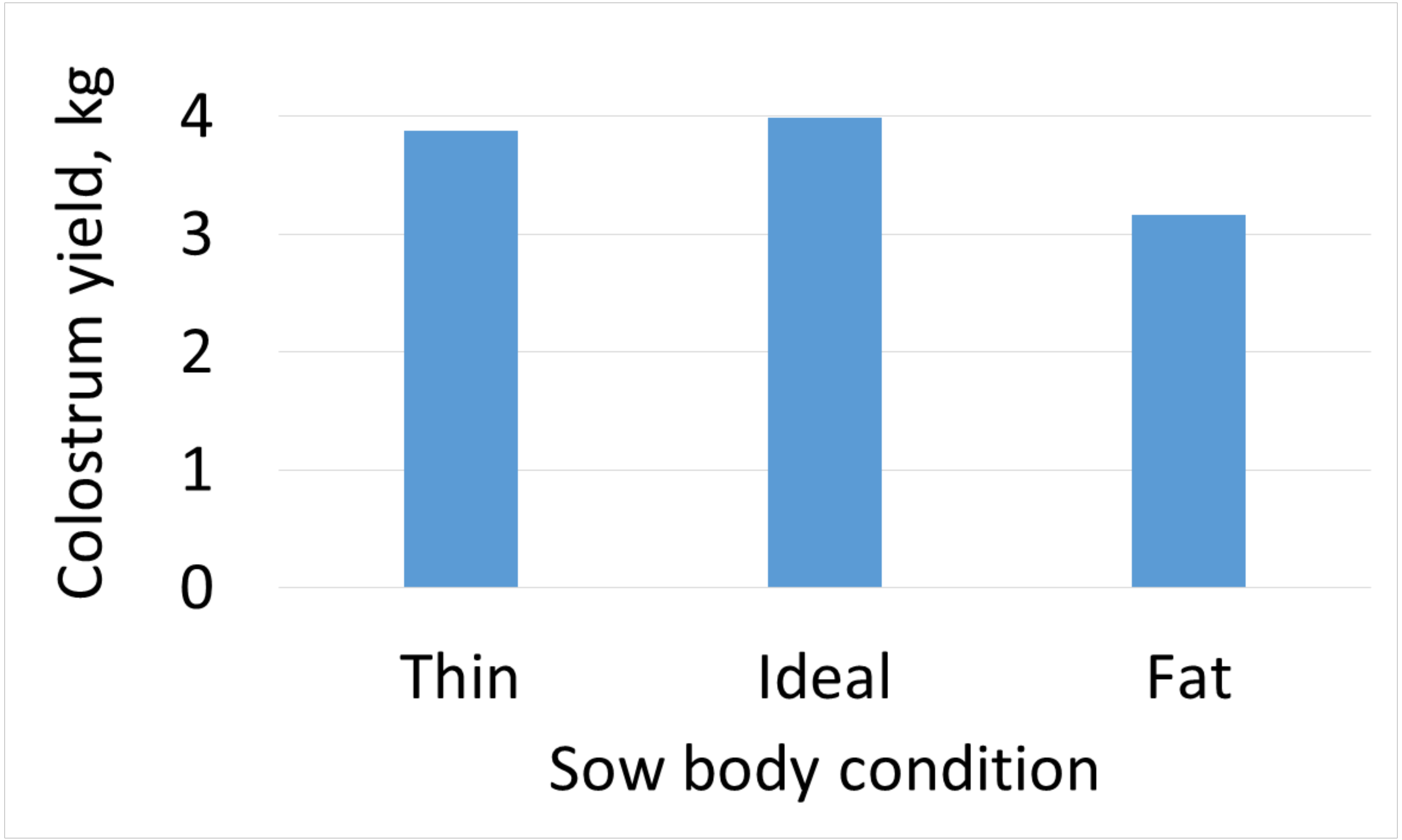
Thin sows – impaired reproduction

- Sows that are too thin
  - Reduced farrowing rate
  - Less likely to exhibit estrus



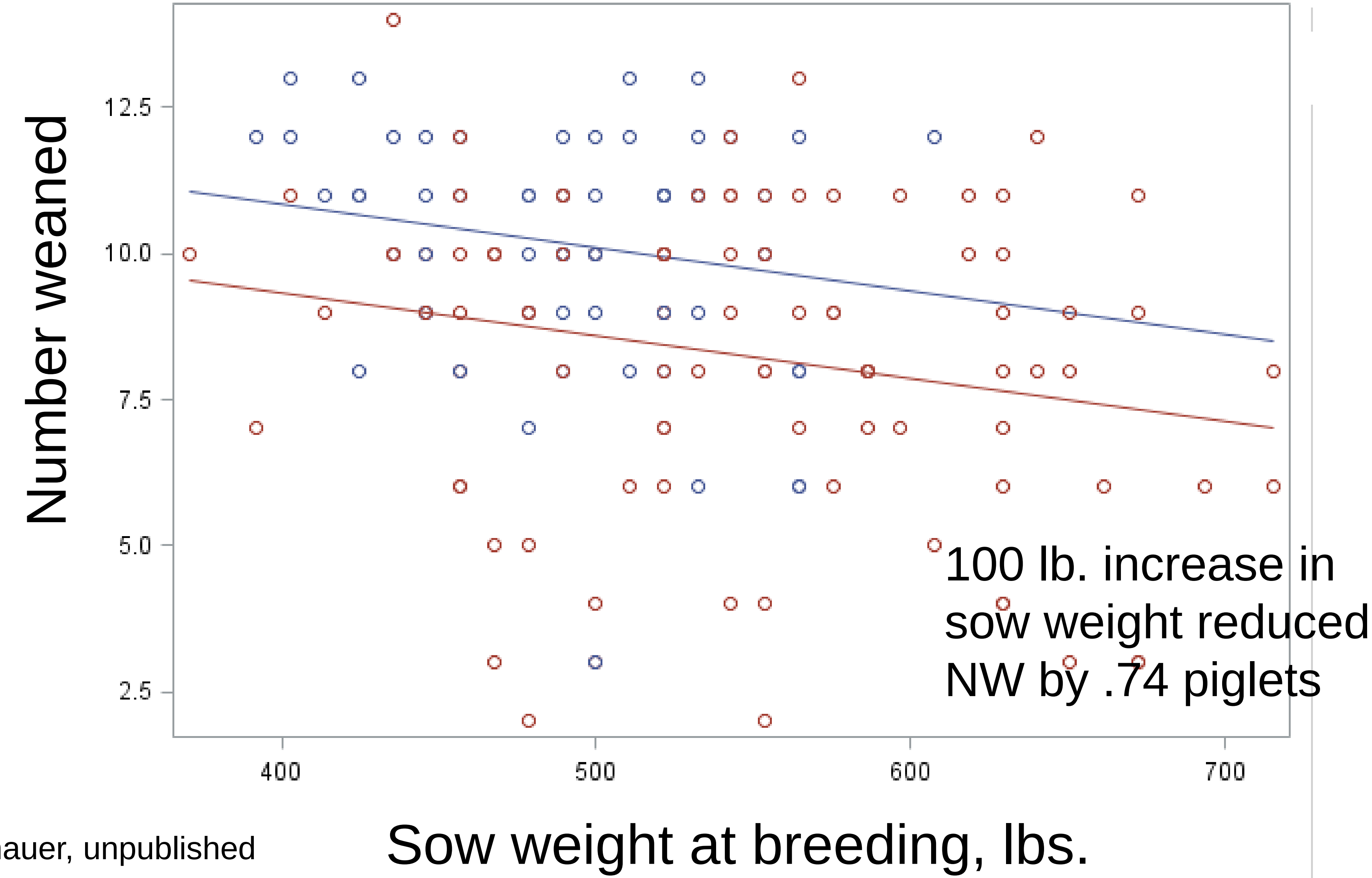
Knauer et al. (2007)

Over conditioned sows produce less colostrum



Decaluwé et al. (2014)

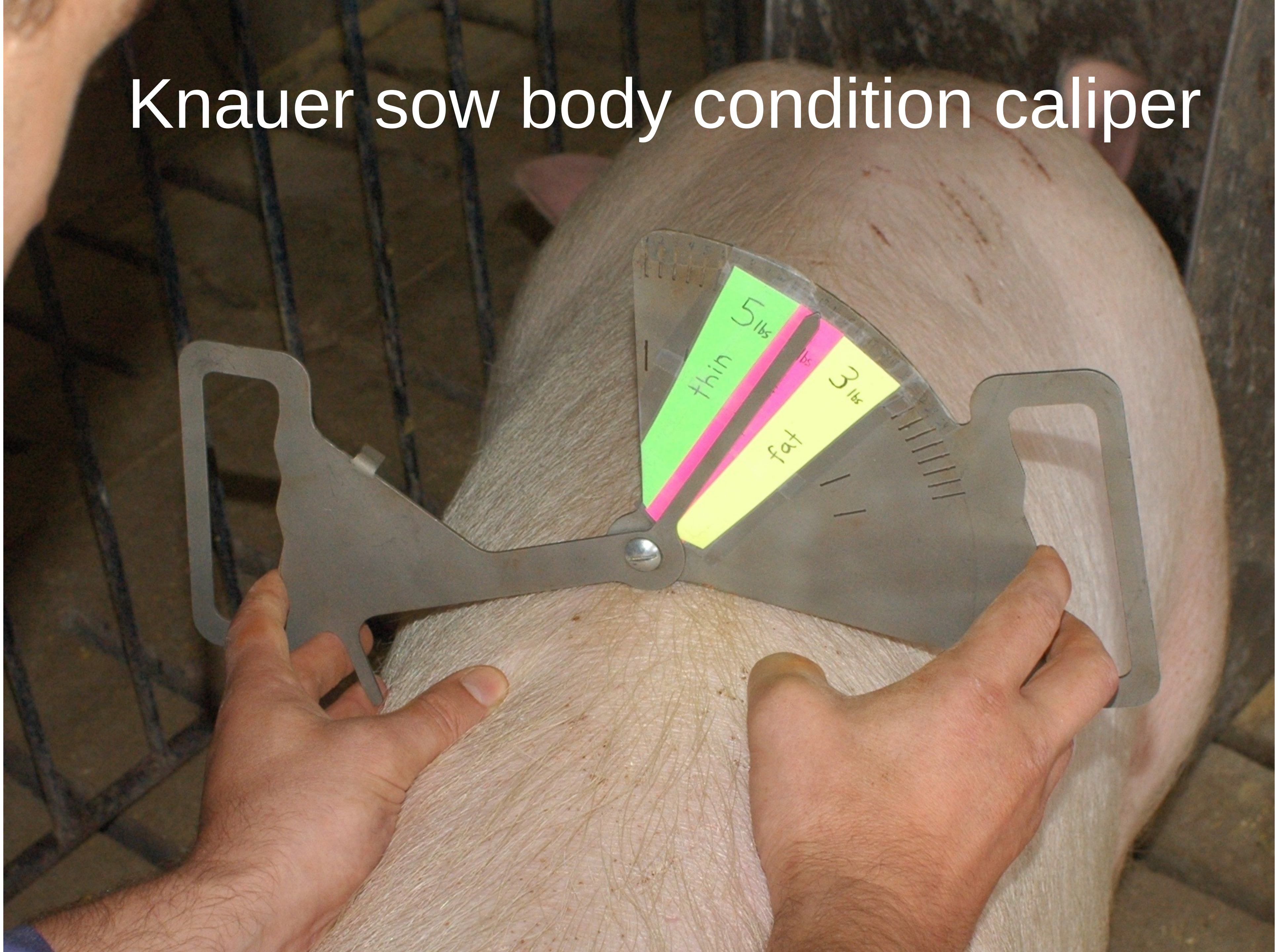
Heavy sows wean fewer piglets



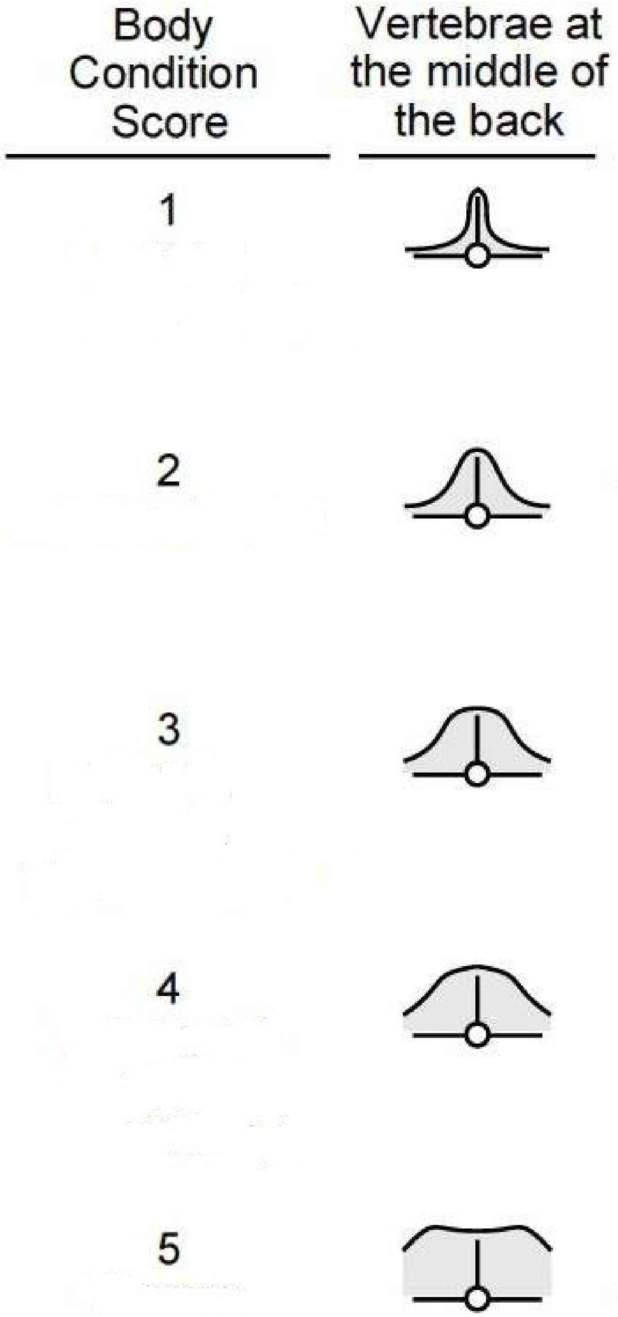
Knauer, unpublished

Objective sow condition tools

Knauer sow body condition caliper

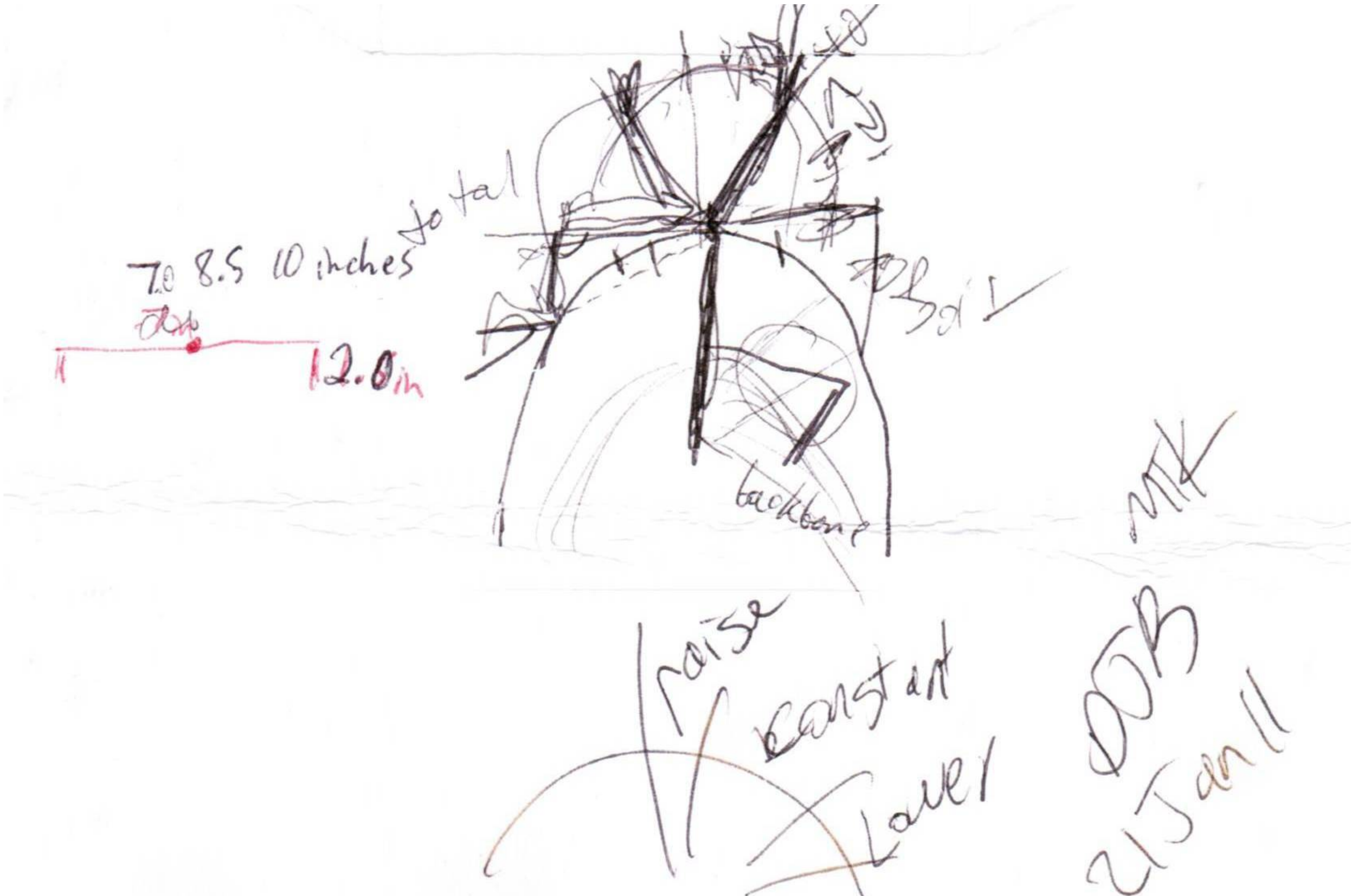


The concept…



Adapted from Edmonson et al. (1989)

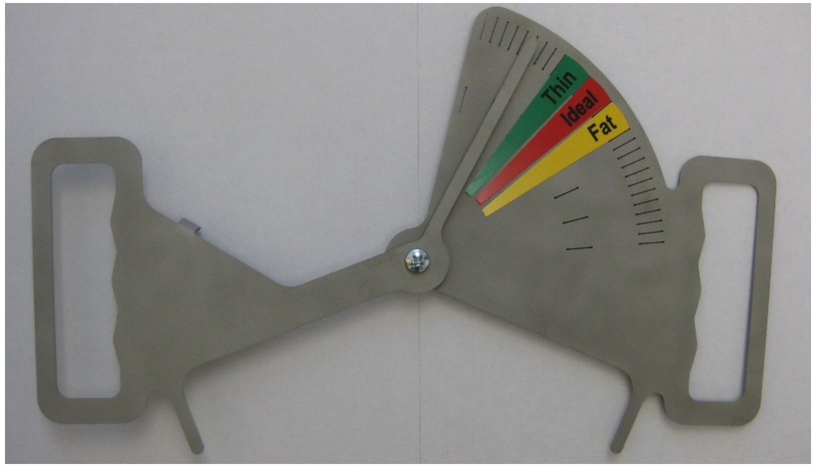
Knauer sow body condition caliper



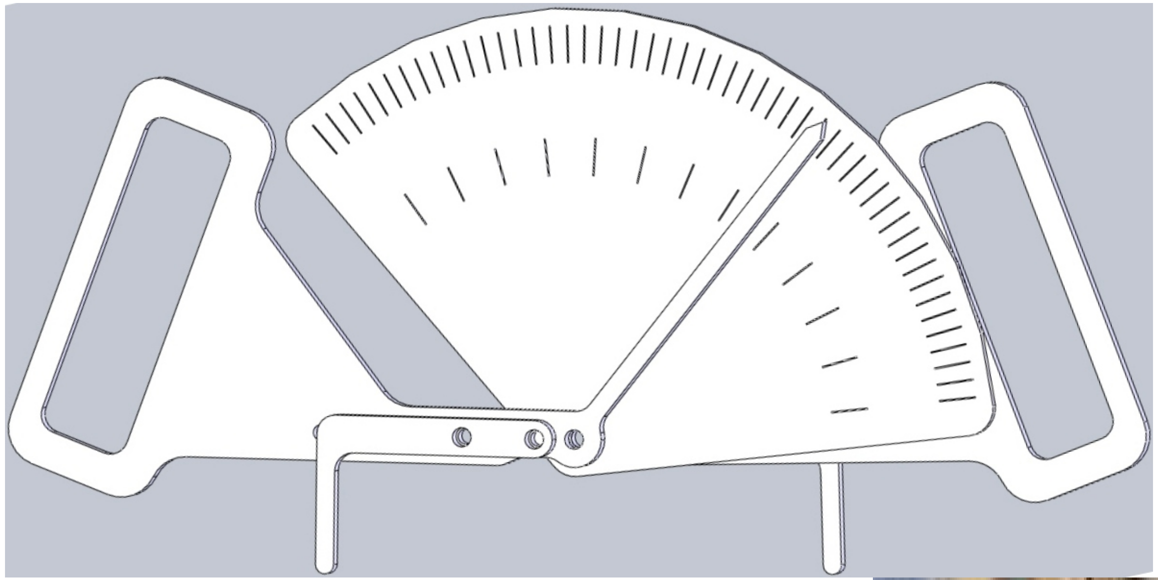
Knauer sow body condition caliper

×

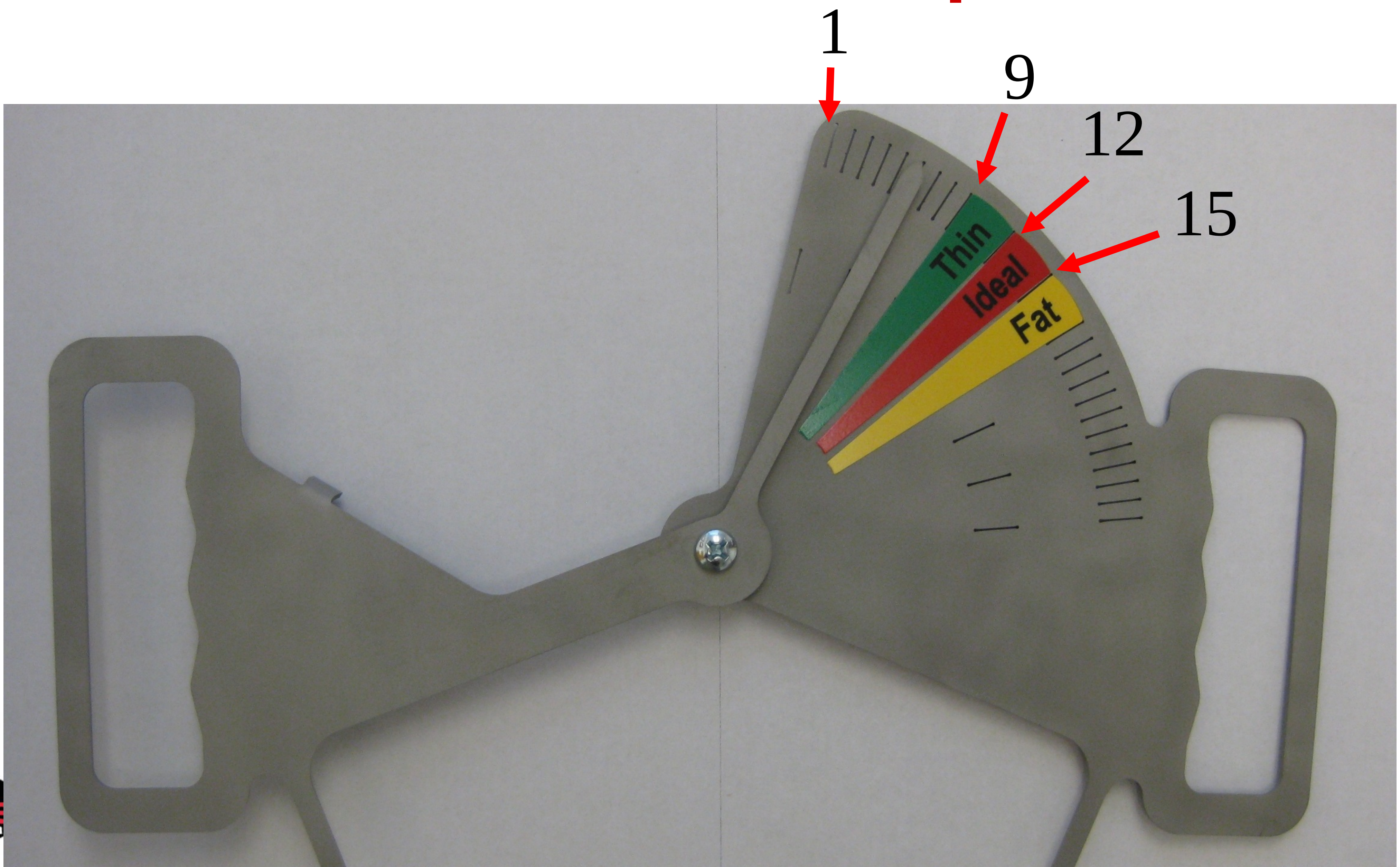
=



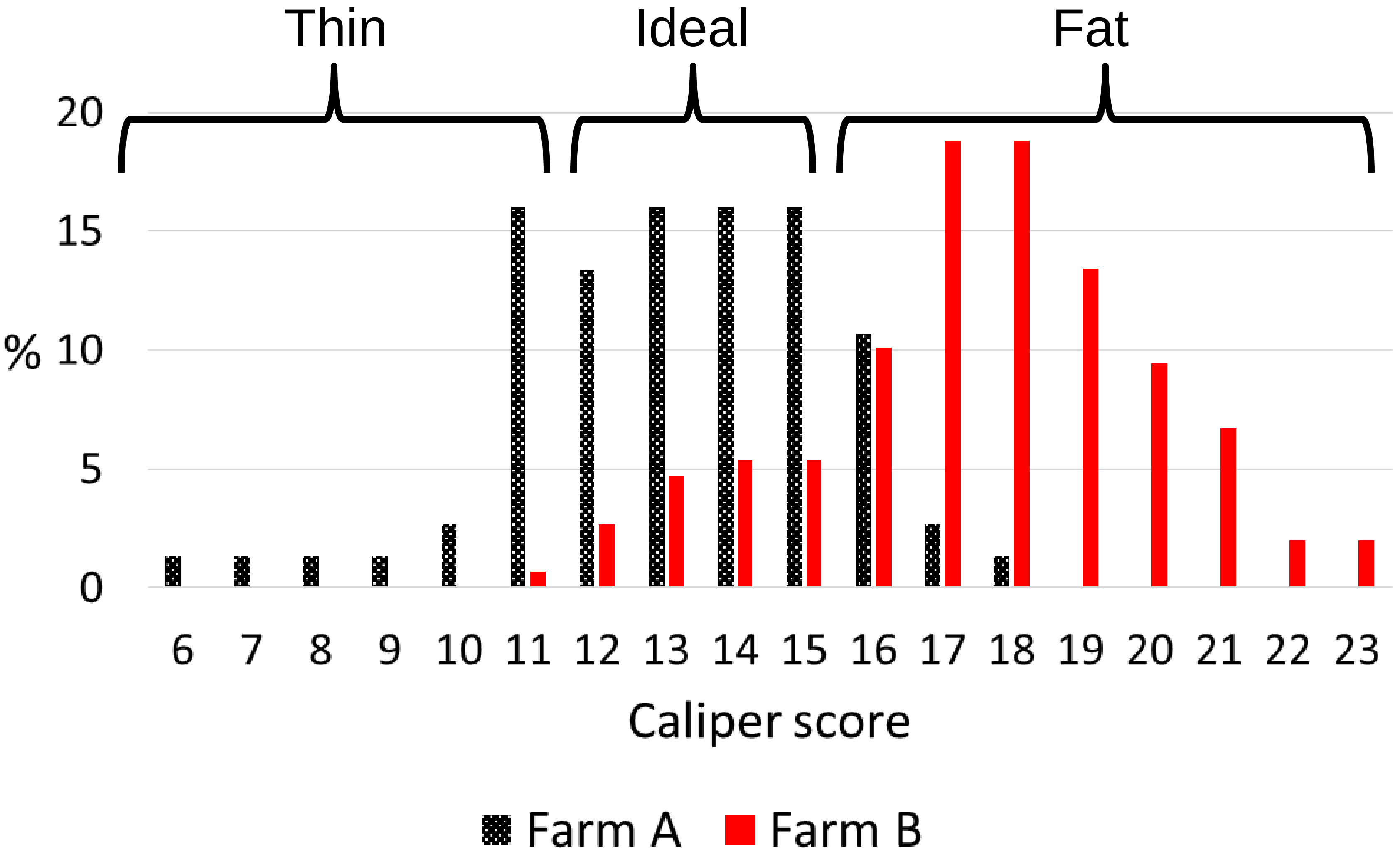
Knauer sow caliper - prototypes



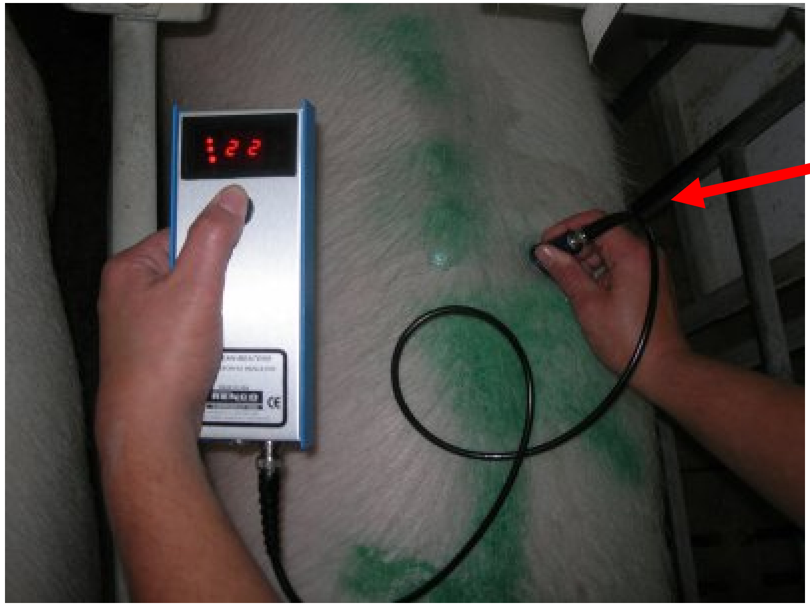
Knauer sow caliper



Validating problems with visual BCS

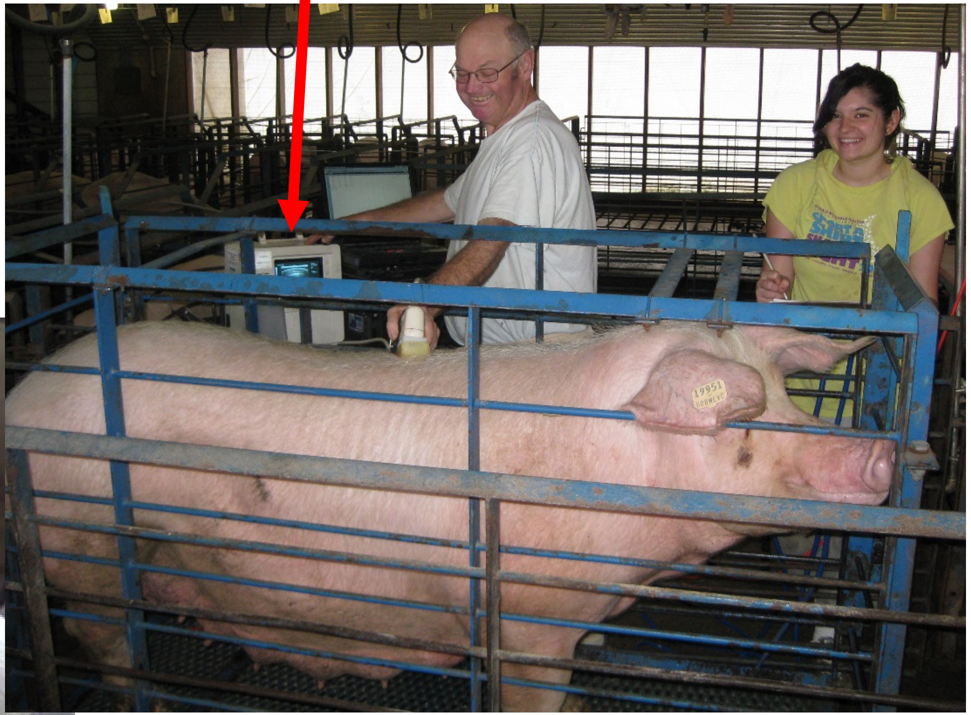


Objective backfat and weight tools



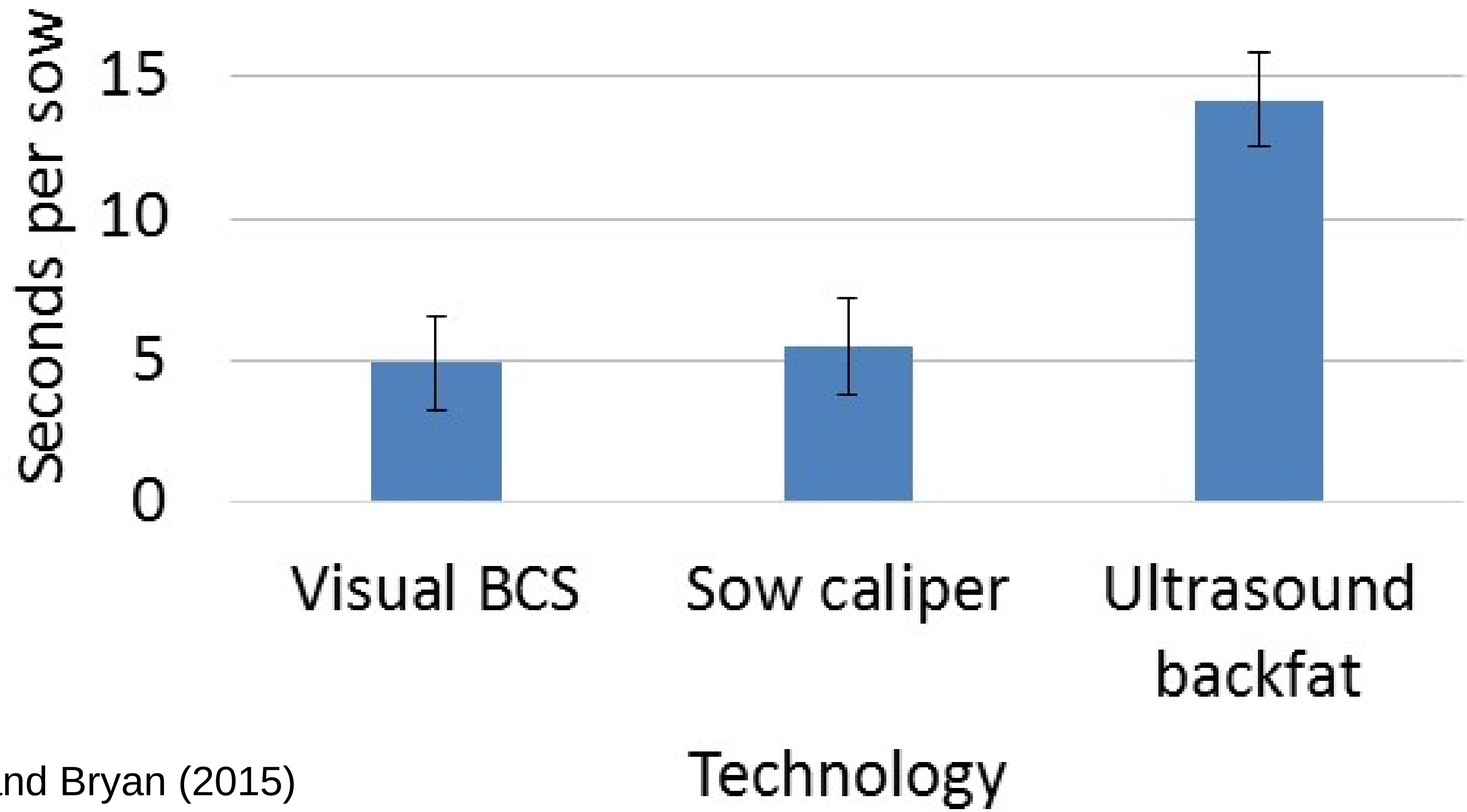
A-mode ultrasound

B-mode ultrasound



Weight

BCS labor requirements



Knauer and Bryan (2015)

What is ideal sow body condition?

Study A – Define ideal body condition in relation to reproduction

- Miranda Bryan Thesis
- Commercial sow farm in eastern NC
- August 2012 - May 2013
- 1,500 whiteline sows
- Multiparous

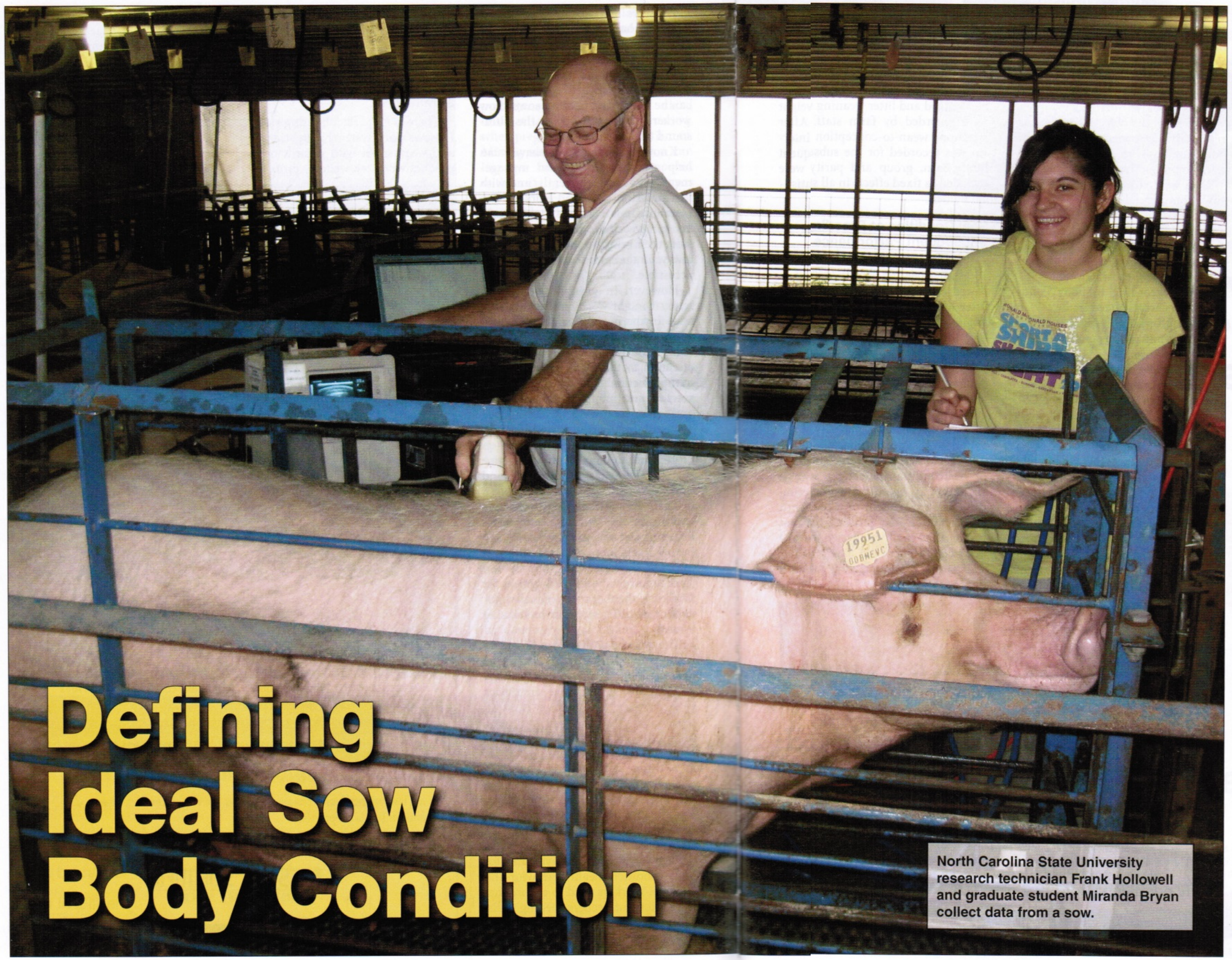


PHOTO BY MARK KNAUER

Defining Ideal Sow Body Condition

North Carolina State University research technician Frank Hollowell and graduate student Miranda Bryan collect data from a sow.

By Mark Knauer, North Carolina State University

Maintaining optimal sow body condition is an important strategy to maximize animal well-being and sow lifetime productivity. Most commercial producers feed gestating sows based on a visual (subjective) measure of body condition. However, the majority of barn workers, farm managers and service people are not highly trained in estimating body composition.

Further compounding problems with visual sow body condition scoring is the fact that the perceived ideal target for sow body condition varies among individuals.

Recently, North Carolina State University (NCSU) research validated sizeable variation in sow body condition between farms within the same production system using the same genetics, diets and housing (see *nationalhogfarmer.com/health/sow-body-condition-caliper-guides-feeding*). The only difference between farms was the people adjusting the feed-drop boxes. These results suggest fast and accurate sow body condition tools would allow for needed standardization across farms.

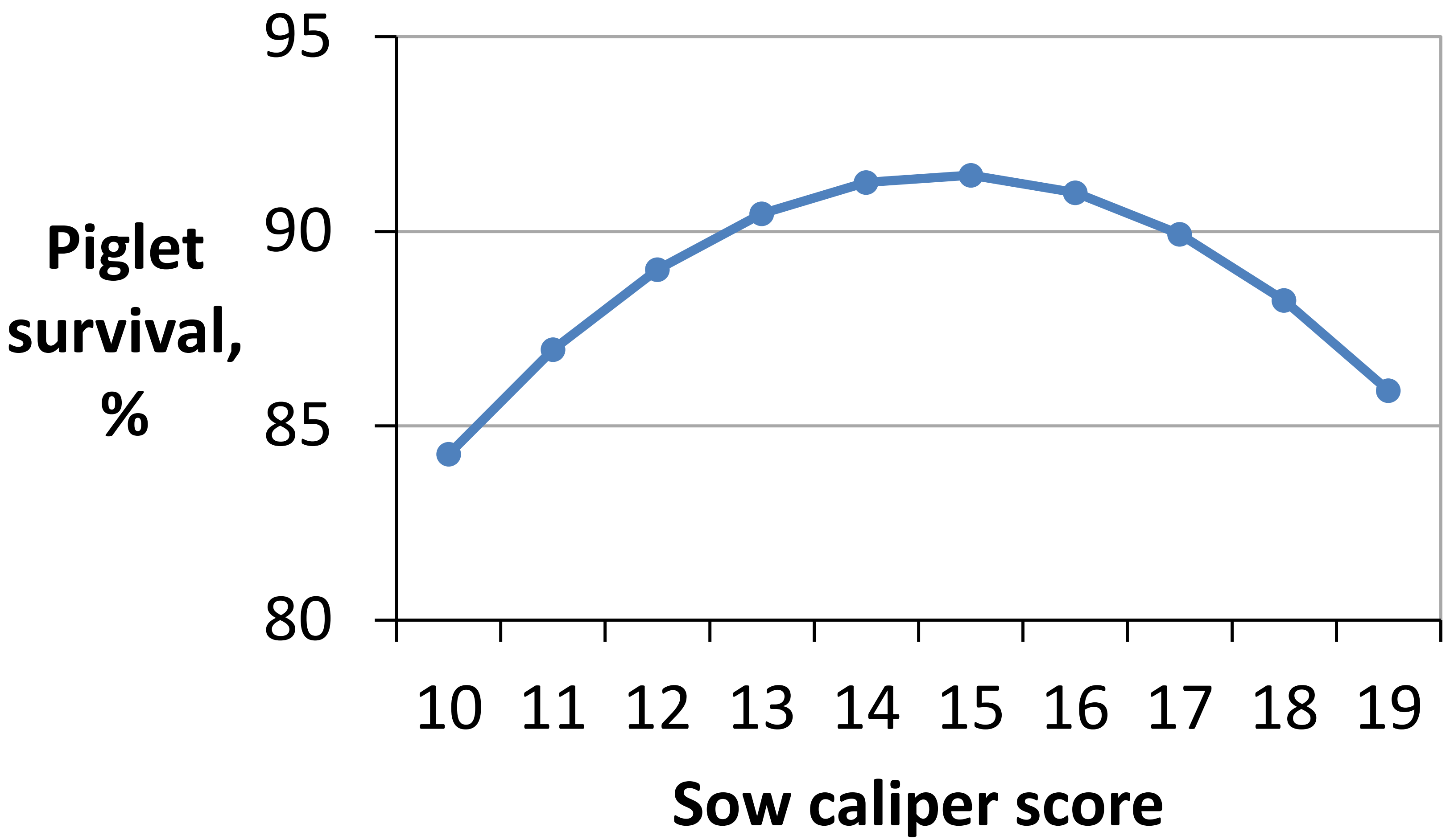
Sow body condition is a composite trait of weight, backfat and muscling. This statement is supported by research results from several studies. In the past, many researchers and producers have used backfat as an objective measure of sow body condition. Backfat measurements can be a decent indicator of body condition. However, backfat is a poor indicator of muscling, an important component trait of body condition. Perhaps objective measurements of sow body condition should account for both backfat and muscling.

Surprisingly few studies have tried to identify the optimal sow body condition in relation to subsequent reproductive performance. Past research indicates a threshold level of body reserves is needed for reproduction. If sows lose greater than 16% of their muscle mass during lactation, subsequent reproductive performance declines. However, on today's commercial farms, determining loss of muscle mass during lactation may not

Sow housing

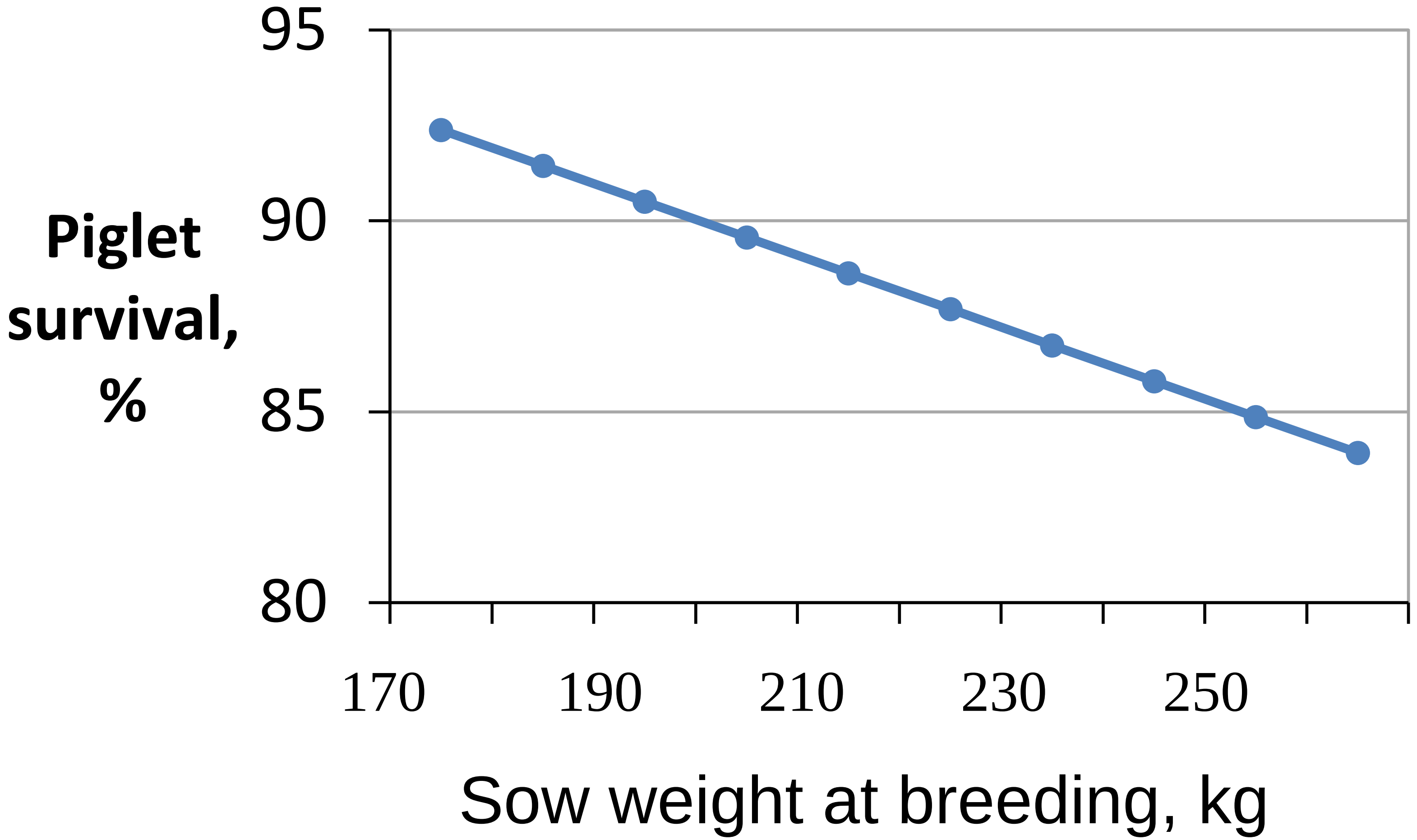
- Stalls
  - Weaning to ~35 days
- Pens
  - 35 days to farrowing
  - 2.4 × 3.0 m
  - 4 to 5 sows per pen

Optimum caliper score for piglet survival



Bryan (2014)

Lighter sows had greater piglet survival



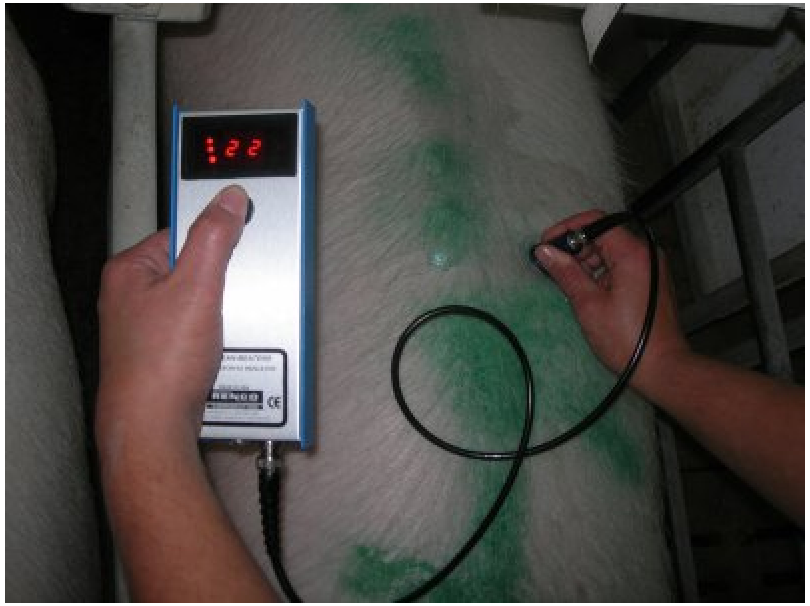
Bryan (2014)

Parity $p>0.05$

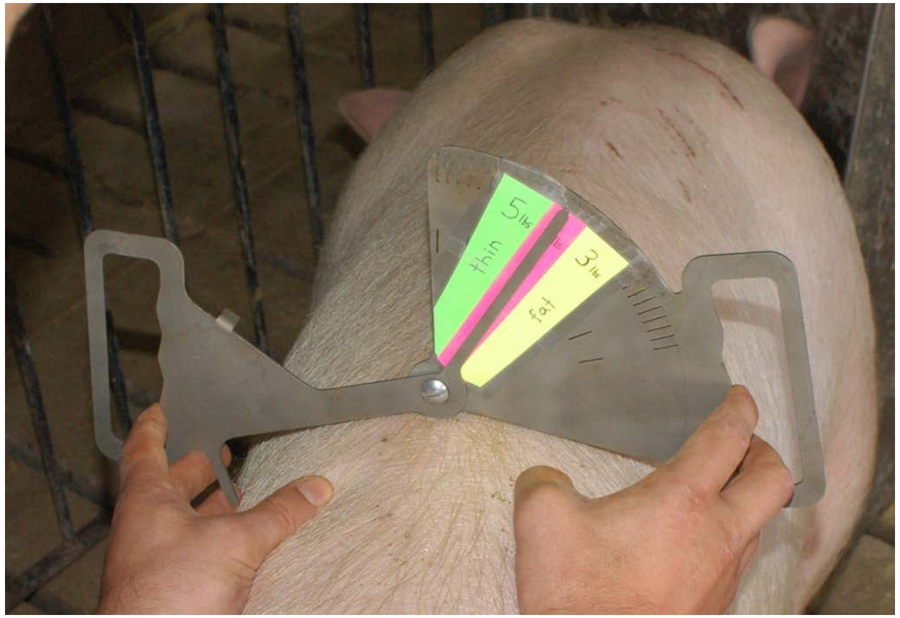
Study B – Define ideal body condition change in relation to reproduction

- Commercial sow farm in eastern NC
  - 885 sows
  - 250 gilts
- Landrace x Large White
- February to August, 2013

Traits measured



Ultrasound backfat



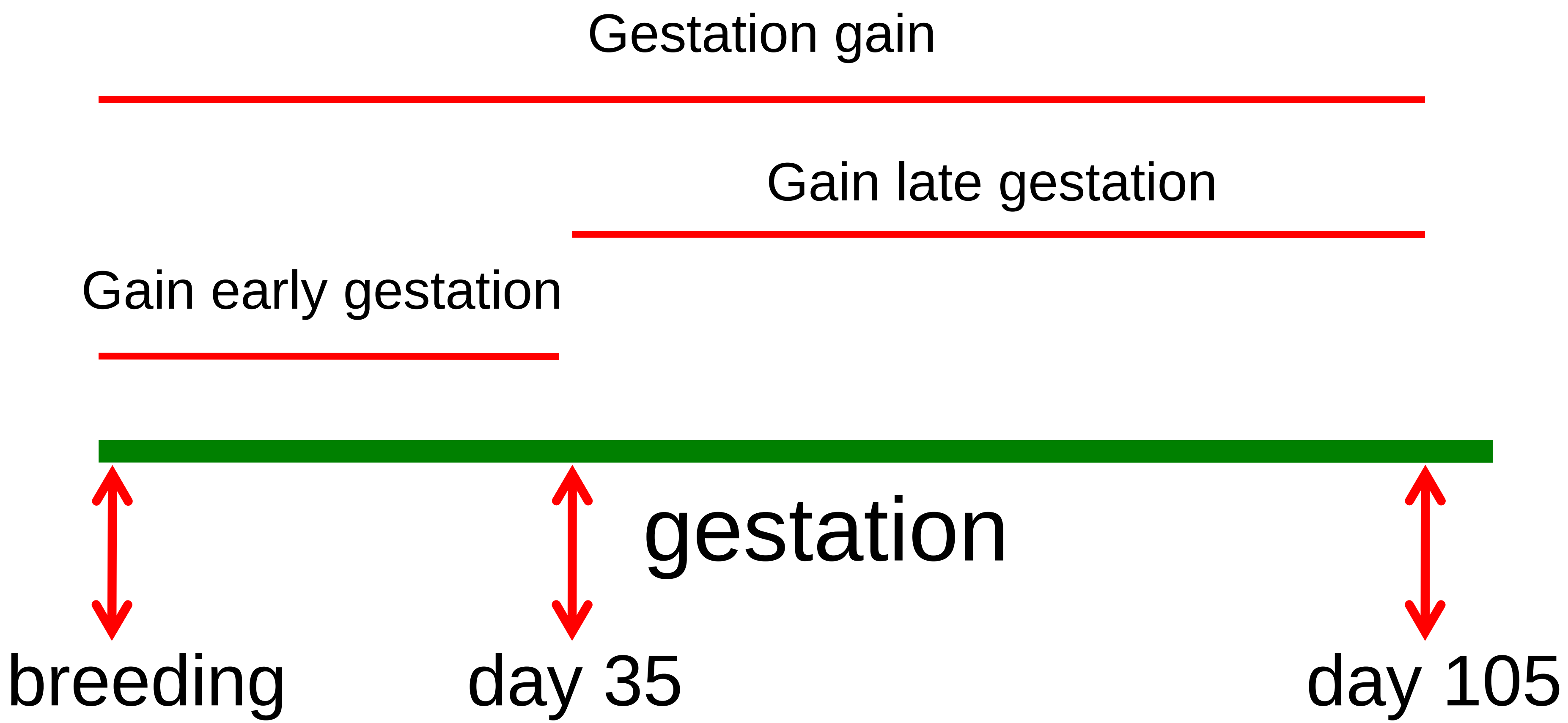
Sow caliper

2 3 4

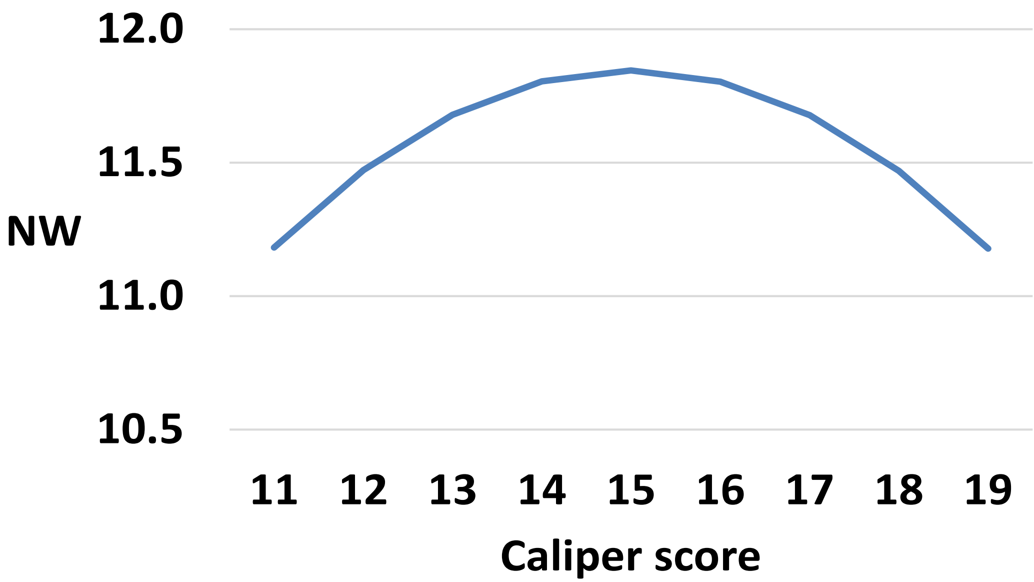
Farm body condition score

Heart girth (gilts)

Backfat, BCS, caliper and gilt weight traits

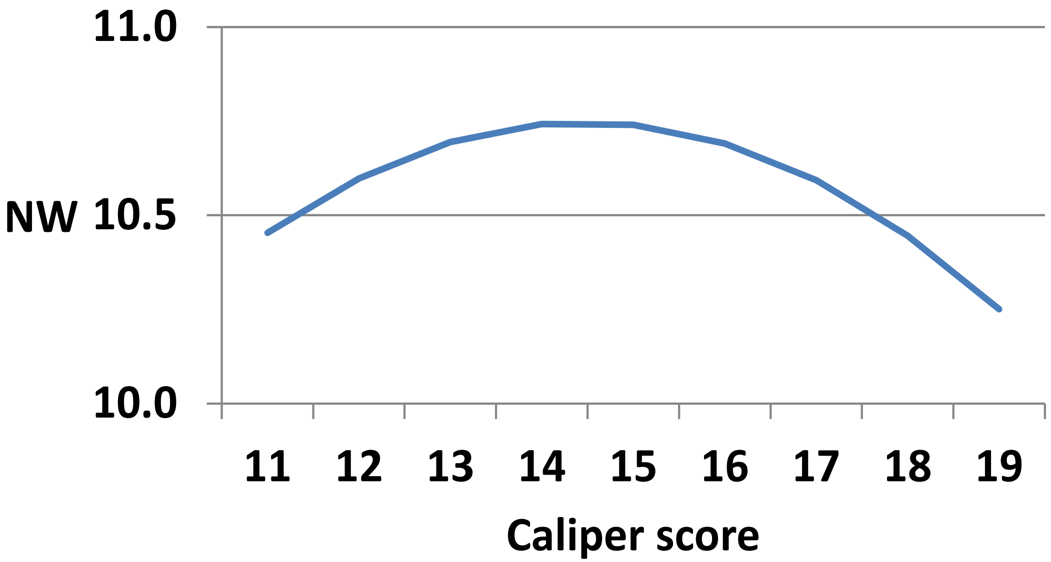


Identifying "ideal" sow body condition

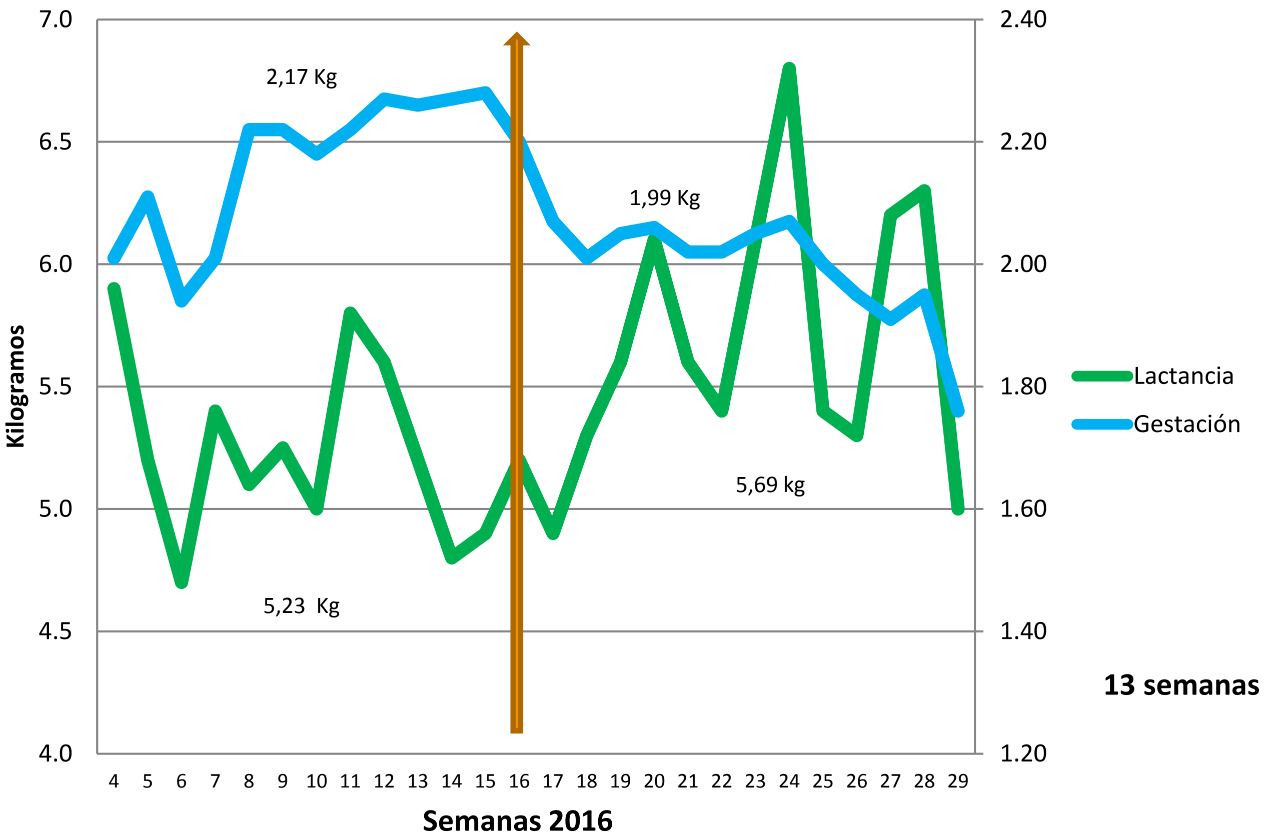


Study A

Study B



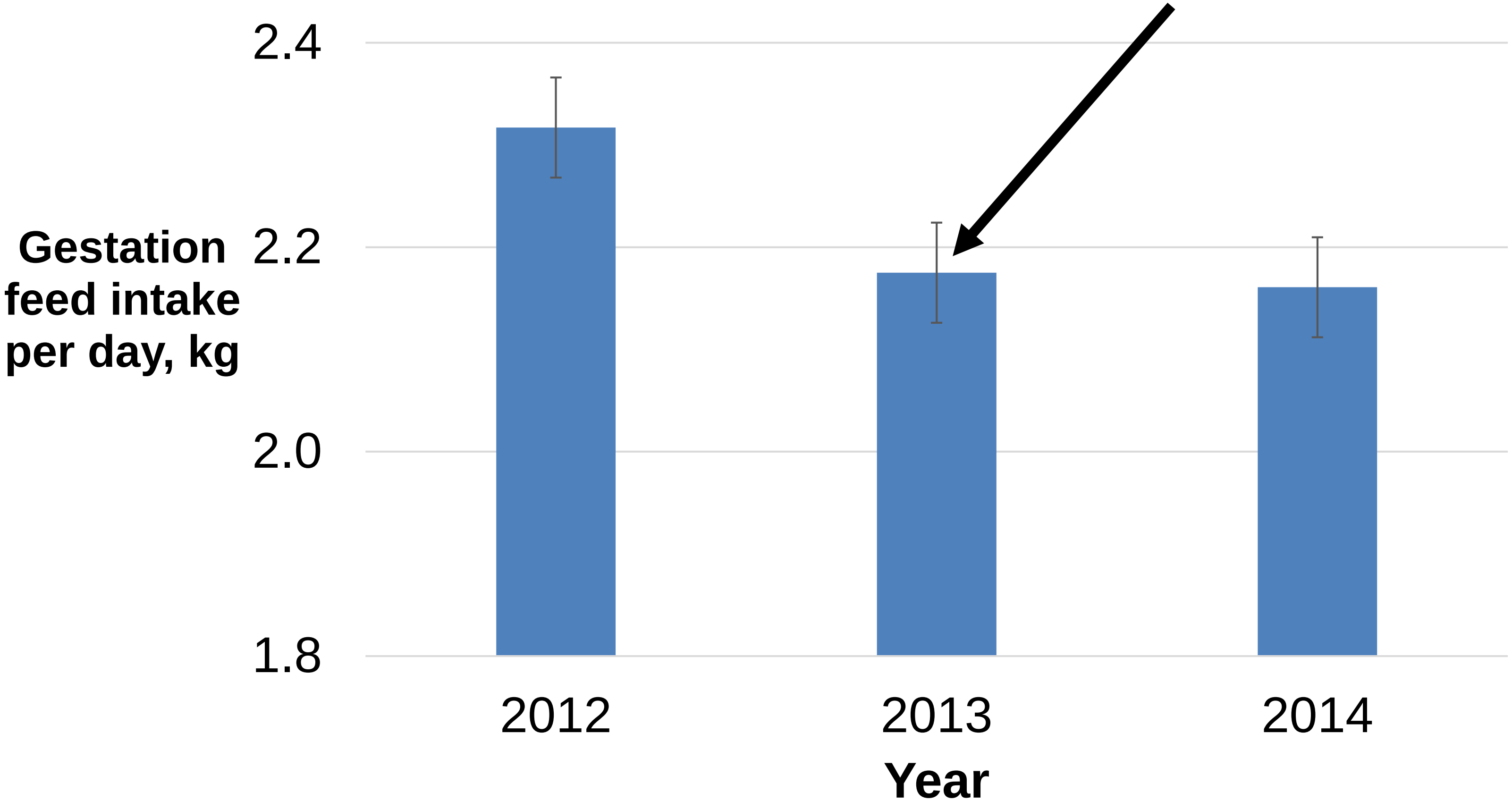
GRÁFICA DE COMPORTAMIENTO DEL CONSUMO DE ALIMENTO GESTACIÓN Y LACTANCIA SEMANALMENTE DE ACUERDO A CAMBIO EN EL PLAN DE ALIMENTACIÓN DE ACUERDO A LA EVALUACIÓN DE CONDICIÓN CORPORAL CON EL PRECISOR



13 semanas evaluadas

18,000 NC system - implementation of sow caliper 2013

savings of $285,000, $15.82 per sow (U.S.)



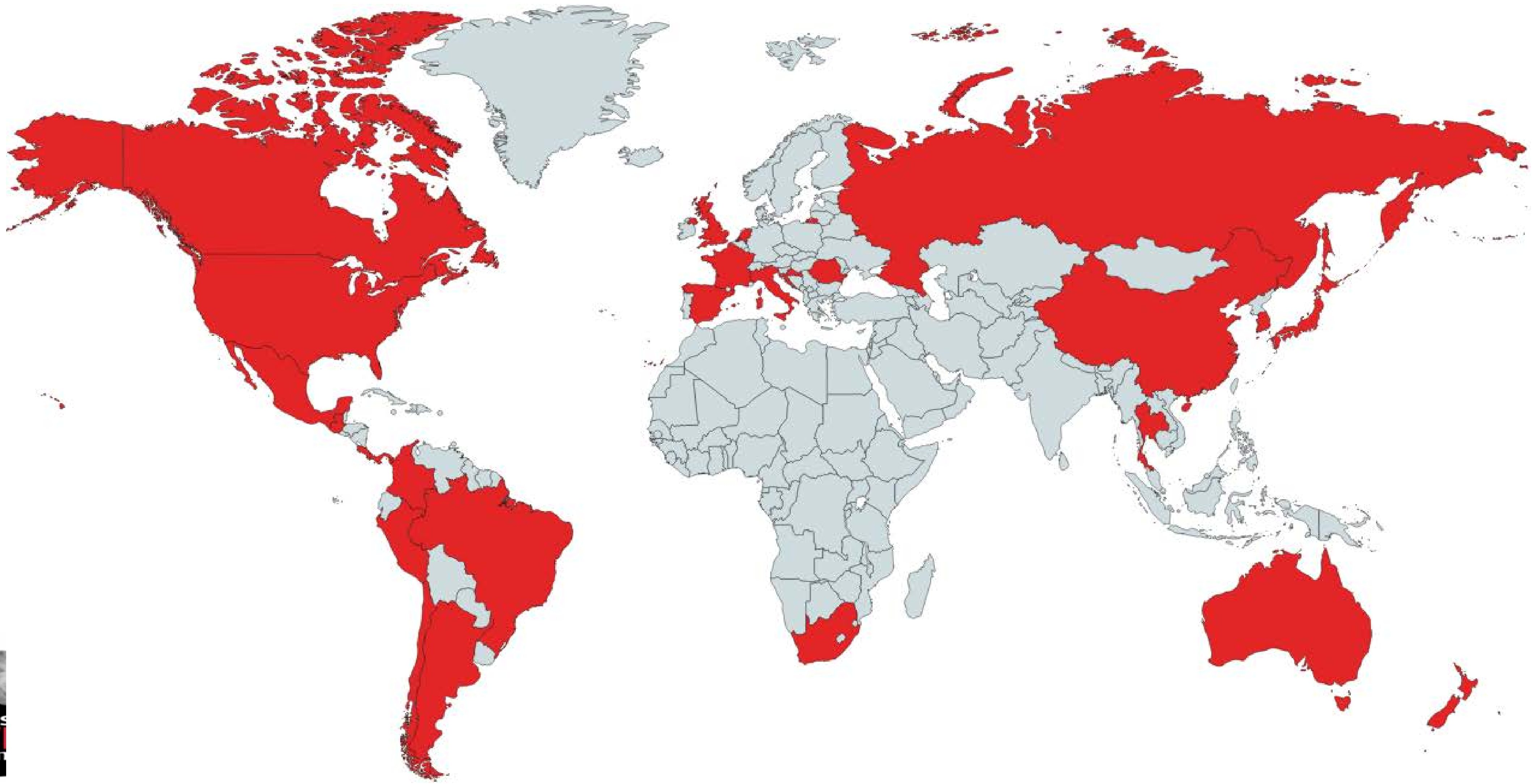
8 farms – 18,000 sows

Summary

- Available BCS tools (sow caliper) eliminates the excuse for sows not in proper BC

- Sow body condition caliper – works & being adopted worldwide
  - 26 countries throughout the world
  - 25 states within U.S.

Sow body condition caliper – adopted worldwide

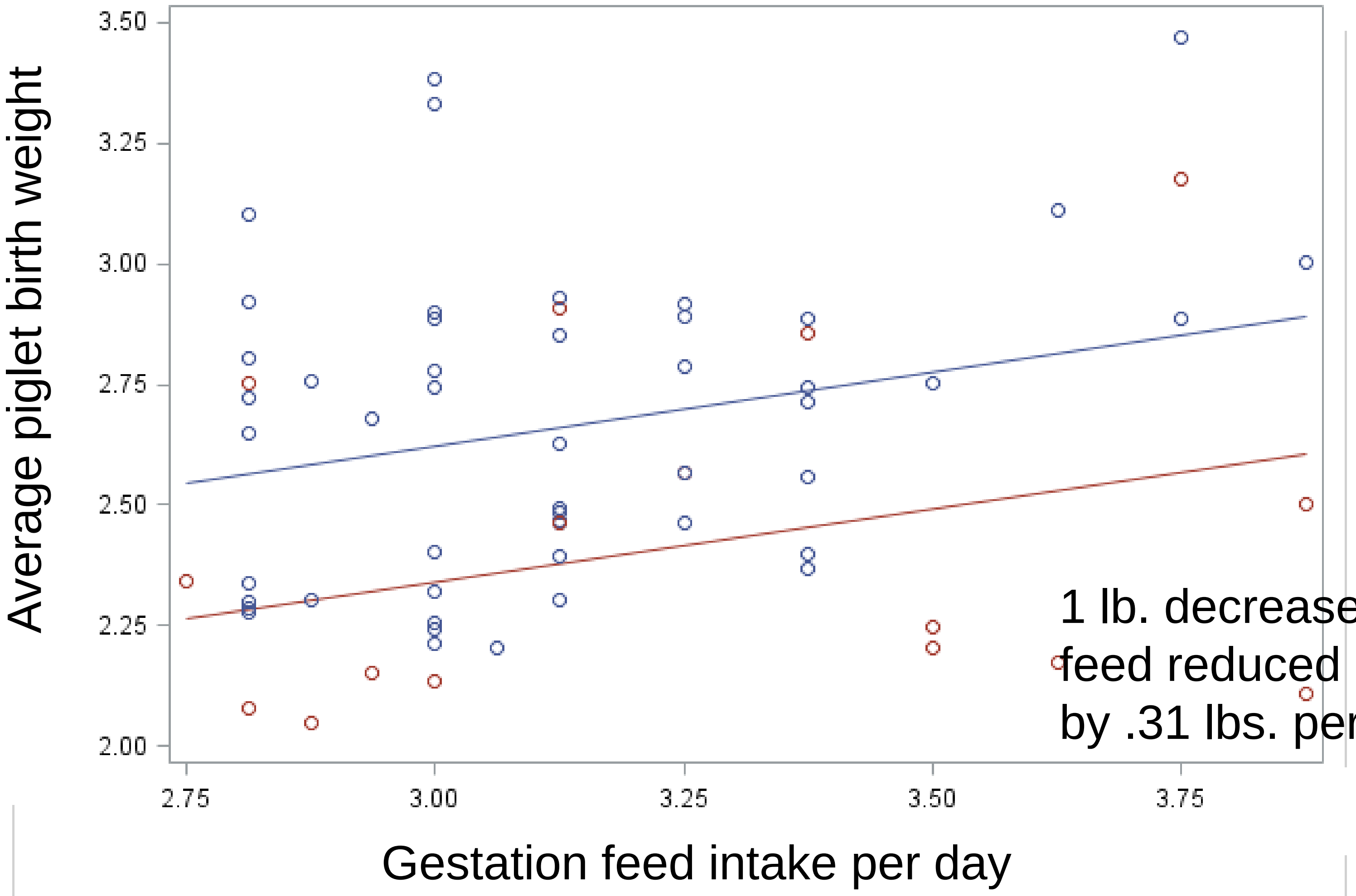


Thank you for your time

Mark Knauer
mtknauer@gmail.com

Do not feed below maintenance requirements

Knauer, unpublished

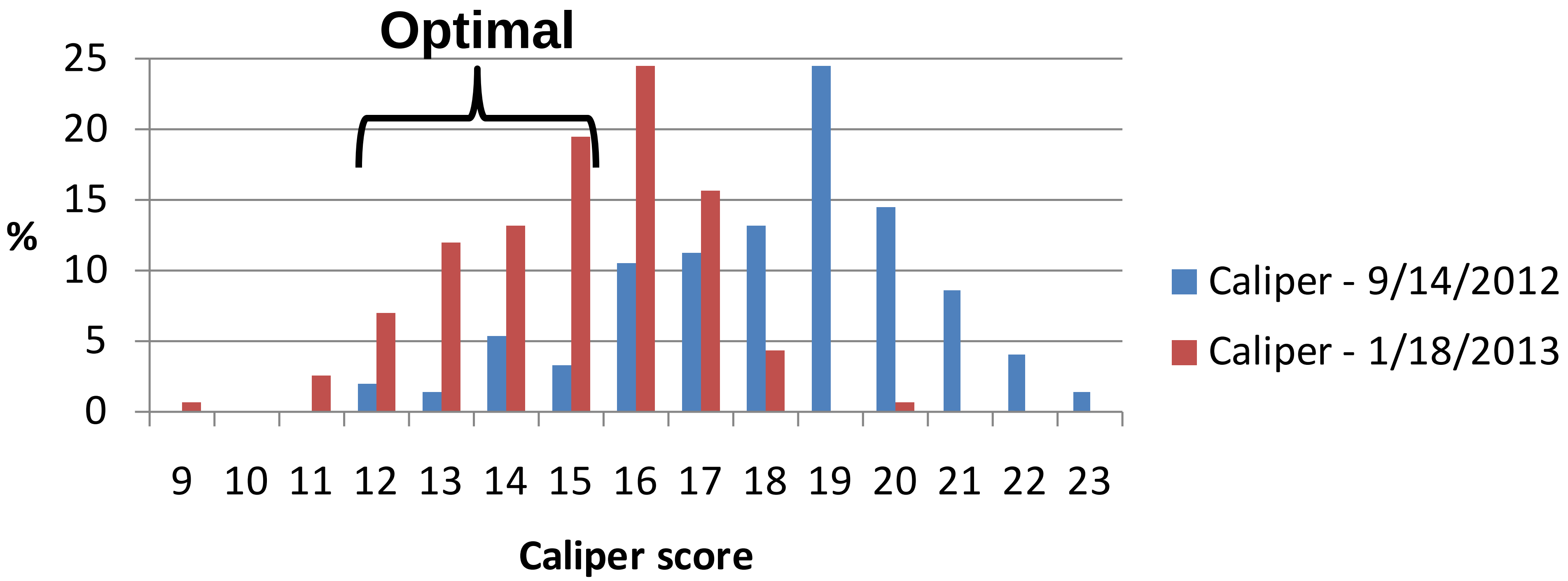


1 lb. decrease in feed reduced birth wt by .31 lbs. per piglet

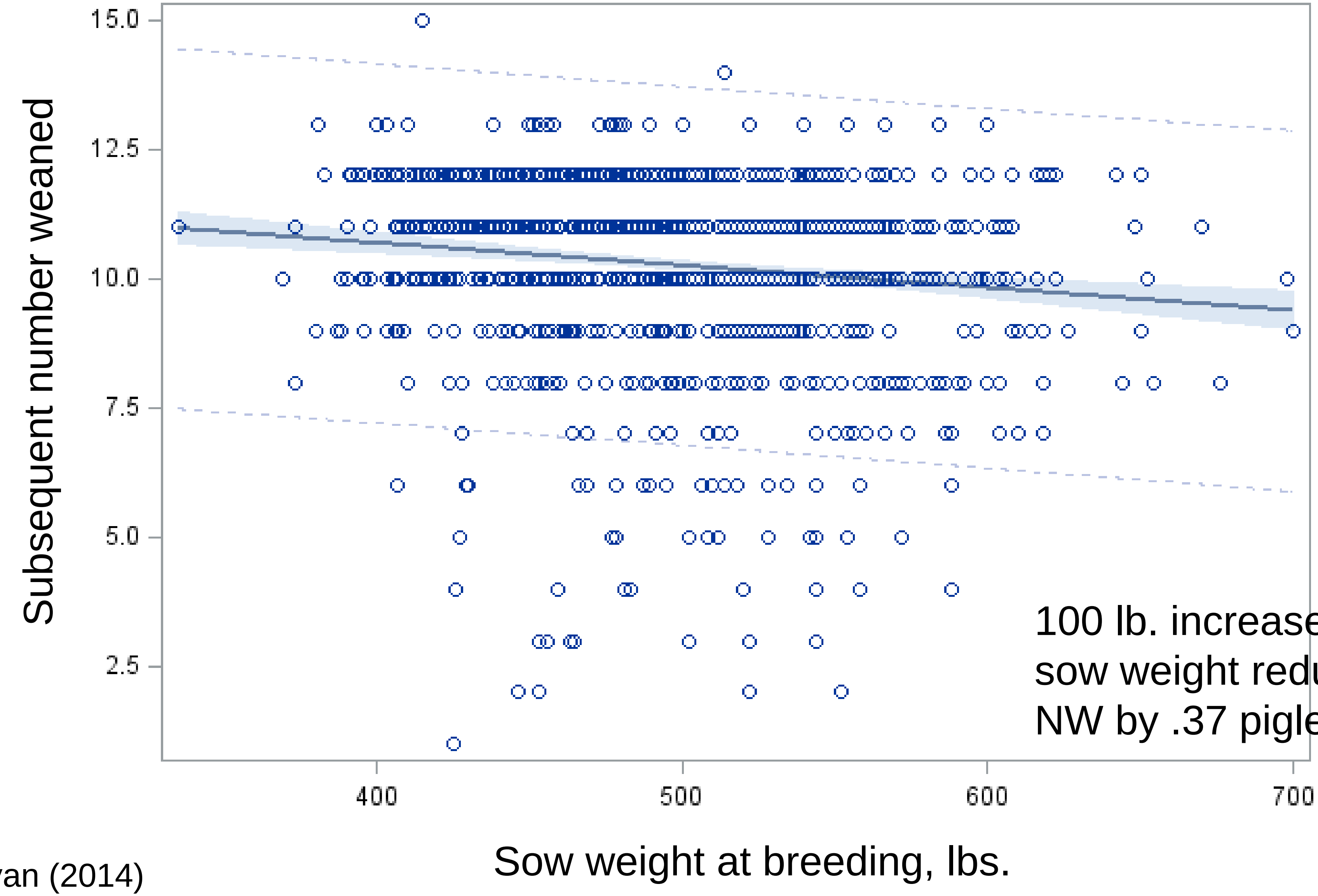
NC State Swine Extension

Fast improvement in sow herd body condition possible

- Average herd caliper score improved from 18.2 to 15.0 in four months



Heavy sows wean fewer piglets – Study B



100 lb. increase in sow weight reduced NW by .37 piglets

Bryan (2014)

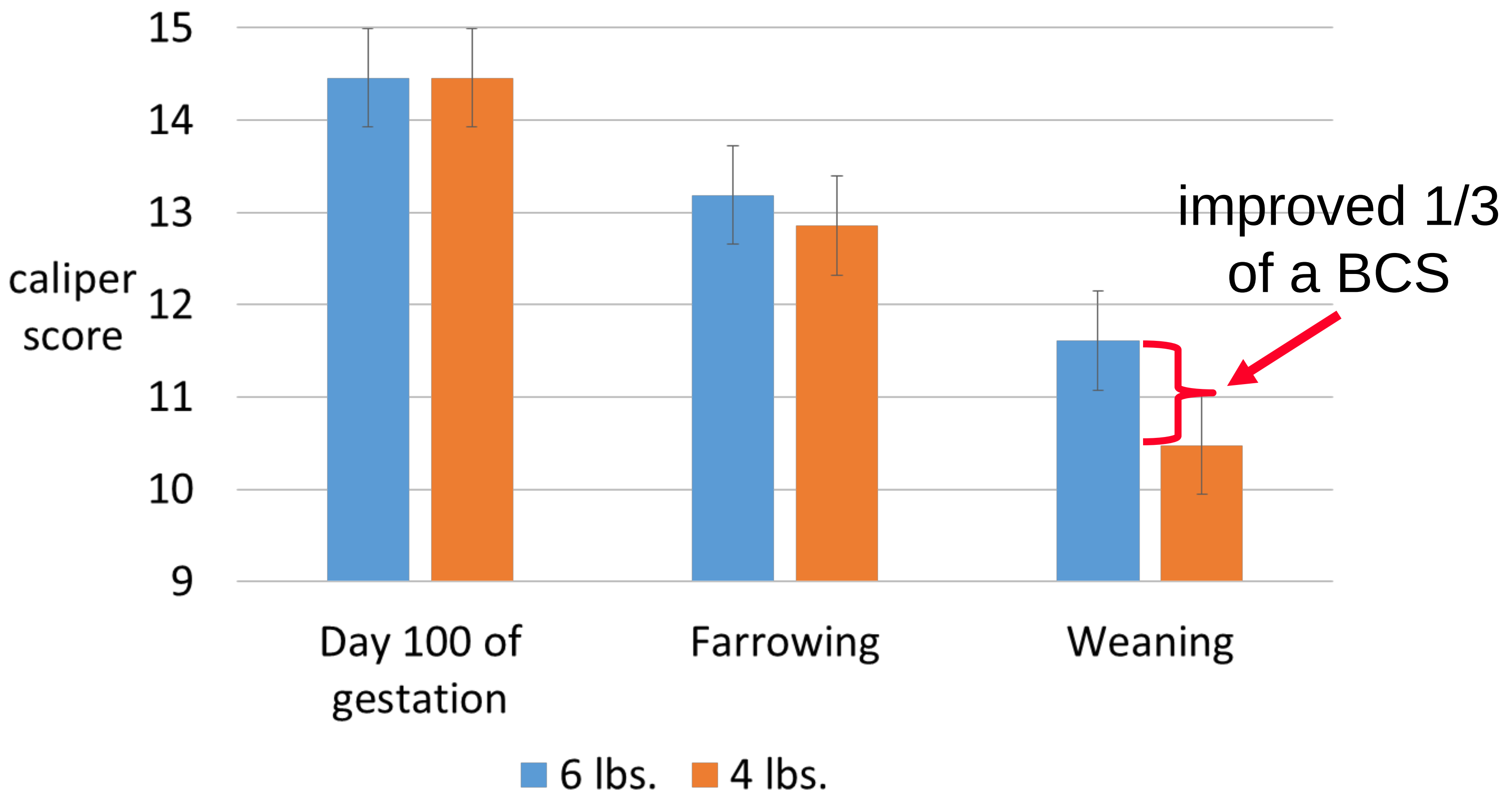
Preventing thin & fat sows

Preventing thin sows

- Gestation – cull if no response to ↑ feeding level
- Lactation
  - Prepare sow in late gestation
  - Management
    - Feed intake
    - Lactation length

NC State Swine Extension

Increase feed in late gestation to improve BCS at weaning



Knauer (2016)

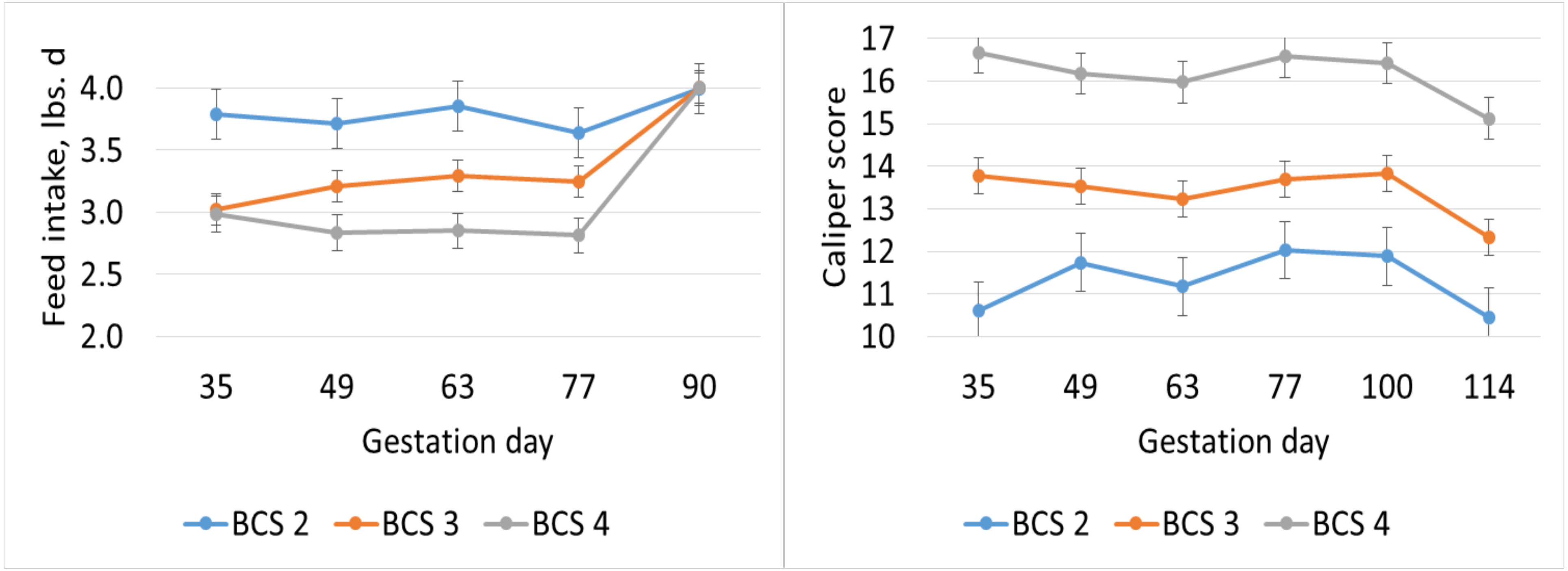
Preventing thin sows

- Lactation – wean if BCS falls below threshold

Preventing fat sows

- “Prevention” is key
- I messed up and my sow is fat
  - Do not try to “fix” during gestation with modern diets
  - Do not bump feed in late gestation
  - Perhaps correct in lactation?

Effect of low gestation feeding levels on sow body condition



Knauer, unpublished

Summary

- Thin & fat sows reduce $
- “Prevention” of fat sows is key
- If a sow becomes thin, increase feeding level
  - Cull if she doesn’t respond to feed increase

Update on feeding strategies for the highly prolific sow

Steve Dritz & Mariana Menegat

Carine Vier, Mike Tokach, Joel DeRouchey,

Jason Woodworth, Robert Goodband

Kansas State University applied swine nutrition

PIC® 2018
Nutrition Seminars

NEVER STOP IMPROVING

Overview

Gestation

- After breeding
- Early-mid gestation
- Late gestation

Peripartum

Lactation

Wean-to-estrus interval

Key points

- Simplification of feeding programs
- Modest impact of nutrition on birth weight
- Maximization of feed intake in lactation

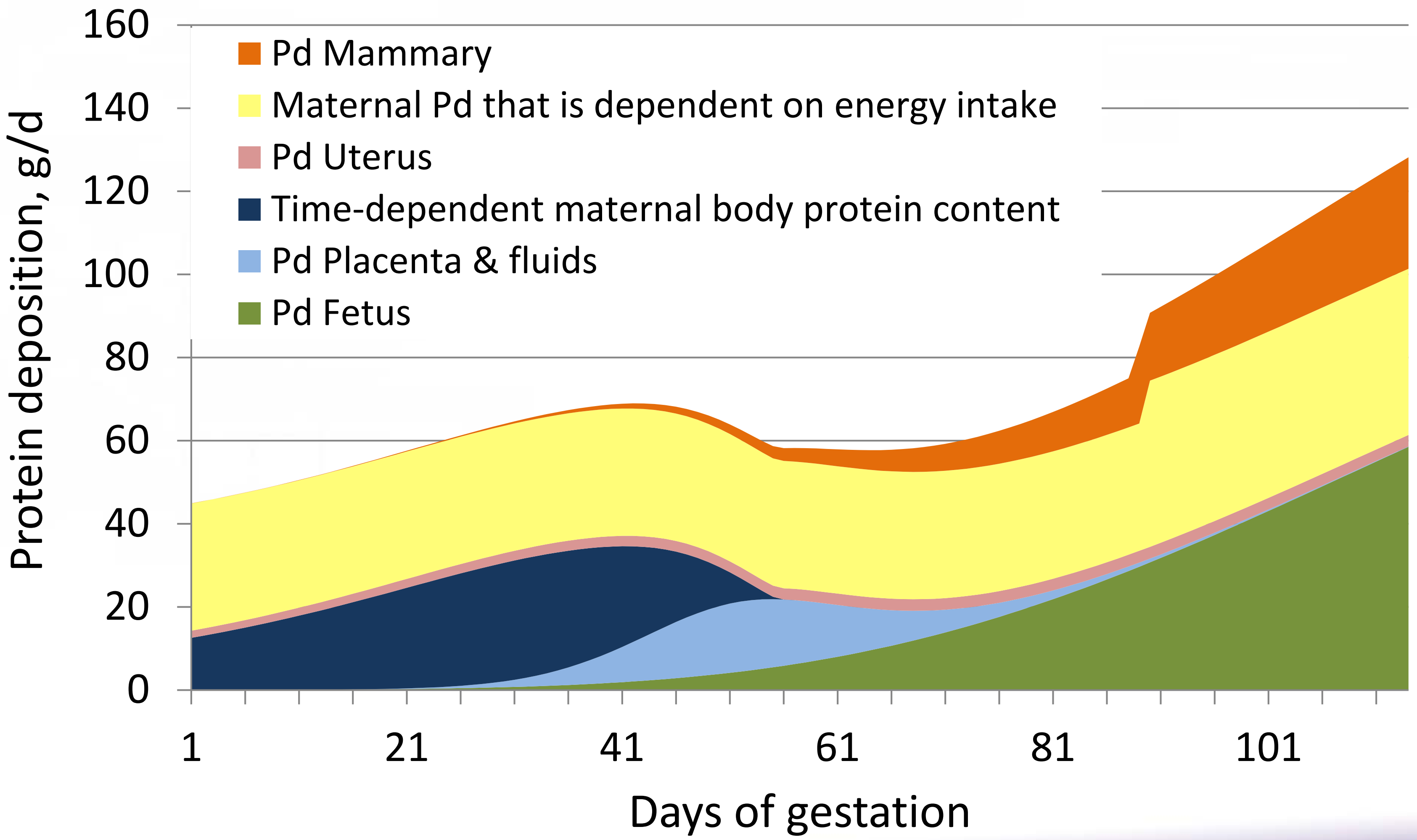
Gestation

Goals of nutrition in gestation:

Meet sow & conceptus requirements

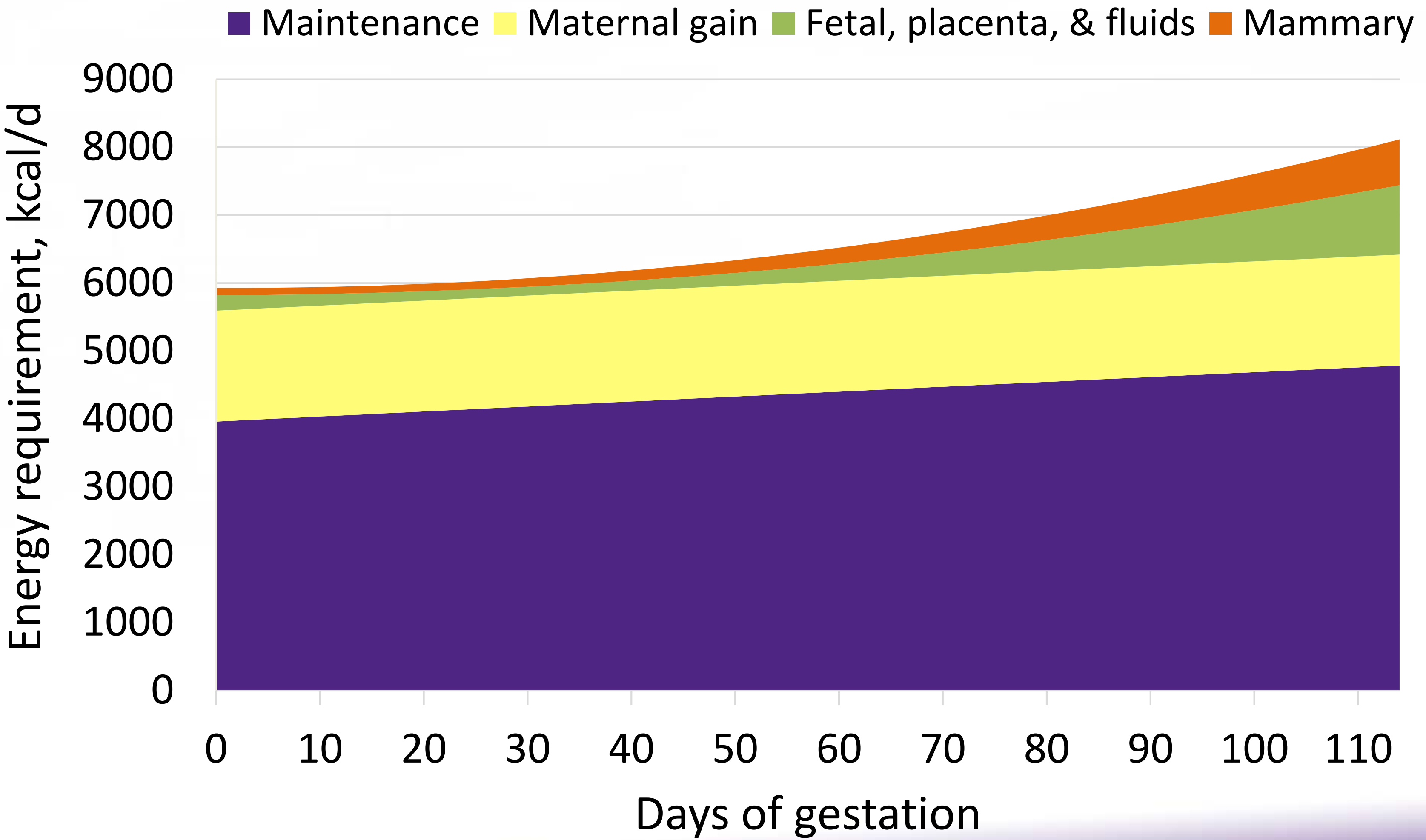
Manage sow body condition

Estimated total protein deposition of sows in gestation



Adapted from NRC, 2012

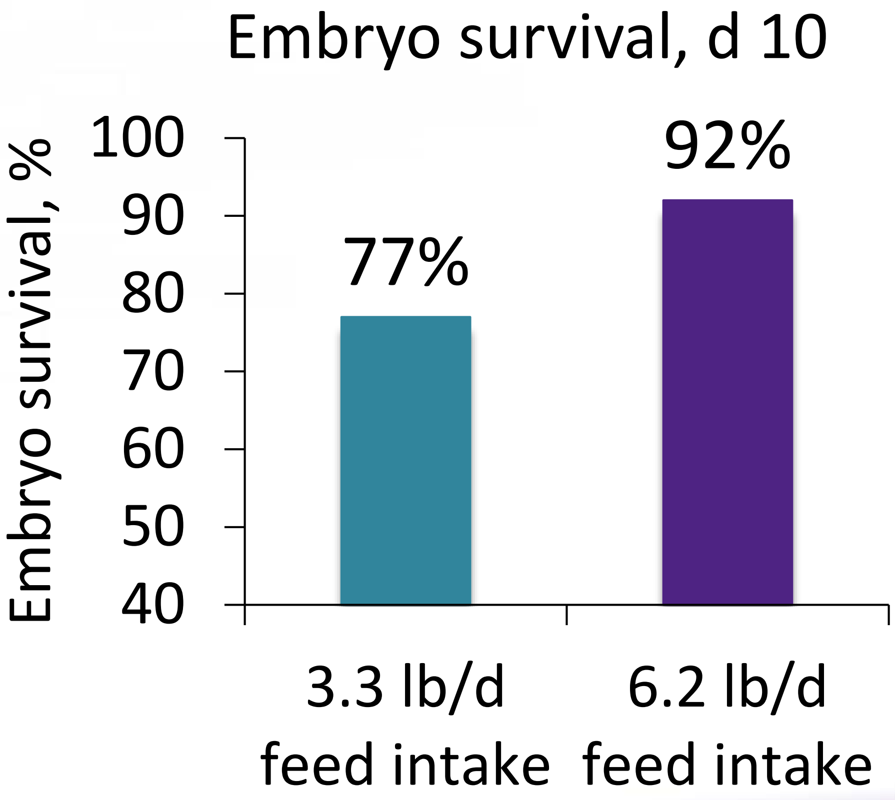
Estimated daily ME requirements of gilts in gestation



Adapted from NRC, 2012

Nutrition after breeding

Adequate feeding level after breeding improves embryo survival in gilts

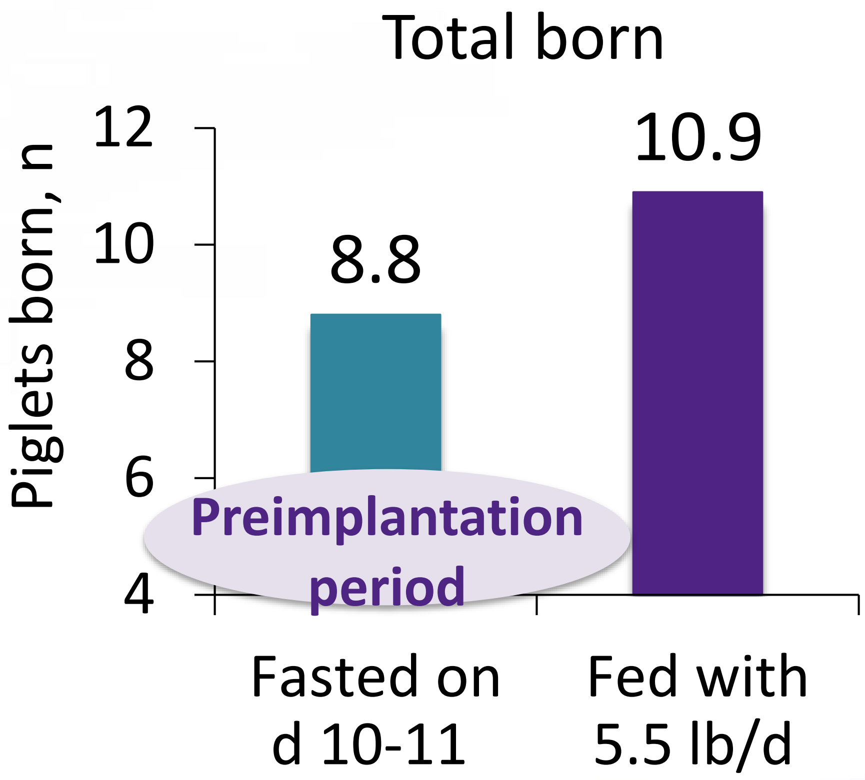


$P < 0.05$
SEM = 3
n = 18 gilts
(Landrace)

Athorn et al., 2013
Reprod Fertil Dev

Nutrition after breeding

Feed restriction in gilts after breeding impact total piglets born

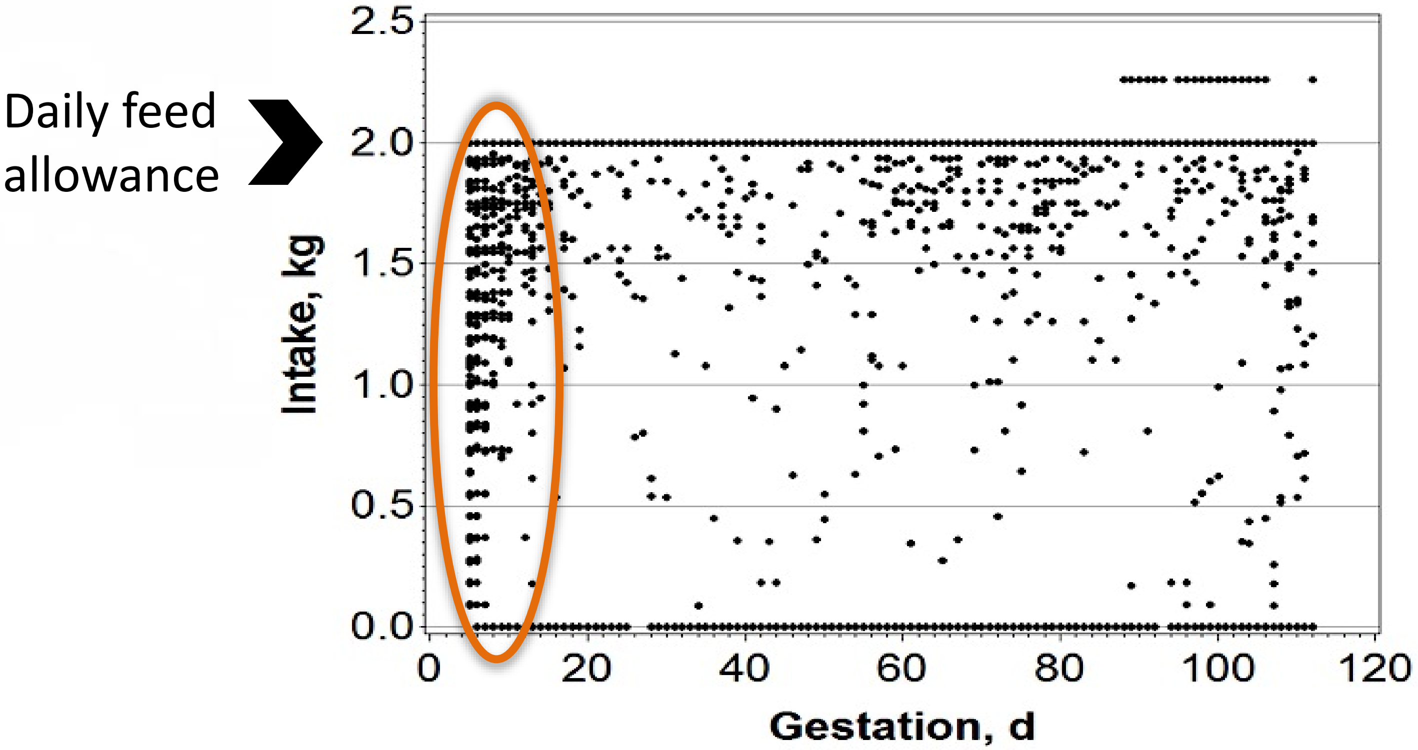


P < 0.05
SEM = 0.7
n = 21 gilts
(Landrace x LW)

Langendijk et al., 2016
Reprod Fertil Dev

Nutrition after breeding

Feed intake of group-housed gilts with an electronic sow feeding system

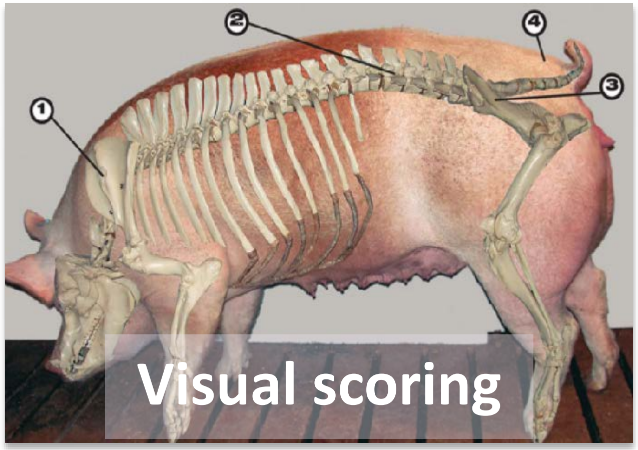


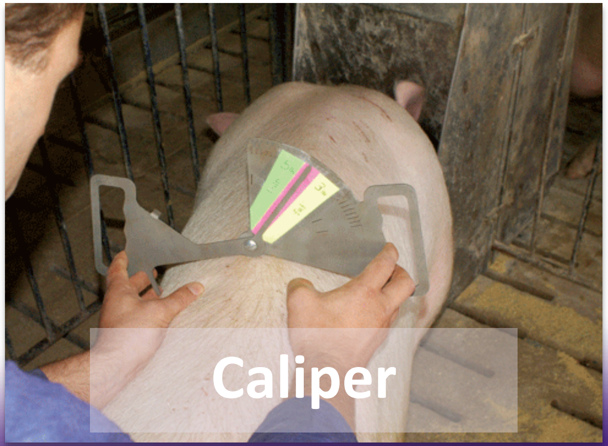
Intake records:
n = 74,114
(PIC 1050, PIC®)

Thomas et al., 2016
KSU Swine Day Reports

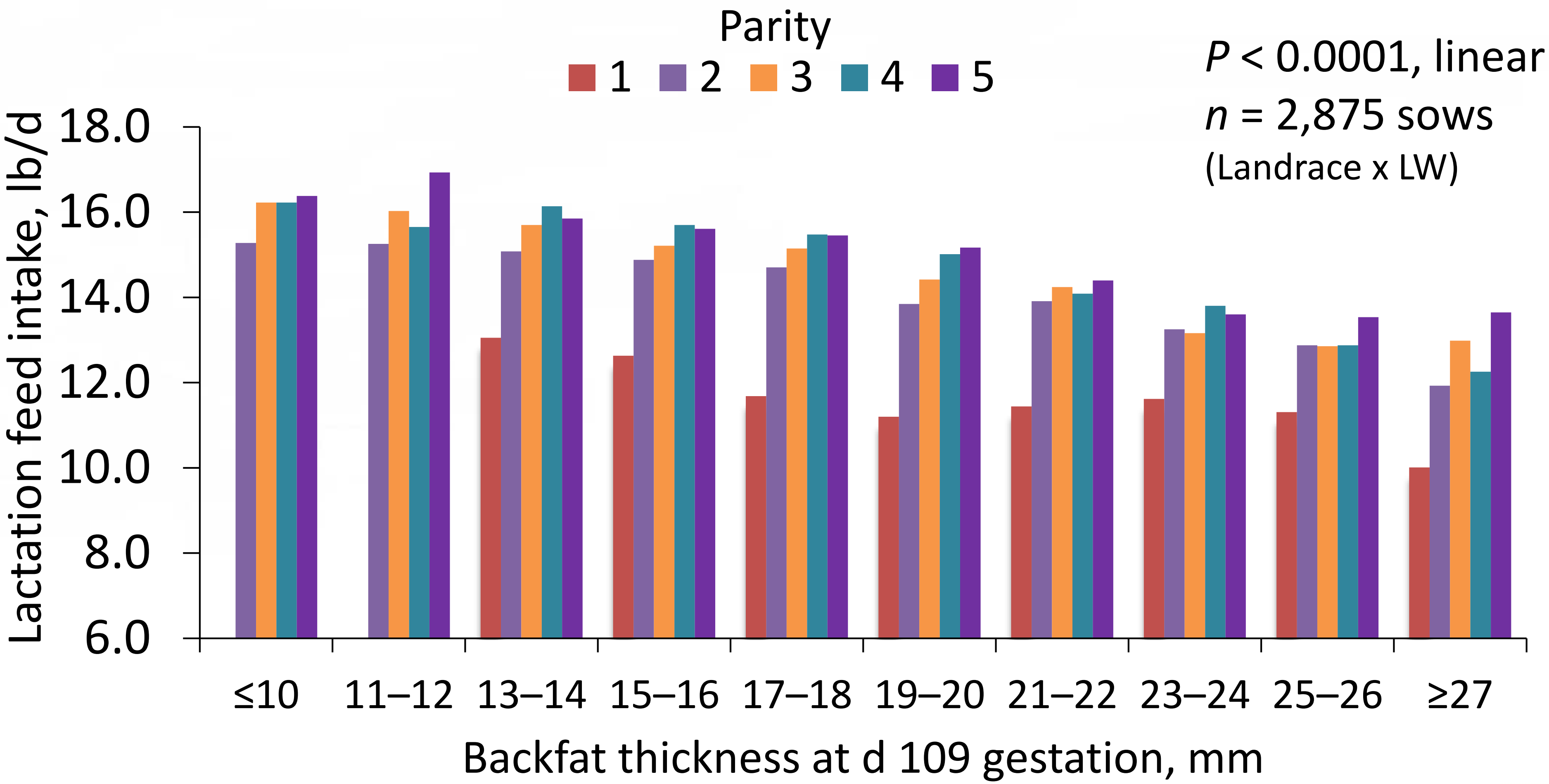
Nutrition in early-mid gestation

Properly conditioned herd





Effect of backfat thickness in gestation on lactation feed intake



P < 0.0001, linear
n = 2,875 sows
(Landrace x LW)

K-STATE Research and Extension

Kim et al., 2015
Acta Agric Scand

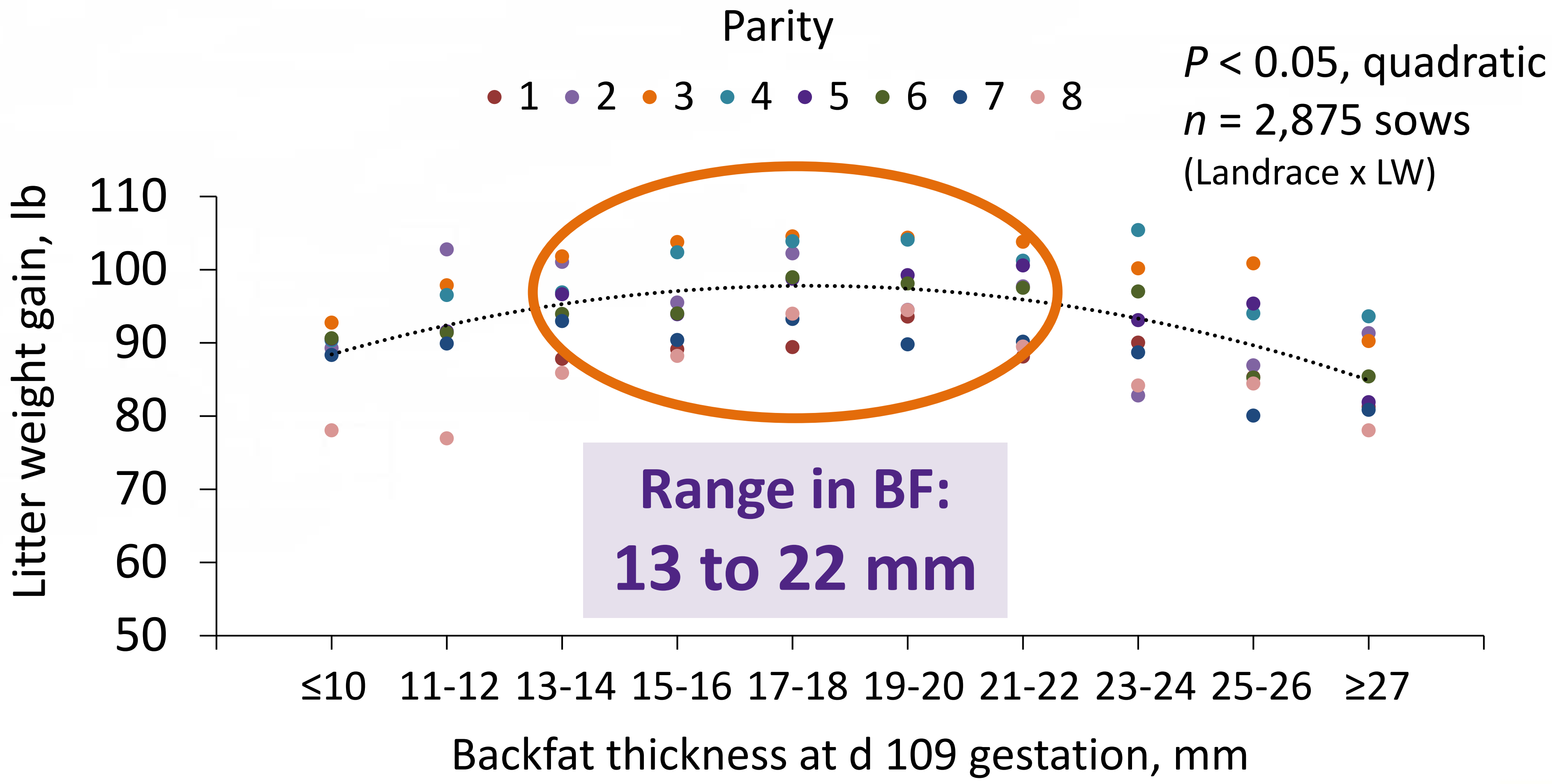
Knowledge for Life

Effect of backfat thickness in gestation on lactation feed intake

+1 mm backfat gestation	**-0.1 to -0.3 lb** daily feed intake in lactation	**+2.9 lb** weight loss in lactation	**+0.25 mm** backfat loss in lactation	**+0.37 mm** backfat gain subsequent gestation

Kim et al., 2015
Acta Agric Scand

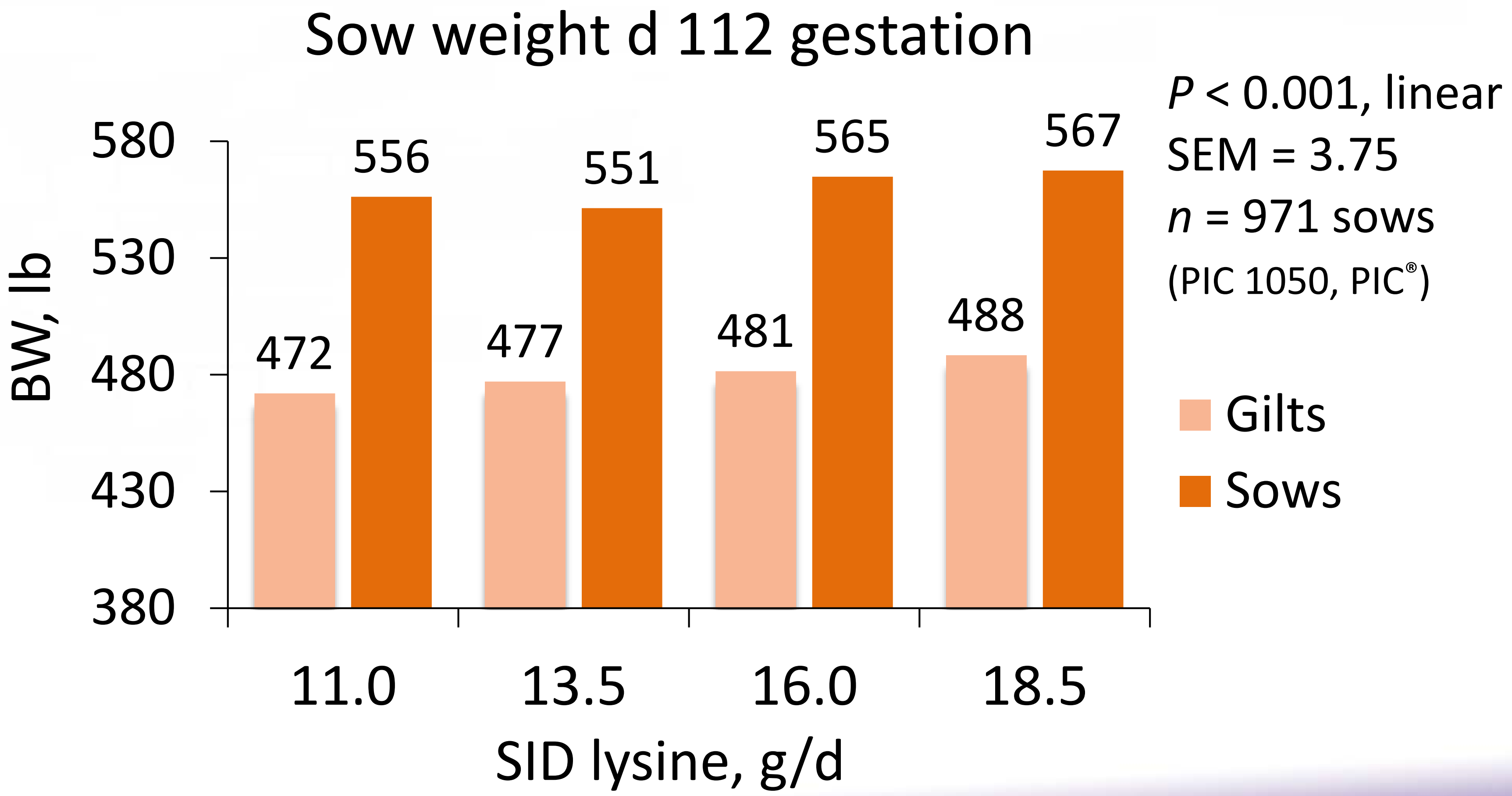
Effect of backfat thickness in gestation on litter weight gain



Kim et al., 2015
Acta Agric Scand

Nutrition in gestation

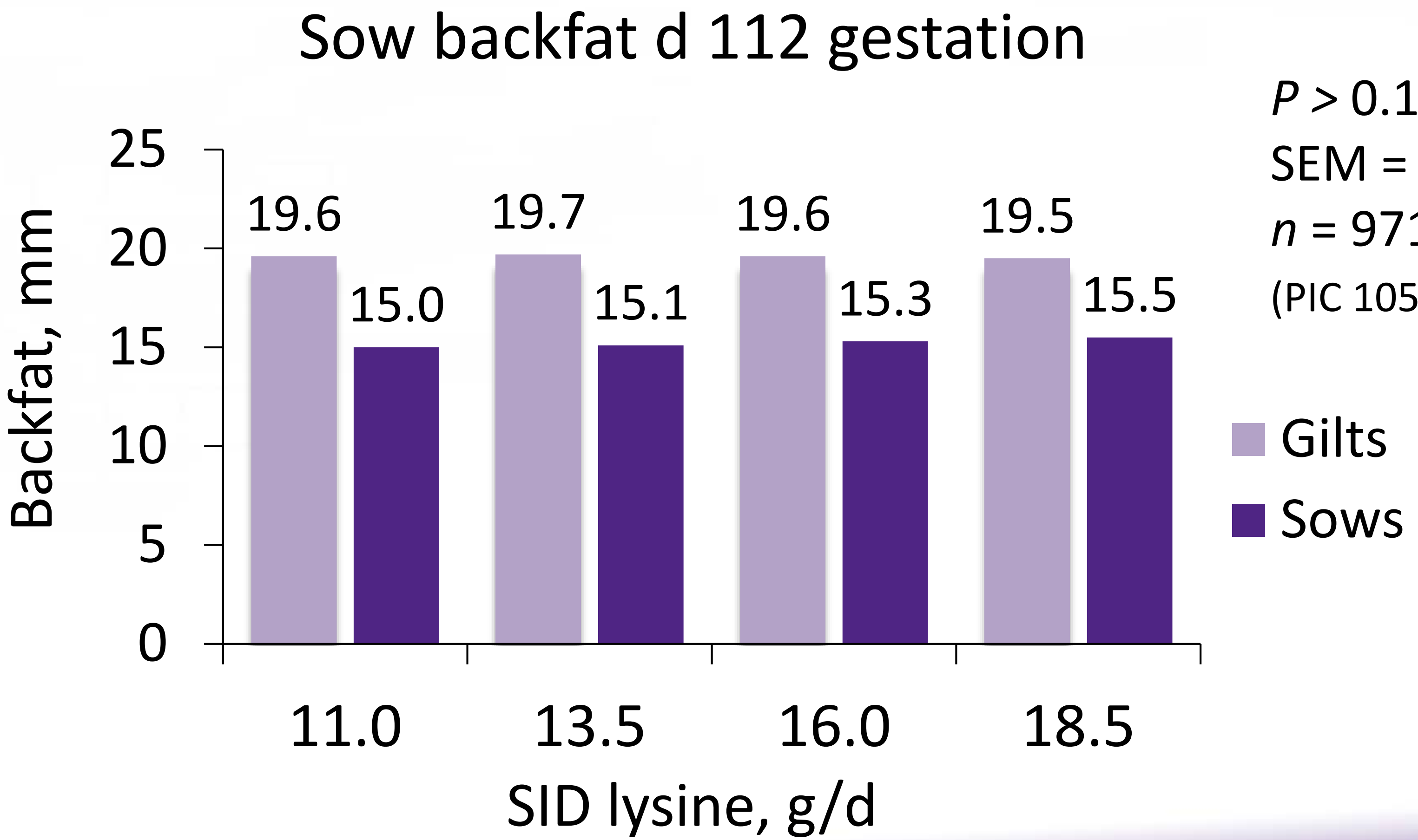
Evaluation of lysine requirements in gestation



Thomas et al., 2018
J Anim Sci (Abstr)

Nutrition in gestation

Evaluation of lysine requirements in gestation



P > 0.10
SEM = 0.32
n = 971 sows
(PIC 1050, PIC®)

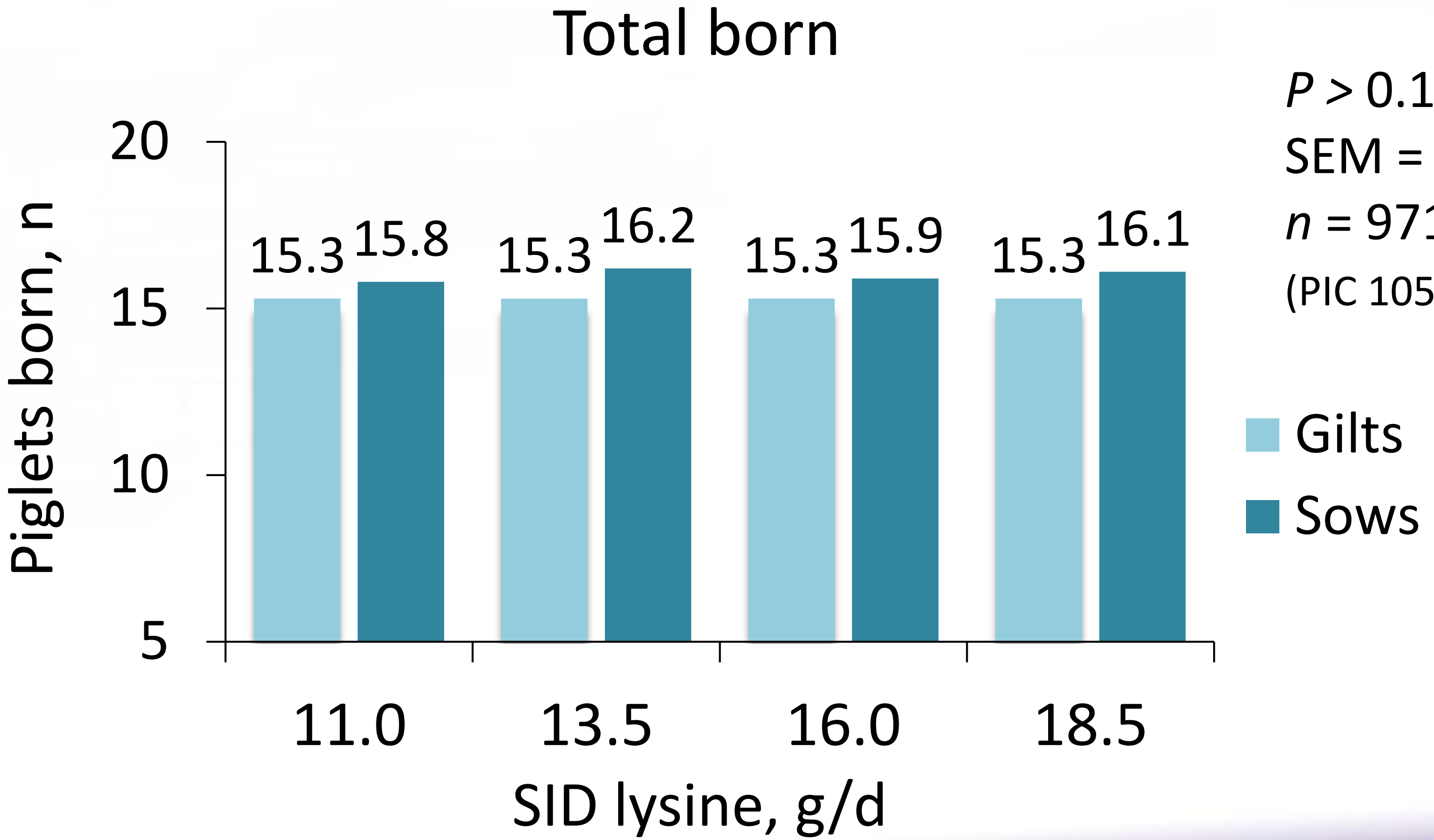
K-STATE Research and Extension

Thomas et al., 2018
J Anim Sci (Abstr)

Knowledge for Life

Nutrition in gestation

Evaluation of lysine requirements in gestation

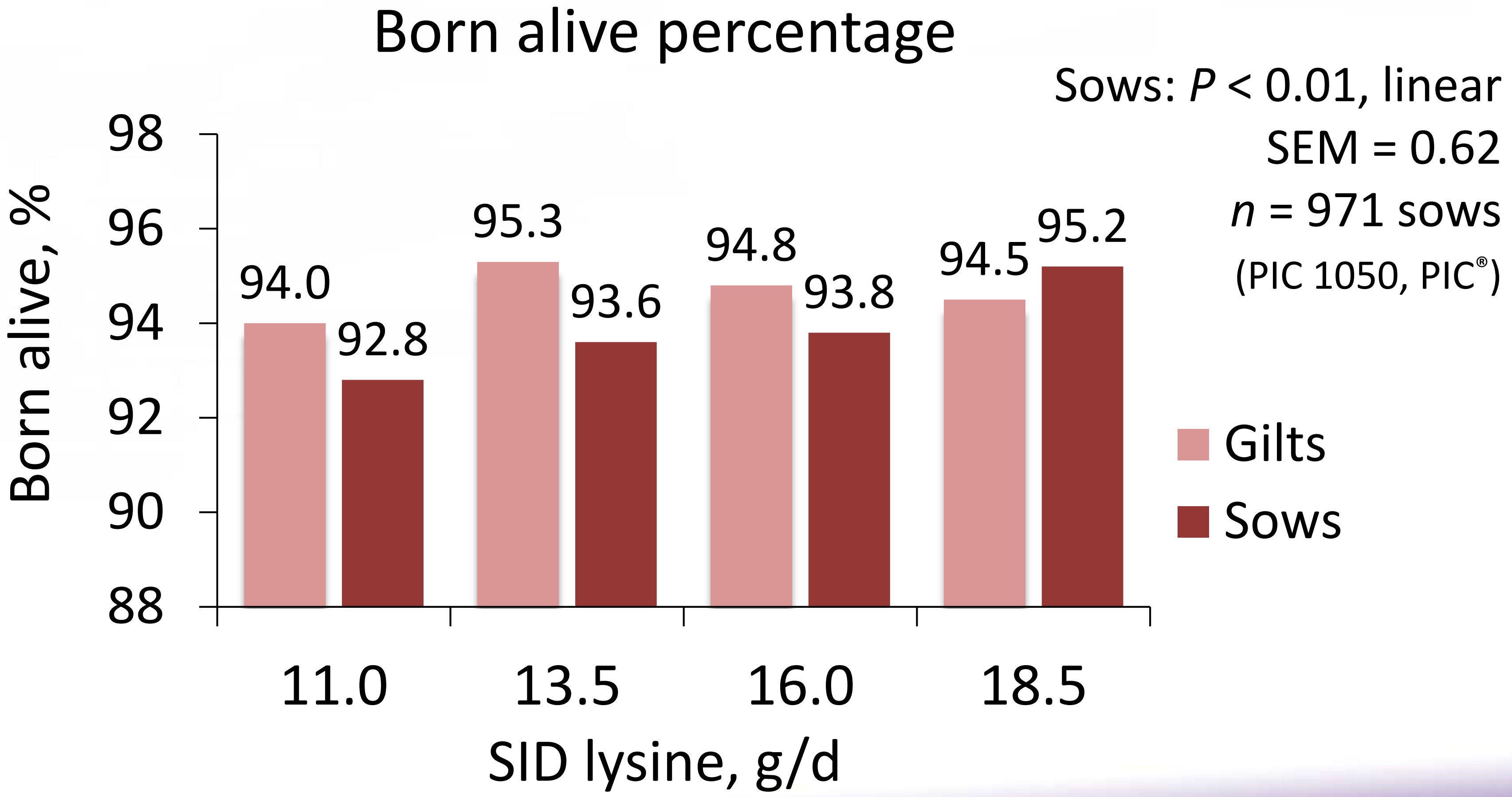


P > 0.10
SEM = 0.31
n = 971 sows
(PIC 1050, PIC®)

Thomas et al., 2018
J Anim Sci (Abstr)

Nutrition in gestation

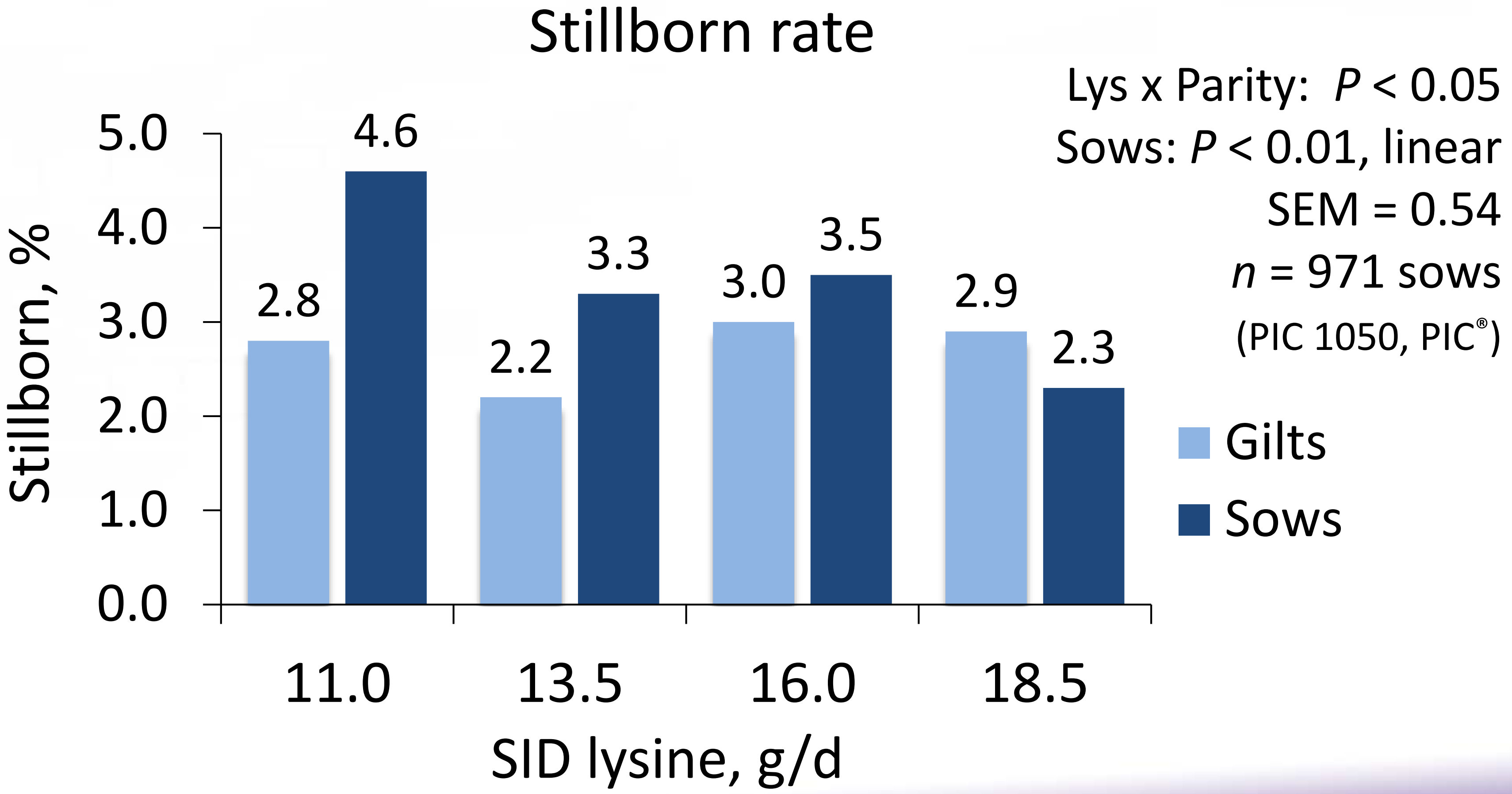
Evaluation of lysine requirements in gestation



Thomas et al., 2018
J Anim Sci (Abstr)

Nutrition in gestation

Evaluation of lysine requirements in gestation



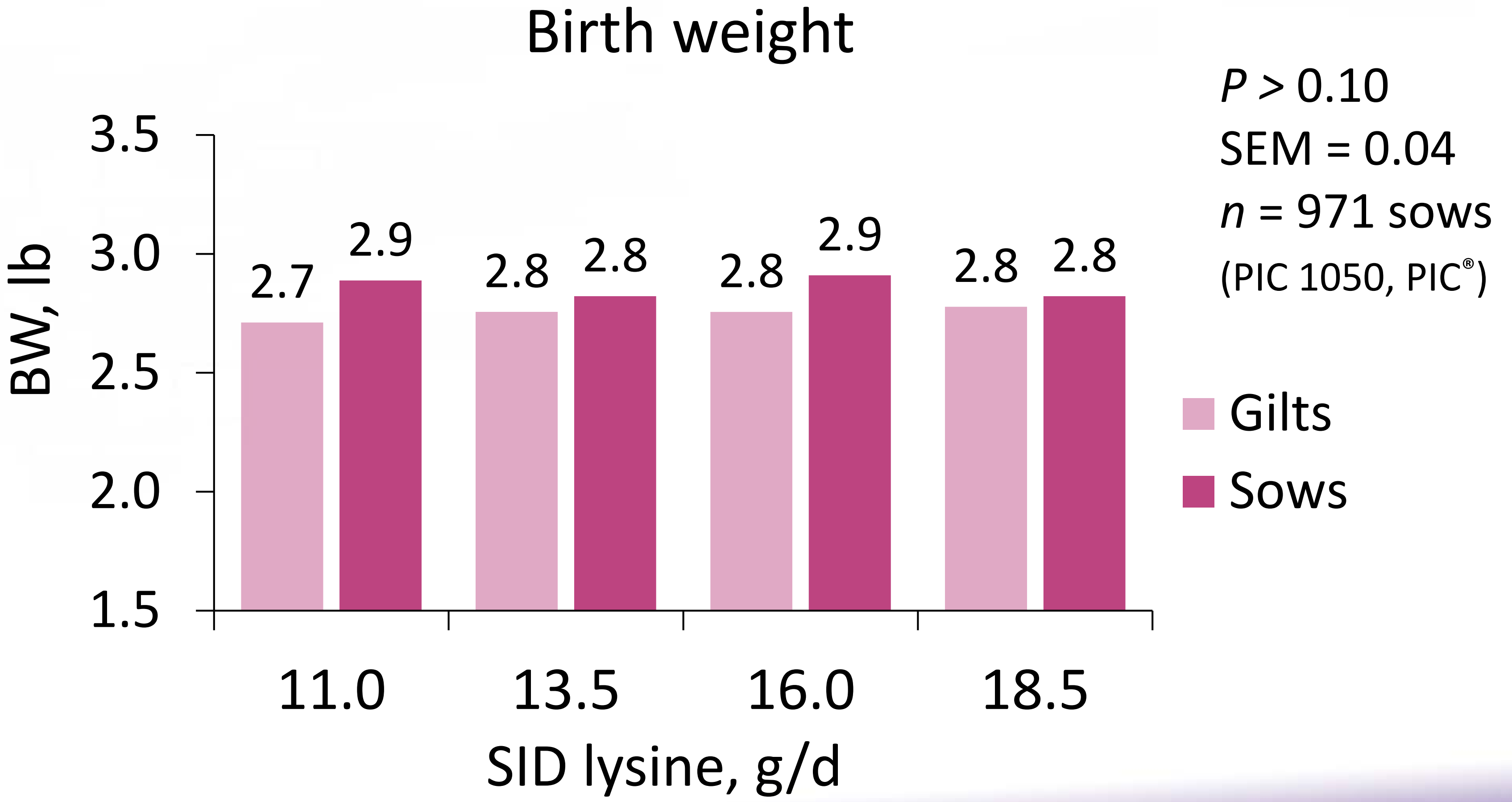
K-STATE Research and Extension

Thomas et al., 2018
J Anim Sci (Abstr)

Knowledge for Life

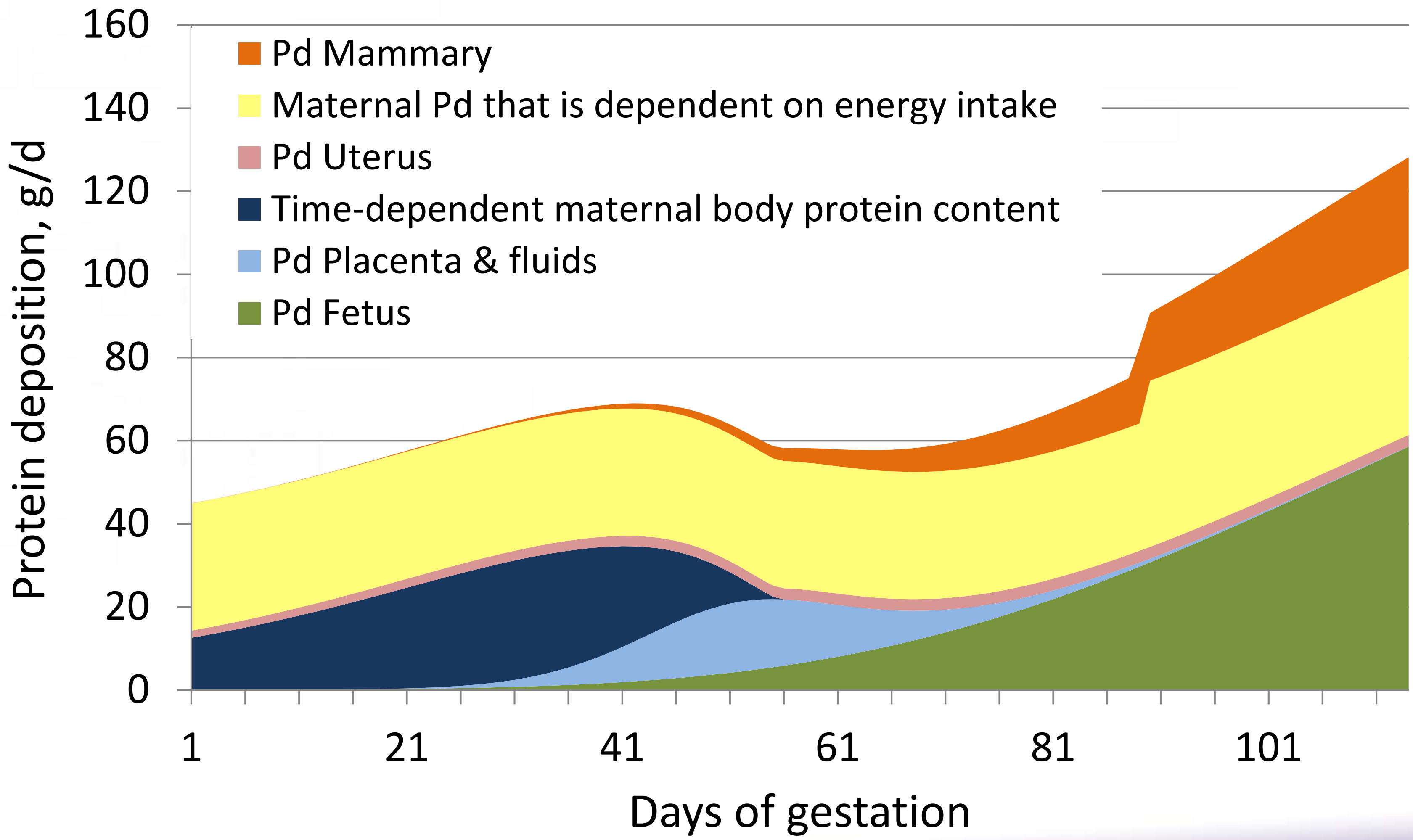
Nutrition in gestation

Evaluation of lysine requirements in gestation



Thomas et al., 2018
J Anim Sci (Abstr)

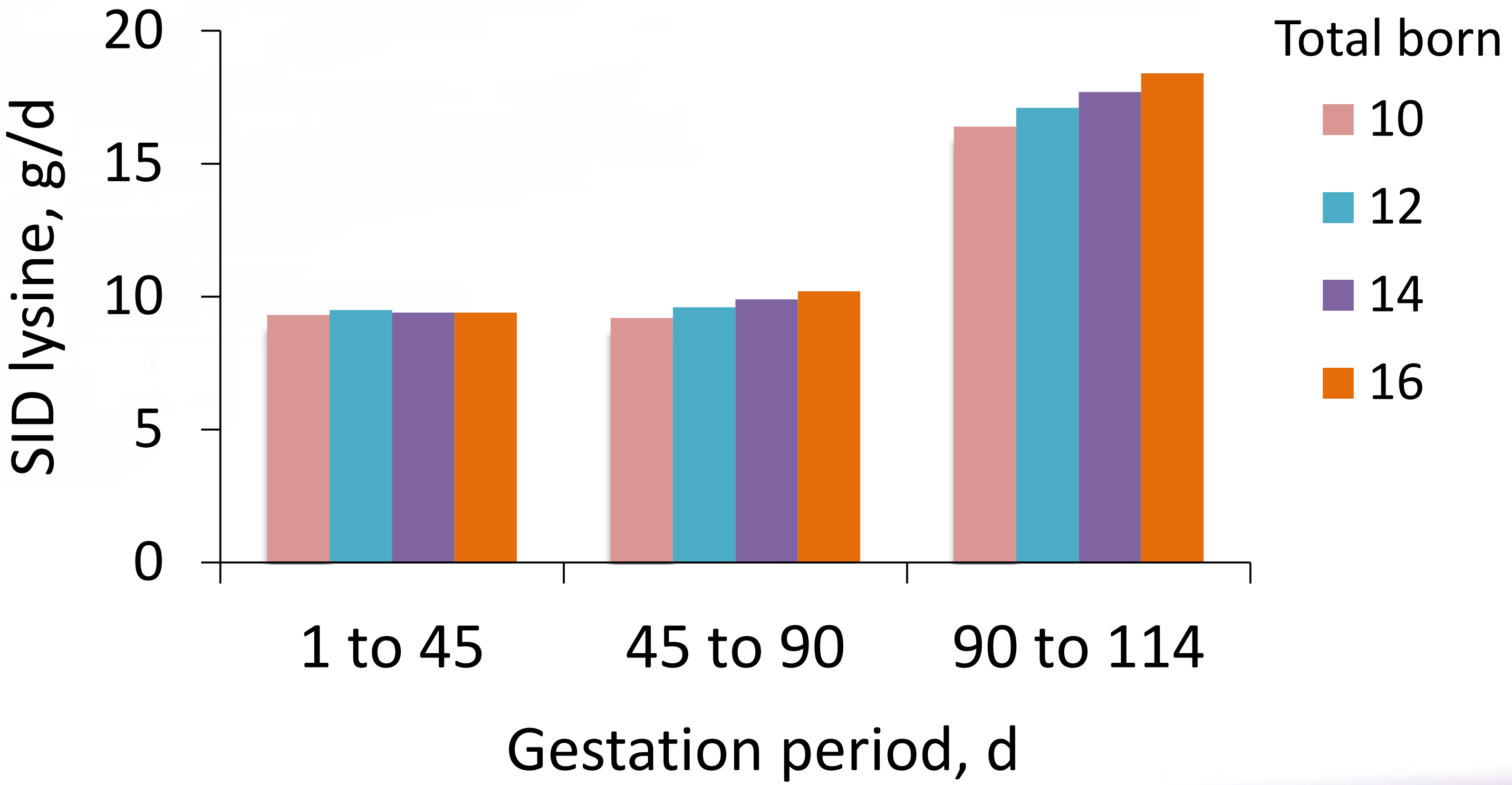
Nutrition in late gestation



Adapted from NRC, 2012

Nutrition in late gestation

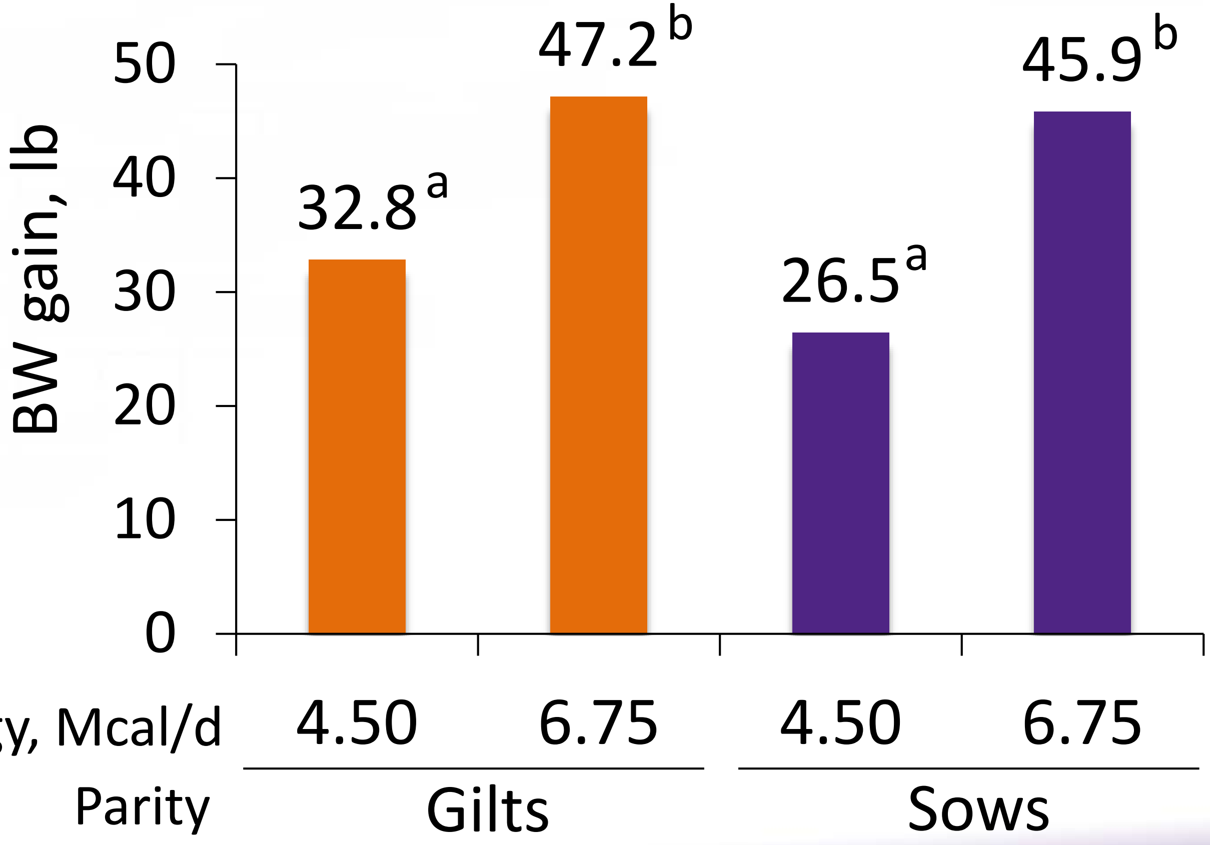
Amino acid requirements greatly increase in late gestation and w/ litter size



Adapted from NRC, 2012

Bump feeding in late gestation

Energy intake in late gestation (d 90-111) increased weight gain by approx. 16.5 lb



Parity x Energy,
P < 0.001
n = 1,102 sows
(PIC 1050, PIC®)

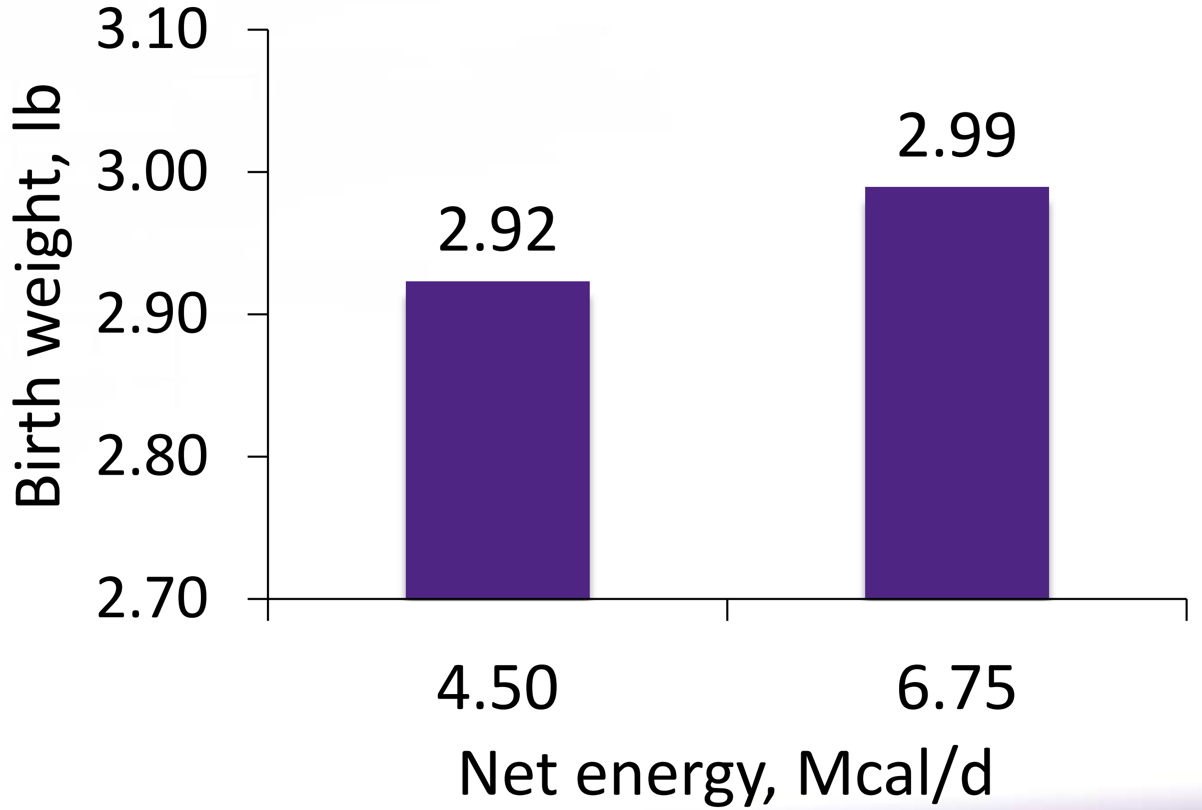
Gonçalves et al., 2016
J Anim Sci

K·STATE Research and Extension

Knowledge for Life

Bump feeding in late gestation

Energy intake in late gestation (d 90-111) increased born alive birth weight by 0.07 lb

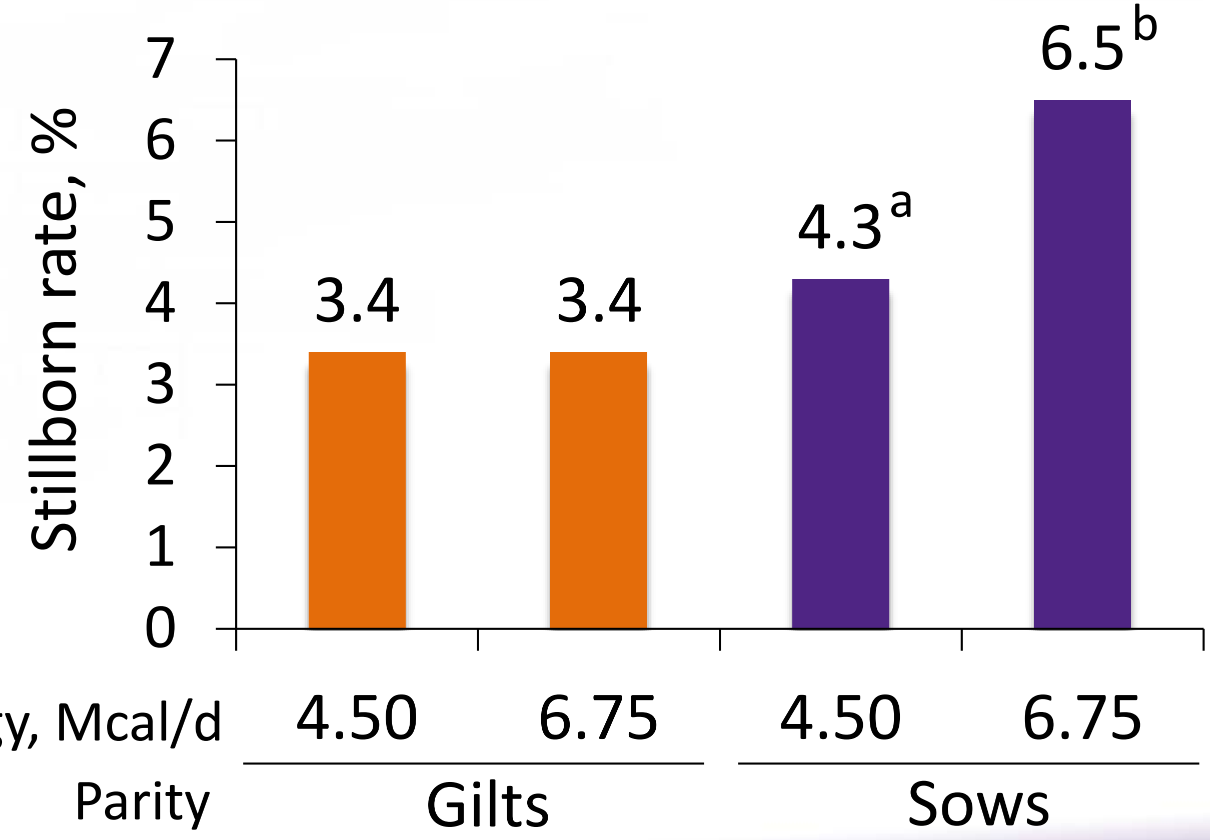


P < 0.01
n = 1,102 sows
(PIC 1050, PIC®)

Gonçalves et al., 2016
J Anim Sci

Bump feeding in late gestation

Energy intake in late gestation (d 90-111) increased stillborn rate by 2.2% in sows

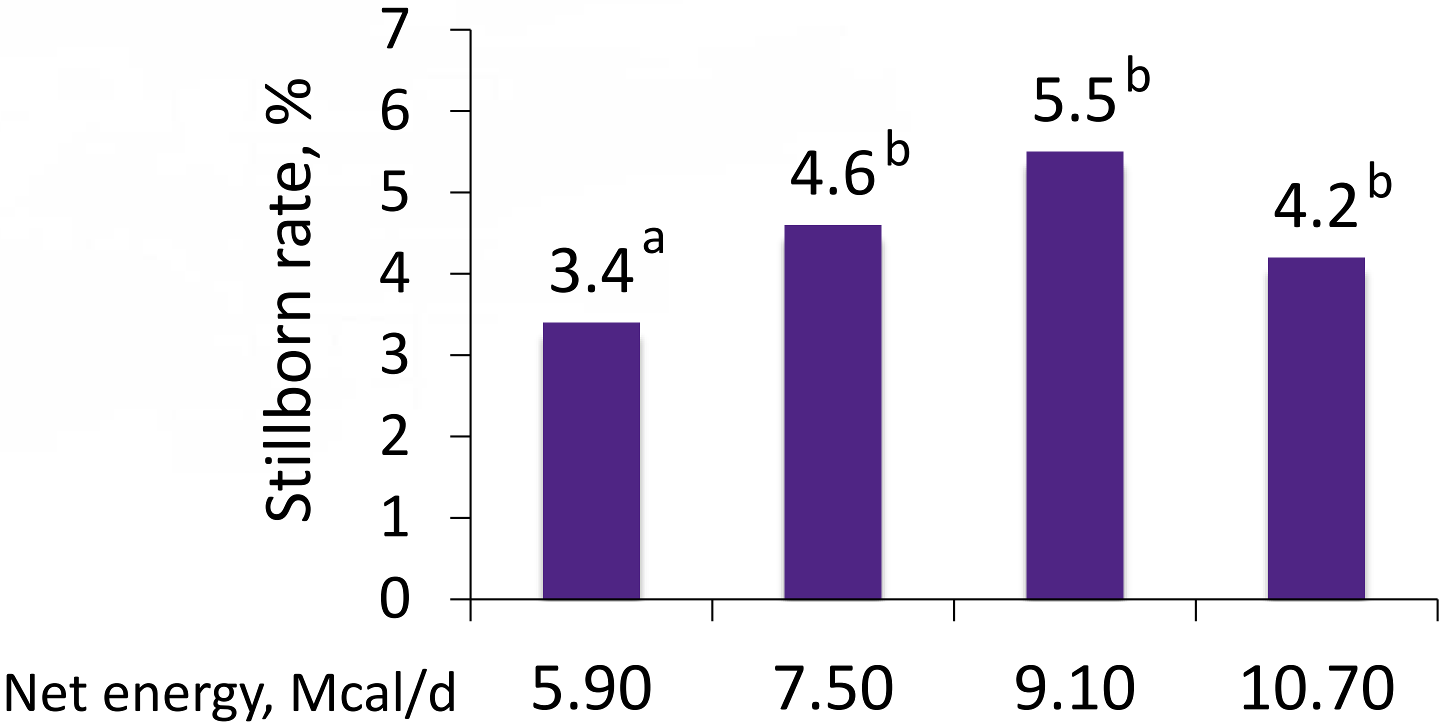


Parity x Energy,
$P < 0.05$
n = 1,102 sows
(PIC 1050, PIC®)

Gonçalves et al., 2016
J Anim Sci

Bump feeding in late gestation

Energy intake in late gestation (d 90-111) increased stillborn rate by 1-2% in gilts



P < 0.05
n = 977 gilts
(PIC 1050, PIC®)

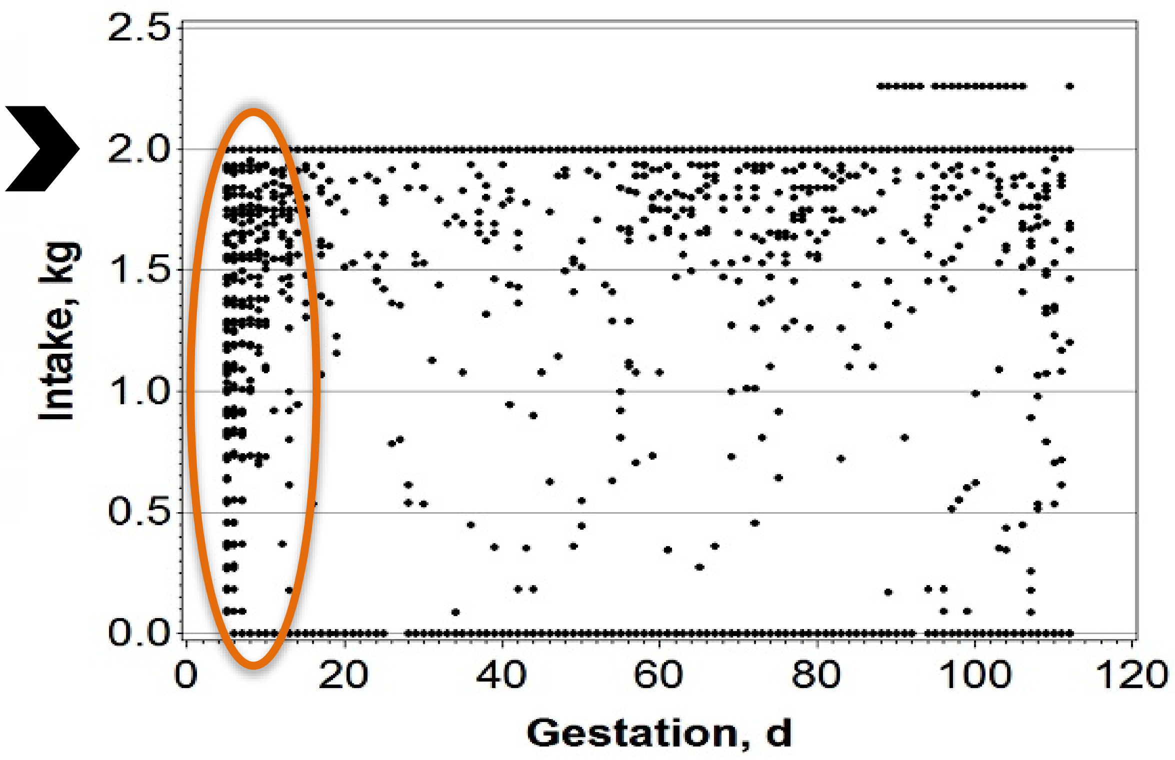
Mallmann et al., 2017
Unpubl., UFRGS

Gestation feeding systems

Electronic sow feeding systems

Feed intake of **gilts** in ESF system

Daily feed allowance



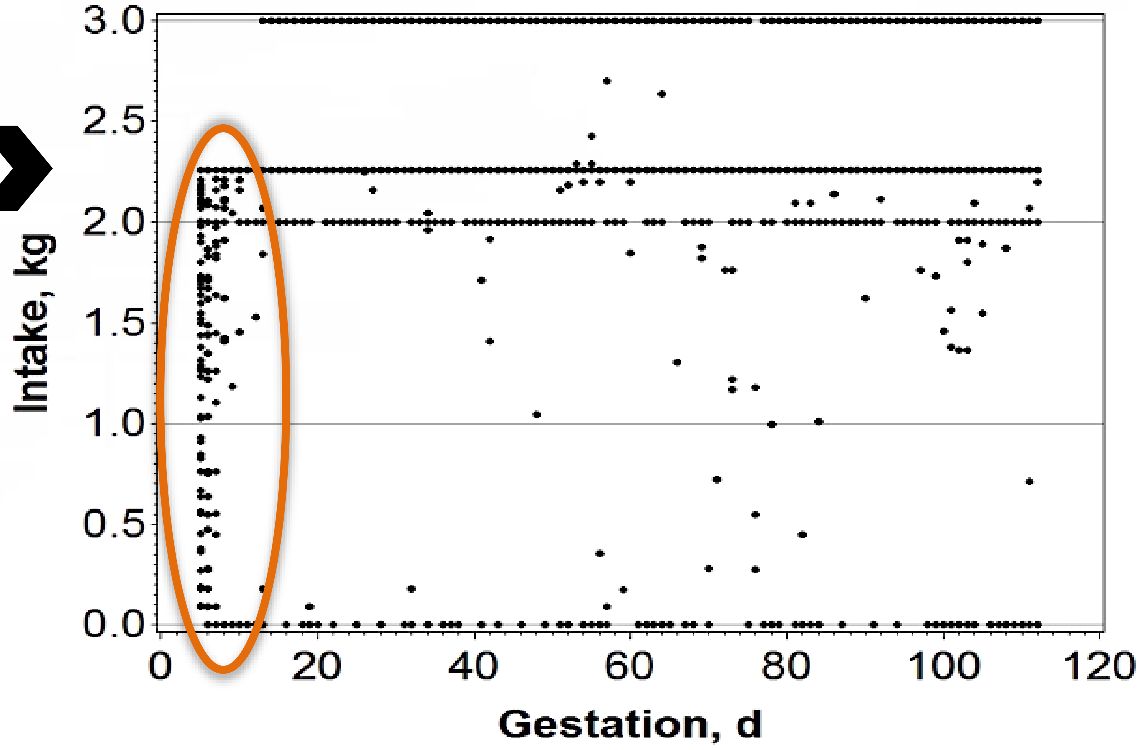
Intake records:
n = 74,114
(PIC 1050, PIC®)

Thomas et al., 2016
KSU Swine Day Reports

Electronic sow feeding systems

Feed intake of **parity 1 sows** in ESF system

Daily feed allowance ❯



Intake records:

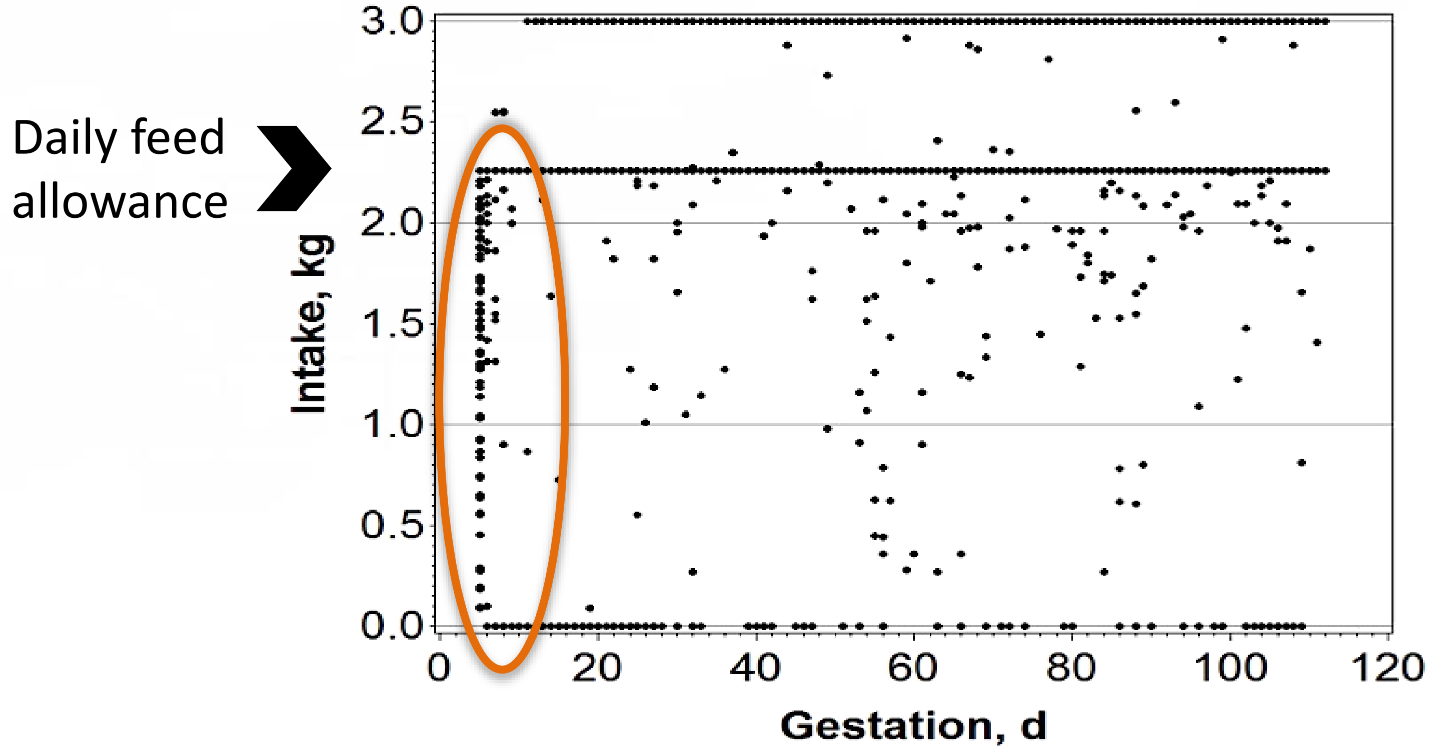
n = 74,114

(PIC 1050, PIC®)

Thomas et al., 2016
KSU Swine Day Reports

Electronic sow feeding systems

Feed intake of **parity 2+ sows** in ESF system



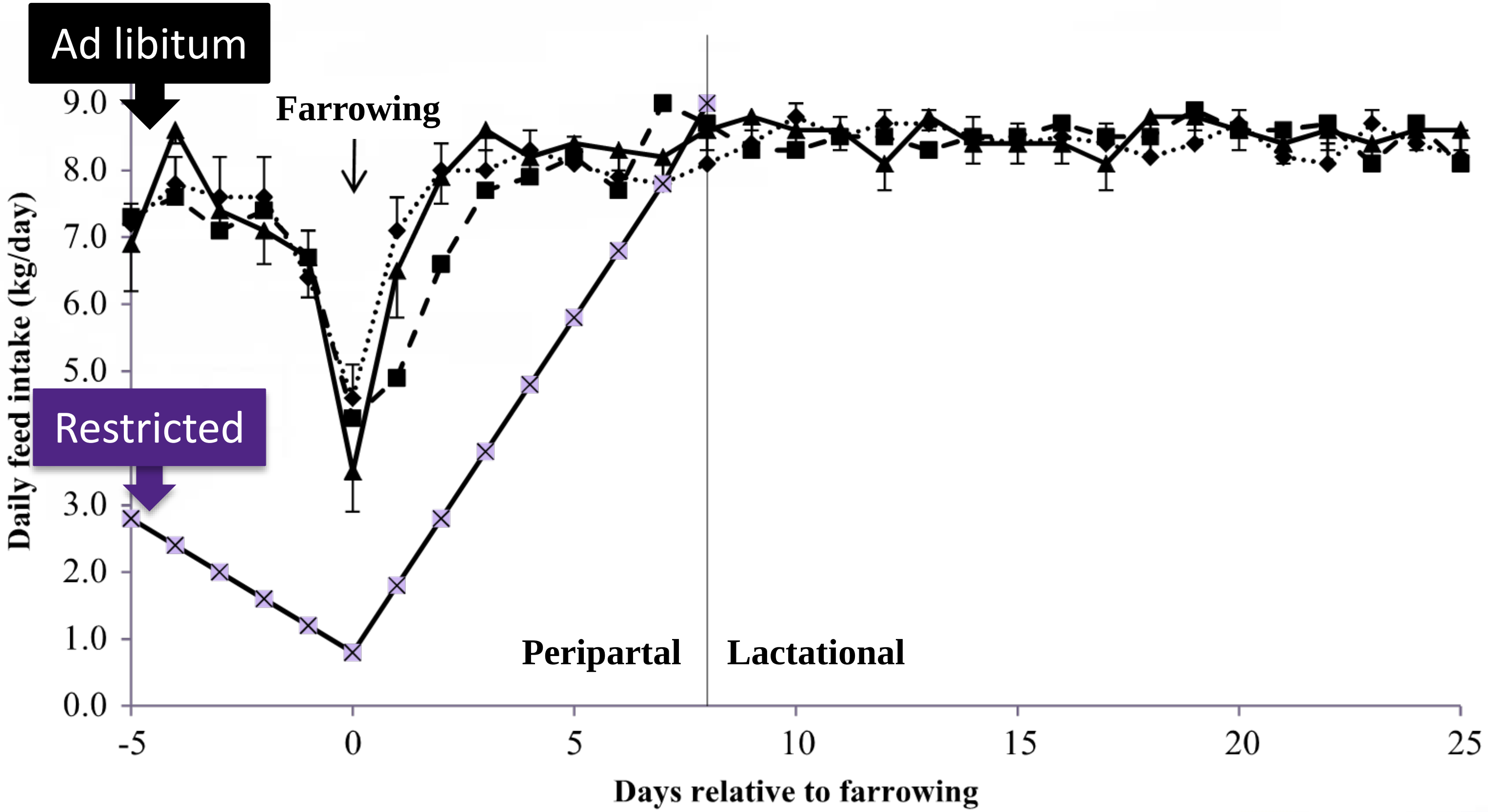
Intake records:

n = 74,114

(PIC 1050, PIC®)

Nutrition in peripartum

Restricted vs. Ad libitum feeding

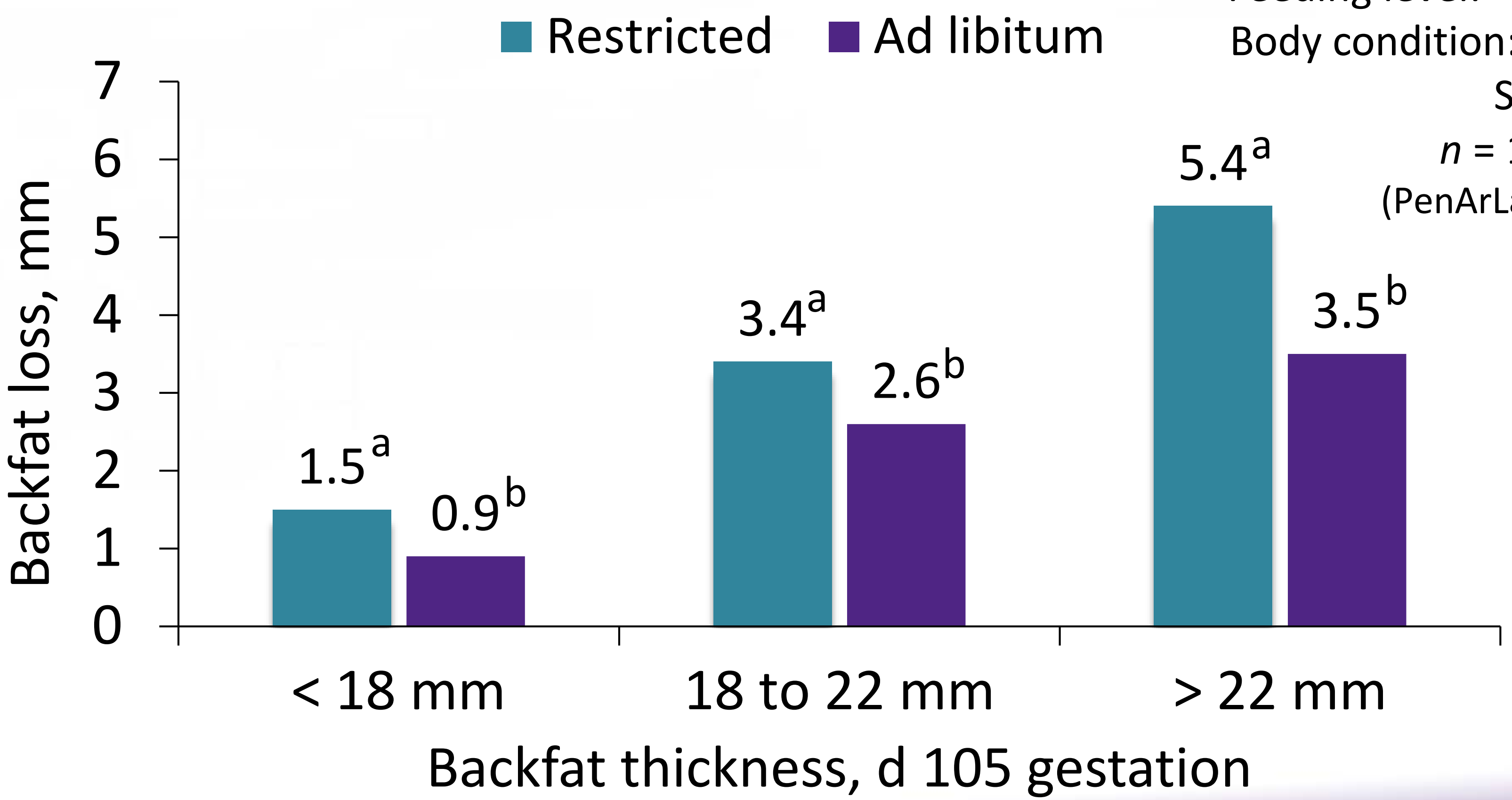


Cools et al., 2014
Anim Reprod Sci

Nutrition in peripartum

Ad libitum feeding on peripartum reduced backfat loss during lactation

Feeding level: [ab] $P < 0.05$
Body condition: $P < 0.01$
SEM = 0.3
n = 112 sows
(PenArLan Naïma)

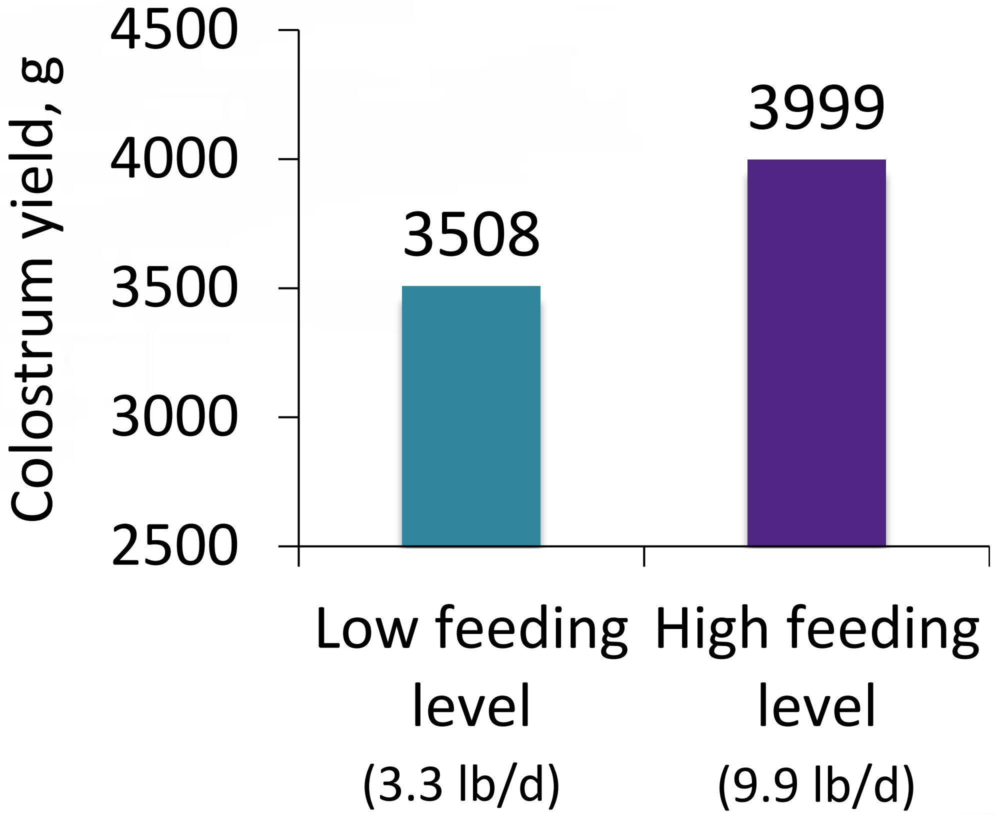


Cools et al., 2014
Anim Reprod Sci

Nutrition in peripartum

Feeding level on peripartum influenced colostrum yield and composition

$P < 0.10$
SEM = 141
n = 50 sows
(PIC®)

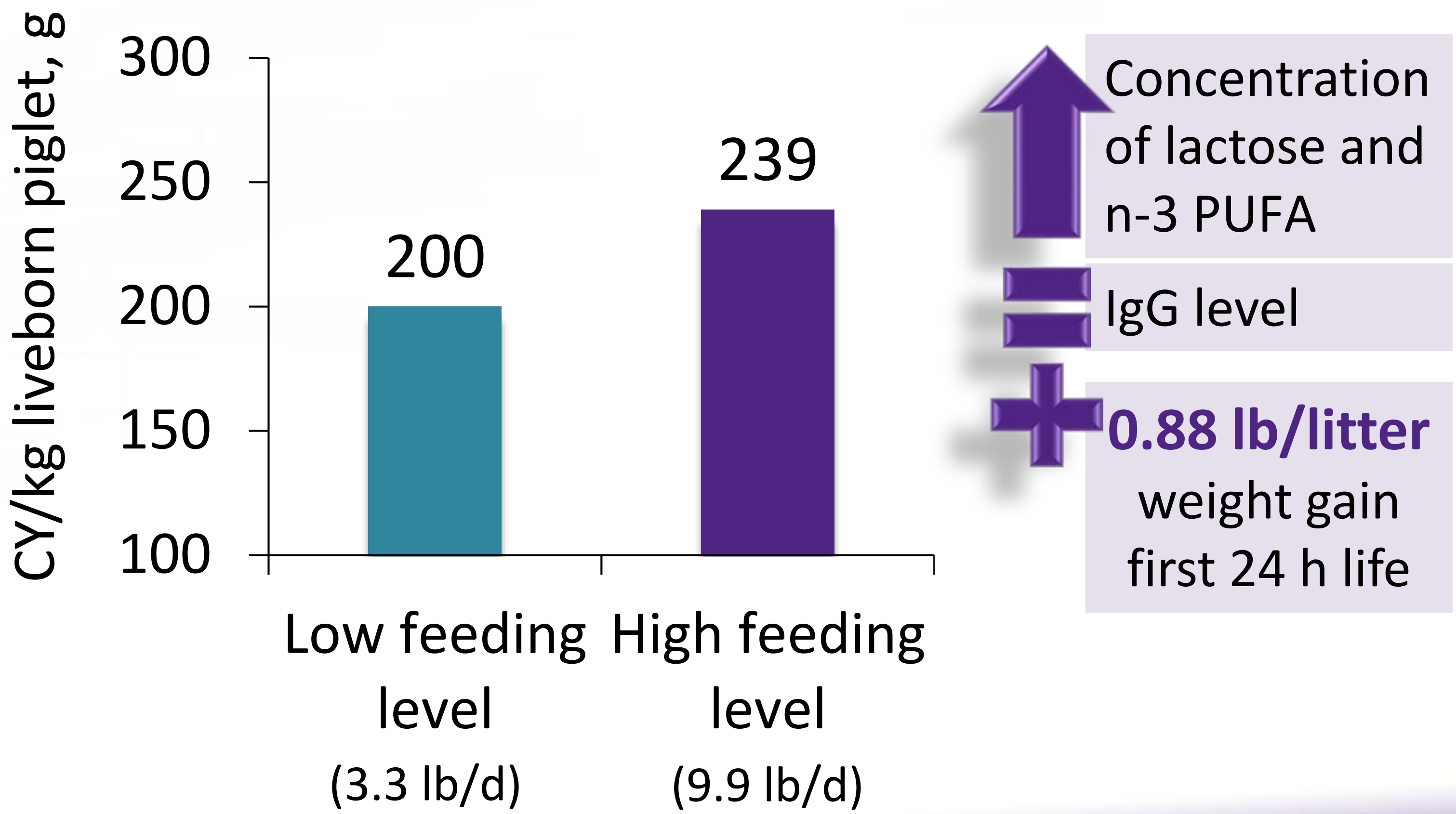


Decaluwé et al., 2014
J Anim Sci

Nutrition in peripartum

Feeding level on peripartum influenced colostrum yield and composition

P < 0.05
SEM = 141
n = 50 sows
(PIC®)



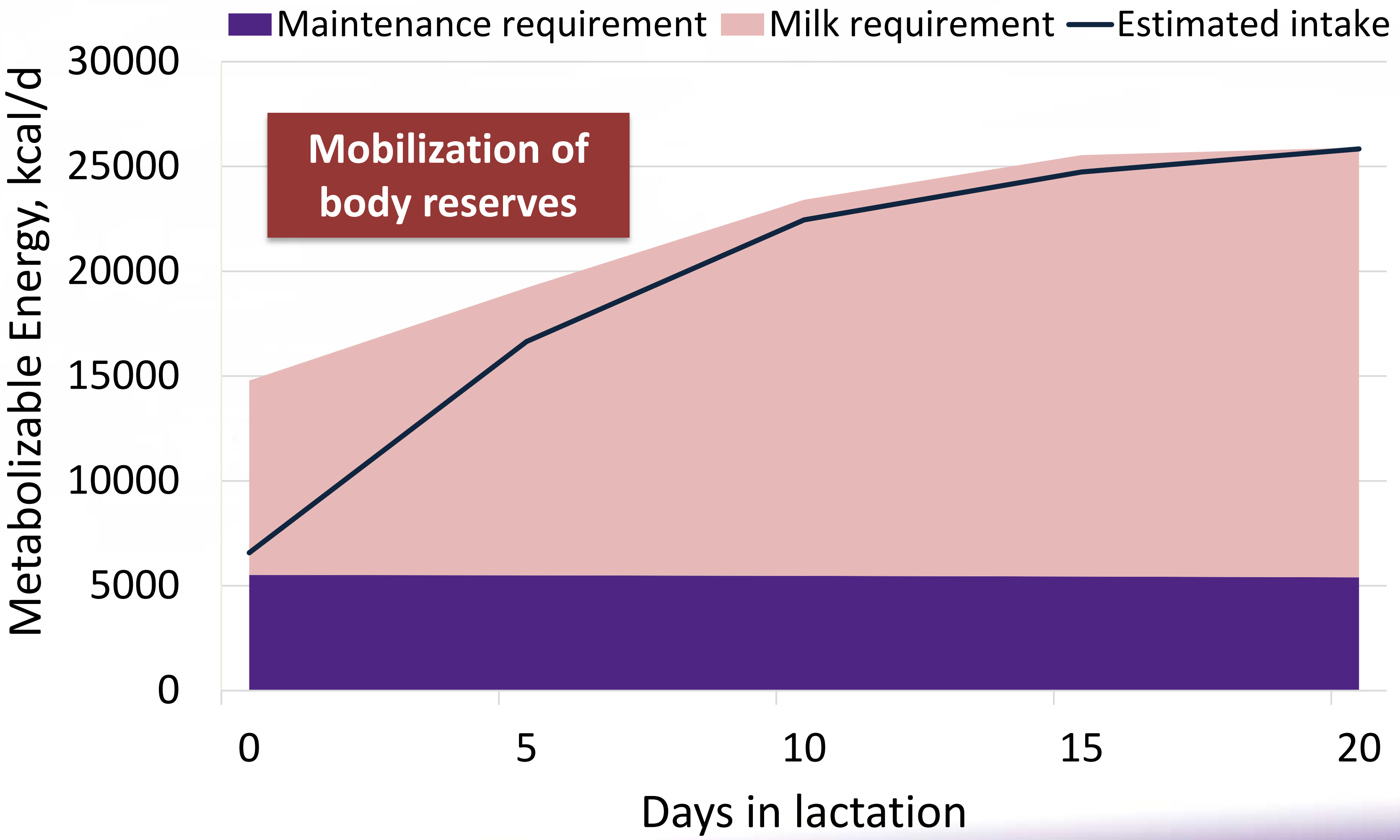
Decaluwé et al., 2014
J Anim Sci

Lactation

Goal of nutrition in lactation:

Maximize feed intake

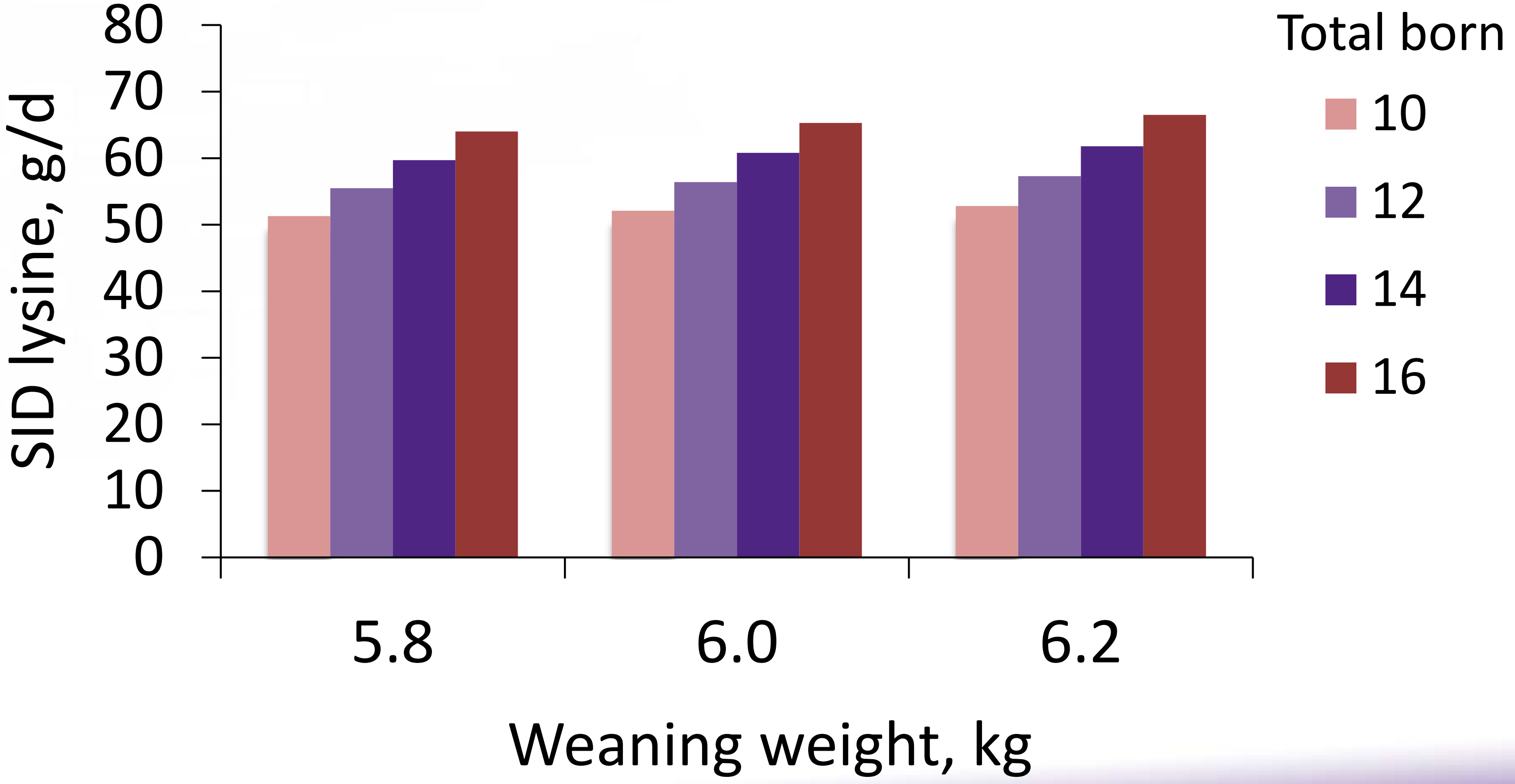
Estimated daily ME requirements and intake of sows in lactation



Adapted from NRC, 2012

Nutrition in lactation

Amino acid requirements in lactation increase w/ litter size and litter growth rate



Adapted from NRC, 2012

Lactation

How to minimize lactational catabolism?

1) **Maximize feed intake**
2) **Appropriate amino acid levels**

Feed intake in lactation

Thermoneutral zone

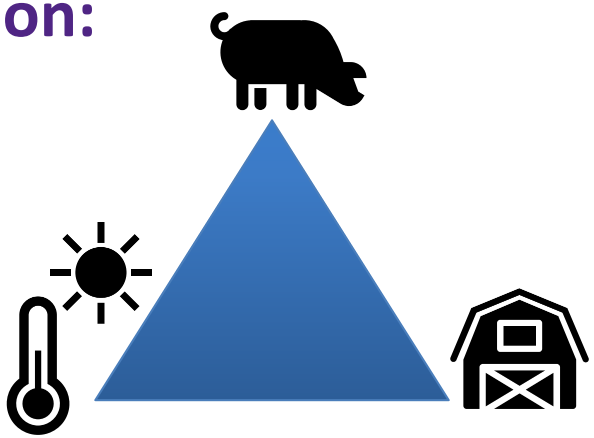
18-20 °C or 64-68 °F

1 °C above 25 °C

- 3.7% feed intake

Diet impact on feed intake in lactation:

- Fat inclusion ≈ 3%
- Soybean meal level < 35%
- Cautious fiber inclusion
- Mycotoxins
- Unpalatable ingredients
- Water access



NRC, 2012

Feed intake in lactation

Water consumption

7.3 gallons water per day

Correlation w/ feed intake

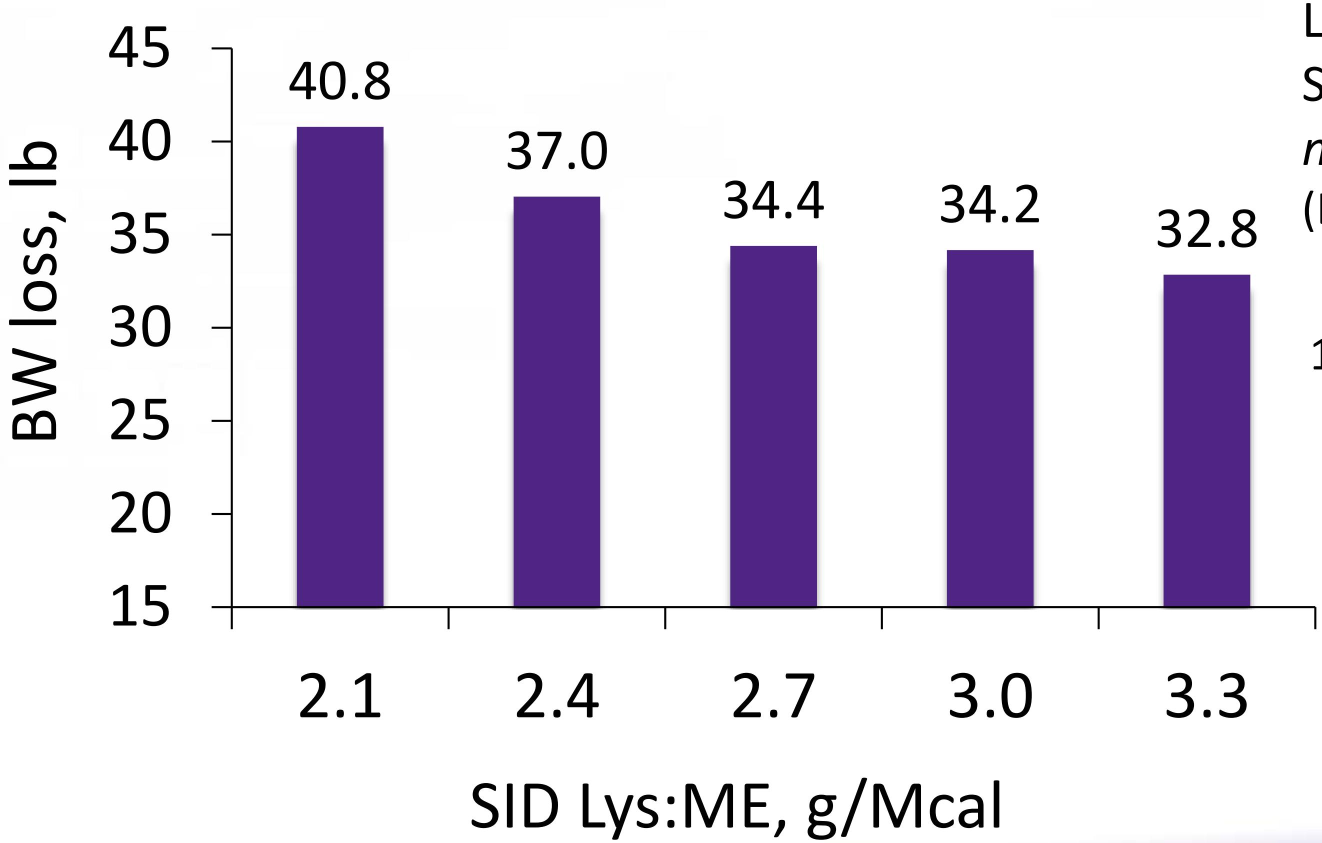
Impact on water intake in lactation:

- Water flow
- Malfunctioning drinkers
- Acquaintance to new drinkers
- Feeder and drinker design
- Temperature

Kruse et al., 2011
Livestock Sci

Amino acid levels in lactation

Appropriate **lysine levels** reduce body weight loss during lactation



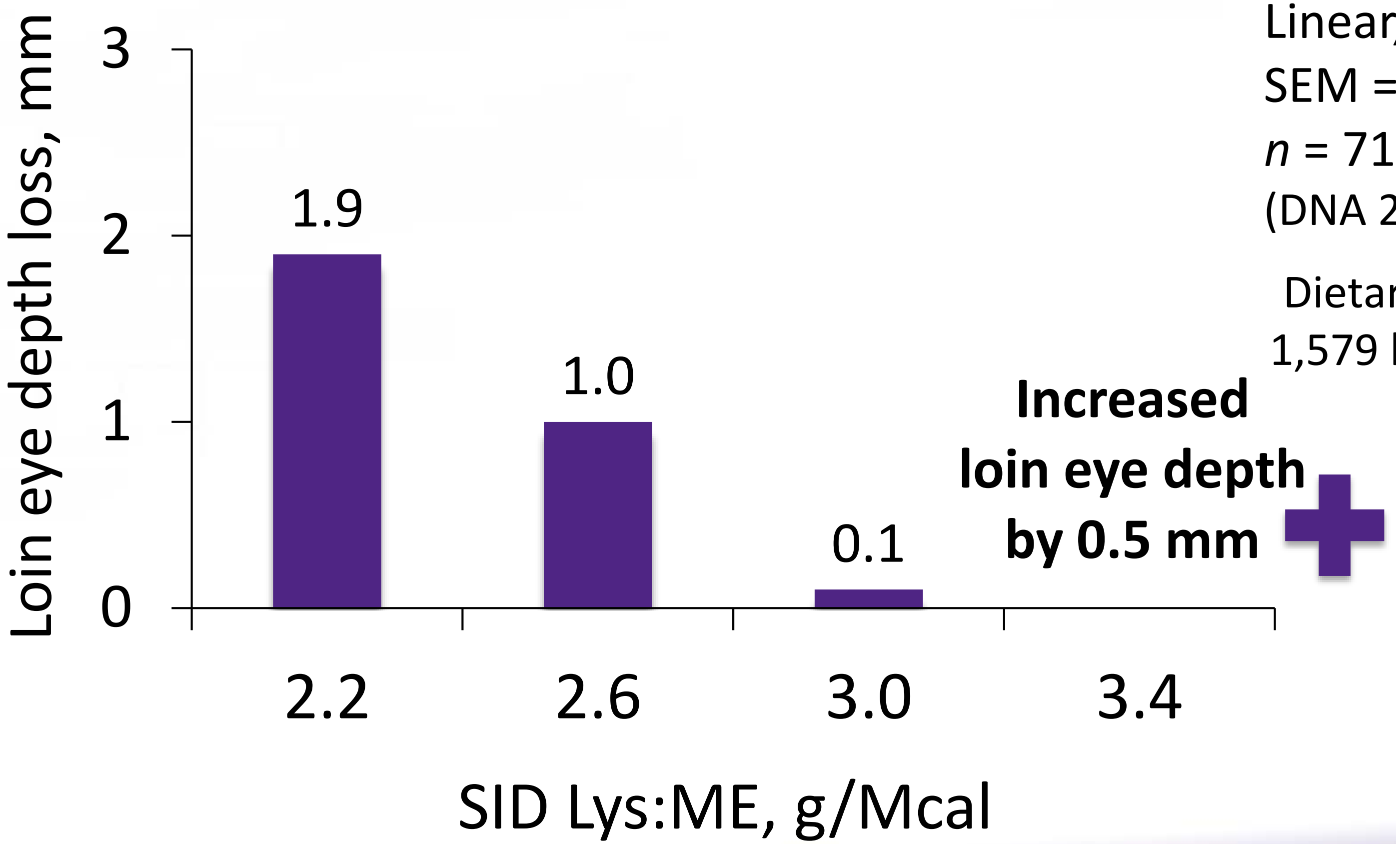
Linear, *P* < 0.01
SEM = 1.63
n = 150 sows
(Landrace x LW)

Dietary energy:
1,474 kcal/lb ME

Xue et al., 2012
J Anim Sci Technol

Amino acid levels in lactation

Appropriate **lysine levels** reduce protein loss during lactation



Linear, $P < 0.01$
SEM = 0.61
n = 710 sows
(DNA 241, DNA®)

Dietary energy:
1,579 kcal/lb ME

K-STATE Research and Extension

Gourley et al., 2017
Transl Anim Sci

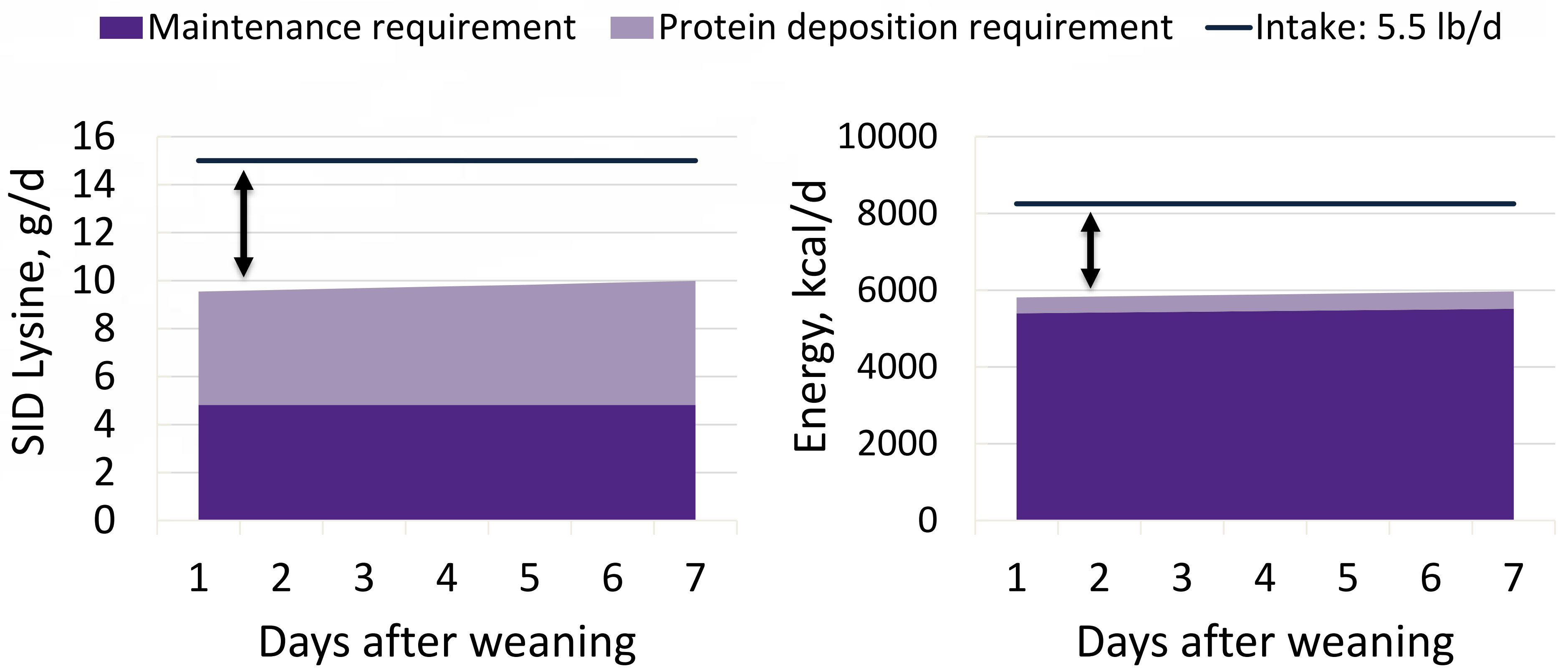
Knowledge for Life

Wean-to-estrus interval

Goal of nutrition in WEI:

Reproduction

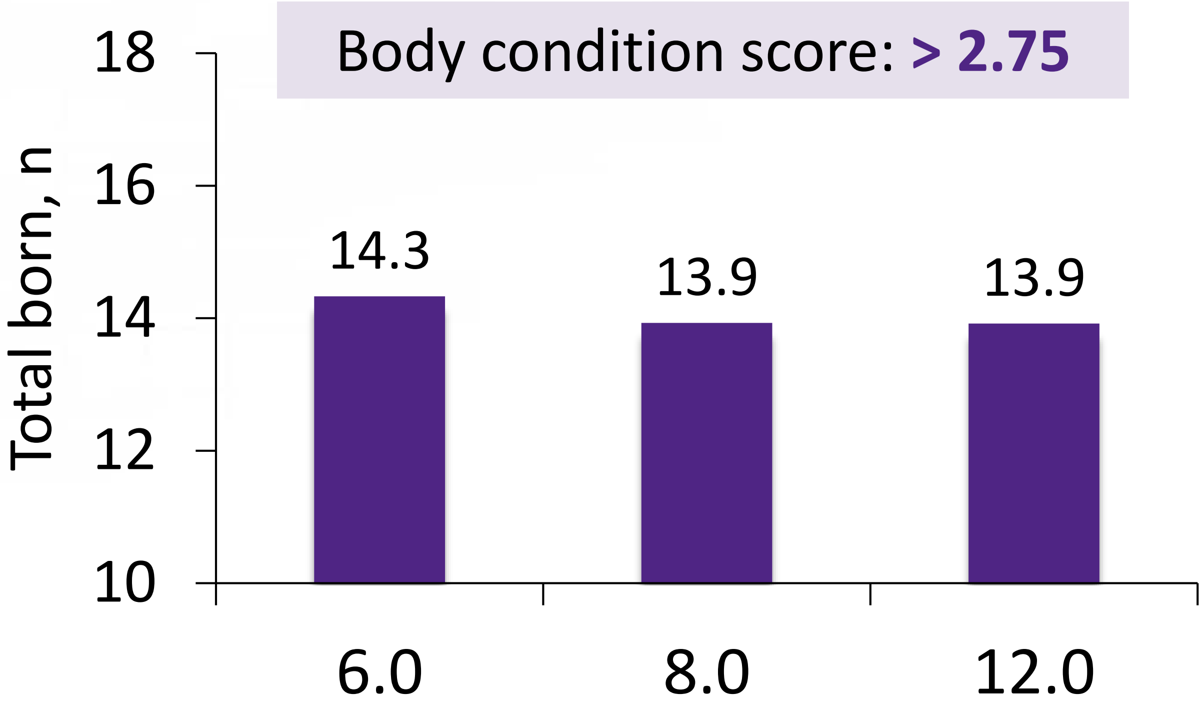
Estimated daily SID Lys and ME requirements and intake in WEI



Adapted from NRC, 2012

Wean-to-estrus interval

Sows in good body condition do not benefit from high feed allowance during WEI

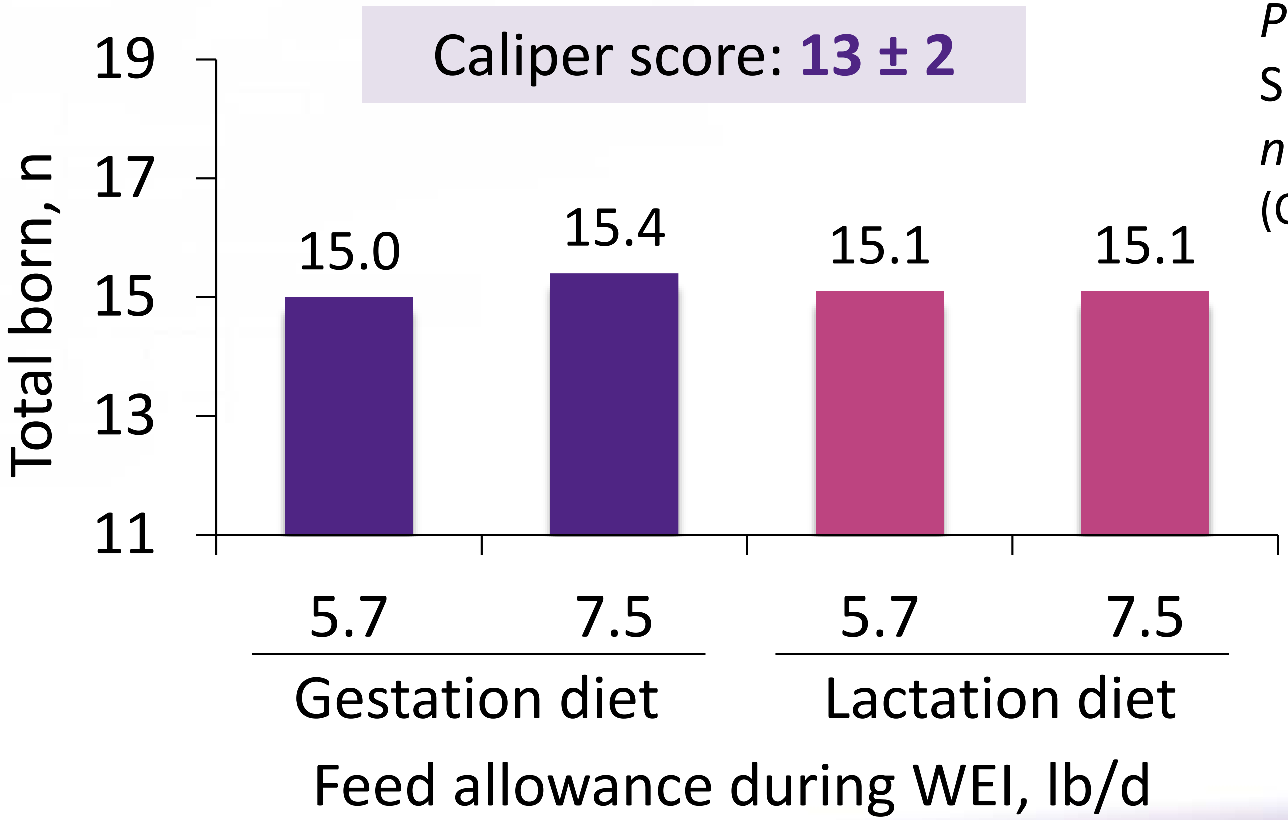


P > 0.10
SEM = NR
n = 638 sows
(PIC 1050/C22/C29)

Graham et al., 2015
J Anim Sci (Abstr)

Wean-to-estrus interval

Sows in good body condition do not benefit from feeding lactation diet during WEI



P > 0.10
SEM = 0.36
n = 542 sows
(Camborough, PIC®)

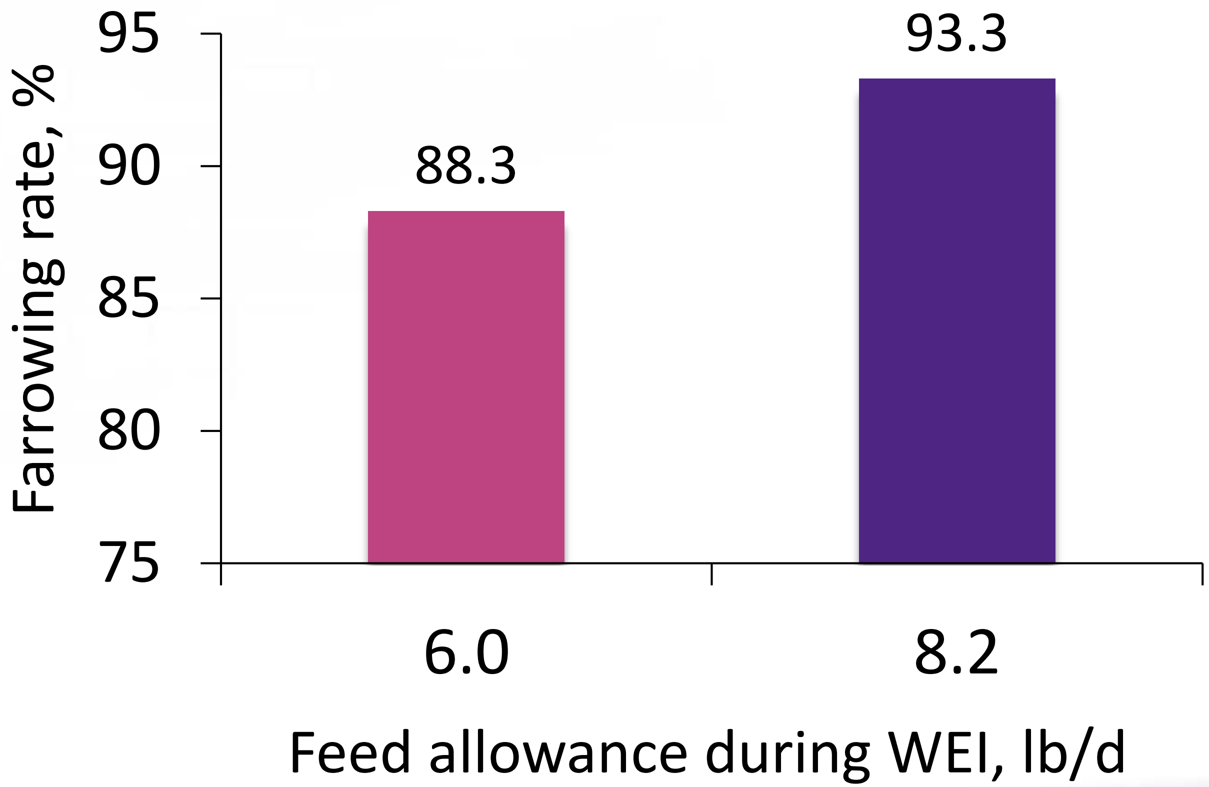
Almeida et al., 2018[a]
J Anim Sci (Abstr)

K-STATE Research and Extension

PIC® Knowledge for Life

Wean-to-estrus interval

Contrarily, high feed allowance of lactation diet improved farrowing rate



P = 0.05
SEM = 2.78
n = 543 sows
(Camborough, PIC®)

Almeida et al., 2018[b]
J Anim Sci (Abstr)

Take-home message

- Avoid feed restriction after breeding
- Adjust body condition by day 30 of gestation
- Impact of nutrition on birth weight is modest
- Maximize feed intake in lactation at placement
- Simplify feeding programs
- Investigate strategies for transition feeding and WEI

Thank you!

Visit ksuswine.org

Kansas State University | applied swine nutrition

PIC® 2018
Nutrition Seminars

NEVER STOP IMPROVING

PIC®

Never Stop Improving Nutrition.

Feeding Group-Housed Sows

Global Technical Services

PIC

Introduction

- Modern consumers demand production practices and facilities that they can associate with animal friendliness

- Beyond the housing setting definition, producers have to decide what feeding system to use

Introduction

Never
Stop
Improving
Nutrition.

- Basic principles need to be well understood to develop sound management practices and stay competitive in the business
- There is not the best one group housing system, but each one with the pros and cons
- We would like to share our experience and lessons learned over the last few years

PIC®

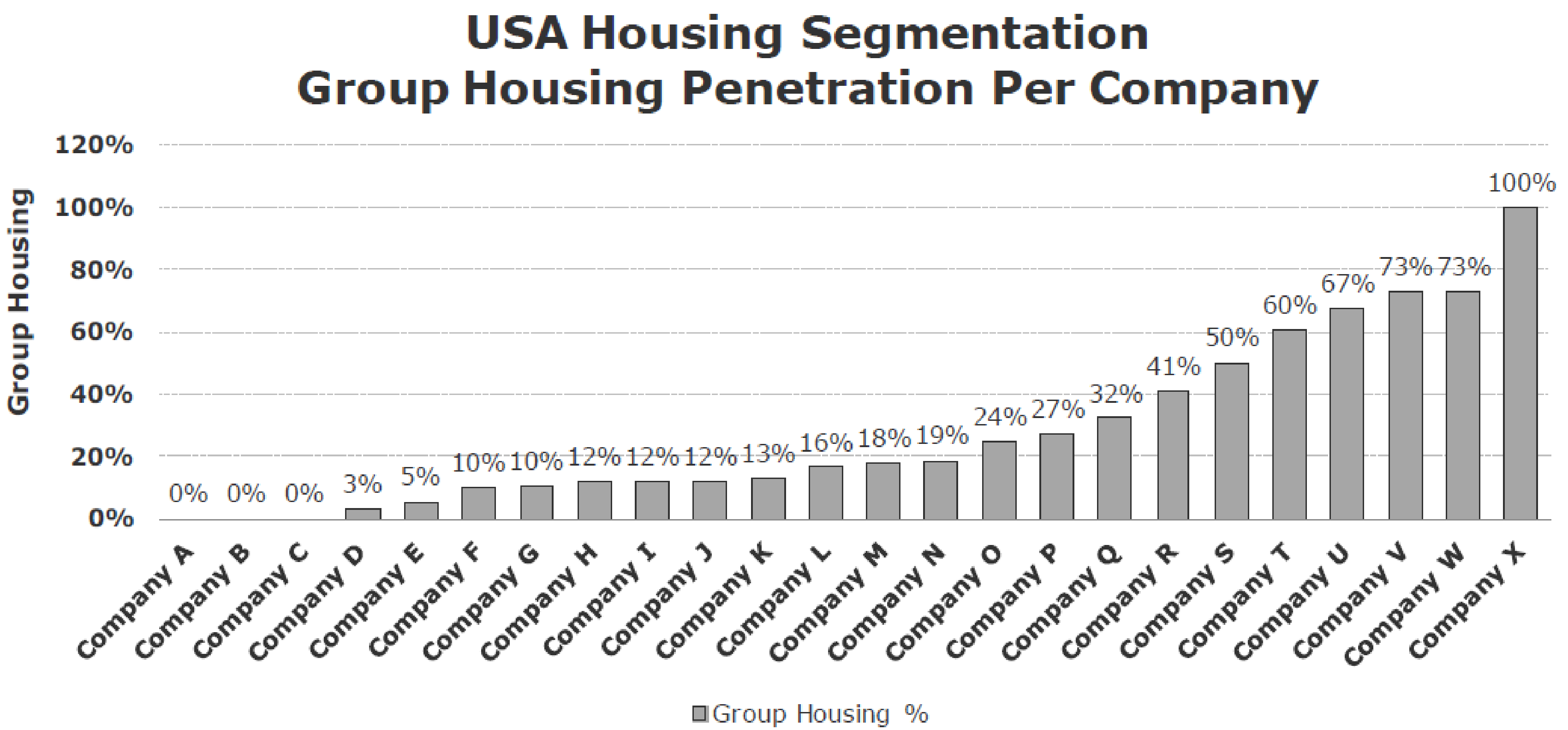
Outline

- Overview
- Lessons Learned
- Take Home Message

Group Housing in NA Industry

Last Segmentation Done by PIC

- 88% of the companies had sows in group housing
- 33% of sow inventory were in group housing



PIC®

Never Stop Improving Nutrition.

Most Common Options

Never Stop Improving *Nutrition.*

Floor Feeding

Stanchion

ESF – Electronic Sow Feeding

Free Access

PIC®

Group Housing Comparison

Never Stop Improving Nutrition.

	Stalls	Free Access	Floor Feeding	Stanchions	ESF	JYGA Gestal
Body Condition Management *	+ + + +	+ + +	+ +	+ + +	+ + + +	+ + + +
Aggressions	x	x	xxx	xx	xx	x
Building / Retro fitting Costs	x	xxx	x	x	xxx	xx
Running Costs	x	xx	xx	xx	xx	xx
Ease of management	+ + + +	+ + +	+ + +	+ + +	+ +	+ +
Feed Usage	x	xx	xxx	xx	x	x

+ poor, ++ acceptable, +++ good, ++++ very good
x lower, xx moderate, xxx higher

* It considers the potential to have a better managed body condition.

PIC®

Stanchions Overview

Never Stop Improving Nutrition.

- Lower building costs and easier to retro-fit stalled farms
- Harder to manage body condition in larger pens
- Tend to use more gestation feed than individual feeding systems (1/4 to 1/2 more lbs/d)

PIC®

Stanchions Key Points

- Needs to consider one feeder per sow in the pen
- Same time feeding pattern every day
- Segregation by body condition, parity and weight. Smaller pens work better (8 to 14 sows)

Floor Feeding Overview

- Lower retro-fitting costs
- Harder to manage body condition in larger pens
- Tend to use more gestation feed than individual feeding systems (1/4 to 1/2 more lbs/d)

Floor Feeding Key Points

Never Stop Improving Nutrition.

- Space below feeders plays a role in the distribution and competition while sows eat
- Same time feeding pattern every day
- Segregation by body condition, parity and weight. Smaller pens work better (4 to 10 individuals)

PIC®

ESF Overview

- Higher building and running costs
- Allow individual sow feeding in group housing
- More challenging to manage
- Technology brings new solutions

ESF Key Points

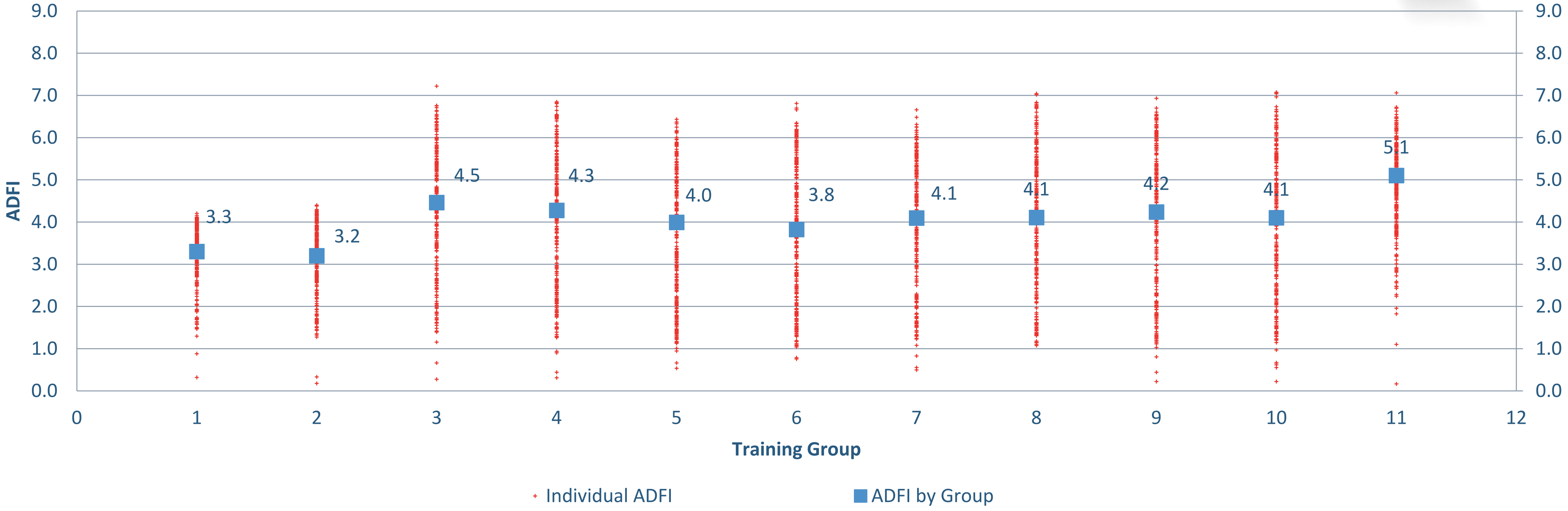
Never Stop Improving Nutrition.

- A proper gilt training process is needed for proper performance
- Be proactive to use the reports to find non-eater sows as soon as possible
- Have people engaged to technology and open to new ways to produce pigs

PIC®

ESF Gilt Training ADFI (lbs.) at a 5K Sow Unit

Never Stop Improving Nutrition.

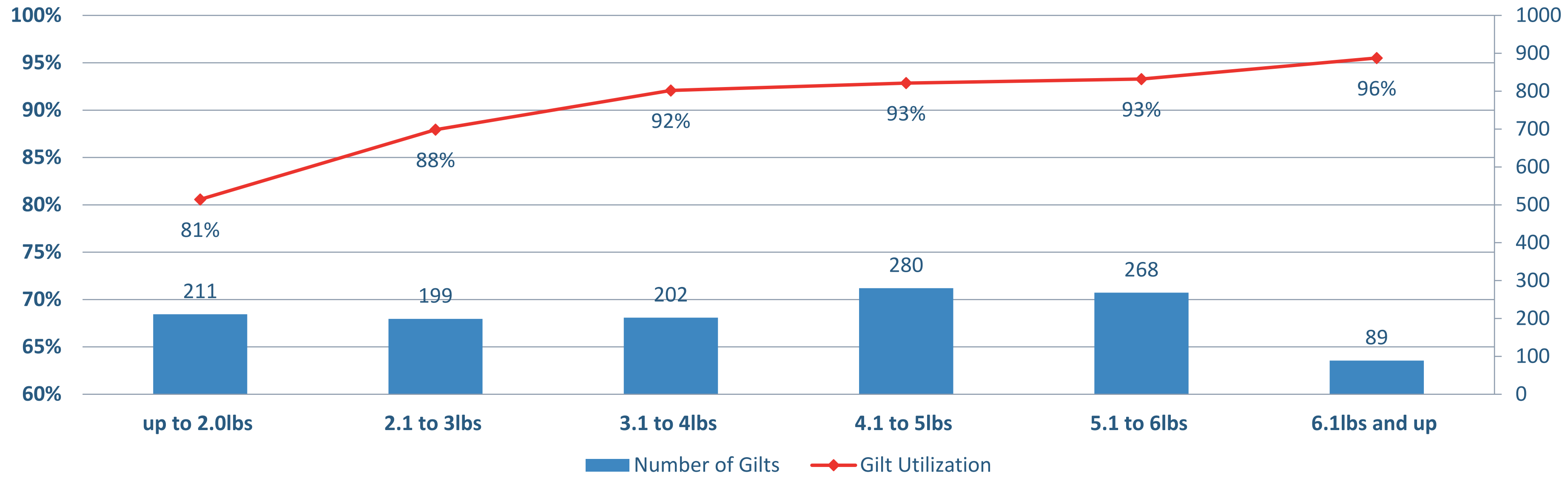


- Blue dots: ADFI for the gilt training group.
- Red crosses: individual ADFI.
- Total of 2,714 gilts trained, ~250 gilts per training group, 11 training groups, 3 weeks gilt training process.

PIC

Gilt Utilization By ADFI (lbs) At Training

Never Stop Improving Nutrition.



* Preliminary results 2018.

- Total of 1,249 gilts bred. Average 90% gilt utilization, 3 weeks gilt training process.

PIC®

JYGA- Gestal Overview

- Combination of ESF and Free Access
- Allows individual sow feeding
- Does not need to have gilt training, but just crate breaking.

Never Stop Improving Nutrition.

PIC®

Free Access Overview

Never Stop Improving *Nutrition.*

- Higher building costs due to stock density/sow

- Easier to manage condition than Stanchion and Floor Feeding: Possible to lock up sows with unfavorable body condition

- Size of pen and segregation by body condition, parity and weight still important

PIC

Group Size

Larger Groups

(More than 150 individuals):

The group is intended to be large enough to minimize or eliminate social hierarchy.

Usually ESF dynamic.

Medium Groups
(40 to 150 individuals)

Structured to match either the size of a breeding group and/or the capacity of a particular feeding unit.
Usually ESF static and Free access.

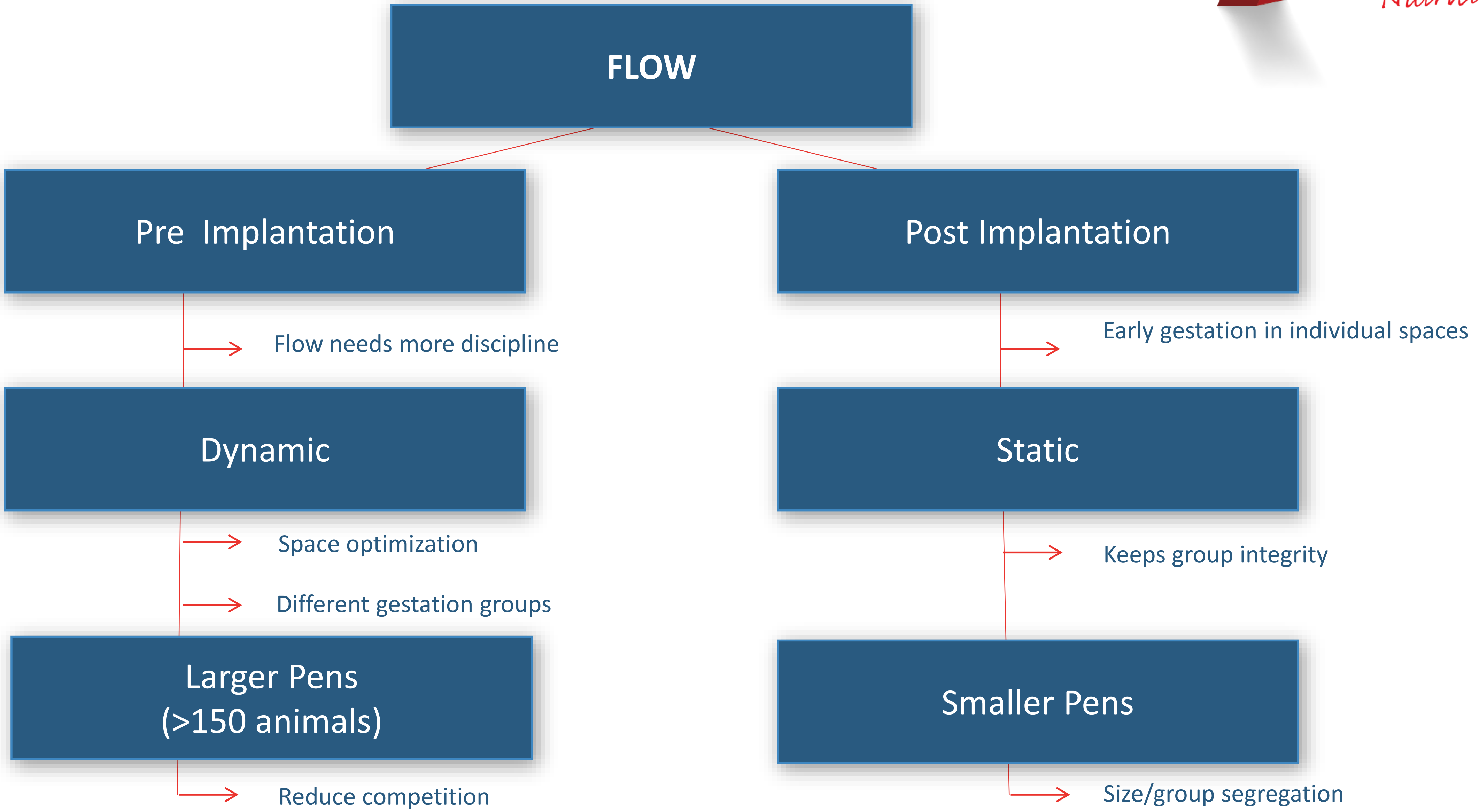
Smaller Groups

(5 to 20 individuals):

Group is typically chosen to have similar body condition, parity and weight, and to have similar feed requirements.

Usually Stanchions and Floor Feeding.

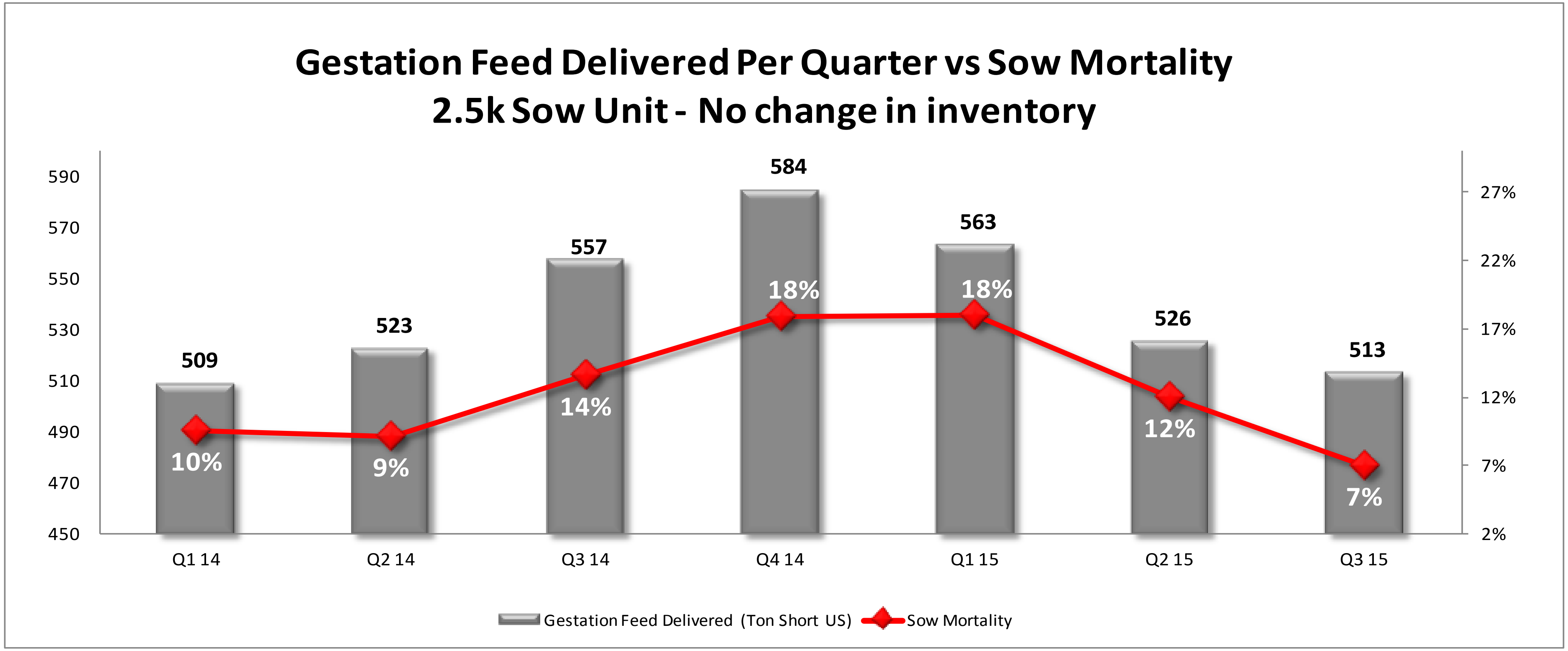
Group Housing Flow



The Usual Challenges

Excessive Body Condition

- A herd in the heavy side will be less forgiving in group housing settings.
- Main reported issue is lameness.

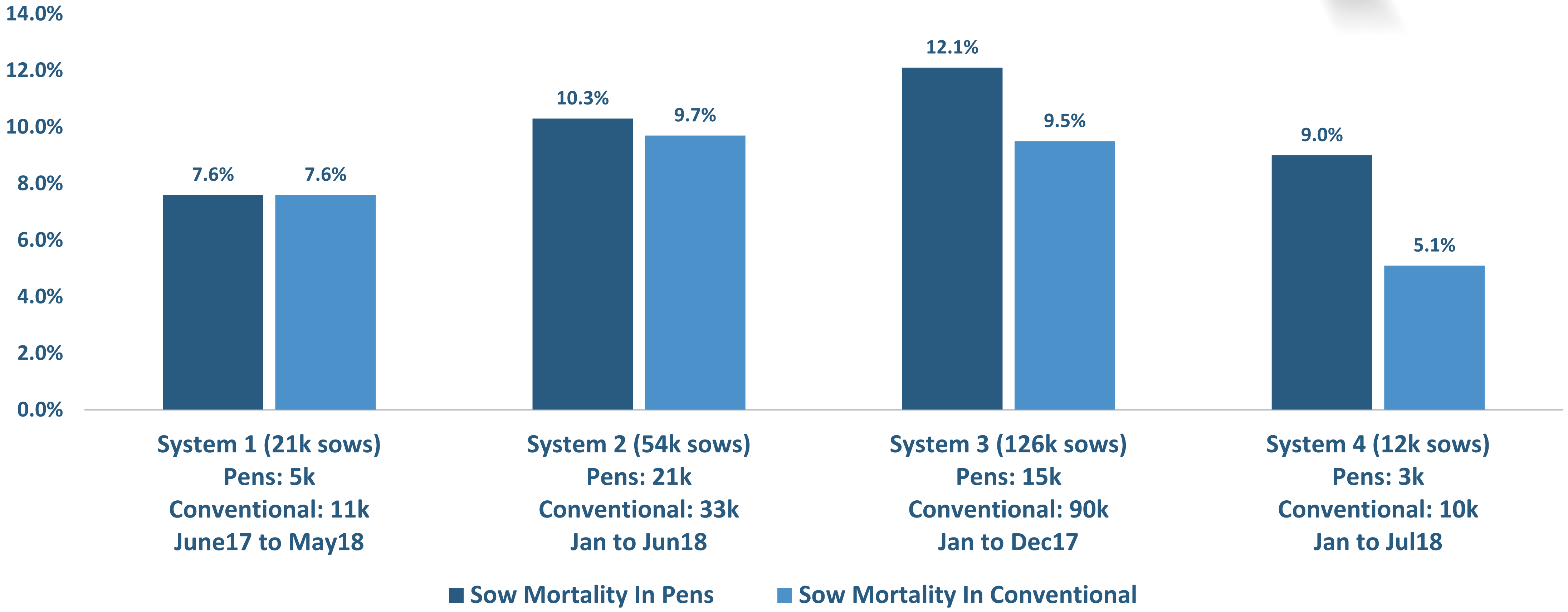


Never Stop Improving Nutrition.

PIC

Pens vs. Conventional

Sow Mortality



	System 1	System 2	System 3	System 4
Difference between sow mortality in pens vs. conventional	0 %	+ 0.6%	+ 2.6%	+ 3.9%

Additional Thoughts

- Harder to identify individual sows in need of intervention
- Retrofitted farms usually faces a spike on sow mortality
- Risk factors have been identified but sometimes are not properly addressed

One Page Summary

- Group Housing is a reality in North America
- There is not a single best type
- Somehow all of them are related to the way to feed sows
- Industry should be aware of the challenges, to overcome them

Never Stop Improving

Camborough Efficiency: Roundtable Discussion

PIC

Lunch + The Science Behind Meat Quality

The Science Behind Meat Quality

PIC

2018 PIC Swine Nutrition Seminar

Pick Your Pork

Never
Stop
Improving
Nutrition.

PIC®

Pork Quality Around the World

Never
Stop
Improving
Nutrition.

PIC

Never Stop Improving Nutrition.

Pork is NOT Beef or Chicken

BEEF

- Ruminant
- ~ 24 months at slaughter
- More “red” fibers
    - Type I
- More collagen
- Difficulty getting pH to go down
- Fatty acid profile more saturated

PORK

- Non-Ruminant
- ~ 6 months at slaughter
- More “white” fibers
    - Type II (mostly IIb)
- Less collagen
- Difficulty keeping pH from going down
- Fatty acid profile less saturated

CHICKEN

- Non-ruminant
- ~ 40 days at slaughter
- All “white” fibers (in breast)
    - Type II (~99% IIb)
- Less collagen (barring defects)
- Difficulty keeping pH from going down
- Fatty acid profile less saturated

PIC®

Never Stop Improving Nutrition.

Pork Quality or Pork Marketing

Table 1—Pork Carcass Quality Grade Based on Lean Color and Marbling [13]

Quality grade	Lean color score	Lean marbling score
USDA Prime	4-5	*Greater than or equal to 4.*
USDA Choice	3	*Greater than or equal to 2.*
USDA Select	2	*Greater than or equal to 2.*

(b) The following descriptions provide a guide to the characteristics of barrow and gilt carcasses in each grade.

(1) USDA Prime—Barrow and gilt carcasses in this grade have at least a slightly firm lean, a color score of 4 or 5, and a marbling score of 4 or greater.

(2) USDA Choice—Barrow and gilt carcasses in this grade have at least a slightly firm lean, a color score of 3, and a marbling score of 2 or greater.

(3) USDA Select—Barrow and gilt carcasses in this grade have at least a slightly firm lean, a color score of 2, and a marbling score of 2 or greater.


≠



≠


ALL NATURAL
COMPART®
FAMILY FARMS
PREMIUM
DUROC
The "Black Angus" of Pork®
www.compartduroc.com

PIC®

What is Quality?

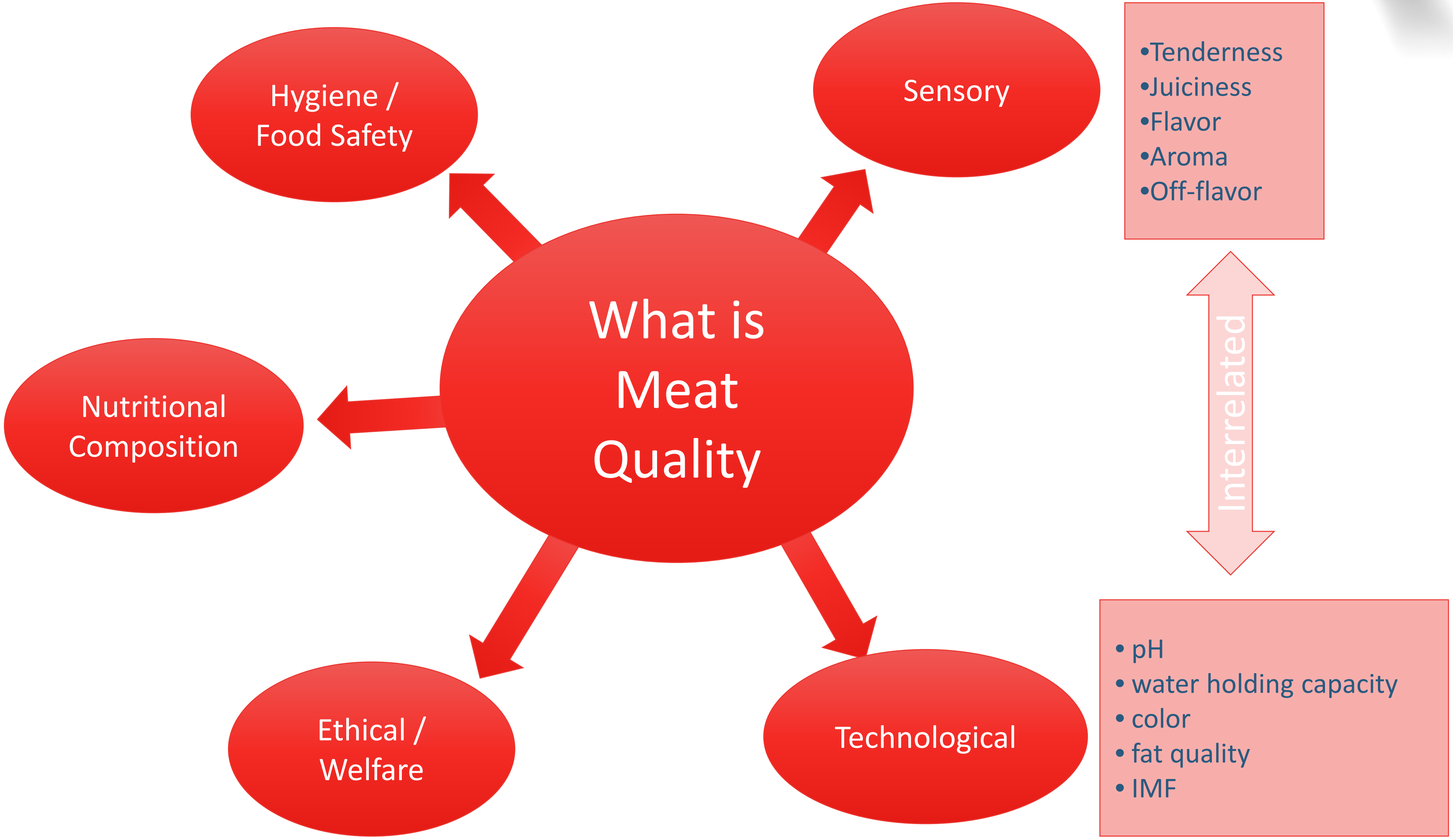
Never Stop Improving Nutrition.

Quality is the total of all characteristics that cause differences between samples of a product and which influence the appreciation by the end user (processor - consumer)

End users define “quality” based on different characteristics

PIC®

How Do You Define Meat Quality?

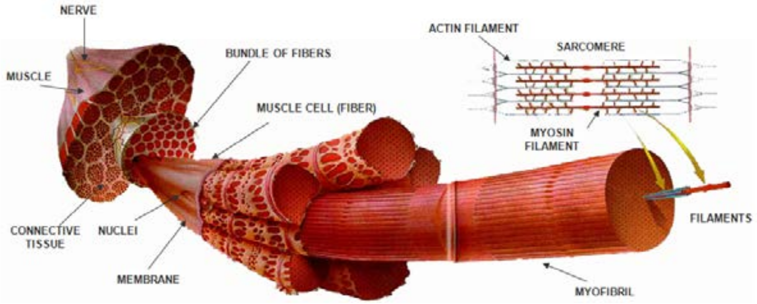


Never Stop Improving Nutrition.

PIC

Never Stop Improving *Nutrition.*

Conversion of Muscle to Meat



Glycogen → Lactate

		45 min post-mortem				24 h post-mortem				
7.2	7.0	6.8	6.6	6.4	6.2	6.0	5.8	5.6	5.4	5.2

pH scale

Sodium hydroxide	Bleach		Ammonia	Milk of Magnesia	Baking soda		Water	Milk			Orange juice	Lemon juice		Battery acid
14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Basic (Alkaline) **Neutral** **Acidic**

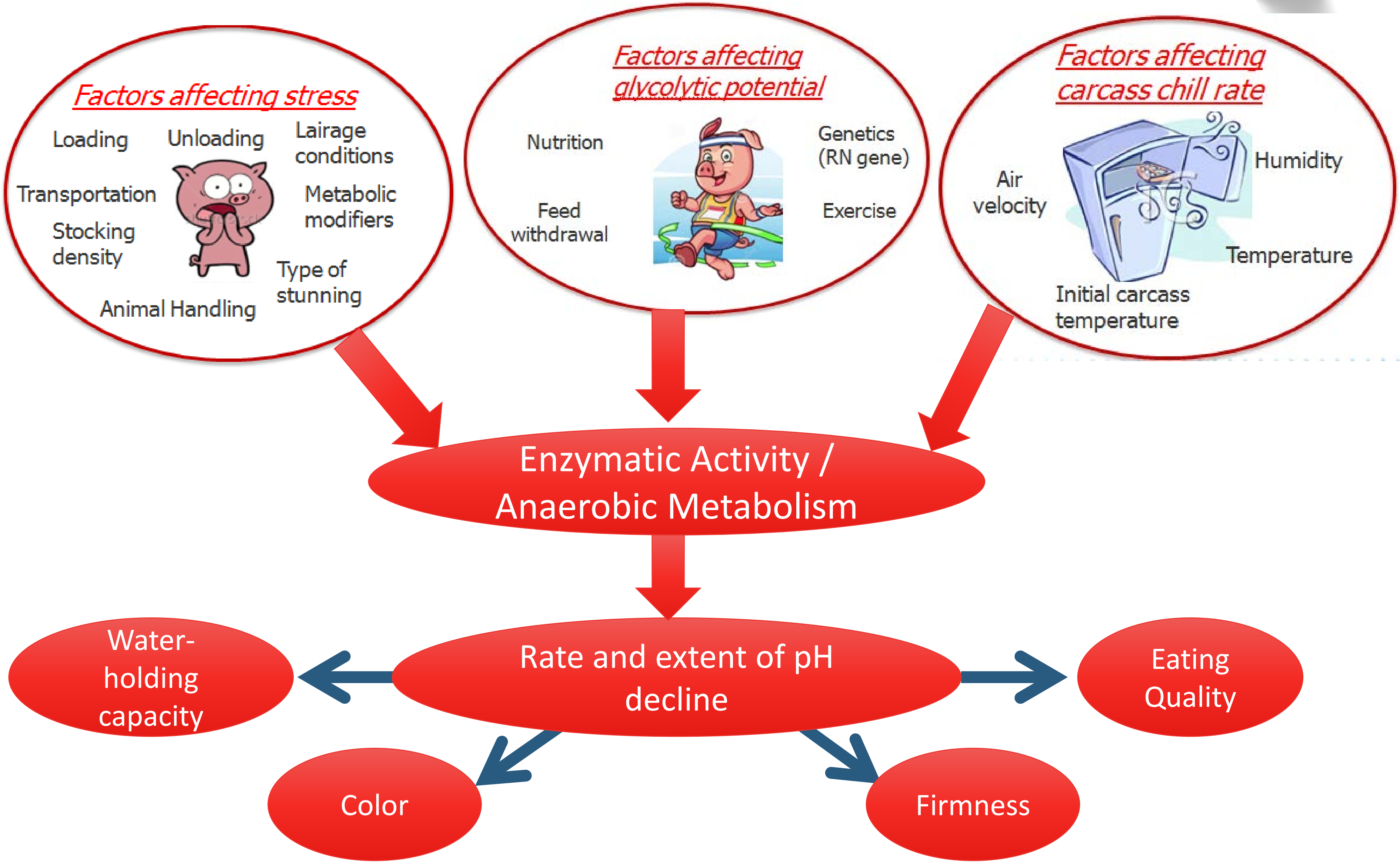
Rate and extent of pH decline influenced by:

- glycolytic potential
- enzymatic processes
- carcass temperature
- stress

PIC®

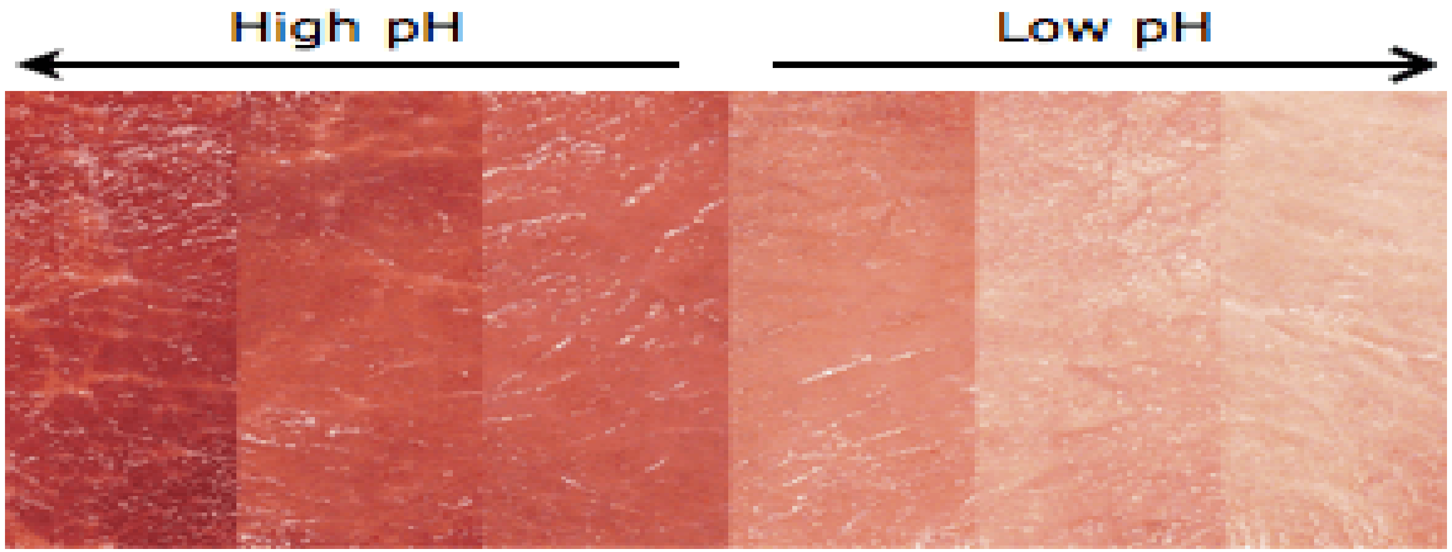
Factors That Determine Pork Quality

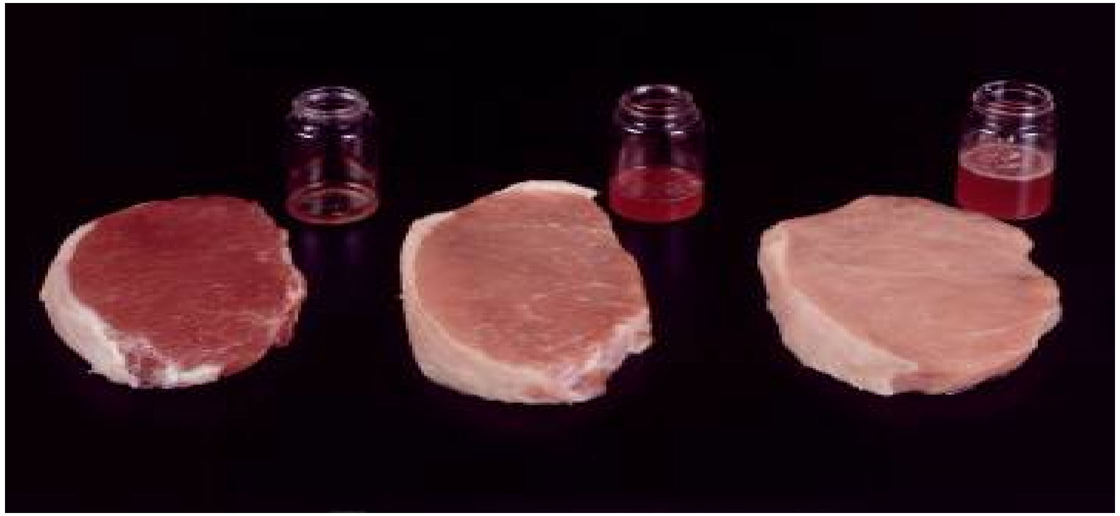
Never Stop Improving Nutrition.



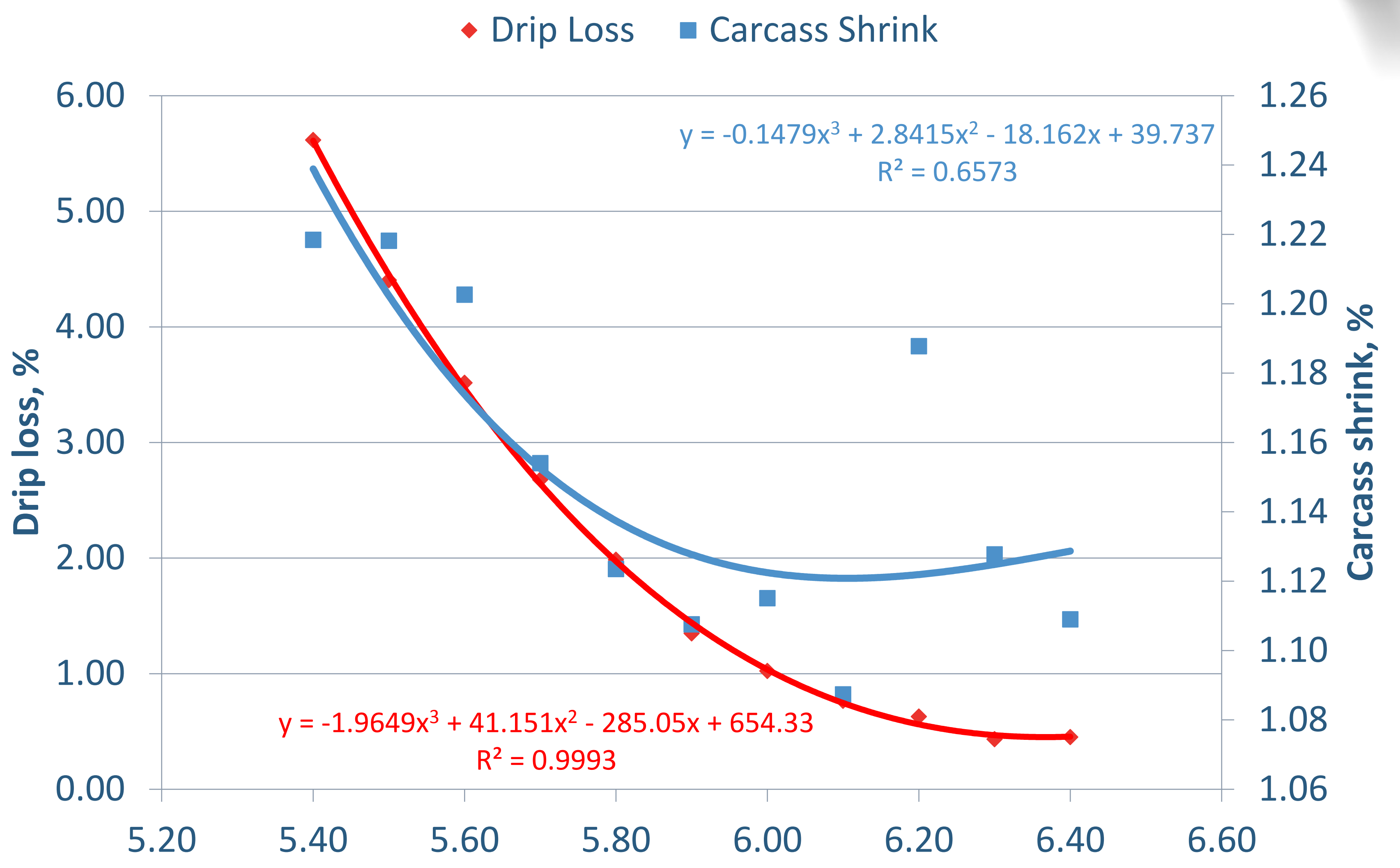
PIC®

Meat Quality Relationships



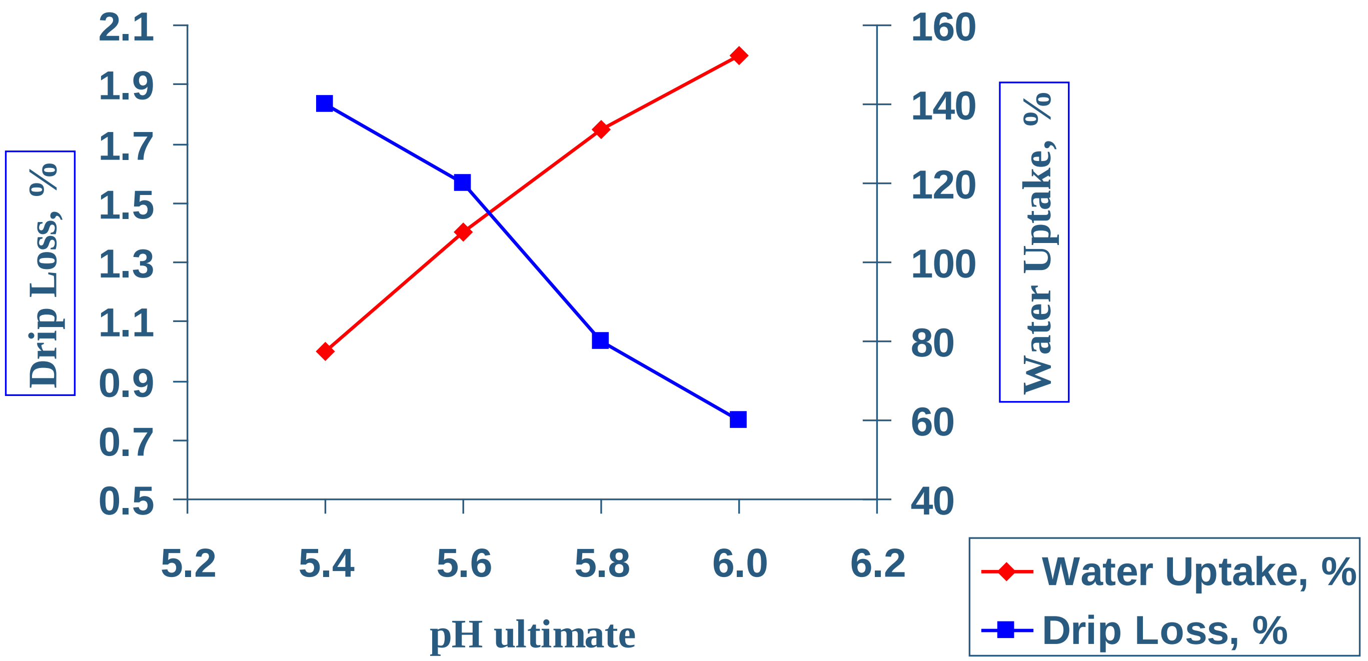


Effect of pHu on Water Losses



*****Sample size was 28,024 for drip loss and 21,996 for carcass shrink.

Relationship of Drip Loss and Water Uptake to pHu

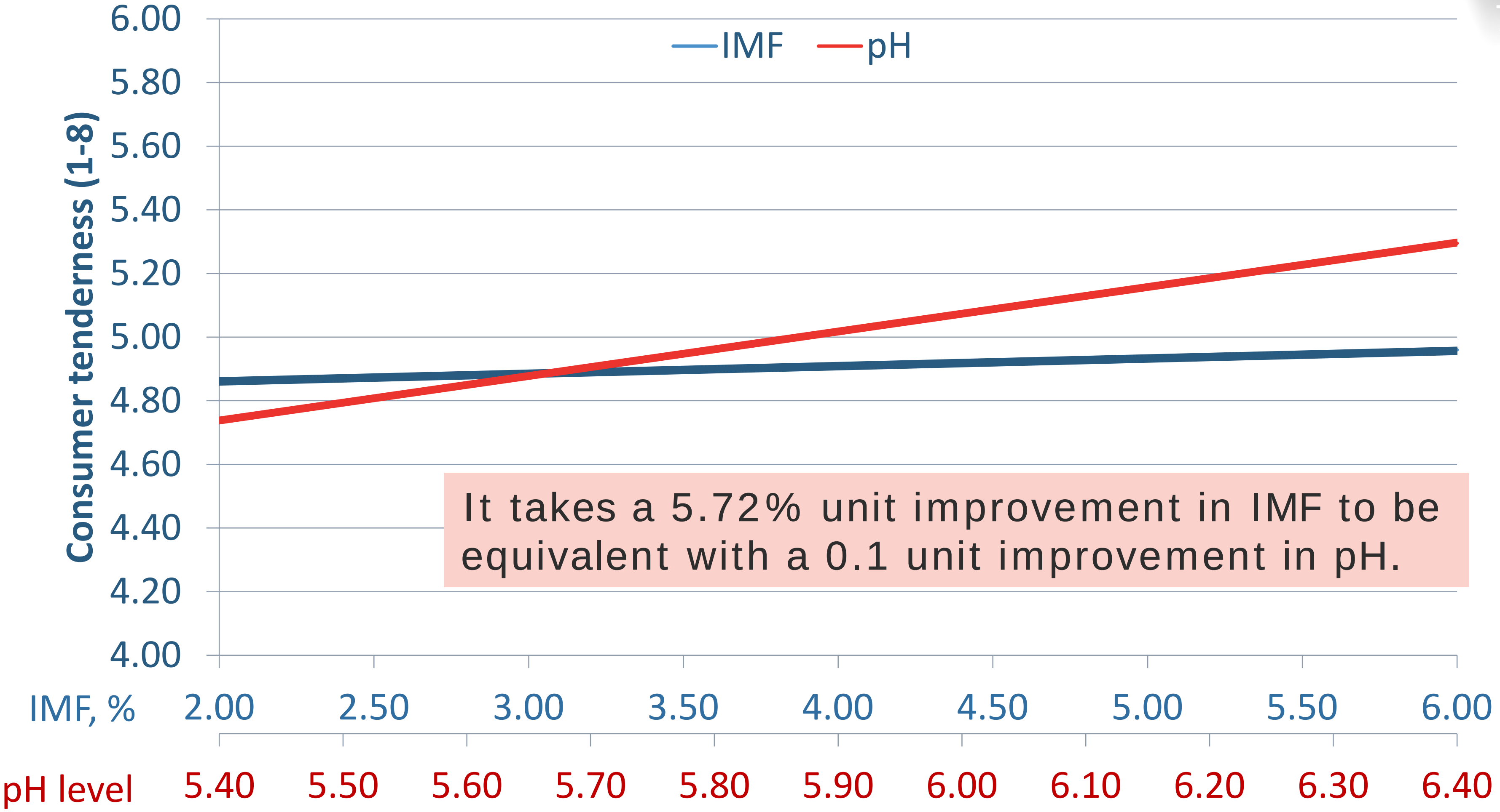


Adapted from: (Eikelenboom et al., 1995)

Effect of IMF and pH on Consumer Tenderness

Never
Stop
Improving
Nutrition.

7



It takes a 5.72% unit improvement in IMF to be equivalent with a 0.1 unit improvement in pH.

* Adapted from Moeller et al., 2010; Consumer score 1 = most unfavorable and 8 = most favorable.

PIC®

Managing the Pork Quality Quiz

Never Stop Improving *Nutrition.*

Non-systemic Environmental Factors = Not Well Understood

± 10%

Systemic Environmental Factors = Manageable

60 to 70%

Genetics 20 to 30%

PIC

PIC Pork Quality Blueprint

Areas that have influence on ultimate pH

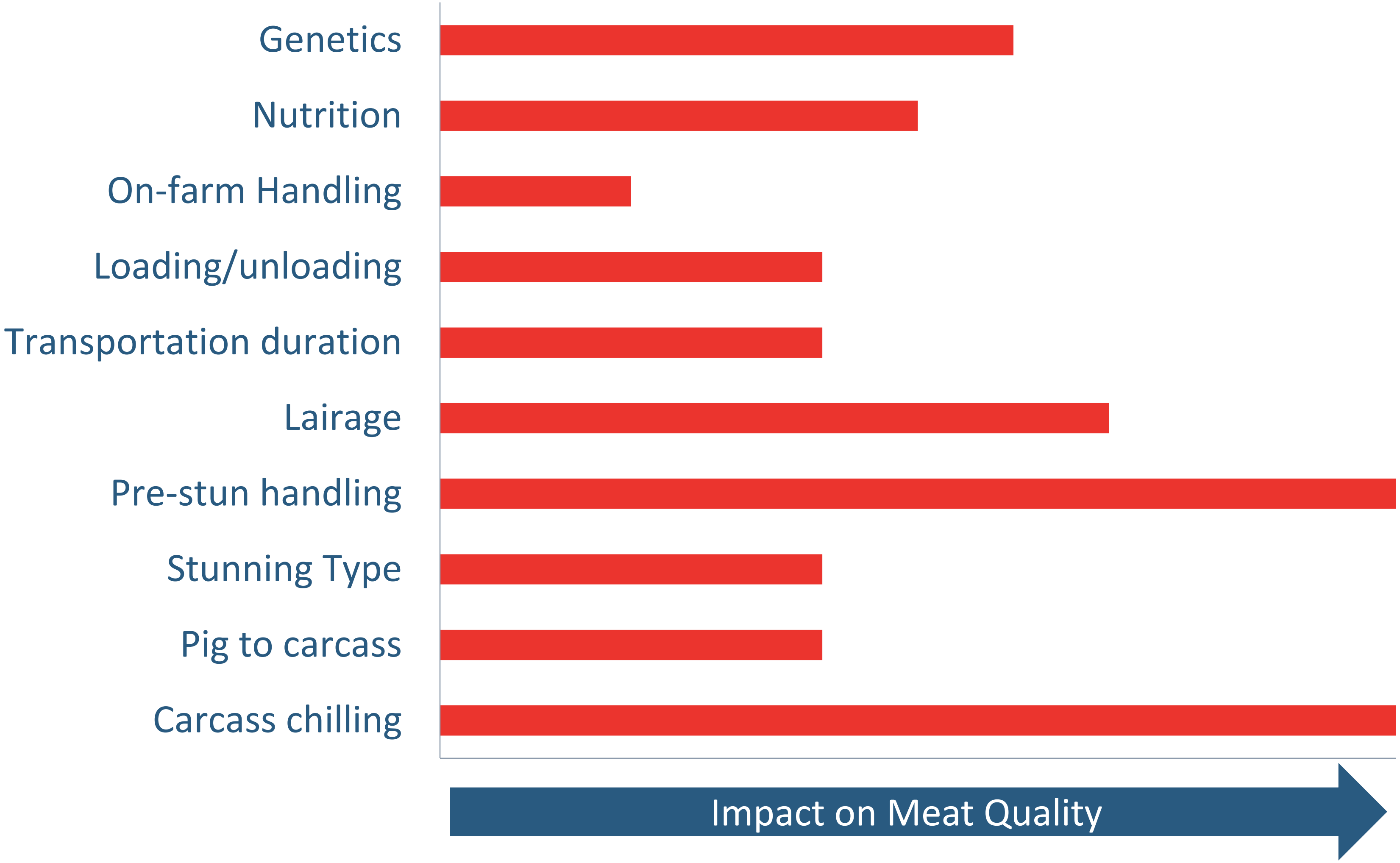
Areas that have influence on initial pH

Areas influencing chilling

Genetics	Feed withdrawl	Loading stress	Transportation stress	Unloading stress	Lairage and movement	Stunning	Stun to chill	Chilling
Must start with good genetics Remaining procedures can not "make-up" for poor genetics	Minimum of 6-8 hours on farm feed withdrawal with a maximum feed withdrawal of 24 hours (farm to stun)	Move small groups No electric prods Practice good pig movement behaviors Loading ramp less than 25°	Provide ample bedding Stocking density Length of transport	Move small groups Unloading ramp less than 25° No electric prods	Proper ventilation Water misters use during warm weather Proper stocking density Move in small groups Avoid 90° turns Avoid excessive water on floor Maintain good lighting Minimize reflections	Minimize stress moving animals into the stunner Move in small groups Try to maintain fluid movement of pigs CO2 Stunning Concentration >95% Dwell time >90 sec No overloading gondolas Electric Stunning Use proper settings Maintain equipment Proper tong placement	Stun to stick time of <60 sec for CO2 stunning or <20 sec for electrical stunning Use proper effective sticking procedures Scald temperature <60°C (tub) Minimize stun to chill time; <40 minutes is desirable	Chill as quickly as feasible Attain 32°C in the deep ham and loin before pH goes below 6.00 Good blast chilling is a combination of air flow (>10 m/s during early stages) and temperature Great chilling will maintain meat quality but not correct issues earlier in the "chain"

Never Stop Improving *Nutrition.*

Production Chain Factors Affecting Pork Quality



PIC®

Nutritional Effects on Meat Quality

Feeding to affect fatness/marbling.

- Low lysine diets fed to increase marbling (very expensive as growth rate and FCR are affected negatively).

Feeding vitamins, minerals, or other ingredients to improve pork quality (i.e. color, pH, sensory panel).

- Most cases results are inconsistent (pre- and post-slaughter process are much more influential).
- Carnitine, Chromium, Betaine, Creatine, Mg, Fe, Mn, Niacin, Vit E., Vit. D, and Vit. C are a partial list reviewed in the literature.
- Cost often does not support the benefit.

Feed withdrawal

- Feed withdrawal prior to slaughtering of pigs is essential for developing good pork quality.

Feed Withdrawal and Lairage Rest Time Recommendations

Never Stop Improving Nutrition.

Target 12 – 20 hours of total feed withdrawal.

- Maximum of 24 hours
- Start losing carcass weight between 24 to 30 hours off feed
- Ensure that on farm feed withdrawal is actual feed withdrawal and not just feed system shut off.

Minimum of 6-8 hours on farm feed withdrawal before loading.

- Gut shuts down once pigs are loaded on the truck

Minimum of 3 hours rest in lairage prior to slaughter.

- Maximum rest time is dictated by not exceeding the feed withdrawal recommendations

PIC®

PIC Pork Quality Achievements

Never Stop Improving *Nutrition.*

- 1990 – Introduced Halothane test
- 1994 – Started pure line carcass dissections
- 1996 – First PIC Pork Quality Blueprint
- 1998 – Using Marker Assisted Selection for pork quality; Added pHu in breeding goals
- 2000 – Removed Halothane stress gene from PIC lines
- 2001 – Removed RN gene from Hampshires
- 2002 – Extensive consumer taste panels
- 2003 – Set up GNX program
- 2005 – Analyzed muscle quality & fiber type
- 2007 – Introduced ultrasound to select for Intramuscular Fat
- 2009 – Added lactate testing as stress indicator
- 2010 – Added fitness to breeding goals; Identified drivers of fat quality and Iodine Value
- 2012 – Characterized fatty acid profiles of pure lines

2017

- Established recording of primal and sub-primal cut-outs on thousands of GNX pigs/week
- Performed large scale benchmark study for fresh pork quality, trained taste and consumer panels

2018

- Implemented EBVs for carcass primals and sub-primals in pure line evaluations
- Started pork tenderness measurements on GNX pigs
- Implemented EBV for pork tenderness

PIC is adding direct selection for desired traits that drive Carcass Value

Primal Value	Processing Value	Eating Satisfaction
Loin Depth, Backfat **Primal Cuts** *(New)*	pH	Marbling, Color **Tenderness** *(New)*

PIC®

Creating Genetic Potential for Total Carcass Value

Never Stop Improving Nutrition.

Selecting For Genetic Potential
Three key breeding objectives

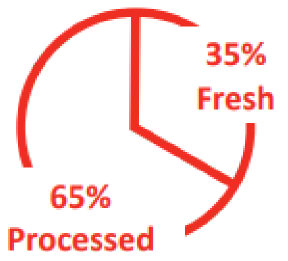
Primal Value:
Maximize Quantity

Until 2017	2018 Forward
One point measures of backfat & loin depth	Direct selection on weight and value of individual cuts

1,000s pigs / week
Number of animals on which PIC measures Primal Values

Processing Value:
Preserve Quality in Plant

Majority of pork is processed
pH & water holding capacity critical to preserving quality during processing

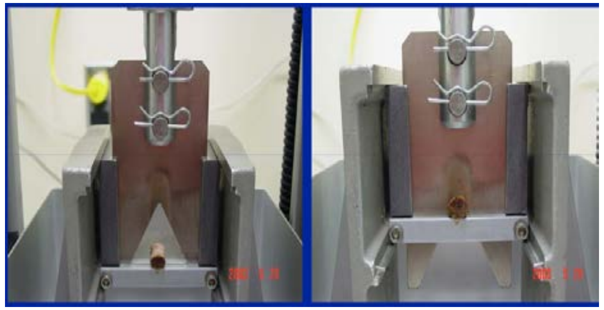


1998:	2003:
PIC introduced pH in its genetic index	pH measurement added to PIC's GNX program

Eating Satisfaction:
Drive Consumer Value

Tenderness identified as **main driver of eating satisfaction**

PIC is the first breeding company to measure and select for tenderness



PIC

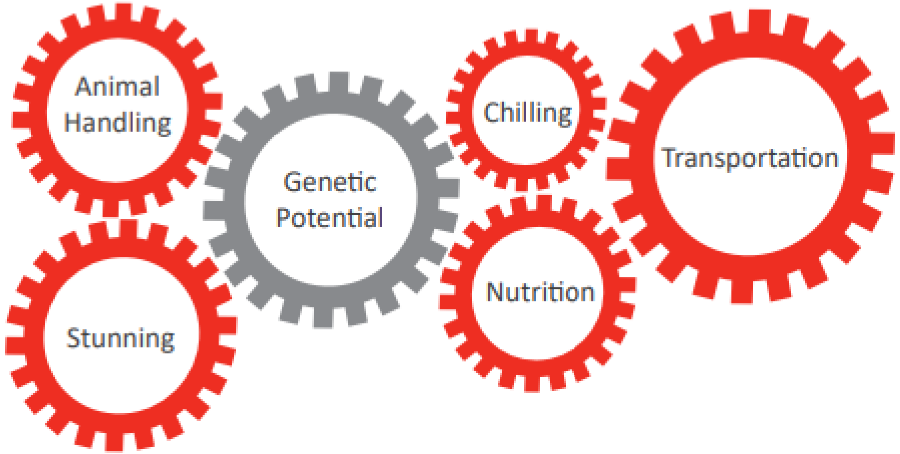
Realizing Genetic Potential of Total Carcass Value

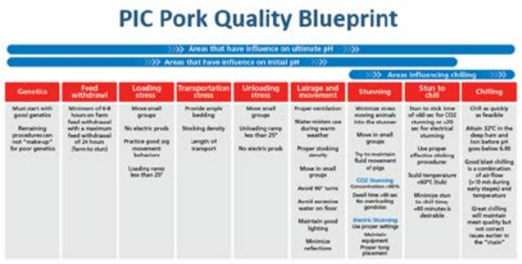
Realizing Genetic Value in the Chain

PIC Pork Quality Blueprint:

Best Practices to Realize the Potential

Many **environmental factors** impact the ability to realize the genetic potential





PIC Meat Science Team:

World Class Experts Available to Help You

Global team of technical experts

40+

Plant visits per year

Summary

Pork is NOT Beef and it is NOT Chicken

- Pigs are unique, requiring unique production practices
- Pork is unique, with different requirements for enjoyable eating experiences

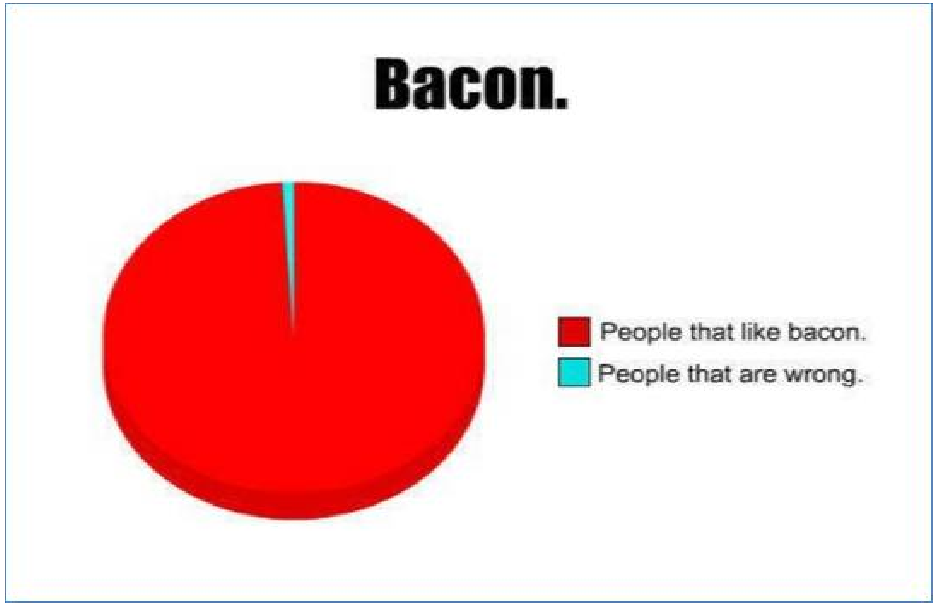
The basic factors influencing pork quality are not new

- Basic biology does not change
- Our understanding of the biology and the environmental impacts constantly improves

PIC is actively focusing on improving pork quality for all of our customers

- Through genetics and services
- We have been for 28 years
- We will continue to do so in the future

Questions or Comments?



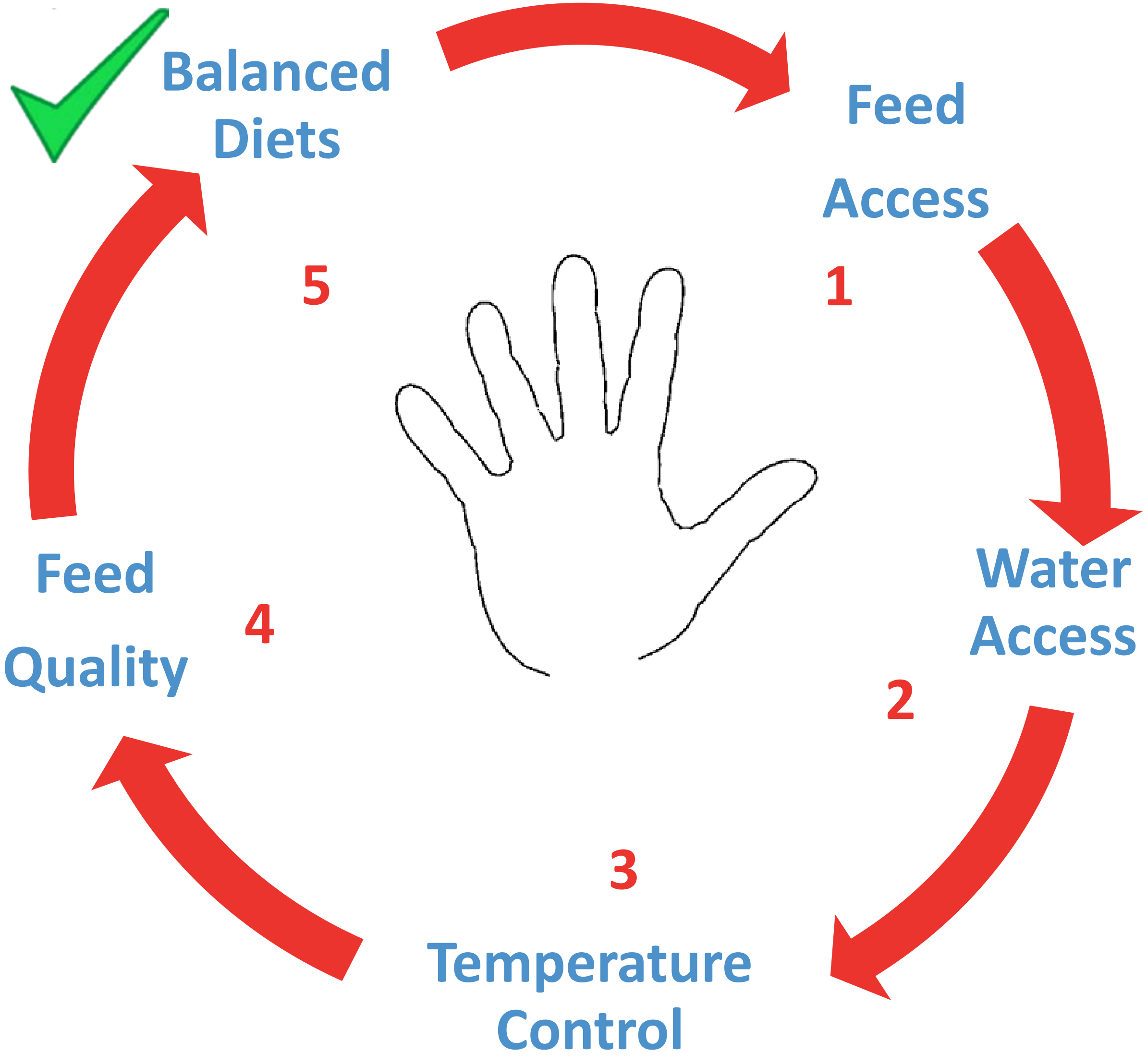
Never Stop Improving *Nutrition.*

Nutrient Availability in Wean-to-Finish

Metric Version

How Can We Ensure Nutrient Availability?

Never
Stop
Improving
Nutrition.



PIC®

Feed Access in Five Dimensions

Never Stop Improving Nutrition.

Feed Access

- Individual Feeder Space
- Feeder Design
- Feeder Space Per Pen
- Feeder Capacity
- Feeder Adjustment

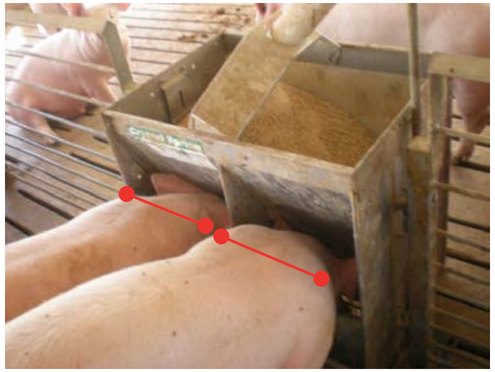
Individual Feeder Space
≥10% of shoulder width
15 inches/feeder space (WF)

Feeder Design
W2F dry feeders:
- 7.5-12 in. Depth
- 4.0-5.0 in. Lip

Feeder Space Per Pen
1.00 in./pig NRY
2.00 in./pig FIN (Dry)
1.25 in./pig FIN (WD

Feeder Capacity
1 day of feed intake per pig

Feeder Adjustment
Economic decision
Pan Coverage 50%->35%





Measure by Pig → Market Weight Decisions

Measure by Pen → Stocking Density Decisions

PIC®

Space per Feeder Hole- Example in GDU

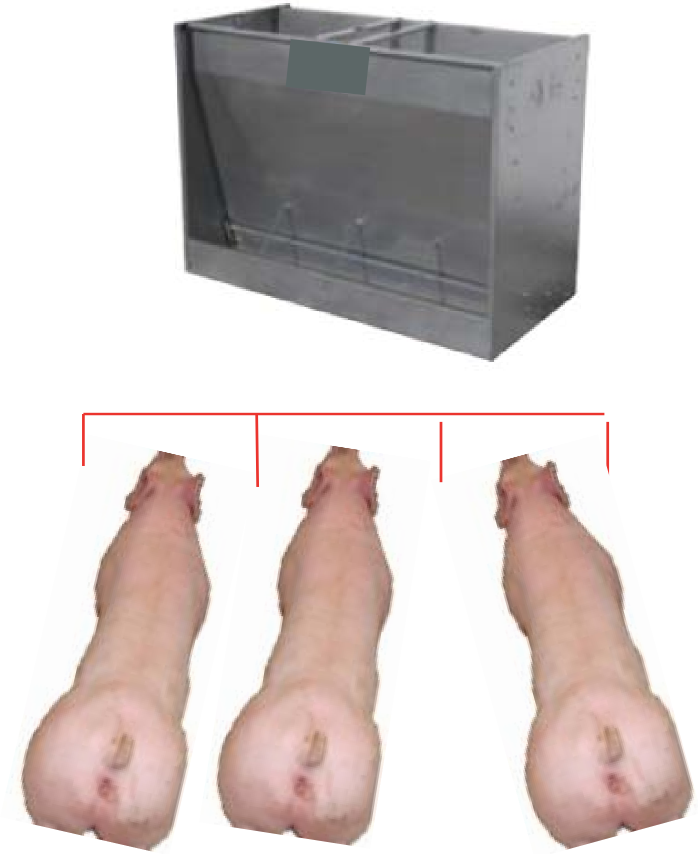
3 Feeder's divisions ....

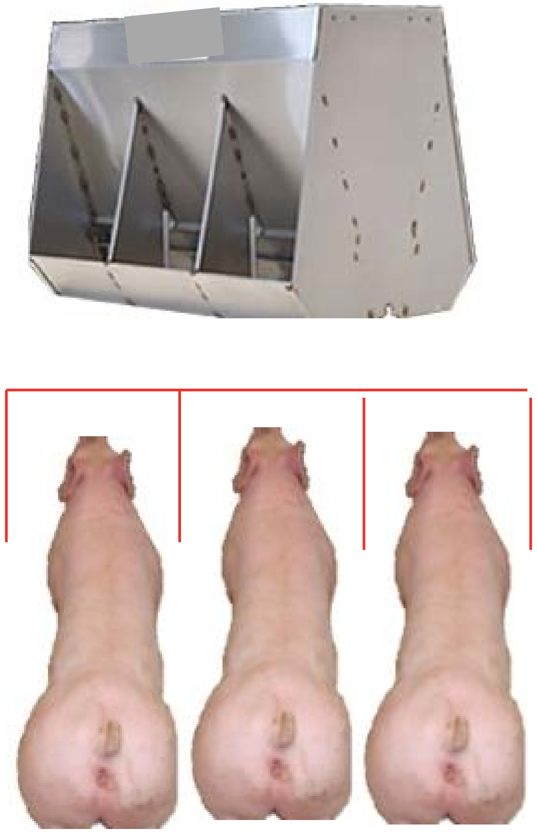
Just 2 pigs can eat!!!

Individual Feeder Space

Important Concept with Solid Feeder Separations, Some Feeder Positions or Deep Feeders

Never Stop Improving *Nutrition.*





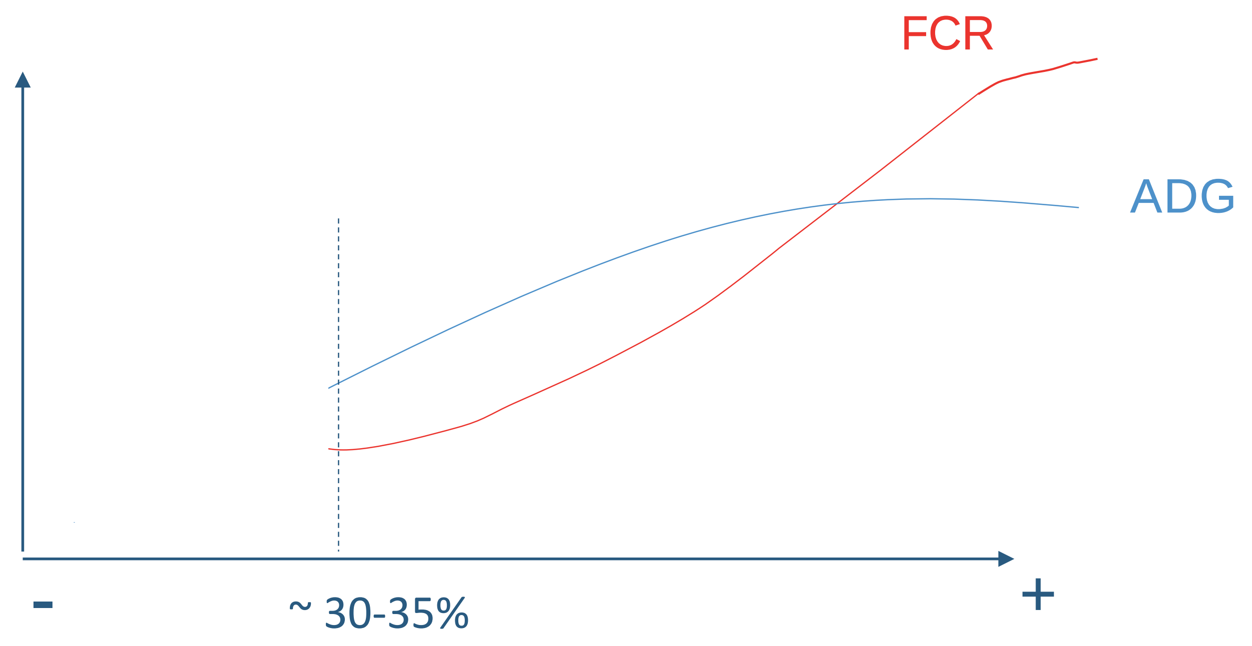
Feeder Position

Dr Brumm picture, 2012

PIC

Feeder Adjustment

Same Nutrient Availability?



Pan Coverage	~15-20%
ADG	-0.1 lb/d
FCR	+0.03
Opp.Cost	$5.0/pig

Pan Coverage	~70-80%
ADG	+0.03 lb/d
FCR	+0.06
Opp.Cost	$2.3/pig

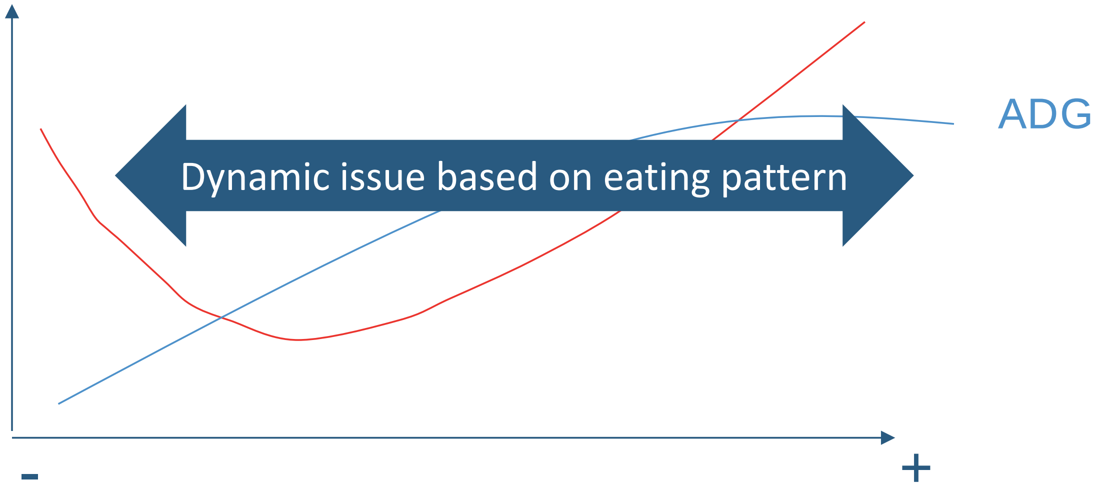
Simulation with Feed Cost: $0.11/lb, Space Cost:$0,12/d, WF: 13-285Kg in 158 DOF

Feeder Adjustment: A Daily Job

Never Stop Improving Nutrition.

I am not guilty

Diseases
Pigs/pen
Temperature
Water Intake
Feed Quality
People
Vaccines
Ventilation
Diet Type

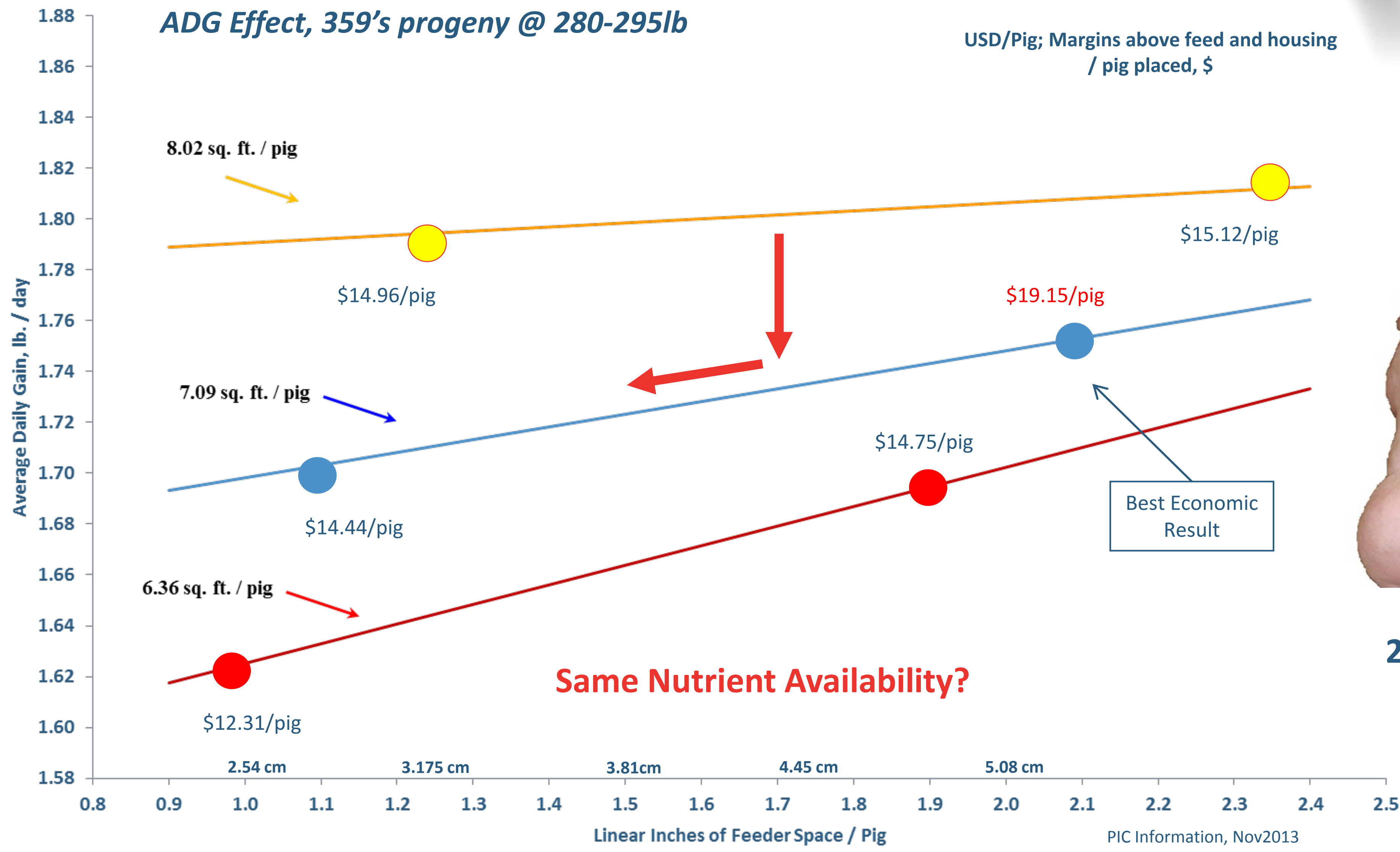


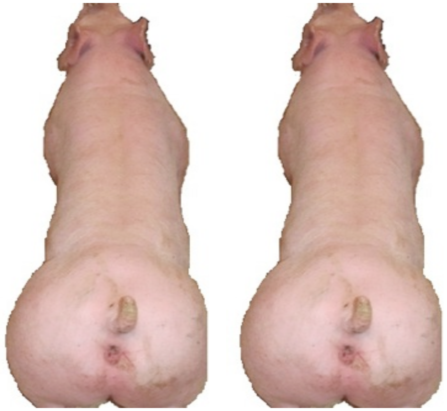
PIC

ADJUSTMENT IS ....EVERY DAY....EVERY PEN..... EVERY FEEDER

Feeder Space & Stocking Density

Never Stop Improving Nutrition.

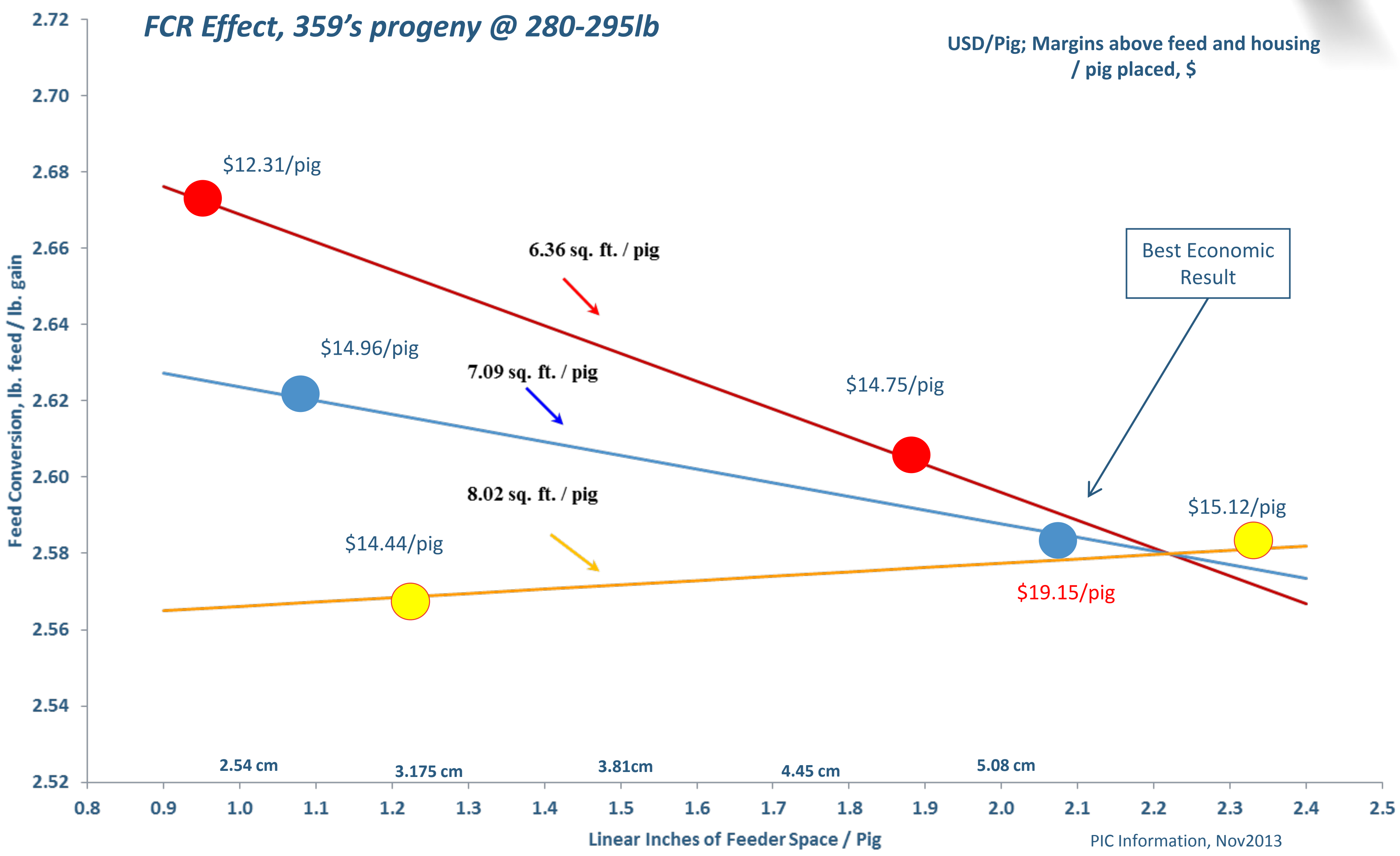




280-295lbs

PIC

Feeder Space & Stocking Density



PIC Information, Nov2013

Never Stop Improving Nutrition.

PIC

Water Access

Water Access

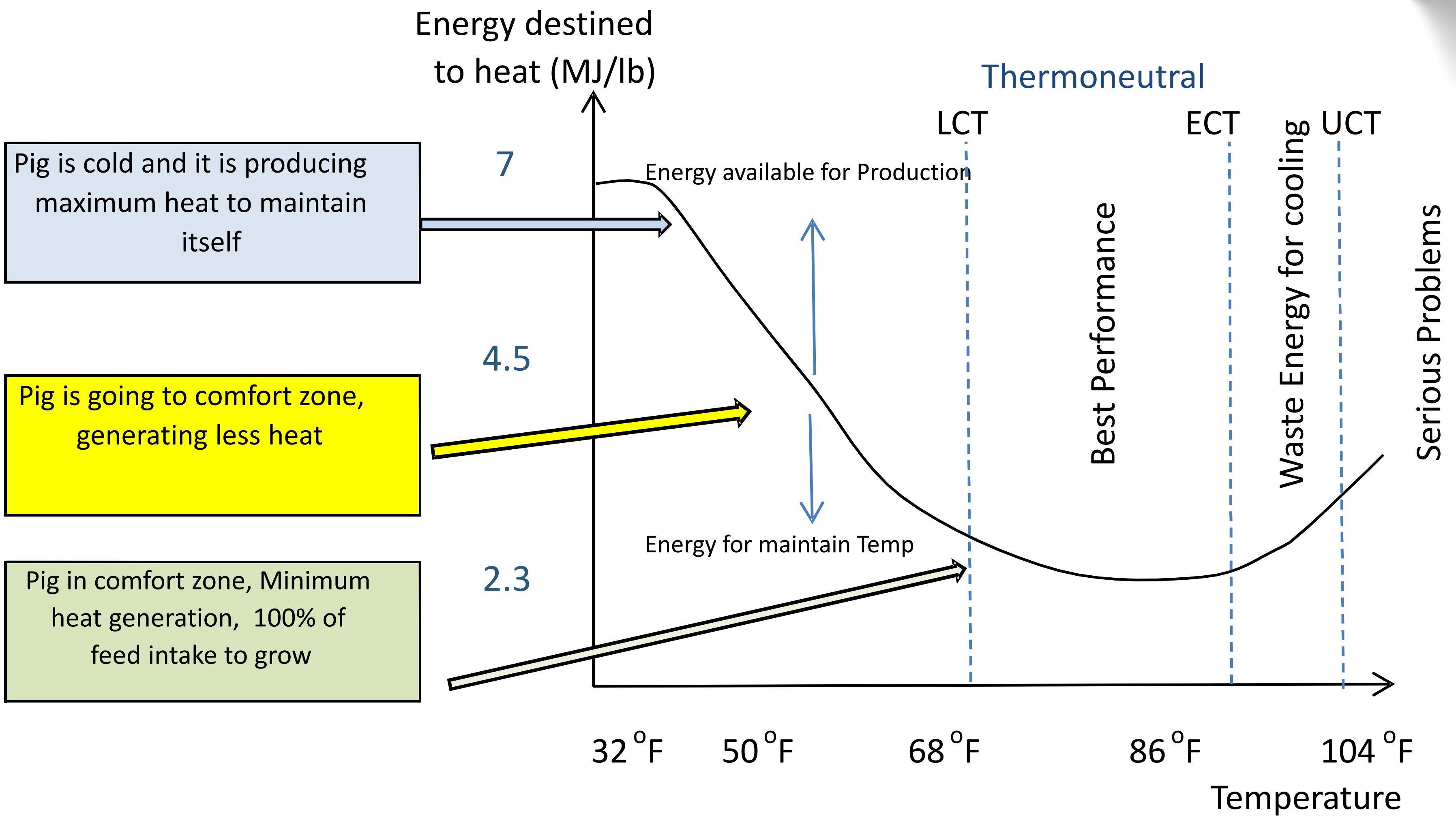
Drinker per Pig	Drinker Height	Water Flow	Water Quality
10-12 pigs/water source	Nipples-90° Shoulder Level (SL[1]) Nipples-60° 2-3 in above SL[1] Bowl 40% of SL[1] •Based on smallest pig per pen	0.5 lt/min NRY 1.0 lt/min FIN 1.0 lt/min WF	Check Section F PIC Nutrition Manual

[1] SL = Shoulder Level

www.wattagnet.com

Measure by Pig | Measure by Pen | Measure by Site

Temperature Impact in Nutrient Use

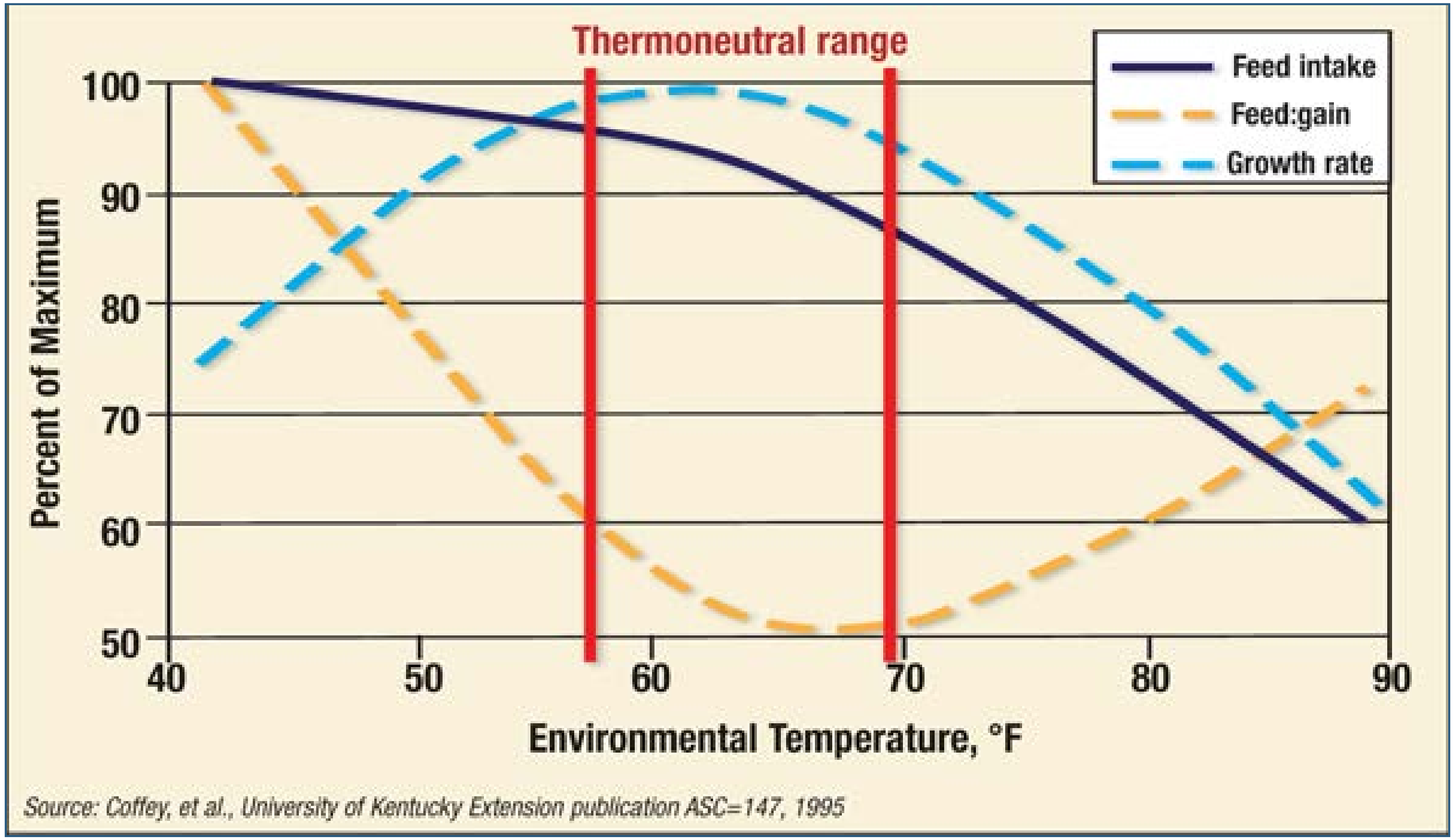


Adapted, John Gadd, 2005

LCT; Low Critical Temperature (below pigs need energy to maintain temperature)
ECT; Evaporation Critical Temperature (temp when pigs start to expense energy in temperature control)
UCT; Upper Critical Temperature (above pigs lose metabolic control and die)

Temperature vs. Grow-Finish Performance

Never Stop Improving Nutrition.



Cold Stress (-5.4°F @ below optimum)	
ADG	-0.20 lb/d (90.7gr/d)
FCR	+0.1
Opp.Cost	$5.59/pig

Heat Stress (+5.4°F @ above optimum)	
ADG	-0.19 lb/d (86.3gr/d)
FCR	+0.01
Opp.Cost	$2.80/pig

PIC®

Nutrient Availability Impacted by Water Availability

Never Stop Improving *Nutrition.*

1.25 inches/pig

Wet- Dry

Losing WD feeder advantages

2.0 inches/pig

Dry

Too Many Water Sources or Water Pressure Problems

Not Drinking

Key

Too Much Water Inside

Heat Stress Situations or Water Pressure Problems

Wet- Dry

Heat Stress? >85°F and >200lb additional drinkers?

Pan Drinker

Liquid Feeding?

PIC

Heat Stress vs. Water/Feed Intake

Never Stop Improving Nutrition.

Finishing Windchill Effect Based on Building 40' wide x 7'6" ceiling
Pig Weight = 50 lbs., NO Evaporative cooling

Nat. Ventilation	Tunnel

Losing ADG	Temperature
	70
	74
	78
	81
	84
	87
	90
	93
	95
	96
	97
	98
	99
	100

Using Nutrients to Keep Cold Temperature

Using nutrients to Keep Cold Temperature

Same Water Intake?
Same Feed Intake Pattern?
Same Nutrient Access?

Table presented by Isaac Singletary, Mexico 2012

PIC®

Never Stop Improving Nutrition.

Nutrient Availability Impacted by Feed Quality

Example with Fines

- Less Pellet Investment Return
- Performance Consequences by Fines
- Feeder Adjustment Problems
- Extra Labor (adjustment + cleaning)
- Potential Feed Outages
- Mycotoxin Risks

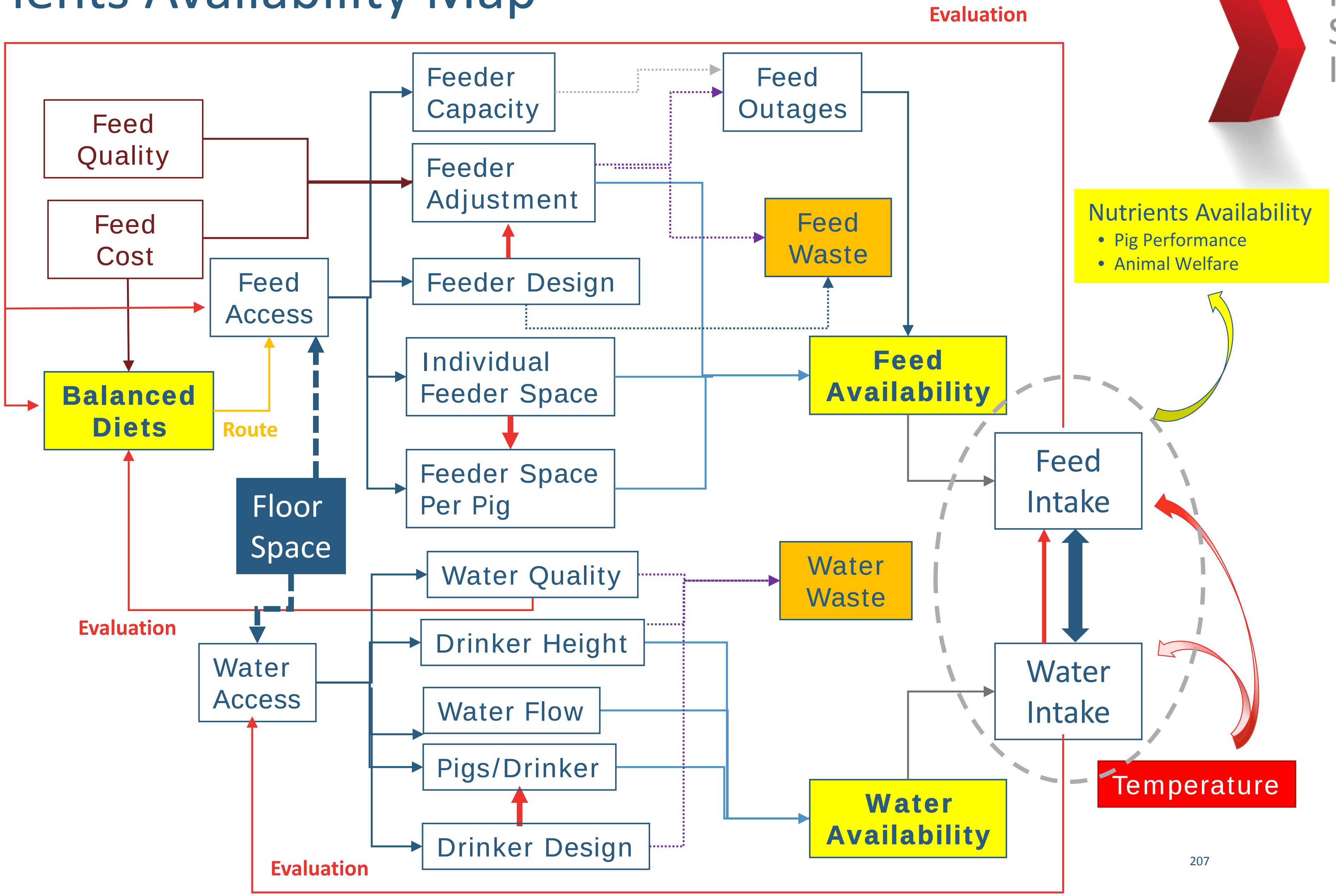
It's not always is understood

Although the feeder adjustment rule is " every day, every pen, every feeder"

Nutrient Access Problems

PIC®

Nutrients Availability Map



Never Stop Improving *Nutrition.*

PIC®

Take Home

- Balanced nutrients must be available for good pig performance (ADG, FCR, Full Value Pigs and meat quality) and animal welfare
- Diets provide an important part of nutrient availability but it isn't everything, along with water, nutrients must be available for pigs with minimum waste
- Access to both feeders and water sources should be evaluated in all their dimensions. Because they provide the availability of both feed and water, there are several direct factors impacting them
- Factors like Temperature and Stocking Density could play an important role in nutrient availability at pig performance level

Formulating for Profit

Wayne Ca$t

PIC®

Any damn fool can put in plenty.
The trick is putting in just enough.

Just enough is different in each market scenario.

- ✓ Pig and ingredient prices.

Nutritionists are in a tough spot: more people look at close-out performance instead of cost/profitability.

Nutrient Access

The pig should eat to meet his energy needs… IF we let him…

I will talk about the nutrients we need

Fernando talked about environment, equipment, and management

…so the pig is **willing** and **able** to consume needed nutrients.

Energy

Biggest cost

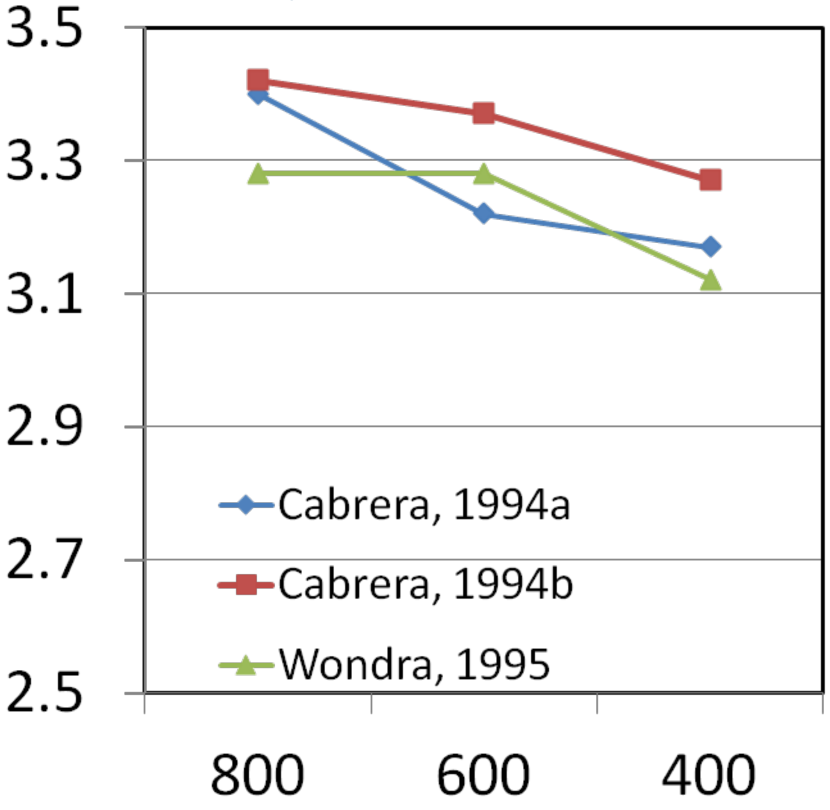
Cheapest fix

- Grind: 100 microns improve 1.0% F/G and costs 5 cents/t
- Fat would cost $2.5/t

Effects of Particle Size on F/G of Finishing Pigs

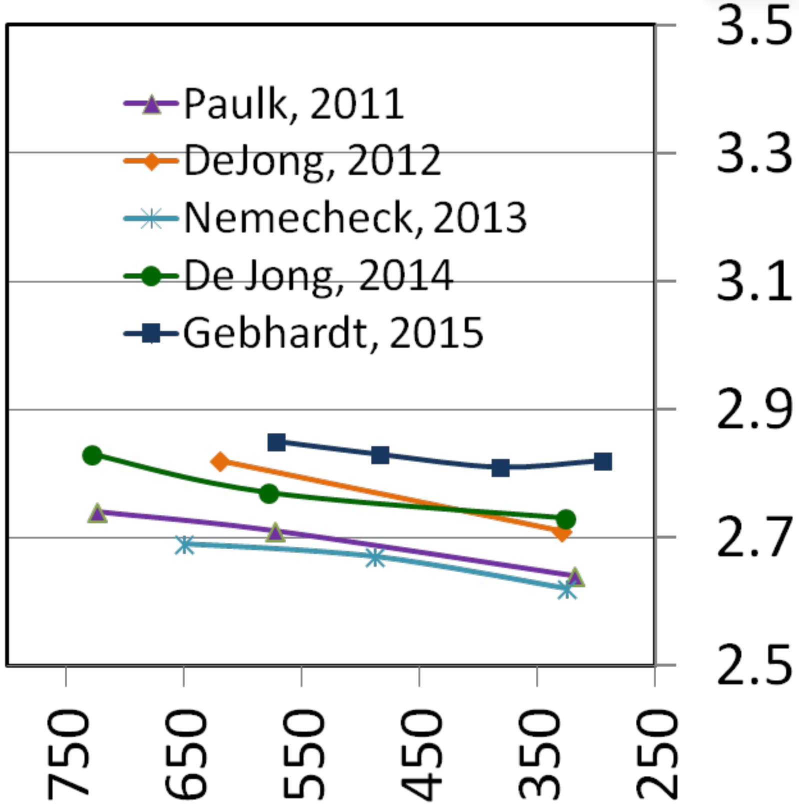
Never Stop Improving *Nutrition.*

1.2% per 100 microns



Particle size, microns

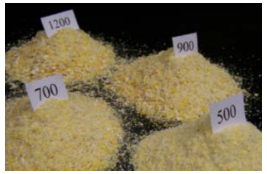
1.0% per 100 microns



Particle size, microns

Woodworth et al., 2015; ICFES

PIC



Why Not Embraced?

Feed flowability… or, maybe,… flow. Or, it could be also flow.

2 ISU students

- Don’t put feed on top of feed
    - Tandem bins are managed poorly
- Deflector plates
    - Are not for mash feed
    - Take at least one out!
- Proximity switch: feed run fewer but longer

Figure 1: Single Auger Hopper Bottom with Deflector options

Before You Increase Particle Size Due to Flow, Think…

Never Stop Improving *Nutrition.*

1,200 head barn

Wean-to-finish

Two turns

14 to 290 lb BW

2.6 F/G

$200/ton feed cost

$172,000 goes through the barn per year

PIC®

Response to Energy

F/G fairly consistent

- Rule of thumb
- 20 kcal ME about 1.8% F/G
- More response in summer than winter?
- More response in late than early? Or the other way around?
- Is the first increment as valuable as the last?

ADG not so consistent, why is that?

- Fernando gave us some clues.
- My 2¢: feeder space and pan coverage.

PIC/KSU Optimum Energy Tool

Never Stop Improving Nutrition.

Meta-analysis by Nitikanchana (2015), based on 41 studies

Tool created by Soto (2017)

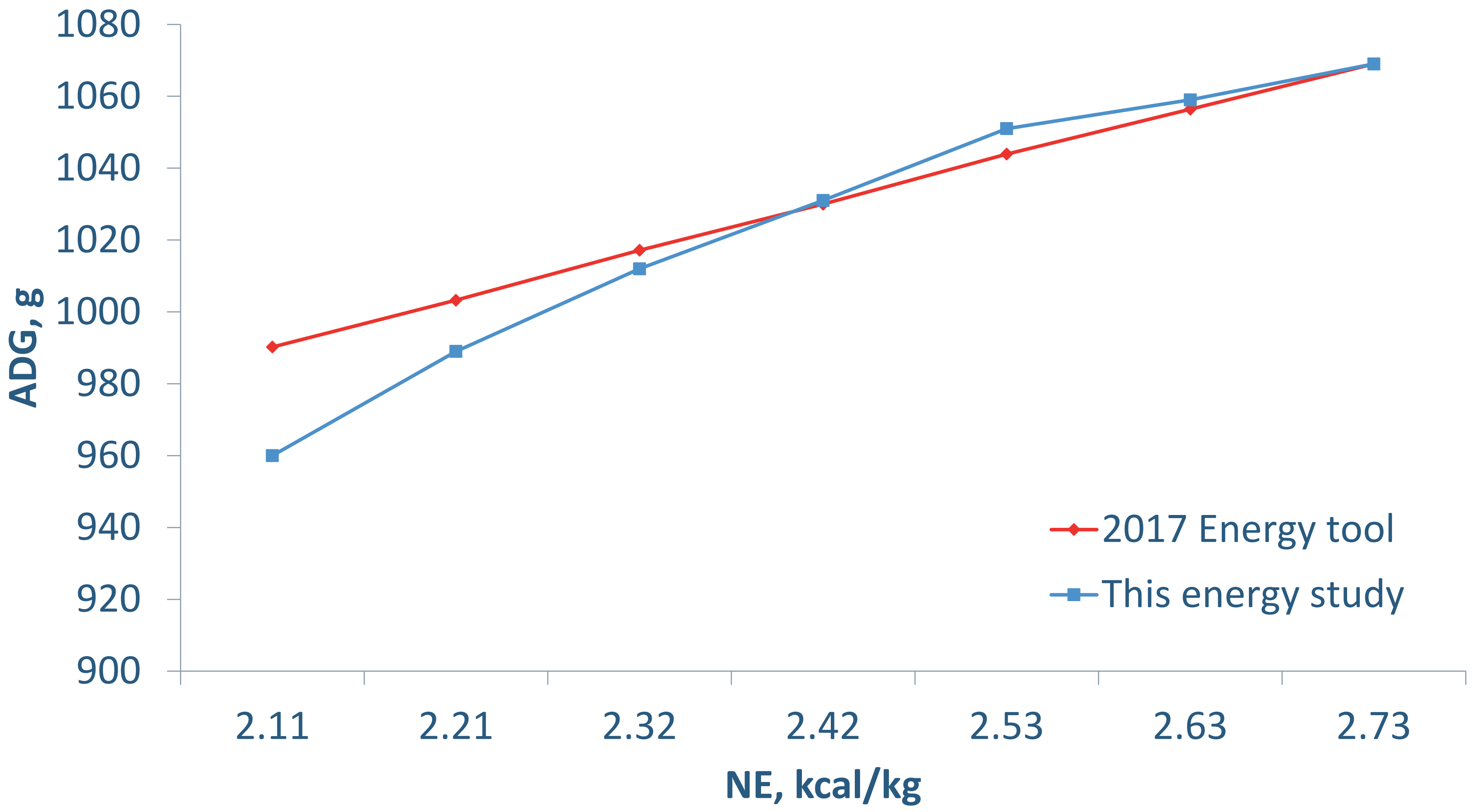
Helps us make better decisions

http://na.pic.com/resources.aspx

PIC®

ADG Prediction

Above 2.3 Mcal NE/kg (3.06 kcal ME/kg), residual error was 1 gram (-6 g overall)

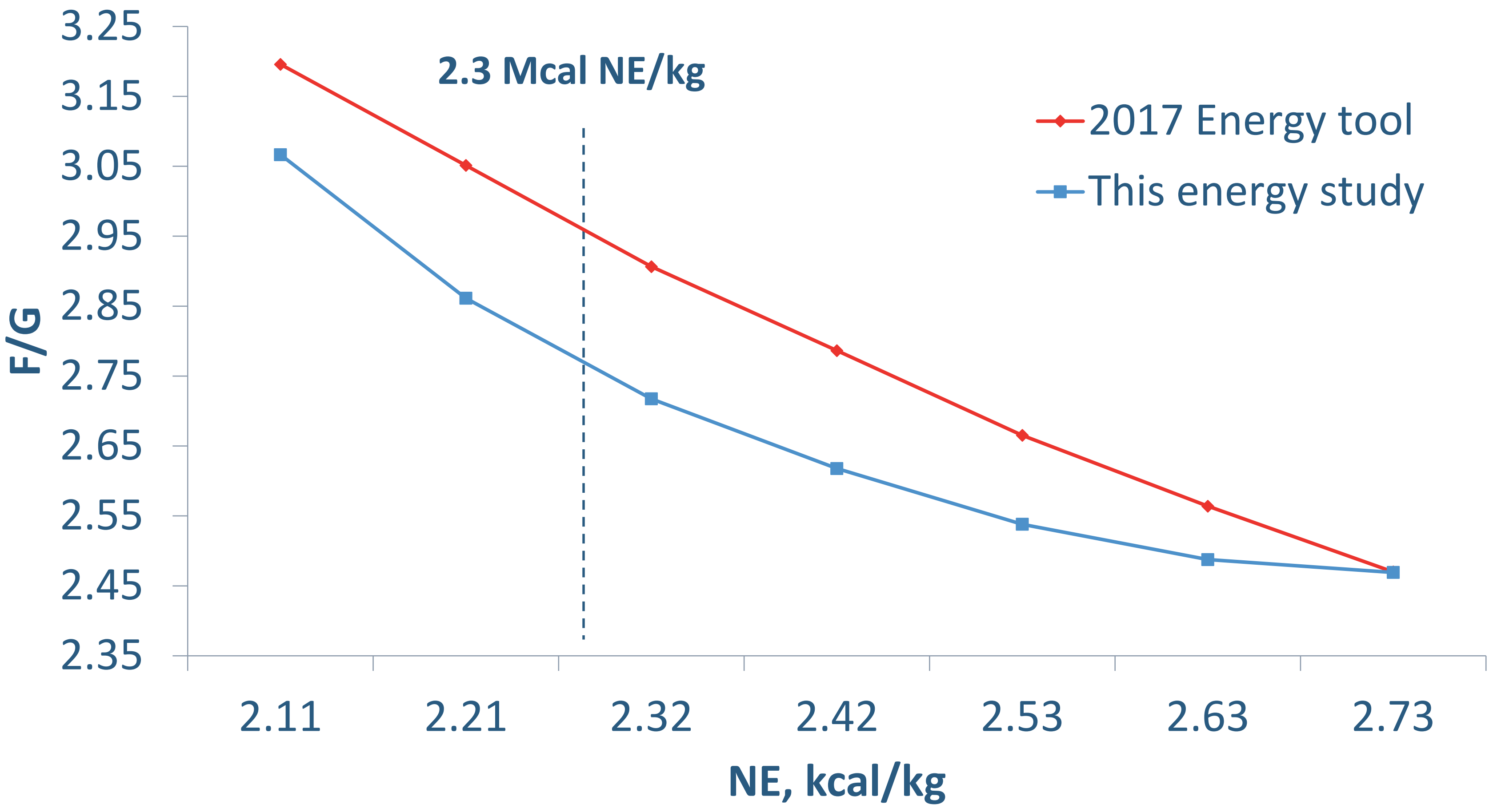


Never Stop Improving Nutrition.

PIC

F/G Prediction

Above 2.3 Mcal NE/kg (3.06 kcal ME/kg), residual error was -0.11 (- overall)



Never Stop Improving Nutrition.

PIC

Amino Acids

Never Stop Improving *Nutrition.*

Lysine Biological Tool

- US or Metric
- ME or NE
- Gilts or barrows
- Values are for 100% of growth and 99% of F/G

- But, may not put the most dollars in your wife's pocket.

- http://na.pic.com/resources.aspx

PIC®

Amino Acids

Never Stop Improving *Nutrition.*

Lysine economic tool

- US or Metric
- ME or NE
- Gilts, barrows or mixed

- The drivers are **pig price** and **feed cost**
- Predicts performance change

- http://na.pic.com/resources.aspx

PIC®

Tryptophan

- Takes more to maximize gain than F/G
- KSU Tryptophan tool
- http://www.asi.k-state.edu/research-and-extension/swine/calculators.html

Av. Phosphorus, %

	Body weight, lbs.				
	50-90	**90-130**	**130-180**	**180-230**	**230-285**
Gilts					
2016	0.30	0.28	0.26	0.25	0.24
2018	0.34	0.31	0.28	0.24	0.22
Barrows					
2016	0.30	0.28	0.26	0.25	0.24
2018	0.32	0.29	0.26	0.23	0.21

STTD Phosphorus, %

Never Stop Improving *Nutrition.*

	Body weight, lbs.				
	50-90	**90-130**	**130-180**	**180-230**	**230-285**
Gilts					
2016	0.33	0.30	0.28	0.26	0.24
2018	0.40	0.37	0.33	0.29	0.25
Barrows					
2016	0.33	0.30	0.27	0.25	0.24
2018	0.37	0.34	0.31	0.28	0.24

PIC

Vitamins

Vitamins

- Less than 1% of feed cost grow finish
- Less than 2% of feed cost sows

On-going wean-to-finish commercial study

United Animal Health -Coming soon!

K-State – Old vs New – Swine Day

Mahan Vit. A and its impact on E

2X industry 4-5X

Flohr Vit. D and its impact on E

Seasonality Tool

Never Stop Improving Nutrition.

Pigs are typically more valuable in the summer time and weights are typically down

Don’t wait until it’s hot to change your diets

This tool can tell you when to change each diet based on:

- Your optimum price window,
- Your feed allocation,
- Start/stop dates for each diet can appear on your Outlook calendar
- http://na.pic.com/sites/genuspic_com/Uploads/Nutrition/April%202018%20Nutrition%20Update.pdf

PIC

Tough Times Ahead?

Never Stop Improving *Nutrition.*

Look hard at additives

- Validation
- Especially those that just drive gain

If the pig has adequate nutrient access

- Look hard at energy - We have a tool
- Look hard at lysine levels - We have a tool
- Look at tryptophan - KSU has a tool
- Review Phosphorous levels

PIC®

Tough Times Ahead?

- When times are good we sometimes put stuff in we shouldn’t.
  - Be proactive and evaluate now.
- When times are bad we sometimes take stuff out we shouldn’t.
  - Stay the course.

Never Stop Improving *Nutrition.*

It is impossible to over communicate your expected changes in performance.

Paul Cline story

PIC®

“No one has to change.
Survival is optional.”
- W.E. Demming

Any arguments,
Talk to my son.

Roundtable Discussion
(10 Minutes)

BREAK

PIC

Never Stop Improving *Nutrition.*

PIC 2018 Nutrition Manual Update

PIC Global Nutrition Team

Uislei Orlando

PIC

40+ nutrition studies with over 50,000 pigs since the last manual update in 2016.

Sow Nutrition and Feeding

Never Stop Improving *Nutrition.*

PIC®

Sow Nutrition and Feeding

Never Stop Improving Nutrition.

Body condition management continue to resist the test of time by being the **single most important factor** in sow feeding.

Current studies suggest that bump feeding gilts as well as sows results **in negative aspects** like increased stillborns and reduced lactation intake with **little to no benefit** in piglet birth weight (Amdi et al., 2014, Buis et al. 2016, Gonçalves et al., 2016, Greiner et al. 2016, Mallmann et al. 2017, Mallmann et al. 2018, Thomas et al., 2018).

Our updates reflect that, we will **stop** recommending bump feeding gilts as well.

PIC®

Sow Nutrition and Feeding

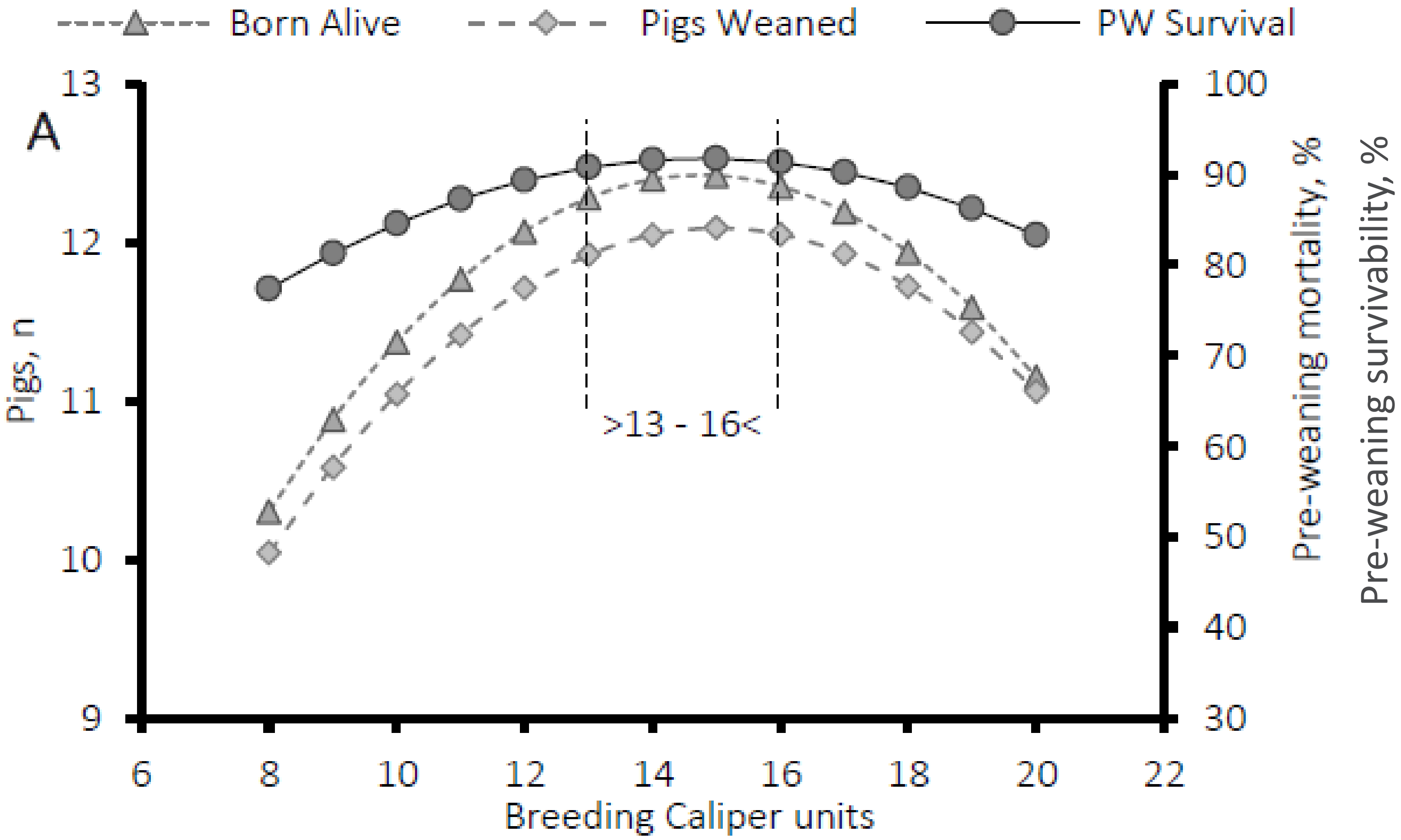
Never Stop Improving Nutrition.

Several experiments were conducted in amino acids requirements for gilts and sows during gestation and lactation and was concluded that current recommendations are adequate for today's prolific sow.

Consider using objective tools such as the Caliper to assess body condition (Bryan, 2014).

PIC®

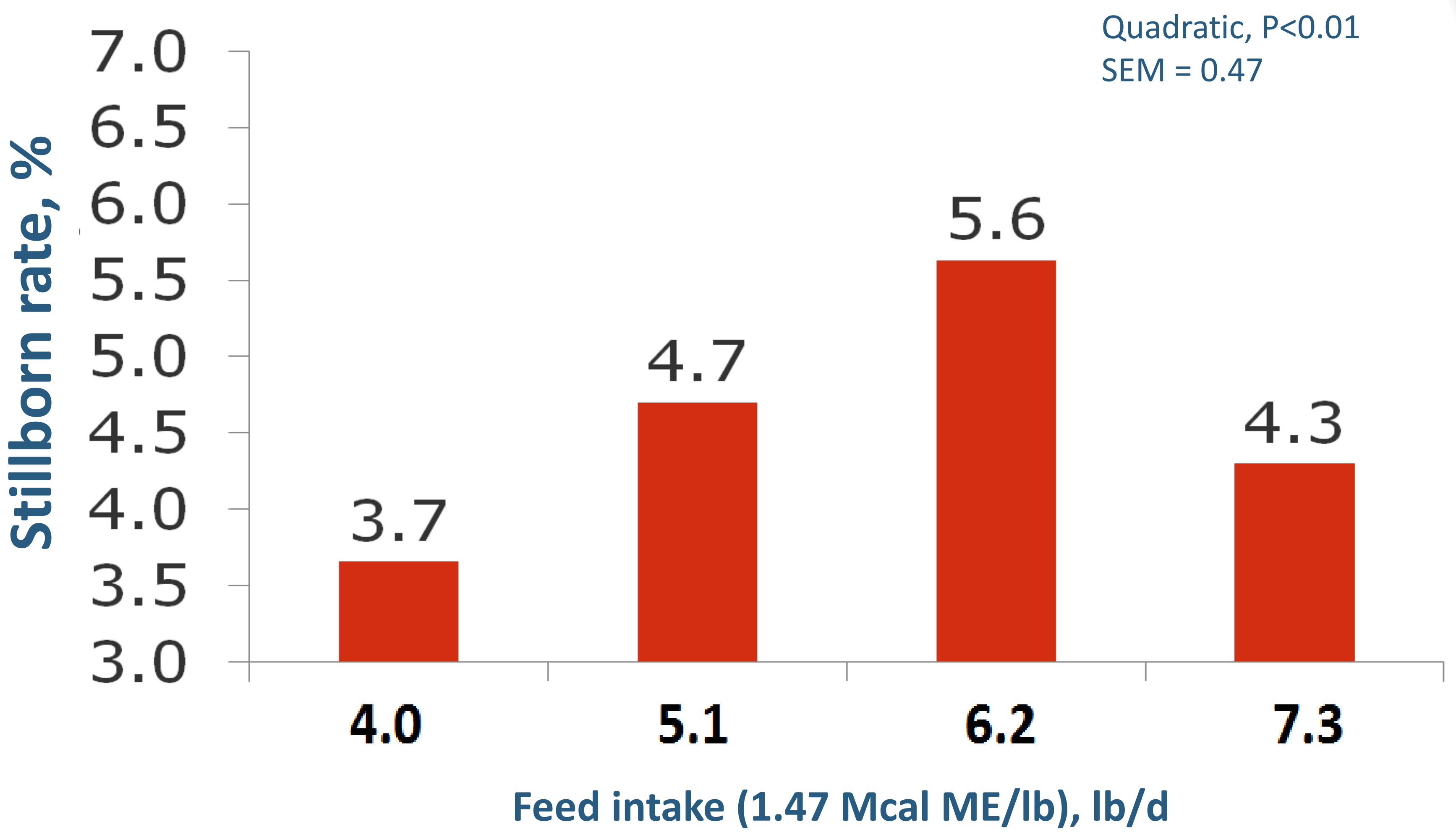
Consider Using Objective Tools Such as the Caliper to Assess Body Condition



Bryan and Knauer, 2014; A total of 2460 sows were used.

Feed Intake in Late Gestation (d 90) and Stillborn Rate in Gilts

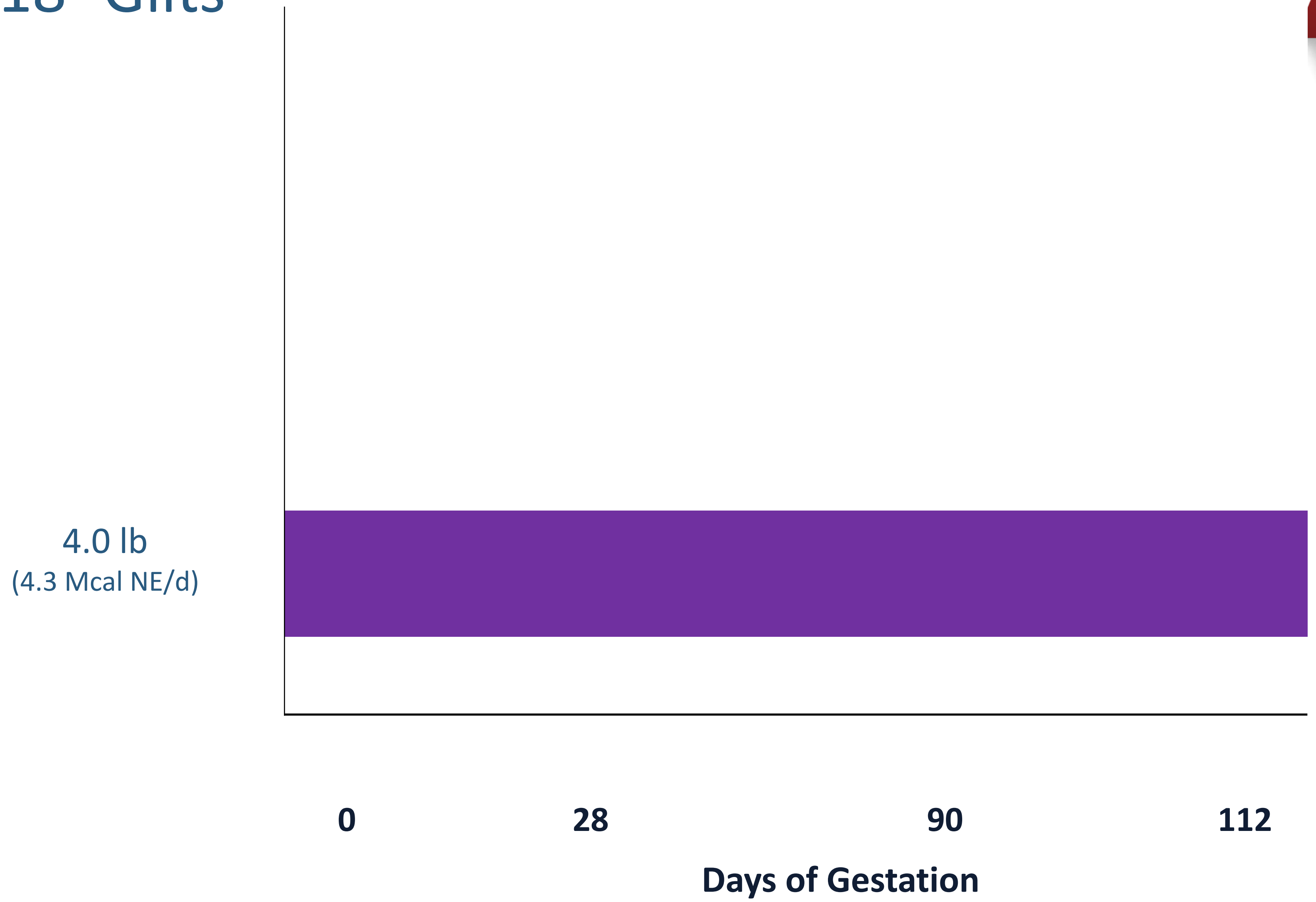
Never Stop Improving *Nutrition.*



A total of 977 gilts; Mallmann et al. 2017

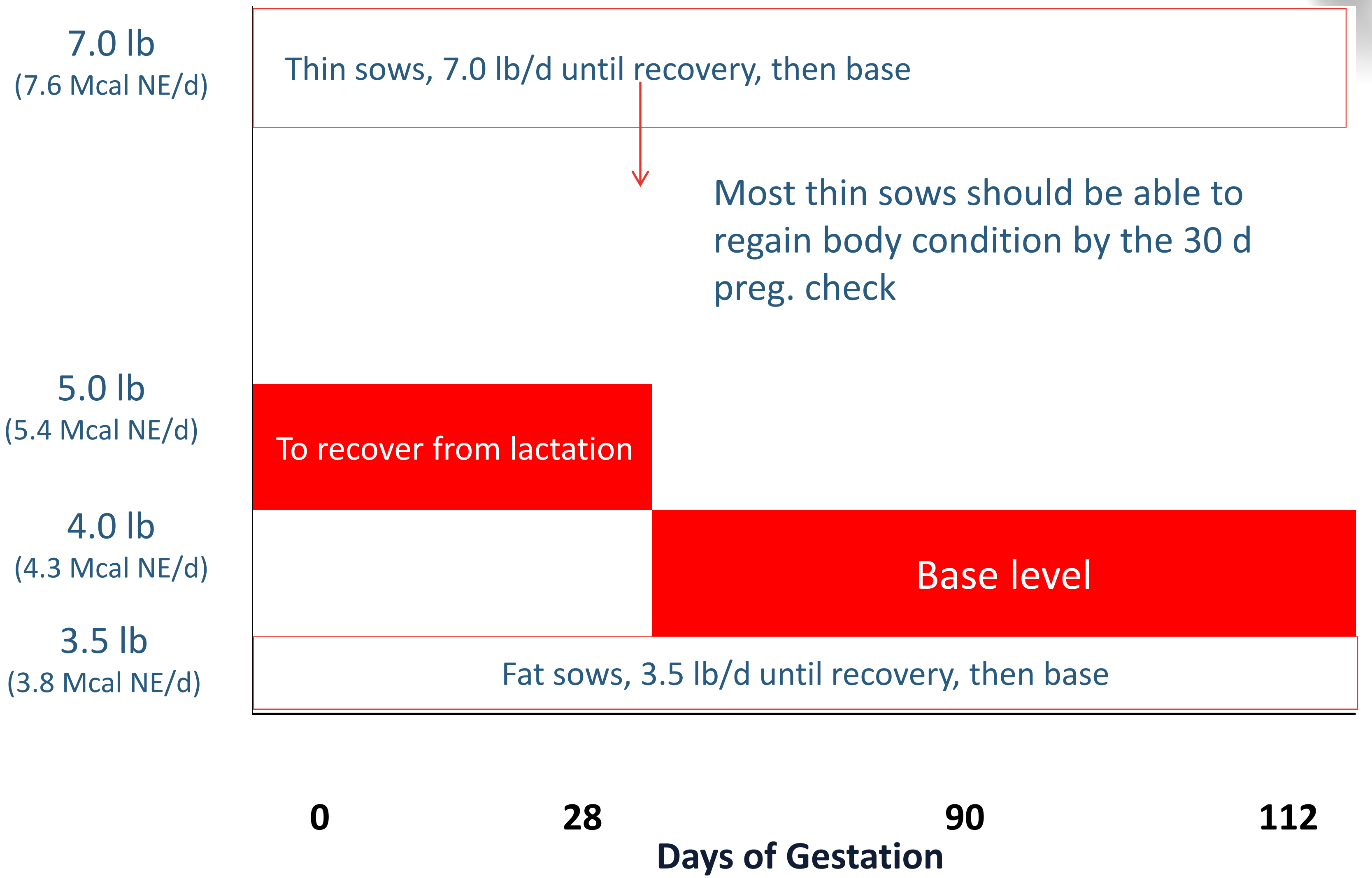
PIC

PIC 2018- Gilts



Assuming corn-SBM based diet with 0.60% SID Lys. Average of SID Lys intake = ~12.5 g/d

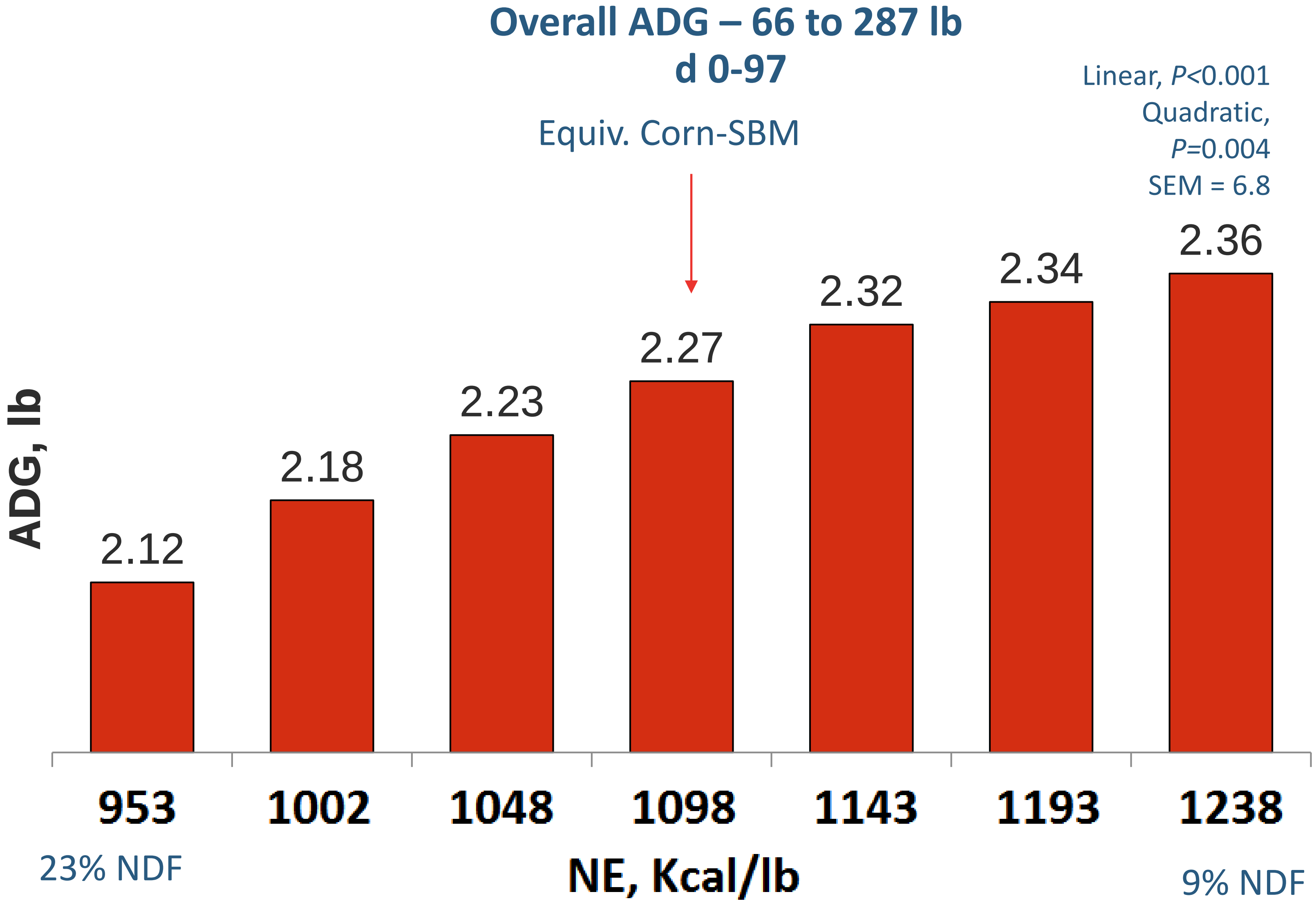
PIC 2018- Sows



Assuming corn-SBM based diet with 0.60% SID Lys. Average of SID Lys intake = ~12.5 g/d

Finishing Pigs

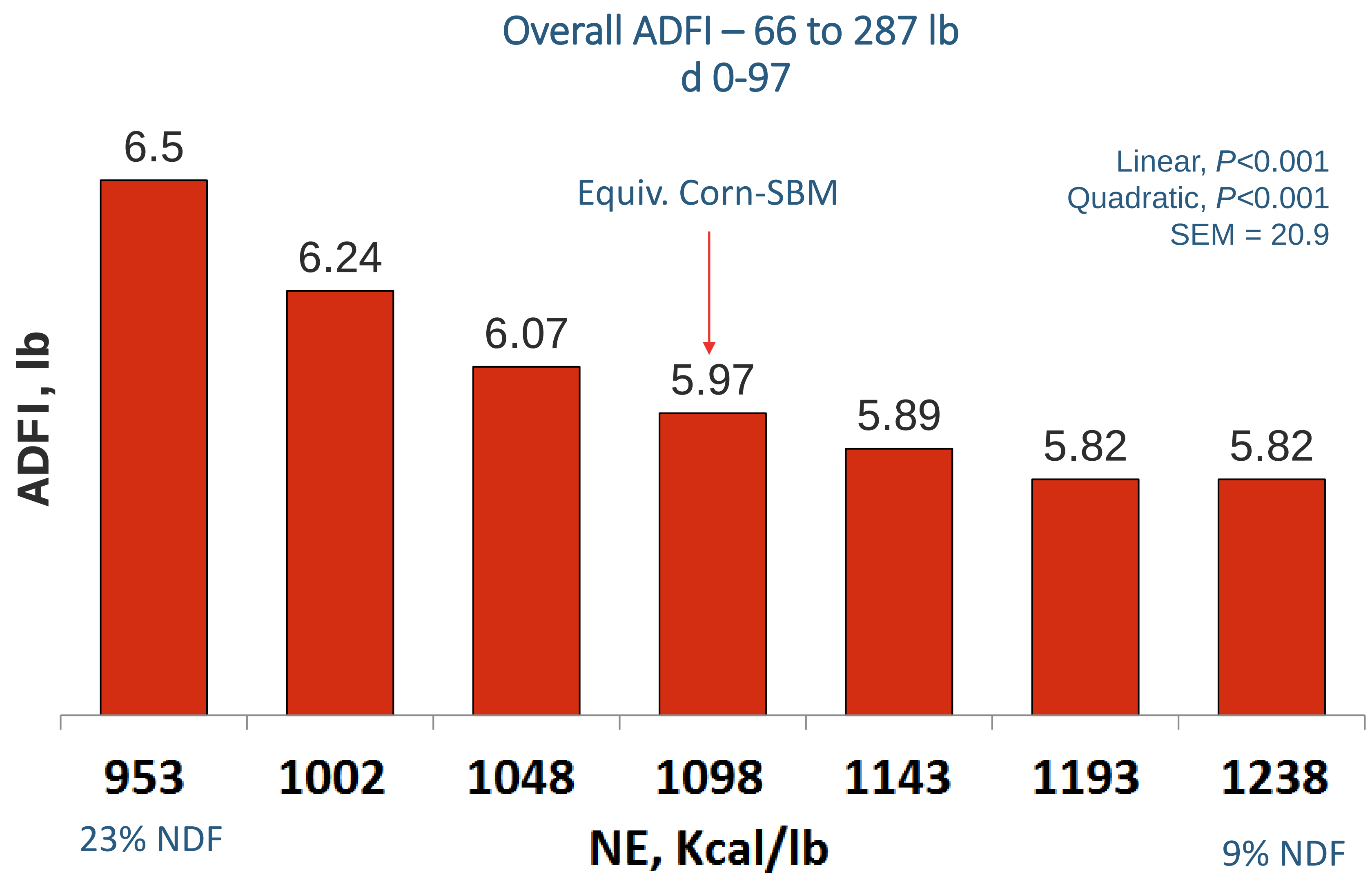
Energy Dose Response



Never Stop Improving Nutrition.

PIC

Energy Dose Response

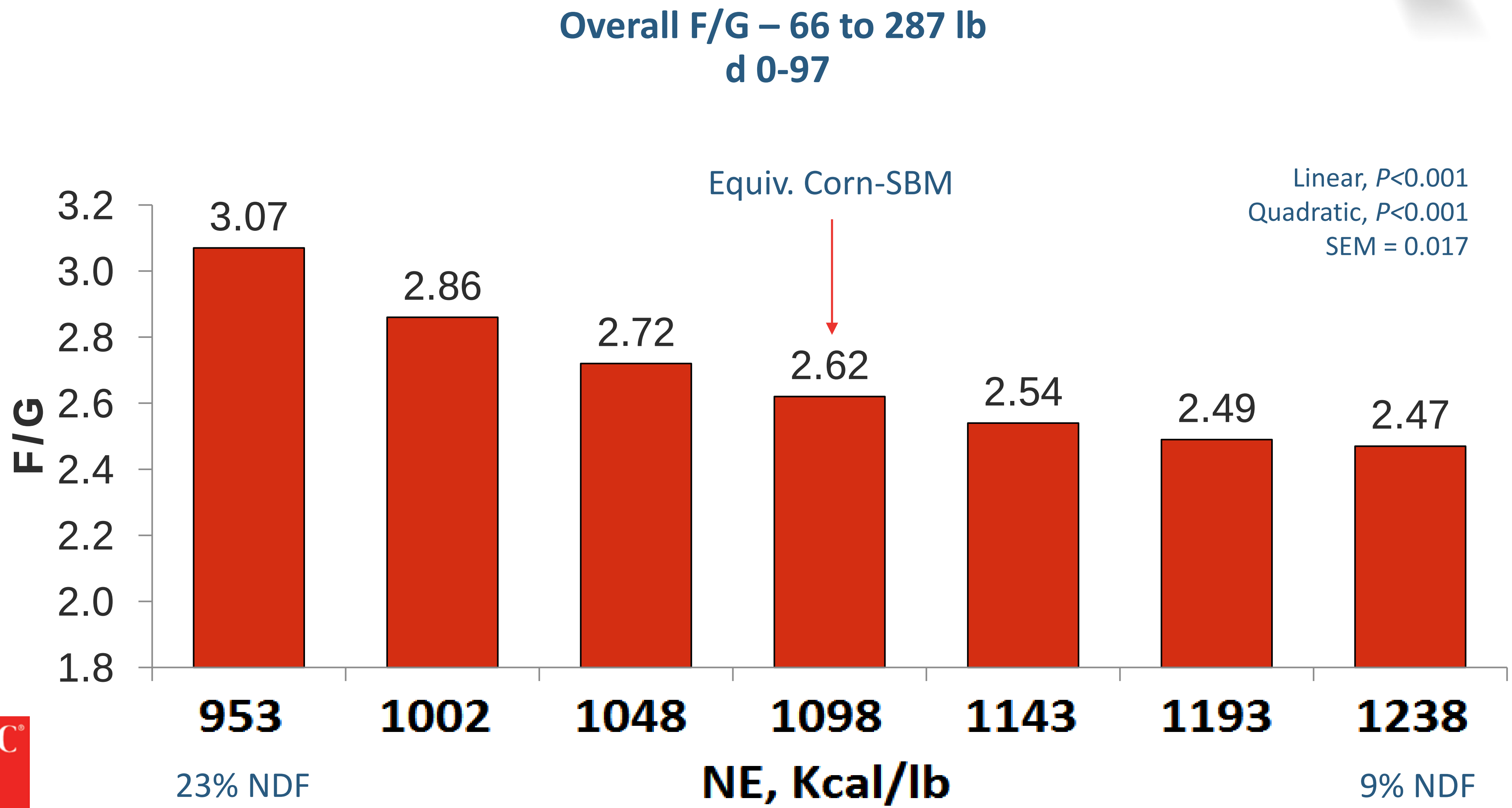


Never Stop Improving Nutrition.

PIC

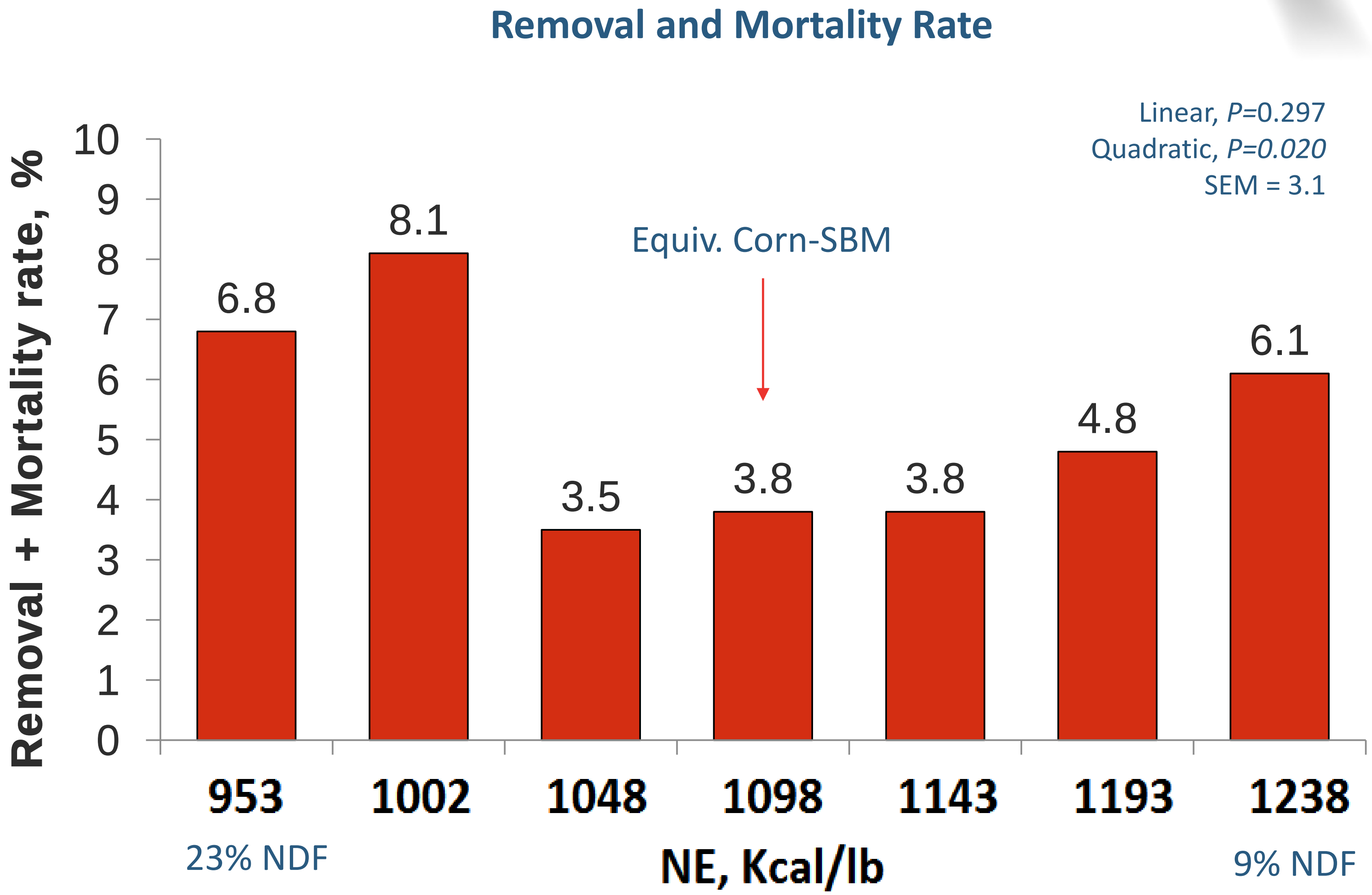
Energy Dose Response

Never Stop Improving Nutrition.

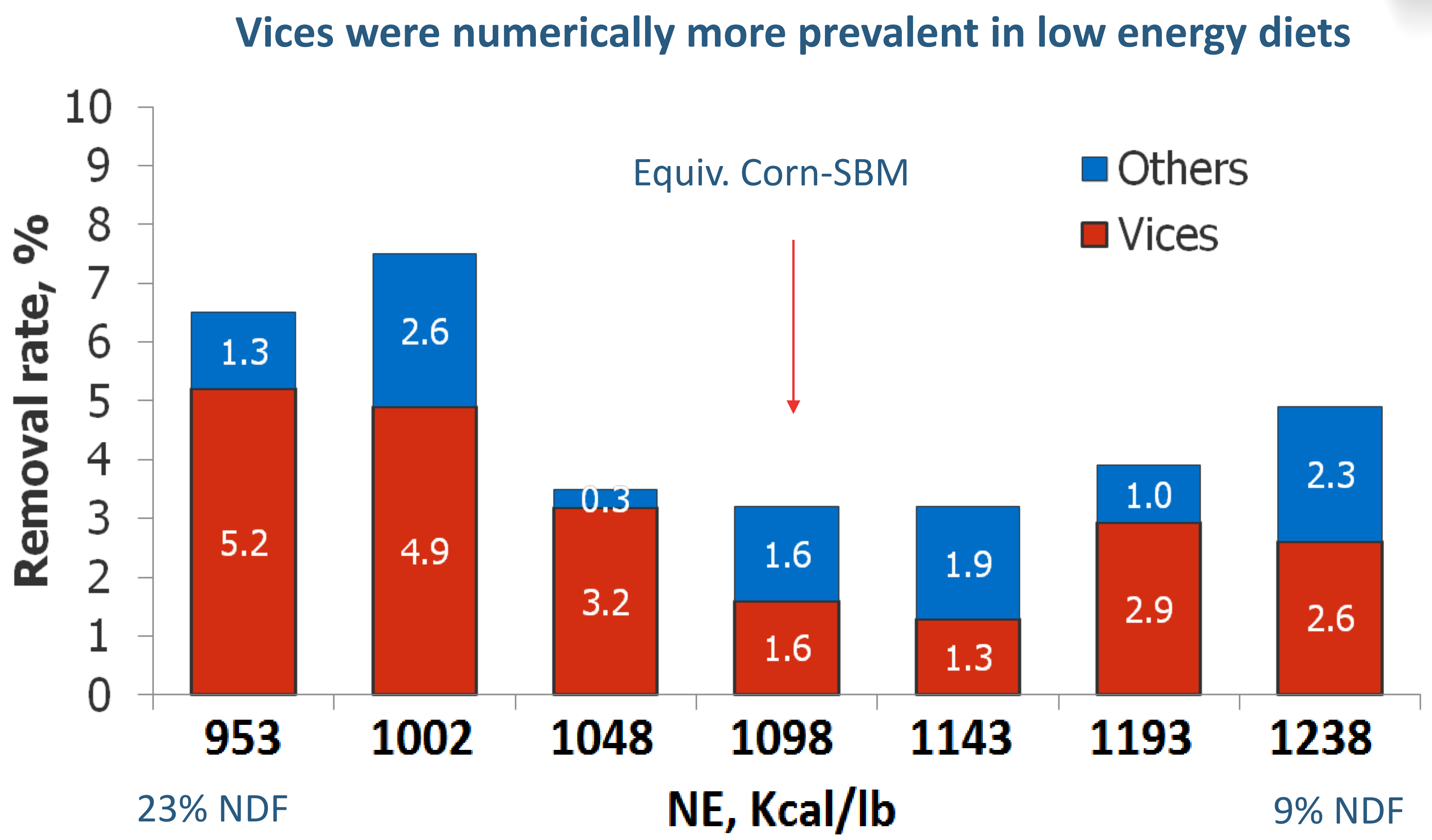


PIC

Energy Dose Response

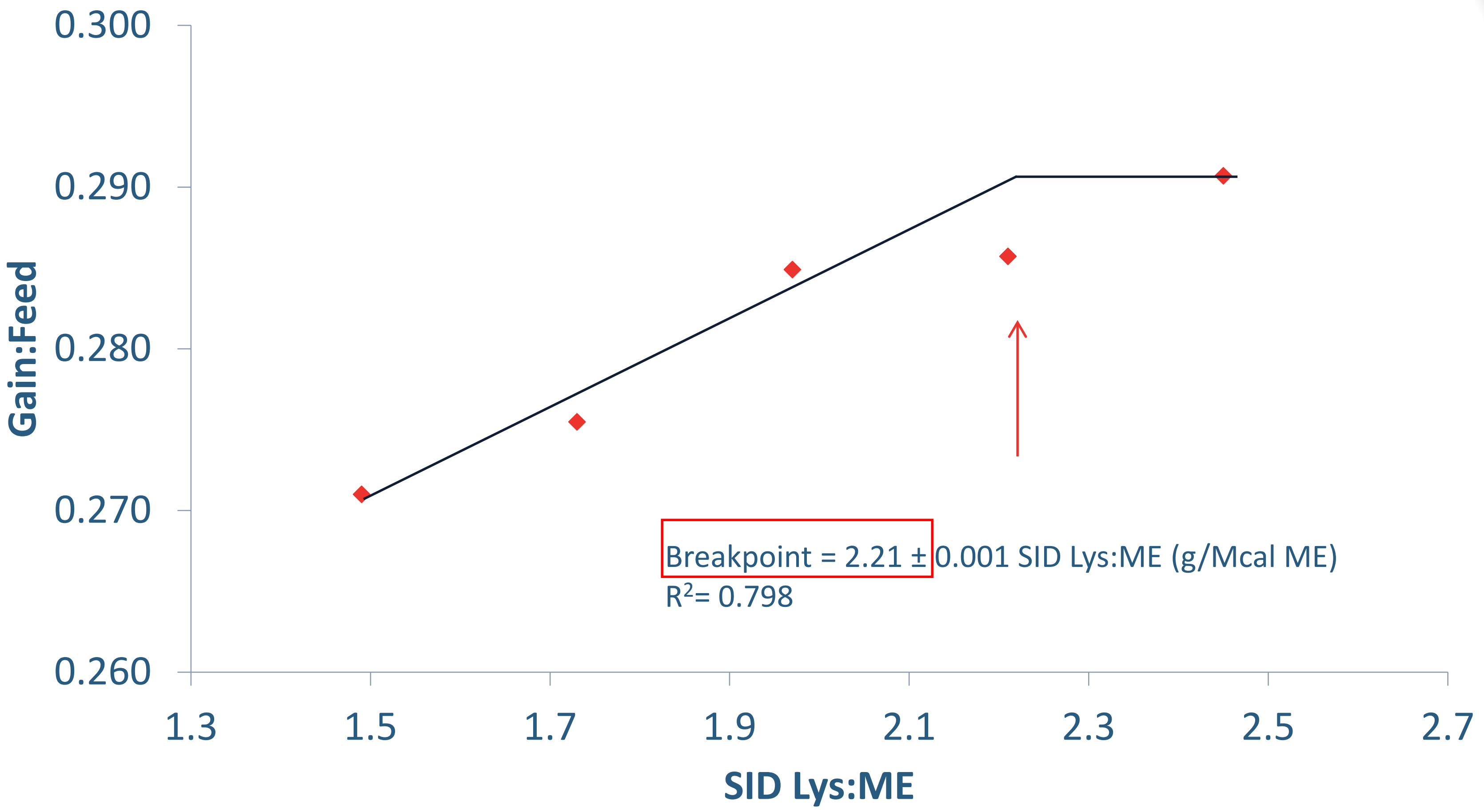


Energy Dose Response



Could not analyze statistically because there is no data of reason per pen, only per treatment.

SID Lysine from 285 to 330 lb of BW



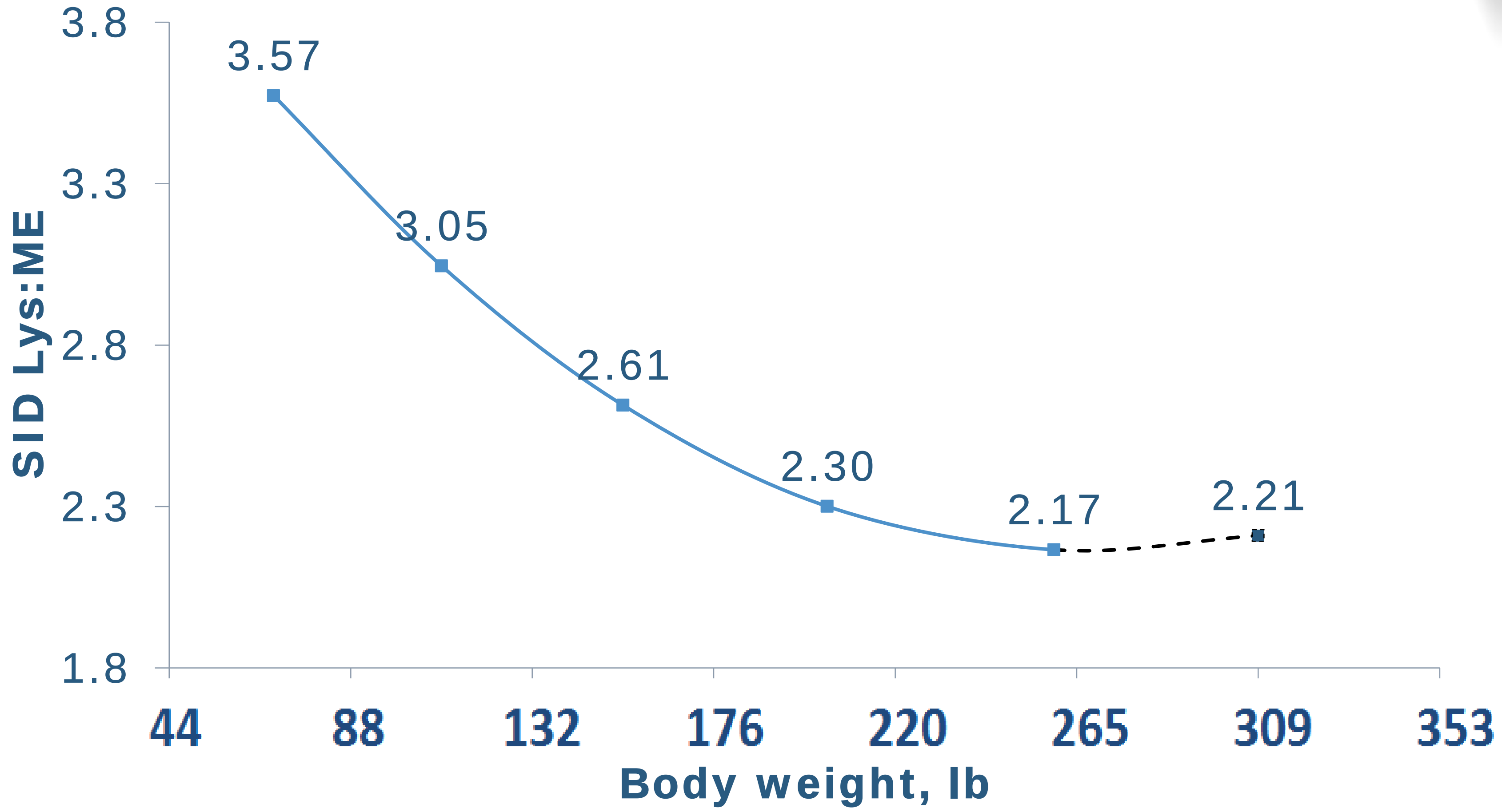
Never Stop Improving Nutrition.

PIC UNITED ANIMAL HEALTH

Orlando et al., 2018

How Does This Data Fit with Current Requirement Curves?

Never Stop Improving *Nutrition.*

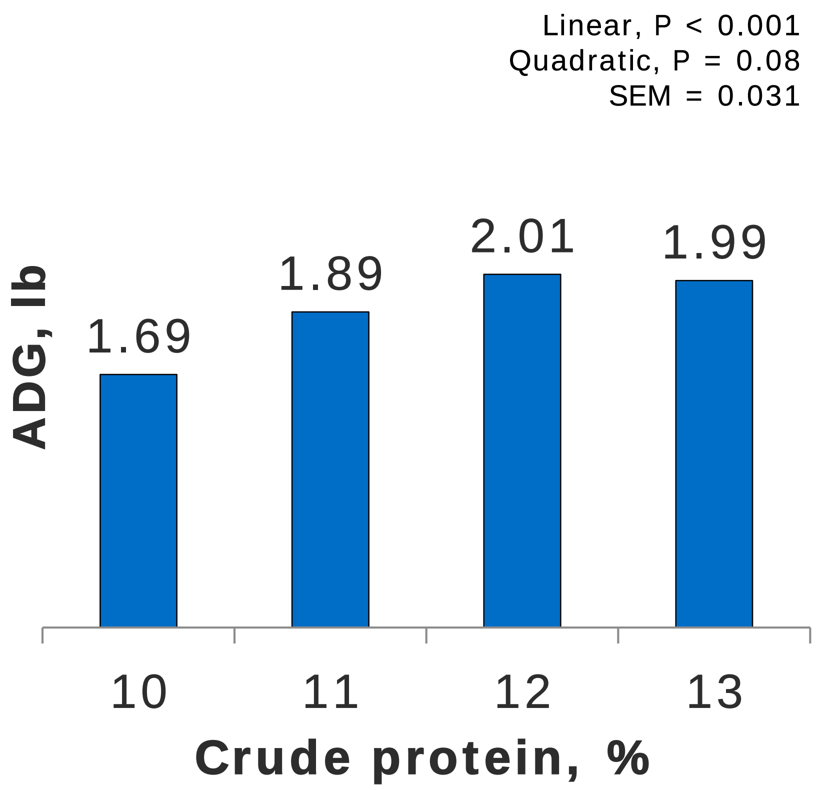


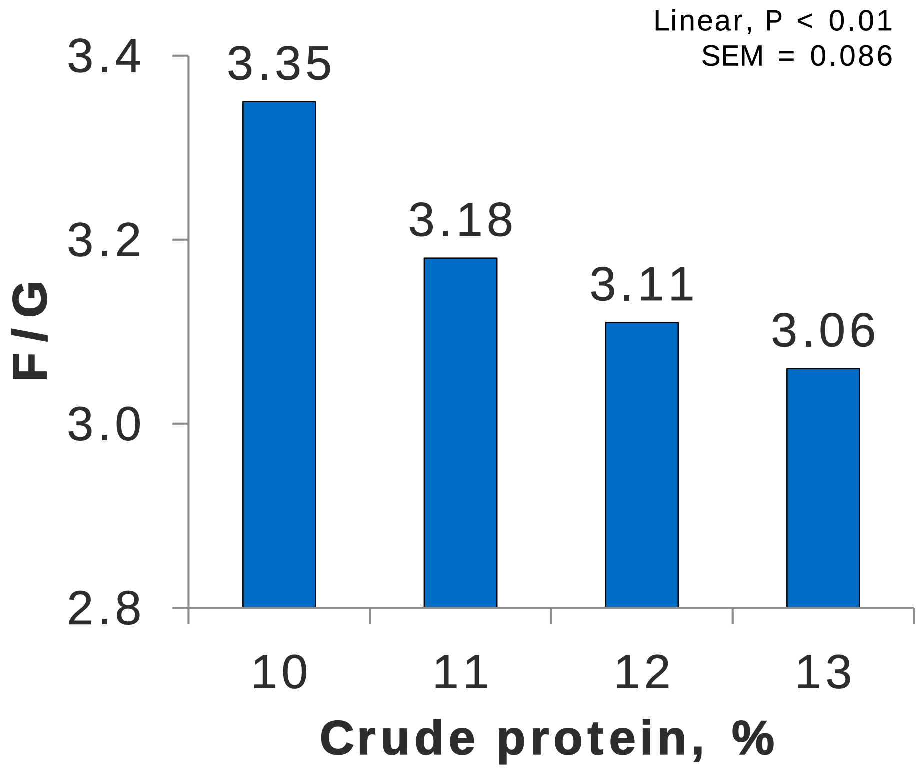
PIC

M. Gonçalves, U. Orlando, W. Cast, and M. Culbertson. Standardized Ileal Digestible Lysine Requirements for Finishing PIC Pigs Under Commercial Conditions: a Meta-Analysis, 2017, ASAS Midwest meetings

Bermuda Triangle of Swine Nutrition

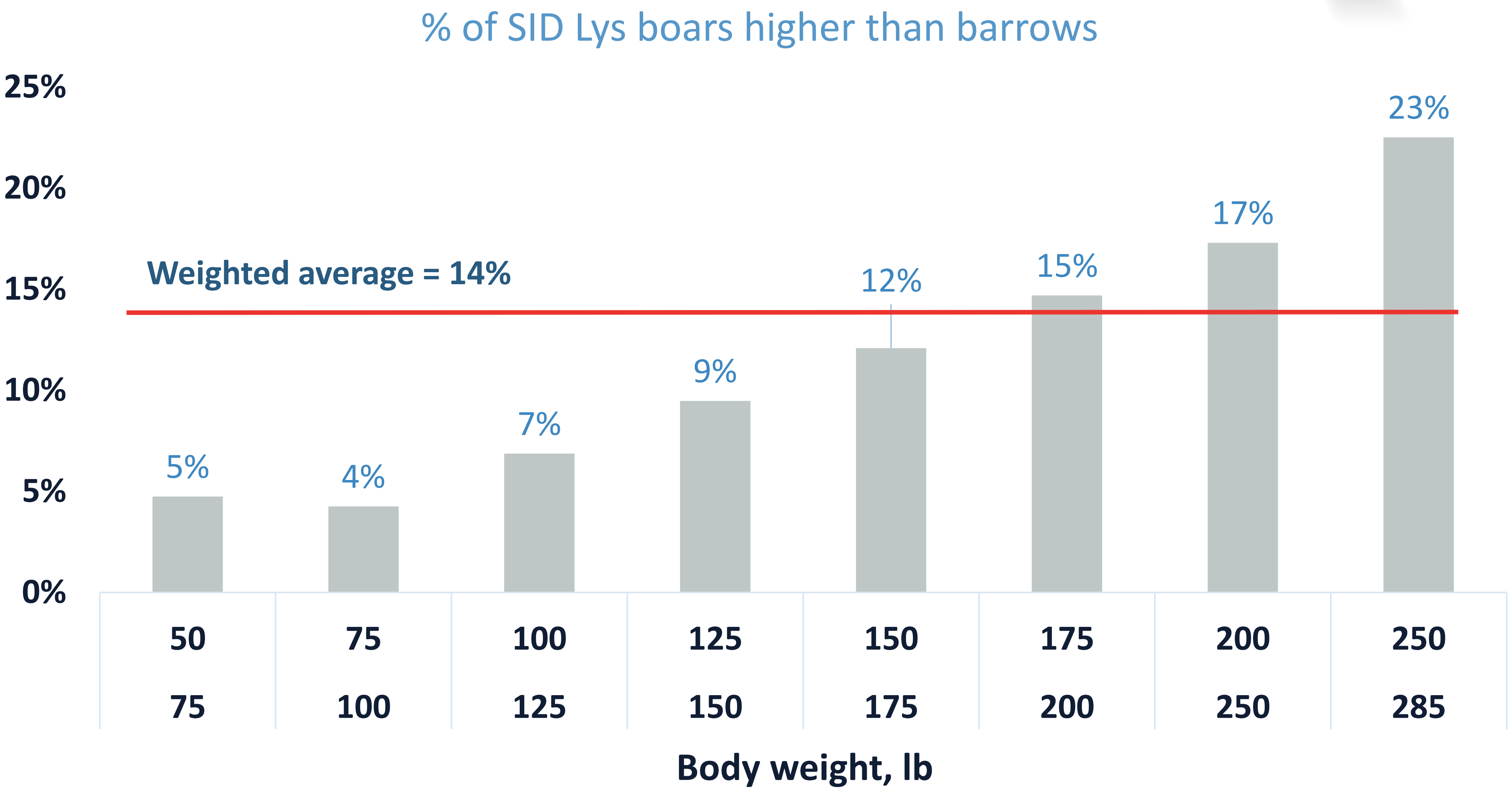
241 to 275 lb (20 d)





Soto et al. 2016;
A total of 224 pigs (PIC 1050 × 327; initially 241 lb) were used in a 20-d experiment with 7 pigs per pen.

Growing Boar Lysine Requirement



Ongoing Studies

Phosphorus during gestation: Univ. Wisconsin/DSM/PIC

Sow transition diet: CF/KSU/PIC

Lys x energy during lactation: CVS/Ajinomoto/PIC

Vitamins during wean-to-finish: DSM/PIC/CVS

Ca:Phos with and without phytase for finishing pigs: KSU/PIC/DSM

Summary

Never Stop Improving *Nutrition.*

2016: Sow feeding and amino acids for wean to finishing pigs

- Stopped bump feeding sows: **Focus** on body condition management
- Updated SID Lysine and Tryptophan
- Tools: Biological and economic SID Lysine, TRP Economic

2017: Energy dose response

- Tool and validation;

2018: Sow feeding and wean to finishing pigs;

- Stopped bump feeding gilts: **MORE focus** on body condition management
- Updated Phos requirement
- Updated SID Lys for Intact male

PIC

Never Stop Improving Nutrition.

Thank You

PIC Global Nutrition Team

PIC

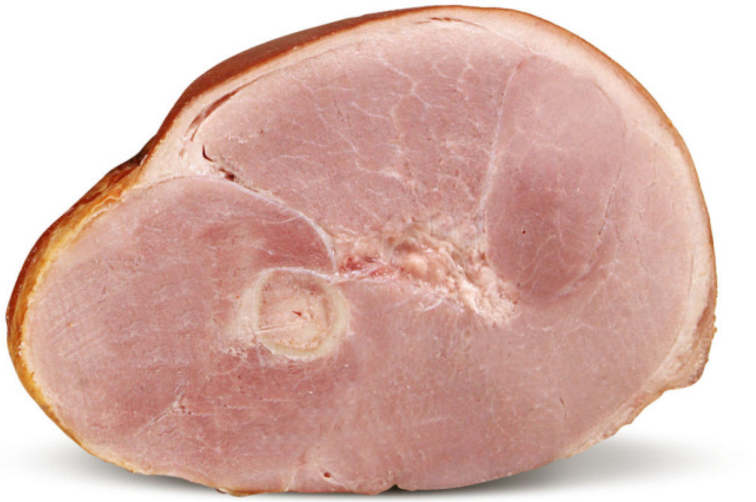

Lysine Economic Tool
PIC

Lysine requirement meta-analysis

- ✓ Lysine is the first limiting AA
  - ✓ The amount of Lysine to **make 1 kg of body weight gain** is virtually the same over the years

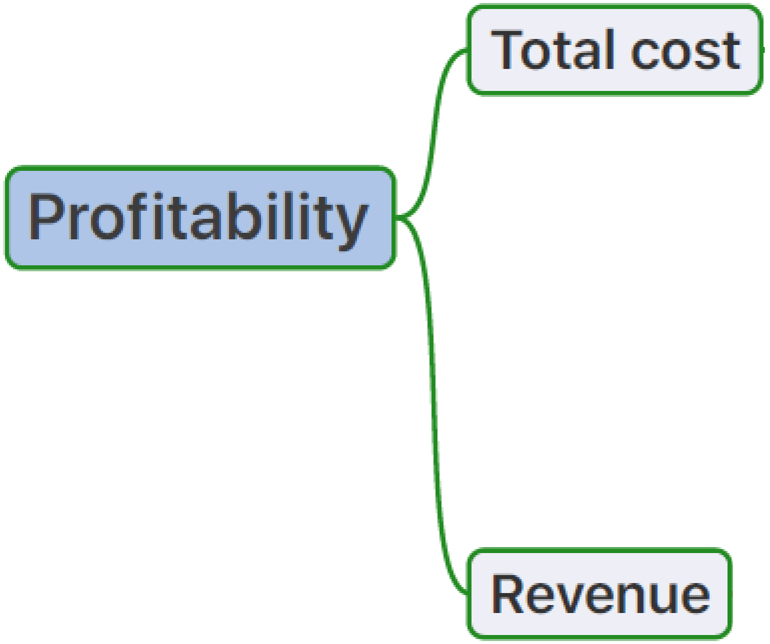
Improved weight gain

Improved feed efficiency

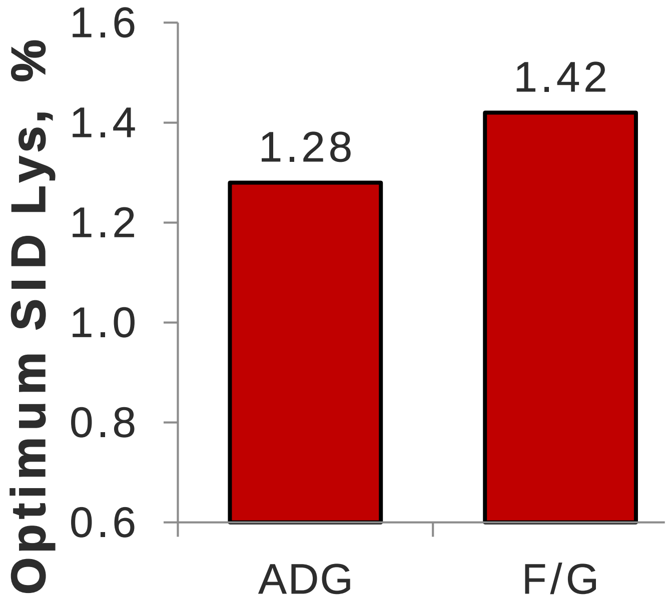


Overtime there is a need to concentrate the diets

Maximizing Profit



Multiple approaches for diet formulation



Maximize performance

.

Example of levels of standardized ileal digestible lysine to optimize different outcomes for PIC pigs (20- to 25-kg pig; PIC internal data).

More than biological requirement…

Lysine requirement for PIC pigs

Energy level, NRC ME kcal/kg	3300	3300	3300	3300	3300	3300
Weight In, kg	23	40	60	80	105	105
Weight Out, kg	40	60	80	105	123	123

Lys:Cal ME						
Barrows	3.48	2.99	2.57	2.25	2.09	2.09
Gilts	3.67	3.10	2.65	2.35	2.26	2.26
Boars	4.36	3.79	3.30	2.91	2.69	2.69

Lys % (ME equation)						
Barrows	1.15	0.99	0.85	0.74	0.69	0.69
Gilts	1.21	1.02	0.88	0.78	0.74	0.74
Boars	1.44	1.25	1.09	0.96	0.89	0.89

Instructions | Lbs - ME | Lbs - NE | **Metric - ME** | Metric - NE

…maximizing profit!

2017 it is worth up to ~$2/pig being at the new PIC lysine specs

Economic model for optimum lysine for PIC pigs

Input ***(please fill beige cells)***

Gender	Barrows and gilts
Live pig price, $/cwt	$55.00
Feeder pig cost, $/pig	$50.00
Facility cost, $/pig/day	$0.12
Other costs, $/pig	$14.00

USA June 2017:
$-0.08 up to 1.94 / pig

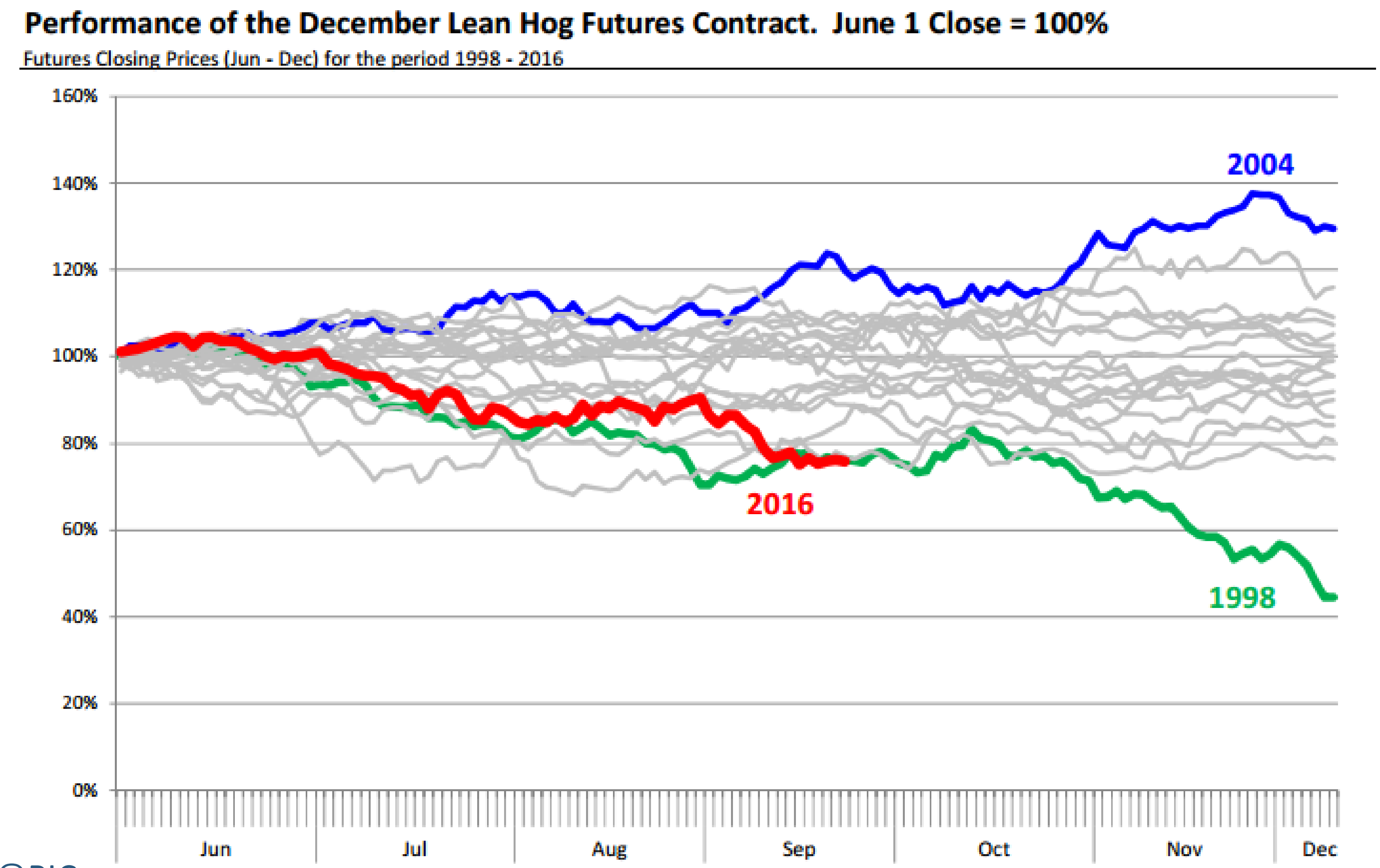
BW, lb		Energy, kcal NE/lb	Biological requirement SID Lys, %	$/ton	Current diets SID Lys, %	$/ton
50	90	1,125	1.19	$224	1.10	$214
90	130	1,125	1.02	$206	0.93	$204
130	180	1,125	0.87	$189	0.78	$180
180	230	1,125	0.77	$179	0.68	$170
230	285	1,125	0.73	$175	0.64	$166

Output

	Biological requirement	Current diets
% of maximum ADG	100.0%	96.6%
% of maximum feed efficiency	98.7%	95.8%
Net profit difference, $/pig		
Fixed time (space short)	+ 1.94	– 1.94
Fixed weight (space long)	– 0.08	+ 0.08

$55/cwt live, corn $3.34/bu, SBM $303/ton
L-Lysine-HCl $0.73.

Futures closing prices



December 2016 was worse scenario for new PIC lysine specs

PIC

Economic model for optimum lysine for PIC pigs

Input *(please fill beige cells)*

Gender	Barrows and gilts
Live pig price, $/cwt	$50.00
Feeder pig cost, $/pig	$50.00
Facility cost, $/pig/day	$0.12
Other costs, $/pig	$14.00

USA Dec 2016:
$-0.38 to -0.23 / pig

			Biological requirement		**Current diets**	
BW, lb		Energy, kcal NE/lb	SID Lys, %	$/ton	SID Lys, %	$/ton
50	90	1,125	1.19	$229	1.10	$219
90	130	1,125	1.02	$211	0.93	$202
130	180	1,125	0.87	$196	0.78	$186
180	230	1,125	0.77	$185	0.68	$177
230	285	1,125	0.73	$182	0.64	$174

Output

	Biological requirement	Current diets
% of maximum ADG	100.0%	96.6%
% of maximum feed efficiency	98.7%	95.8%

PIC

$35/cwt live, Corn $3.00/bu, SBM $300/ton,
DDGS 100% corn price, L-Lysine-HCl $0.78. Economics will vary within a country.

Energy Economic Tool

PIC®

Economic model to optimize dietary net energy for maximum profitability in growing-finishing pigs

JA Soto[1*], MD Tokach[2], SS Dritz[2], MAD Gonçalves[3],
JC Woodworth[2], JM DeRouchey[2], RD Goodband[2], and U Orlando[3]

[1]Vitaplus Corporation, Madison, WI
[2]Kansas State University, Manhattan, KS
[3]PIC-USA Hendersonville, TN

Outline

- Functional aspects of the model:
  - Growth performance prediction equations
  - Carcass yield prediction equations
  - Model optimization (IOTC, $/pig)
- Model validation

PIC®

Background

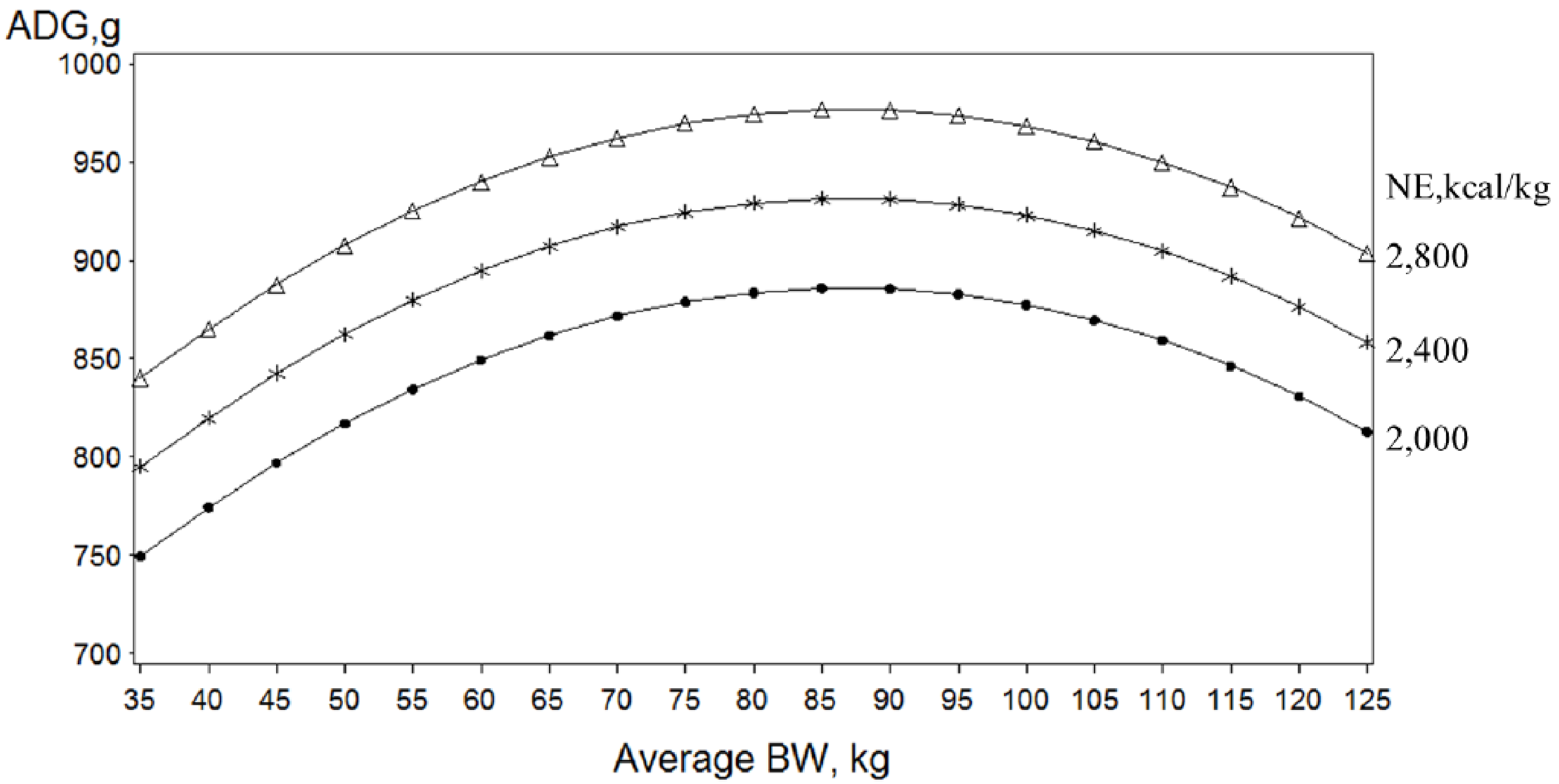
- Feed accounts for up to 75% of pork production cost, with energy alone representing 50% or more of the total cost. Thus, the first and most important step in diet formulation is to set the energy concentration.
- To set the optimal energy level in the diet, we must know how an incremental change in dietary energy affects factors such as: diet cost, growth (ADG, G:F) and carcass traits (yield, lean).
- Even though energy is the most expensive component of the diet, the level used in formulation is often based on history or impact on diet cost rather than an in-depth analysis to determine the most economical level.

PIC®

Objective

- To develop a tool to estimate the dietary NE concentration that yields maximum profitability for growing-finishing pigs.

ADG at various levels of dietary NE

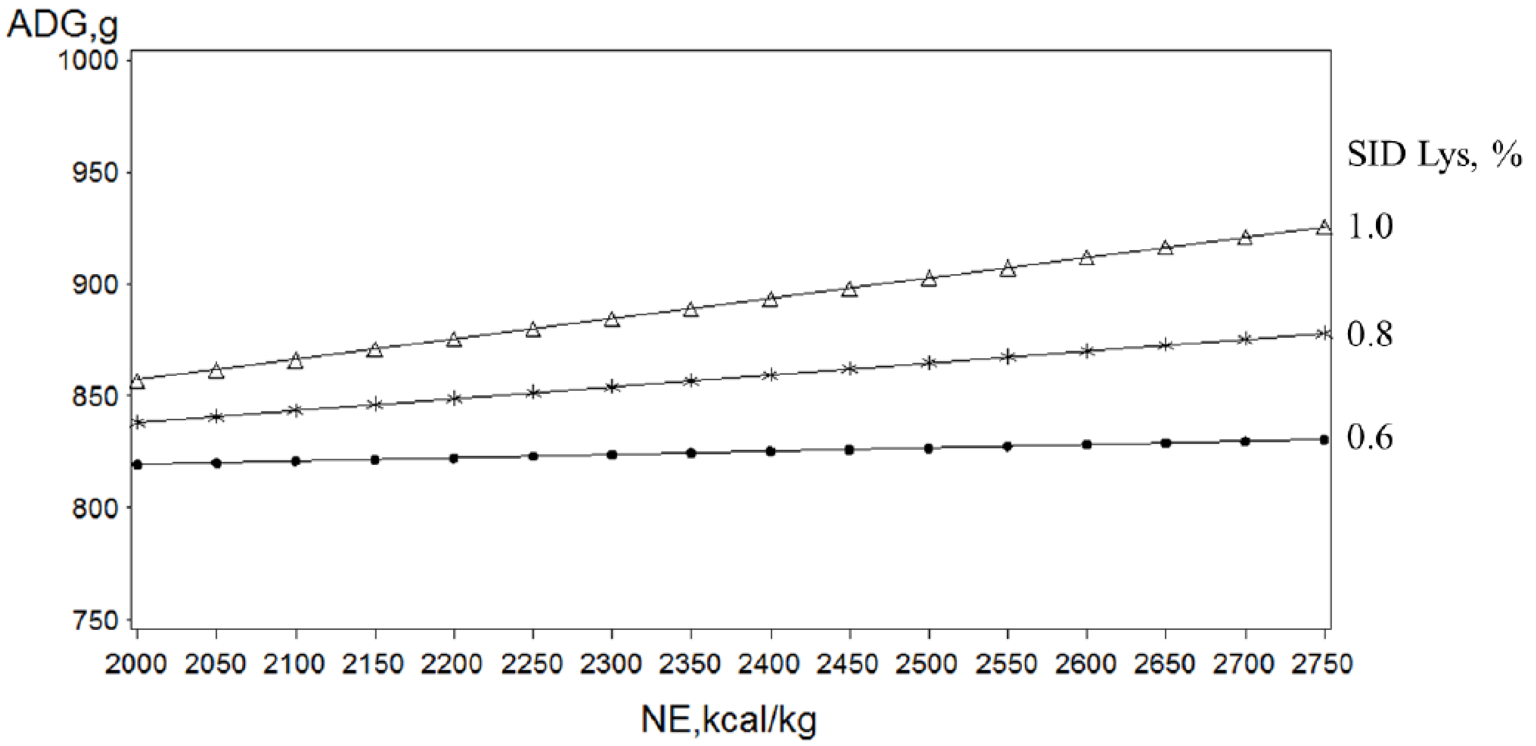


$$\text{ADG, g} = 0.1135 \times \text{NE (kcal/kg)} + 8.8142 \times \text{Avg BW (kg)} - 0.05068 \times \text{Avg BW (kg)} \times \text{Avg BW (kg)} + 275.99$$

Data from 104 observations from 17 trials were used as a database for statistical analysis

Nitikanchana et al. (2015). J. Anim. Sci. 93:2826-2839

Predicted ADG of pigs increasing NE at various levels of SID Lys (%)



ADG, g = -0.1004 × NE (kcal/kg) + 1.674 × Avg BW (kg) – 286.56 × SID Lys (%) + 0.1918 × NE (kcal/kg) × SID Lys (%) + 836.6

Data from 285 observations from 41 trials were used as a database for statistical analysis

Nitikanchana et al. (2015). J. Anim. Sci. 93:2826-2839

PIC®

Growth performance – Model settings

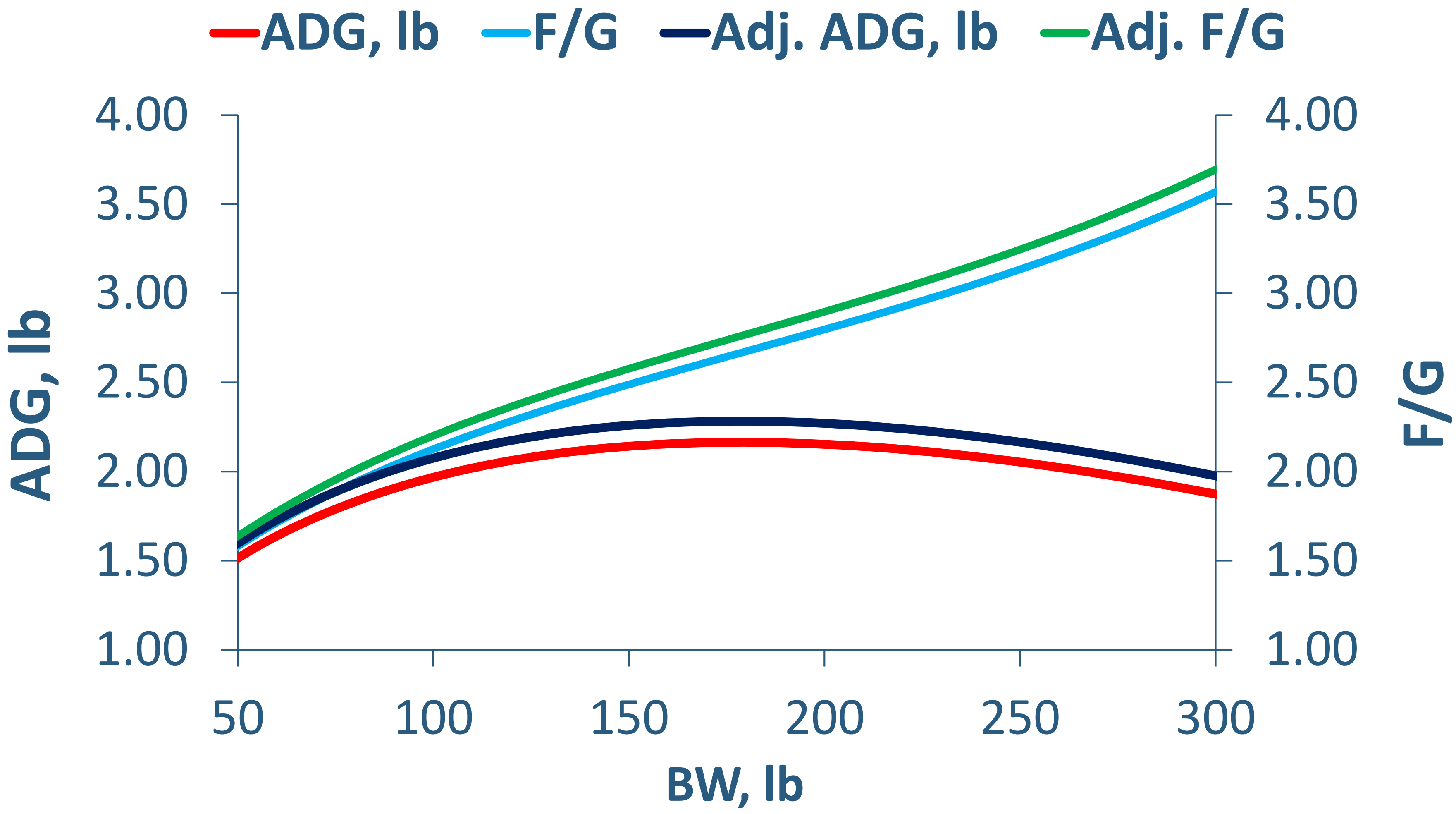
Growth curve – user values

	Section 1. Economics and System performance	
1	Live price, $/lb	0.48
2	Carcass price, $/lb	0.65
3	Feeder pig cost (50 lb), $/pig	55.00
4	Facility cost, $/pig/d	0.11
5	Current ADG, lb	2.10
6	Current Feed efficiency	2.70
7	Current carcass yield, %	73.40
8	Other cost[1], $/pig	8.00
	[1] Veterinary supplies, field service personnel, trucking, etc.	
	Economic evaluation criteria (Live or Carcass)	Carcass
	Marketing basis (Fixed weight or fixed time)	Fixed Time
	Growth curve (enter own values or use default)	Default
		Default
		Own values

PIC®

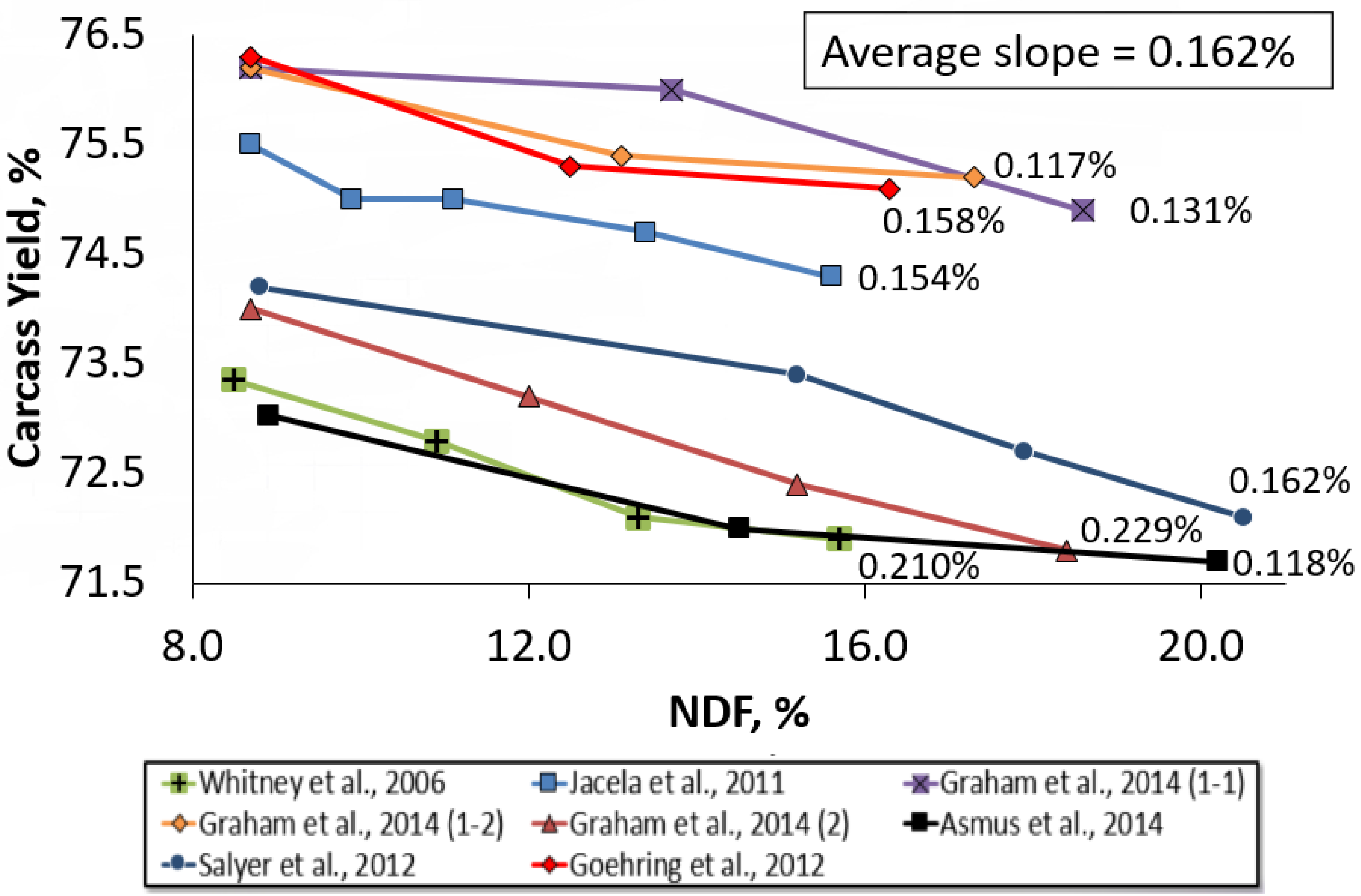
Growth performance – Model settings

Growth curve – Default



PIC 337 reference growth curve (PIC internal data)

Impact of increasing NDF on carcass yield



Coble et al. (2015).

Carcass yield prediction equation

Resulting prediction equation:

Yield, %	= 0.03492 × WP (d) – 0.05092 × NDF1 (%) – 0.06897 × NDF2 (%) – 0.00289 × (NDF2 (%) × WP (d)) + 76.0769

[1] Data from 8 trials were used as a database for the statistical analysis to develop the model.

NDF1 (%) = NDF concentration in dietary phase before final dietary phase.

NDF2 (%) = NDF concentration in final dietary phase before marketing.

WP (d) = Withdrawal period.

PIC

Soto et al. (2017).

Optimization criteria

Maximize: income over total cost

1) IOTC Live, $/pig =

(BW gain, lb + Feeder pig BW, lb) × Live price, $/pig –
Feed cost and facility cost, $/pig – Feeder pig cost, $/pig - Other costs

2) IOTC Carcass, $/pig =

((BW gain, lb + Feeder pig BW, lb) × Yield, %) × Carcass price, $/pig –
Feed cost and facility cost, $/pig – Feeder pig cost, $/pig - Other costs

Kansas State University | applied swine nutrition

Economic model for optimum NE V2.6

PIC

Section 1. Economics and System performance

1	Live price, $/lb	0.62
2	Carcass price, $/lb	0.85
3	Feeder pig cost (50 lb), $/pig	55.00
4	Facility cost, $/pig/d	0.11
5	Current ADG, lb	2.10
6	Current Feed efficiency	2.90
7	Current carcass yield, %	73.00
8	Other cost[1], $/pig	8.00

[1] Veterinary supplies, field service personnel, truckin

Economic evaluation criteria (Live or Carcass)	Carcass
Marketing basis (Fixed weight or fixed time)	Fixed Time
Growth curve (enter own values or use default)	Default

Section 2. Weight by phase and current dietary energy levels

Select number of dietary phases: 6

Phase	Initial weight, lb	Final weight, lb	Current NE, Kcal/lb	Range NE (Kcal/lb) Min	Range NE (Kcal/lb) Max
1	50.0	75.0	1,104	1,083	1,122
2	75.0	125.0	1,122	1,097	1,137
3	125.0	170.0	1,130	1,110	1,153
4	170.0	210.0	1,145	1,119	1,164
5	210.0	250.0	1,150	1,126	1,170
6	250.0	285.0	1,140	1,117	1,159

Back to main menu | Summary of Calculations

Section 3. Dietary specifications

Are your diets adequate on SID Lys? Yes

Dietary Phase	Energy Level	NE, Kcal/lb	Cost, $/Ton	NDF, %
1	Min	1,083	159.71	-----
		1,093	168.08	-----
	Current	1,104	177.77	-----

Model settings

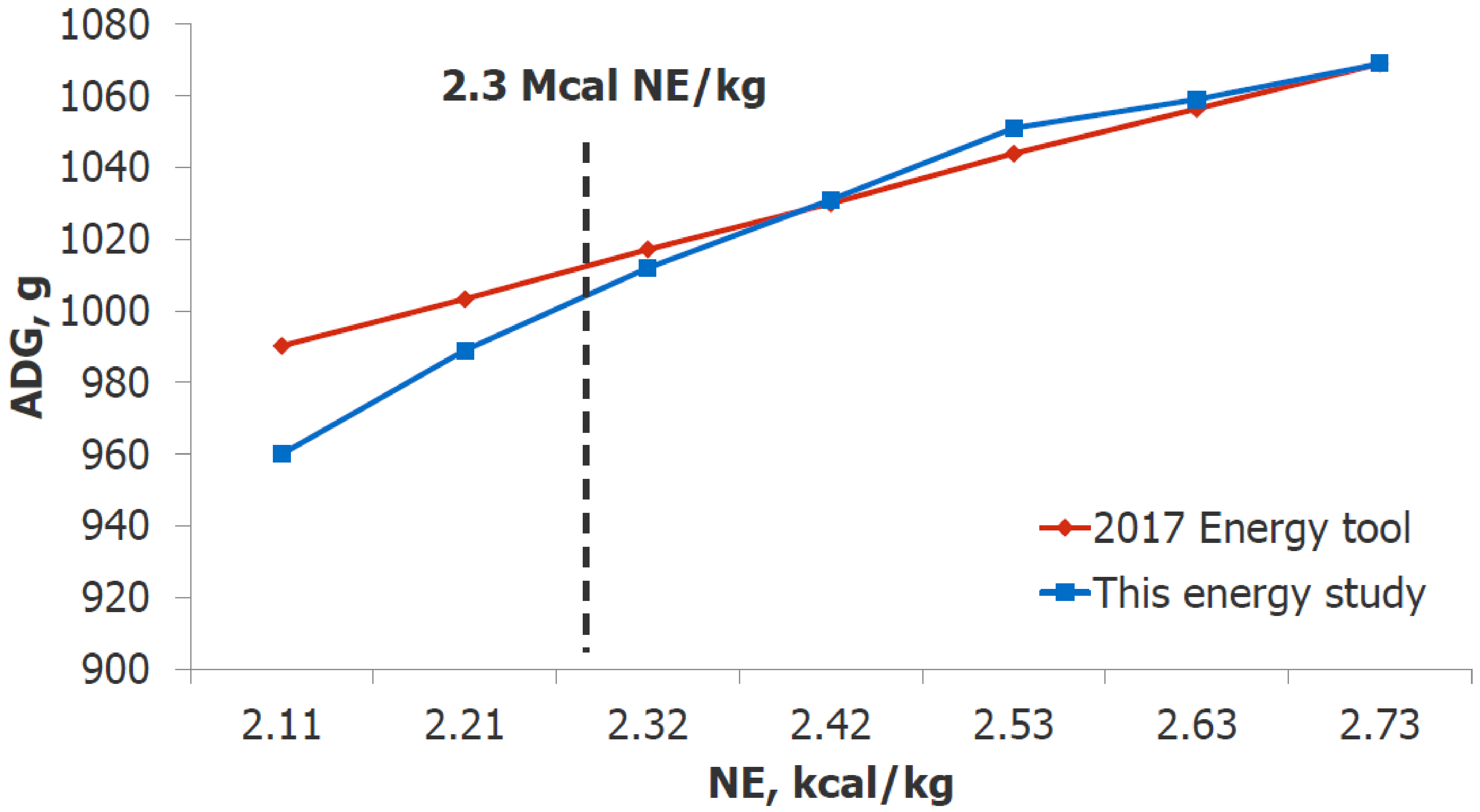
Economics & System Performance

Nutritional program

PIC

ADG prediction

Above 2.3 Mcal NE/kg (3.06 kcal ME/kg), residual error was 1 gram (- 6 g overall)



Economic model to optimize dietary net energy for maximum profitability in growing-finishing pigs

JA Soto[1*], MD Tokach[2], SS Dritz[2], MAD Gonçalves[3], JC Woodworth[2], JM DeRouchey[2], RD Goodband[2], and U Orlando[3]

[1]Vitaplus Corporation, Madison, WI
[2]Kansas State University, Manhattan, KS
[3]PIC-USA Hendersonville, TN

Thank You!

PIC®