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Technical Services*

## Update in Nutrient Availability to Achieve Wean-to-Finish Excellence in PIC Pigs

PIC Global Nutrition and Wean-to-Finish  
Technical Services  
PIC Nutrition Seminar – June, 30<sup>th</sup>

**PIC**<sup>®</sup>

# Update in Nutrient Requirements

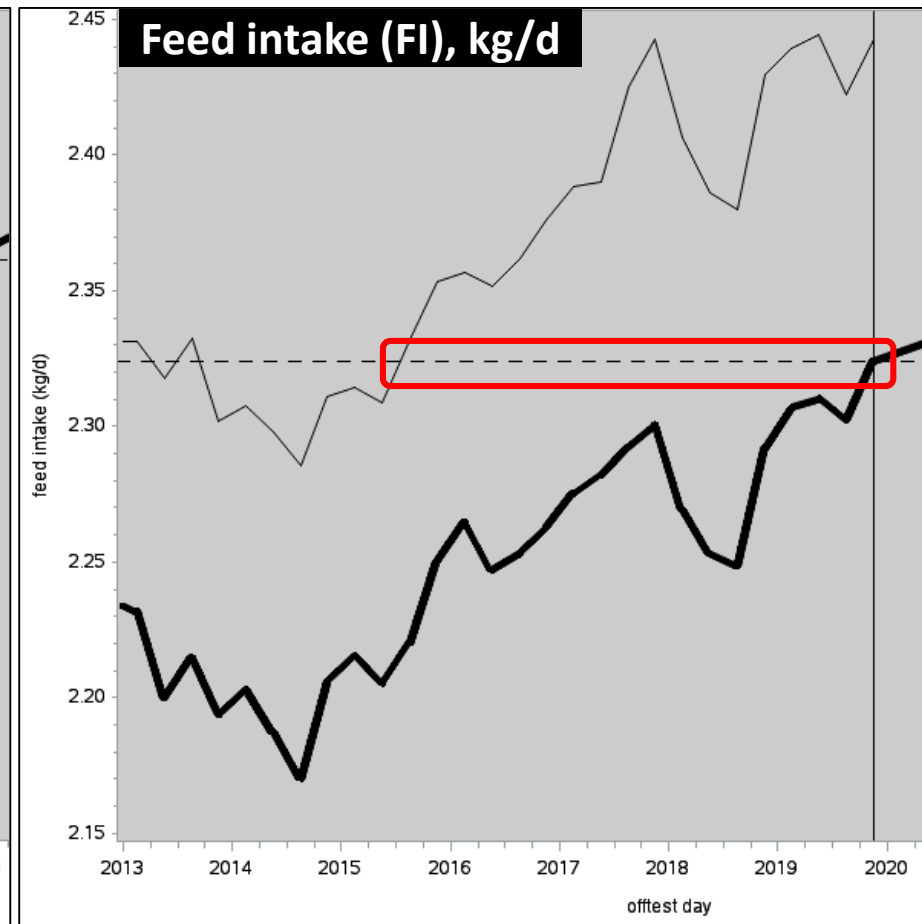
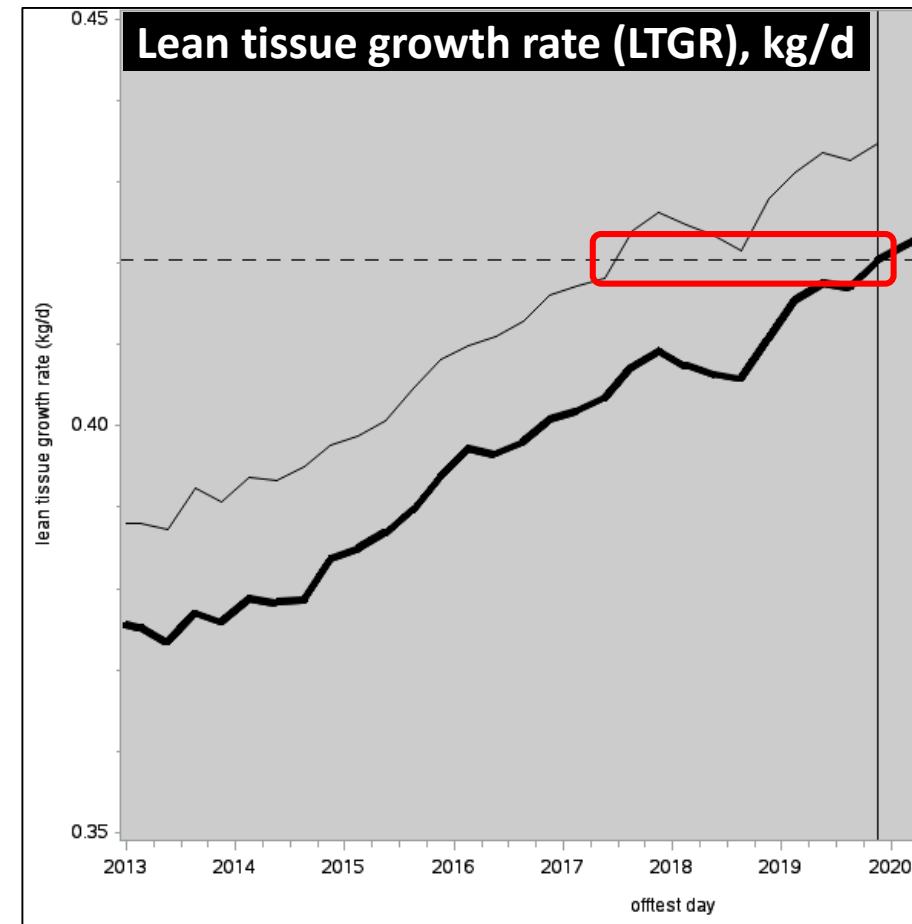


# Genetic development and nutrient requirements changes

## Genetic trends of boars in PIC Nucleus herds



**Bold line:** population mean; **Thin line:** top 25% of the population



**Timeline (years) for the top 25% become the population average**

Lines	LTGR	FI
<b>337</b>	<b>3</b>	<b>5</b>



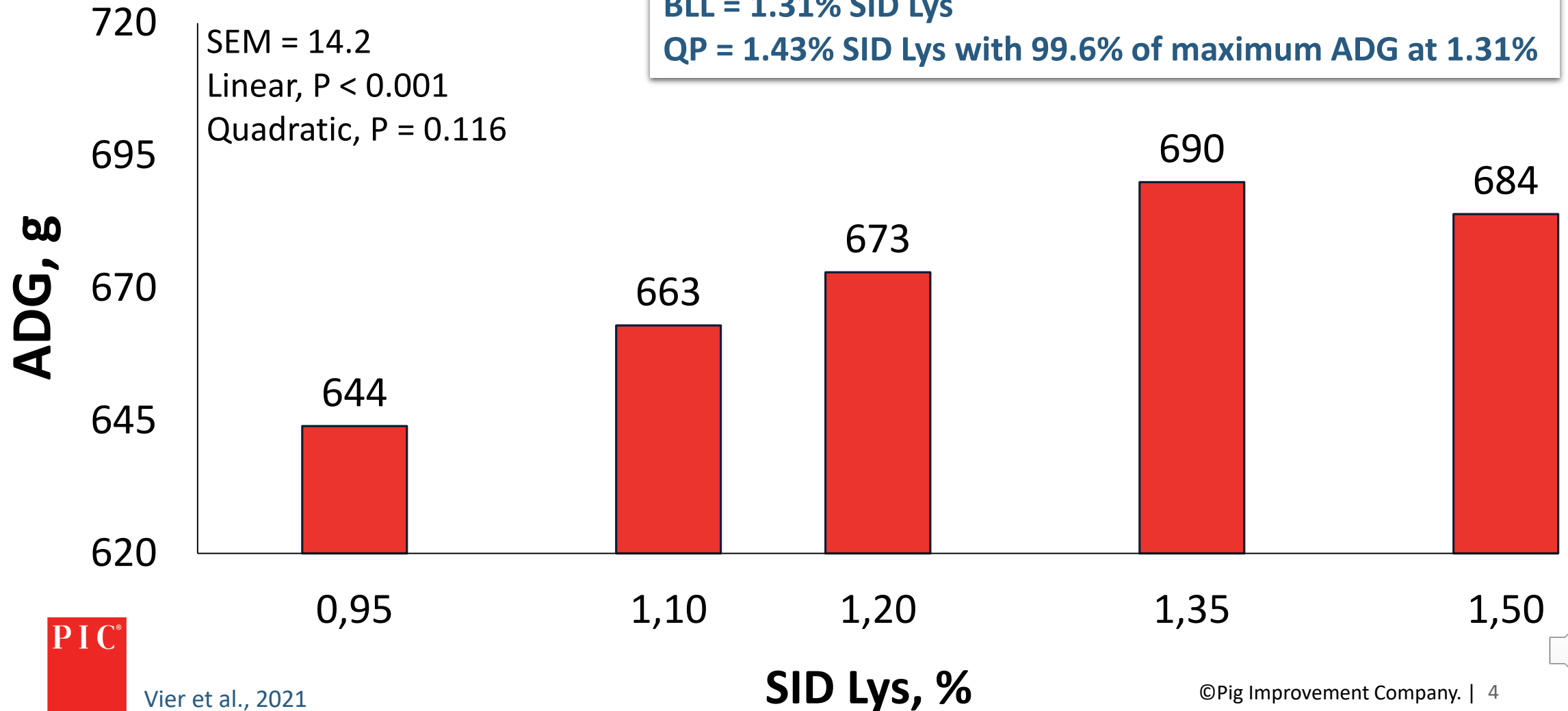
PIC Internal data.



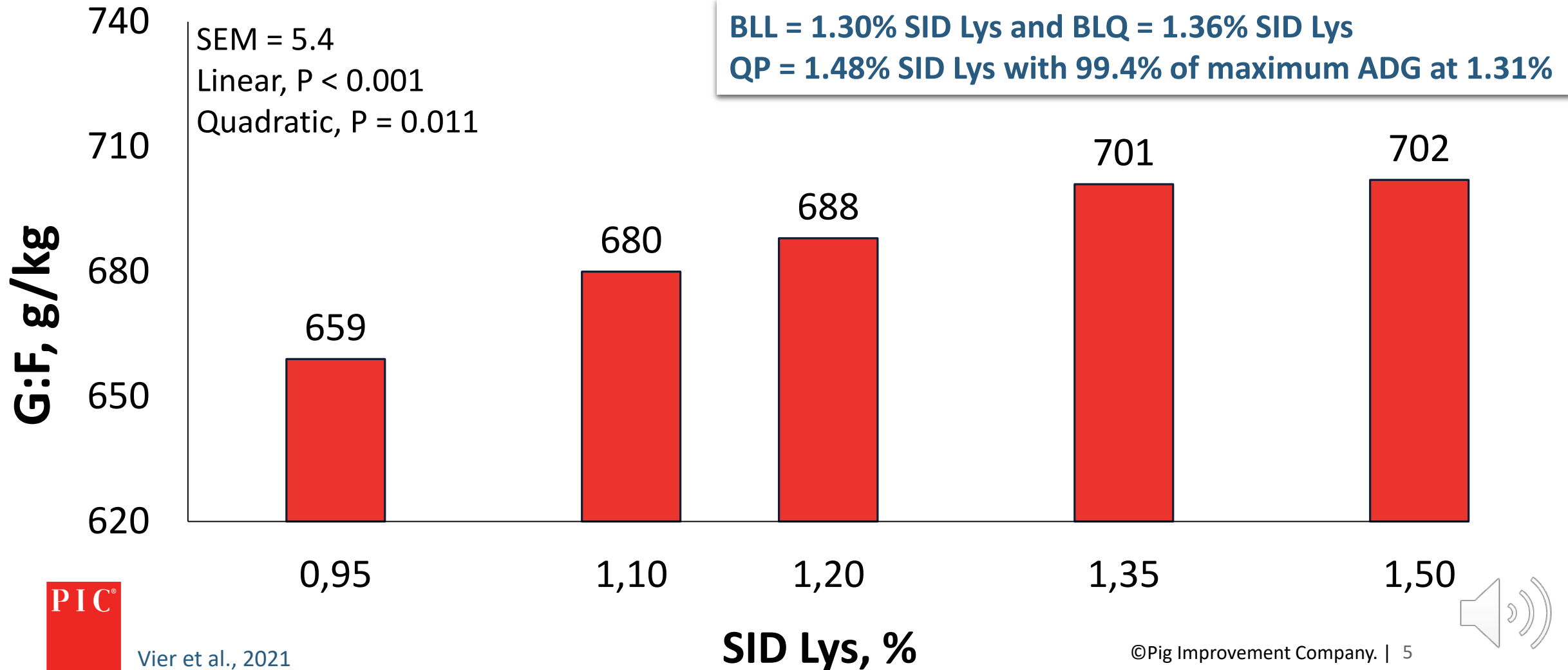
### Average Daily Gain

BLL = 1.31% SID Lys

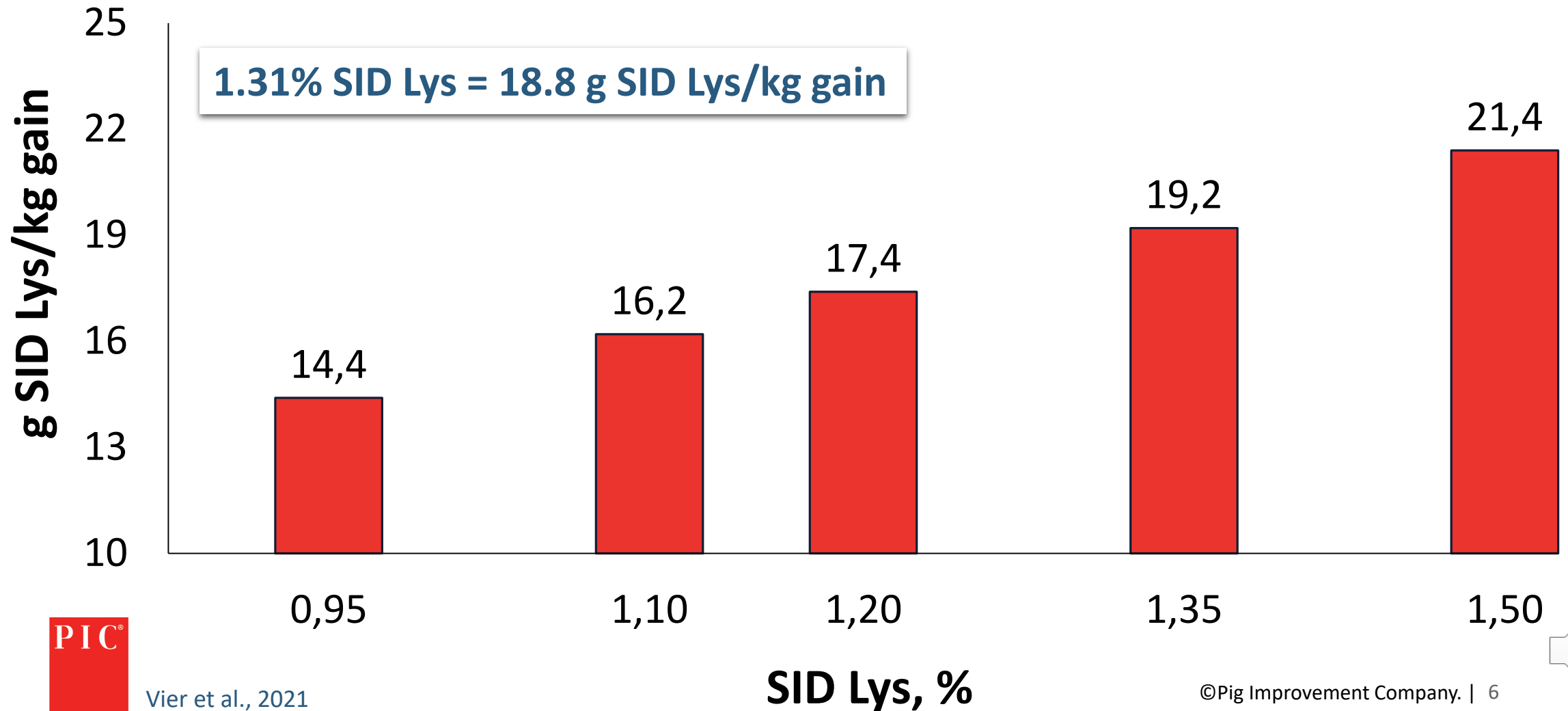
QP = 1.43% SID Lys with 99.6% of maximum ADG at 1.31%



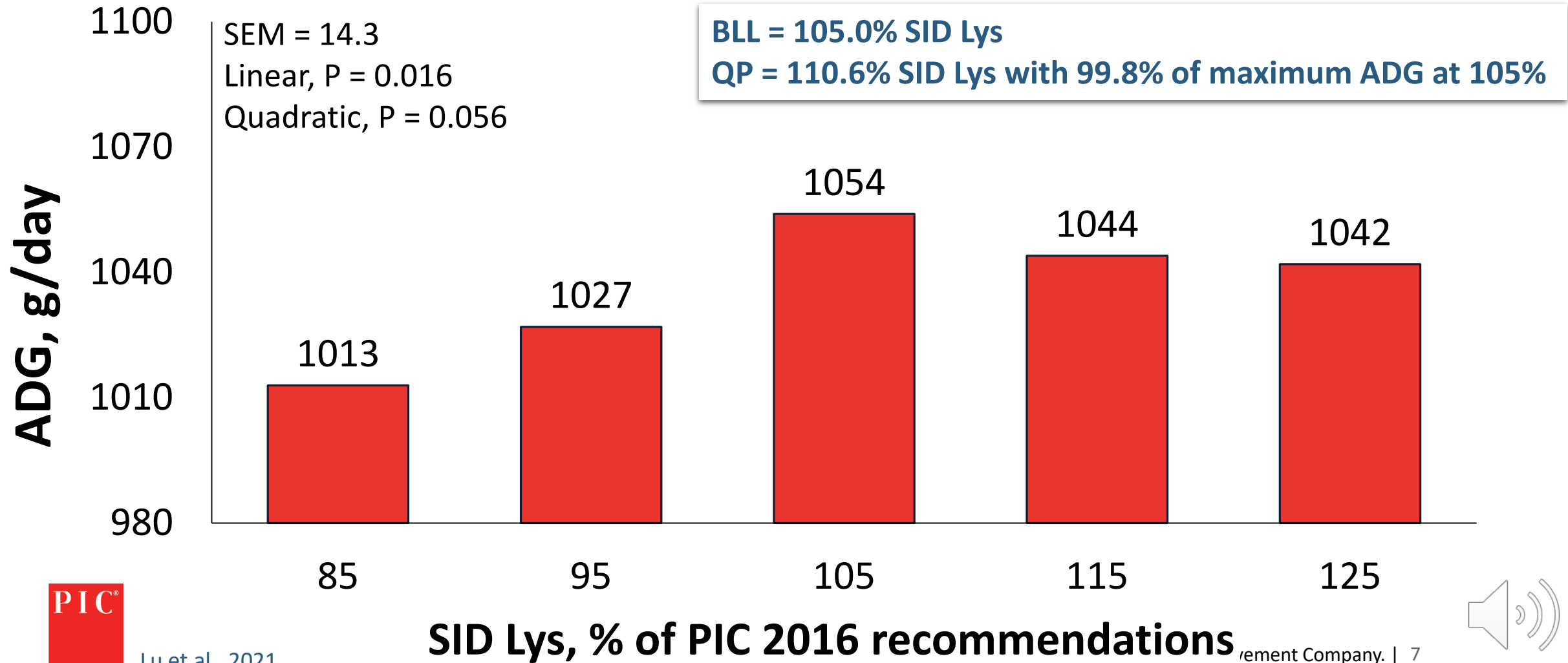
### Feed Efficiency



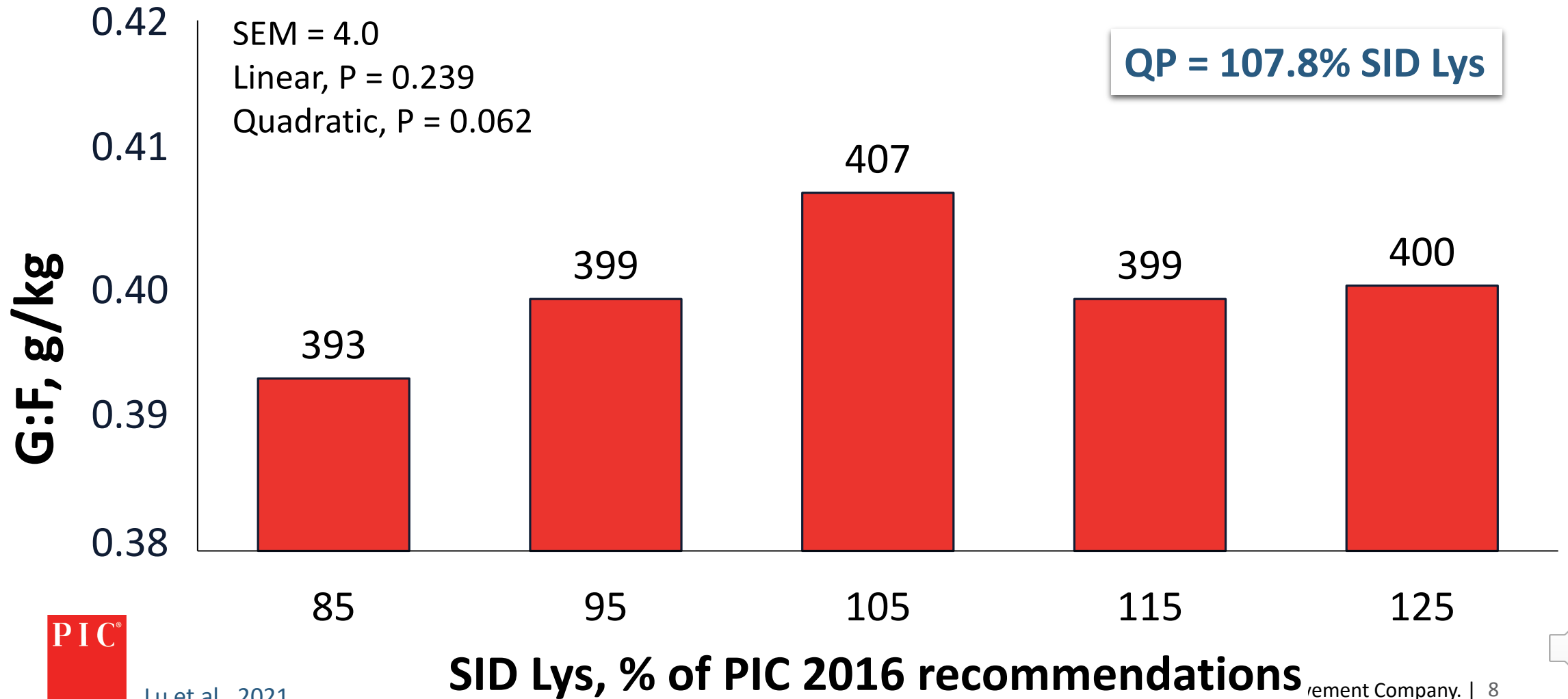
### Grams of SID Lys per unit of body weight gain



### Average Daily Gain

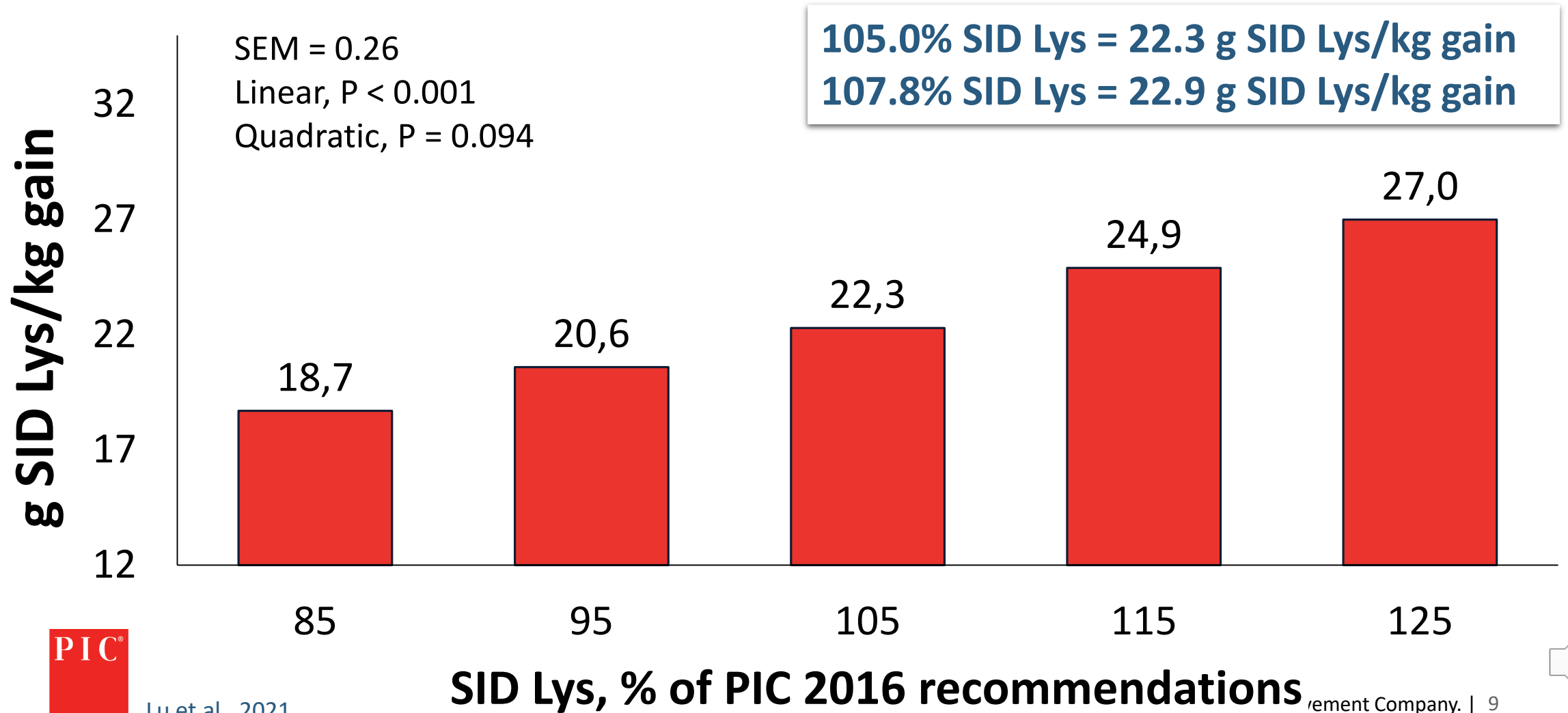


### Feed Efficiency

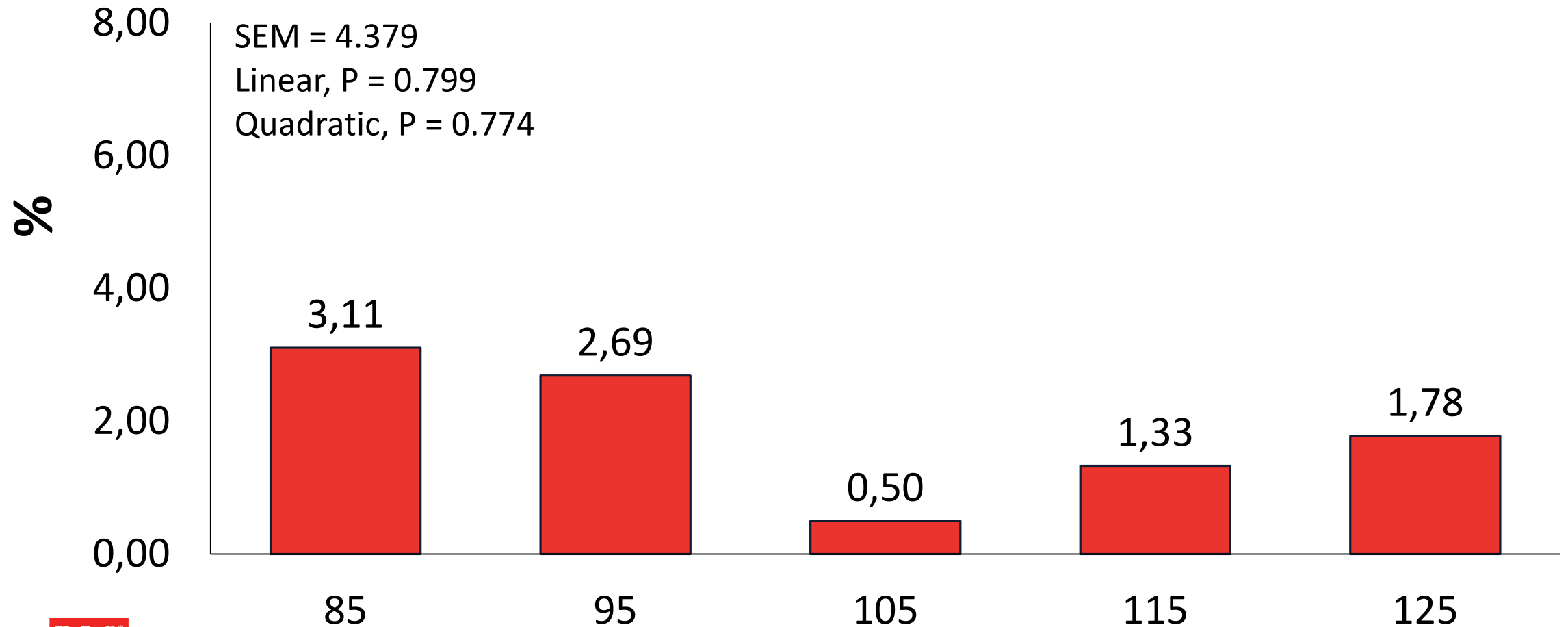




### Grams of SID Lys per unit of body weight gain

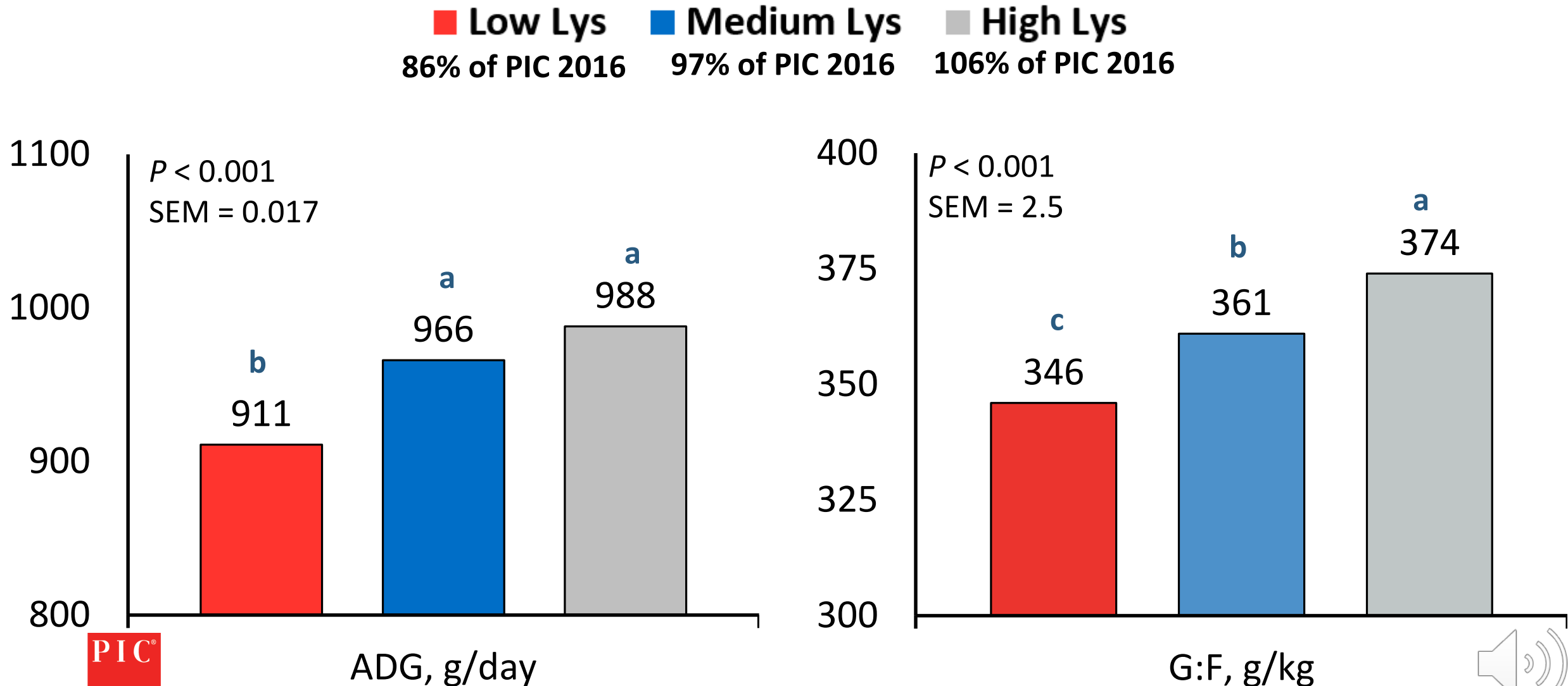


### Removal + mortality rate



# Amino acids

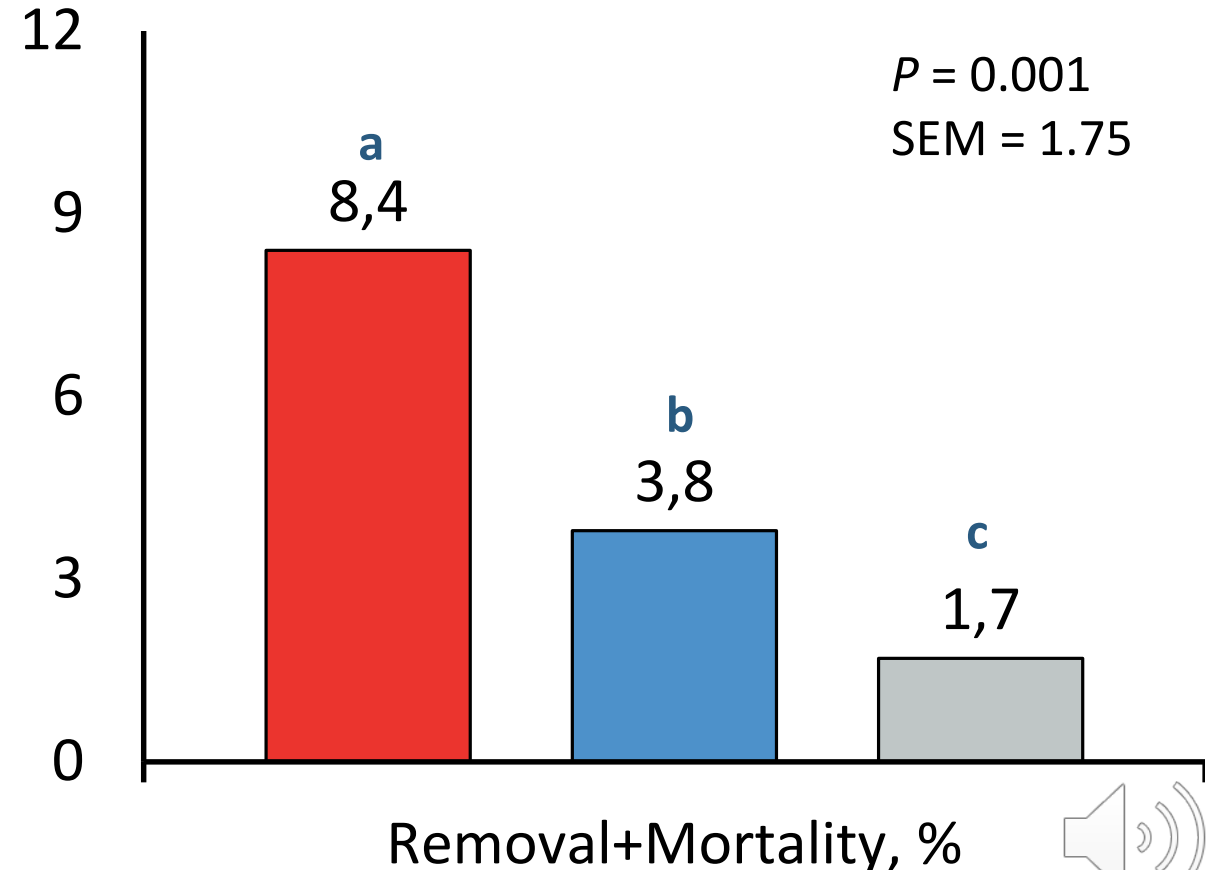
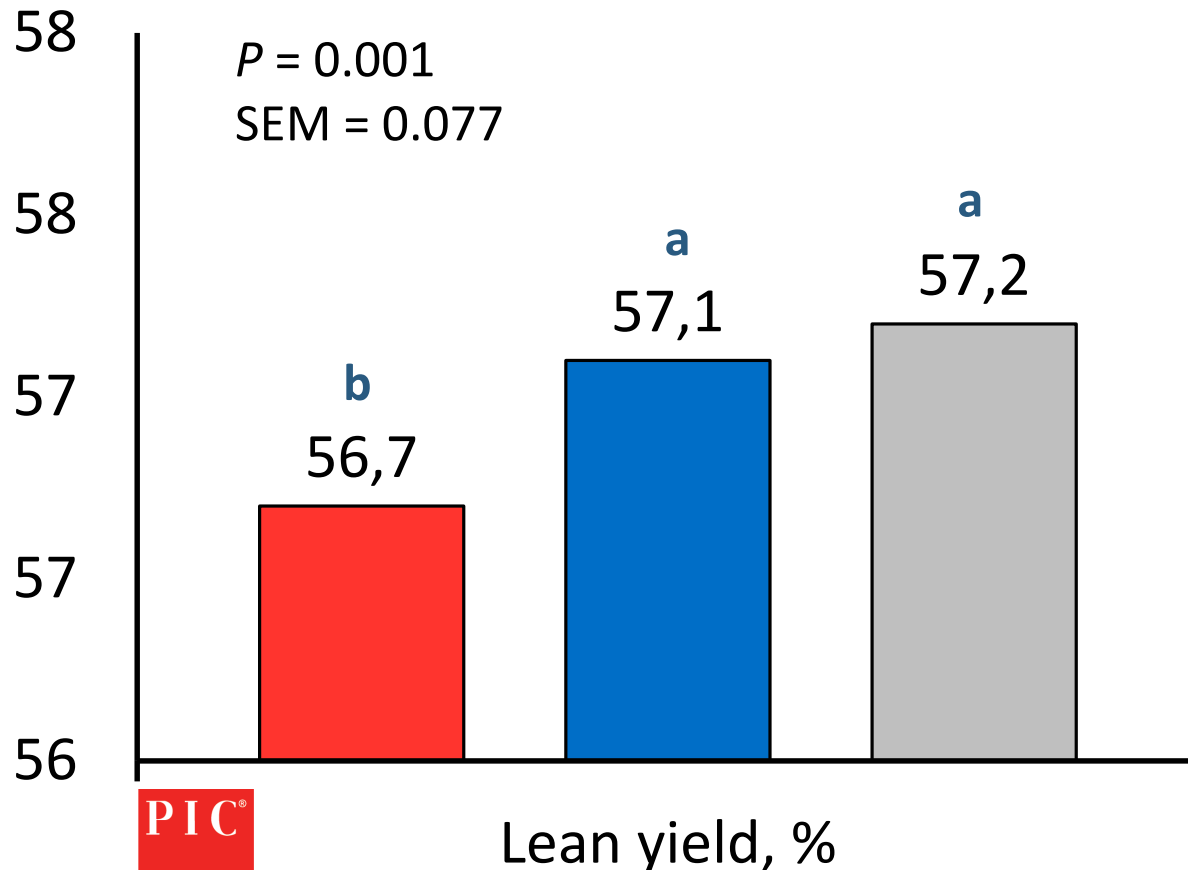
## Effects of SID Lys levels on performance of 29 to 129 kg pigs sired by high index boars



# Amino acids

## Effects of SID Lys levels on performance of 29 to 129 kg pigs sired by high index boars

■ **Low Lys** 86% of PIC 2016   ■ **Medium Lys** 97% of PIC 2016   ■ **High Lys** 106% of PIC 2016



**Meta-analysis:** 29 commercial trials with a total of 48,338 pigs.

### PIC 2016 meta-analysis

- ✓ NRC 2012 loadings for metabolizable energy
- ✓ Adjustment factor of 0.74 for net energy
- ✓ Trials were done with barrows and gilts fed separately
- ✓ Recommendations for mixed gender were the average of barrows and gilts
- ✓ The model was applicable from 23 to 130 kg of body weight

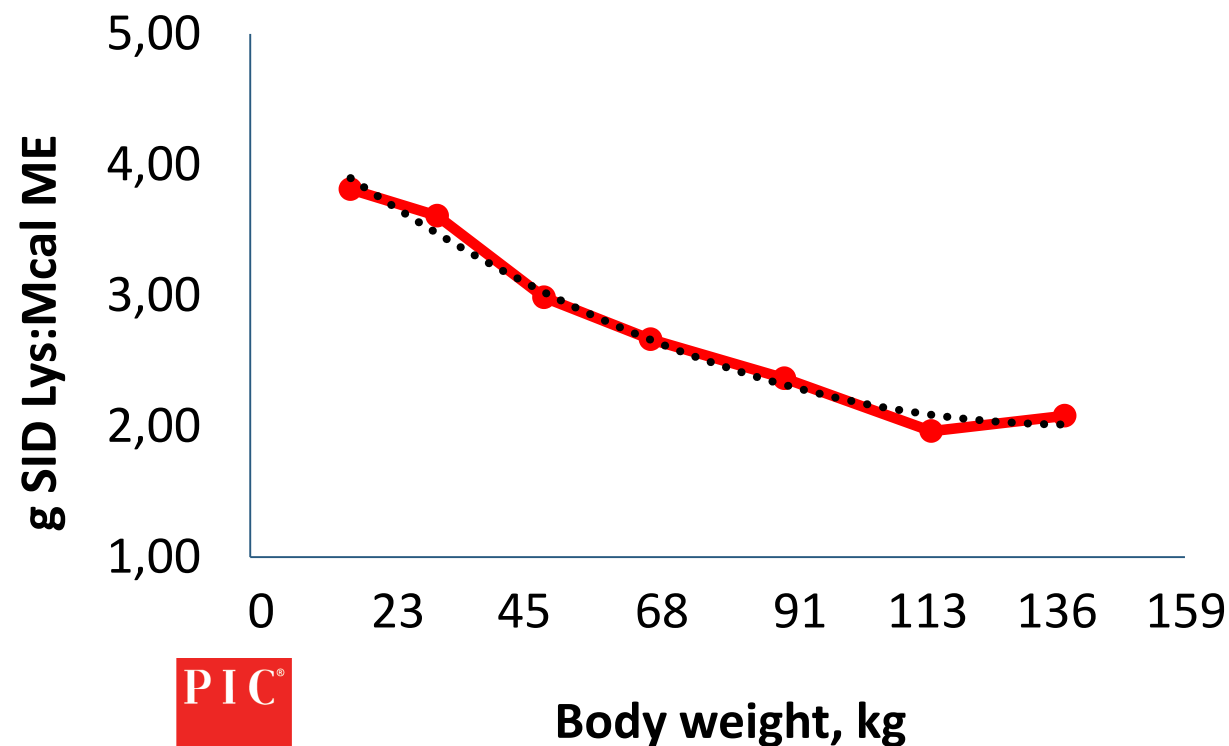
### PIC 2021 meta-analysis

- ✓ NRC 2012 loadings for metabolizable energy
- ✓ NRC 2012 loadings for net energy
- ✓ Mixed gender models were developed
- ✓ Barrows and gilts recommendations are calculated based on the estimated difference from mixed gender
- ✓ The model is applicable from 11 to 150 kg of body weight

### PIC 2021: grams of SID Lys per Mcal of Energy

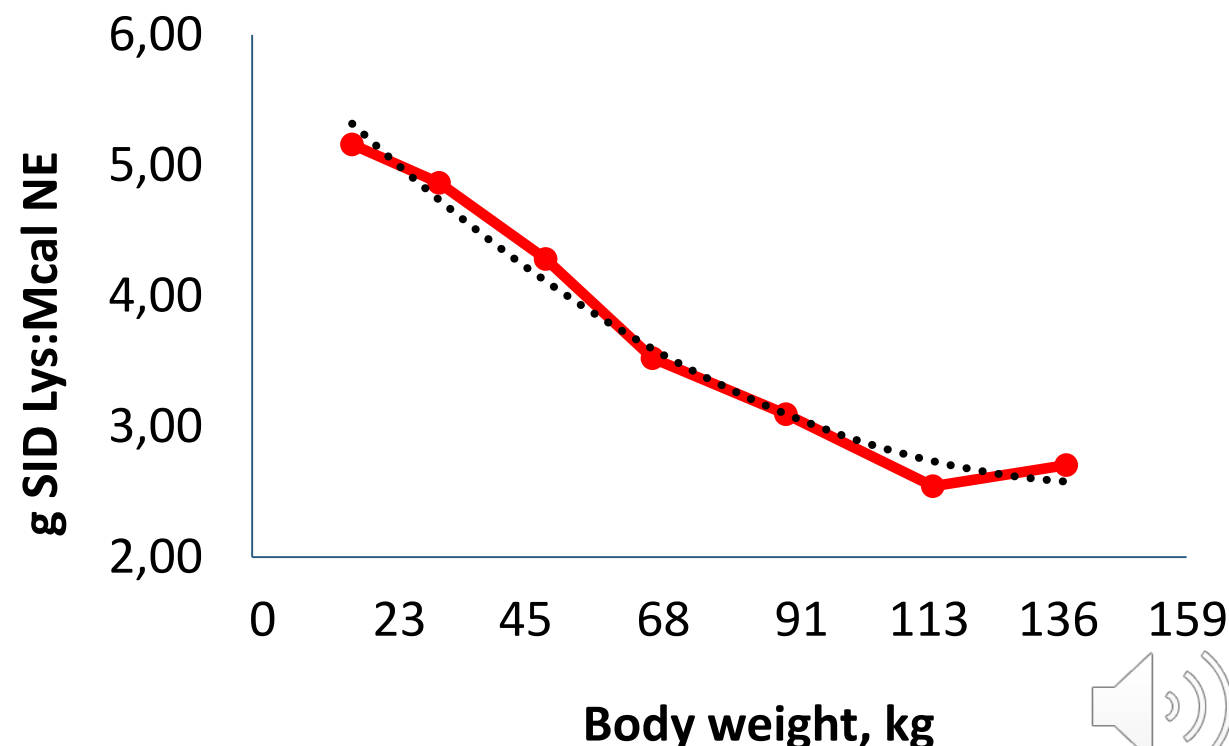
#### Metabolizable Energy Basis

$$\text{g SID Lys:ME} = 0.0000255654 \times (\text{BW, kg} \times 2.204622)^2 - 0.0157978368 \times (\text{BW, kg} \times 2.204622) + 4.4555073859$$

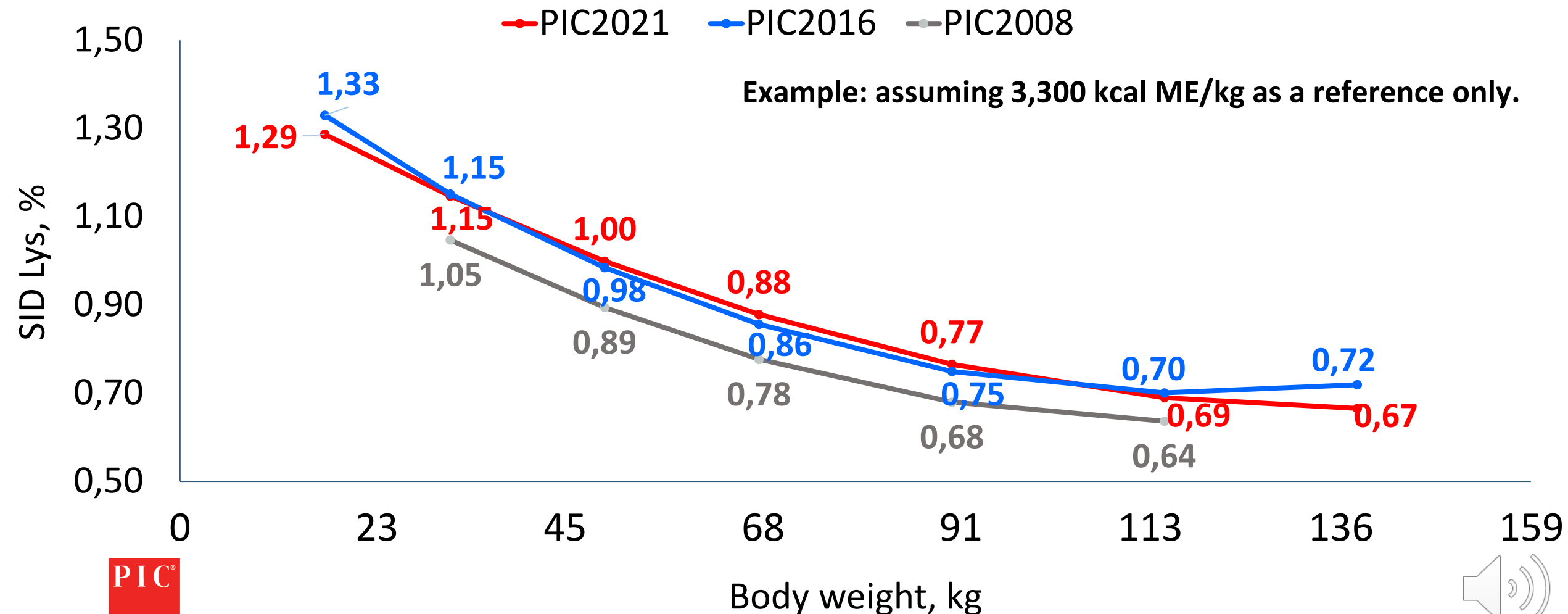


#### Net Energy Basis

$$\text{g SID Lys:NE} = 0.0000327185 \times (\text{BW, kg} \times 2.204622)^2 - 0.0214484253 \times (\text{BW, kg} \times 2.204622) + 6.0773690201$$



### PIC 2008 – 2016 – 2021 comparison based on SID Lys:ME curve



# Amino acids

## SID Lys meta-analysis for 11 to 150 kg pigs

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**PIC** **SID Lysine Biological Requirement for PIC Pigs** 

Energy level, NRC ME kcal/kg	3200	3200			3300	3300	3300	3300
Weight In, kg	12	90			23	40	70	100
Weight Out, kg	90	140			40	70	100	130


### SID Lys, grams:Mcal ME

Barrows	3.36	2.02			3.48	2.83	2.30	2.02
Gilts	3.53	2.16			3.48	3.00	2.49	2.16
Gilts development **	3.43	1.86			3.38	2.91	2.41	1.86
Boars	3.53	2.56			3.61	3.14	2.72	2.56
Barrows and Gilts	3.45	2.09			3.48	2.92	2.39	2.09

### SID Lys, % of the diet

Barrows	1.08	0.65			1.15	0.93	0.76	0.67
Gilts	1.13	0.69			1.15	0.99	0.82	0.71
Gilts development **	1.10	0.60			1.11	0.96	0.80	0.61
Boars	1.13	0.82			1.19	1.03	0.90	0.84
Barrows and Gilts	1.10	0.67			1.15	0.96	0.79	0.69
Boars and Gilts	1.12	0.70			1.15	1.00	0.84	0.72

!   
 \*\*   
 Because the weight range is so wide, PIC biological requirement is set as 85% of the requirement at the beginning of the phase   
 if desired weight at breeding is not met, PIC recommends using 97% of SID Lysine requirement for commercial gilts above 90 kg

**PIC** **SID Lysine Economic Tool for PIC Pigs<sup>α</sup>** 

Input (please fill yellow cells)

Economic evaluation criteria  
Carcass price, \$/kg  
Facility cost, \$/pig/day  
Current carcass yield, %

Carcass	
\$/kg	\$1.48
\$/pig/day	\$0.10
%	76

Phase	Initial weight, kg	Final weight, kg	Energy, kcal	Current diets		Biological requirement	
				SID Lys, %	\$/tonne	SID Lys, %	\$/tonne
1	21	34	2,540	1.12	\$243.75	1.24	\$249.75
2	34	47	2,560	1.02	\$233.92	1.13	\$238.92
3	47	64	2,582	0.92	\$221.61	1.02	\$227.62
4	64	82	2,610	0.82	\$210.84	0.91	\$217.84
5	82	96	2,621	0.74	\$200.45	0.82	\$206.45
6	96	136	2,635	0.65	\$193.27	0.72	\$198.27

### Performance and economics output - Fixed Weight (space long)

Using PIC biological requirement levels will increase the current growth rate by 1.53% and improve feed efficiency by 2.05%; however, resulting in losses of \$0.21 per pig in IOFFC given the current ingredients and pig prices.

In this scenario, it isn't economical to feed PIC SID Lysine biological levels.

### Performance and economics output - Fixed Time (space short)

Using PIC biological requirement levels will increase the current growth rate by 1.58% and improve feed efficiency by 2.03%, resulting in gains of \$3.08 per pig in IOFFC given the current ingredients and pig prices.

In this scenario, it is economical to feed PIC SID Lysine biological levels.

**PIC**

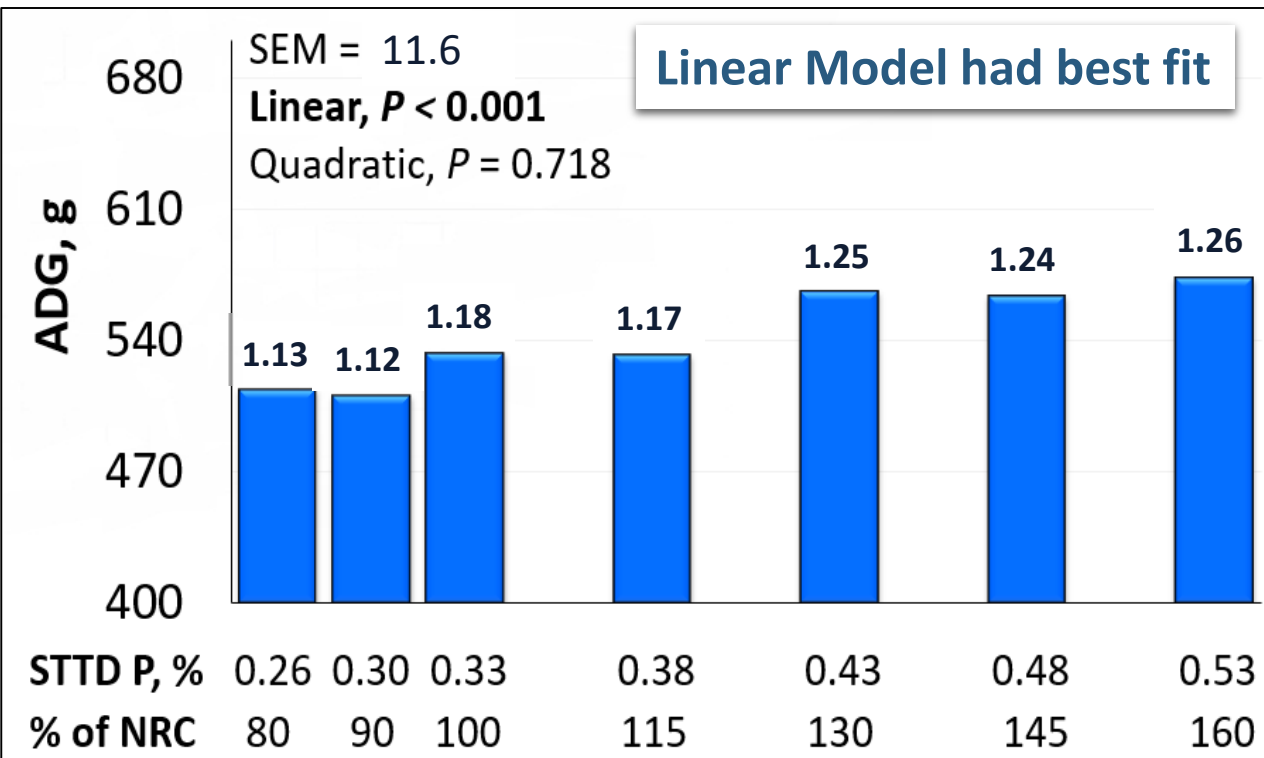
Orlando et al., 2021



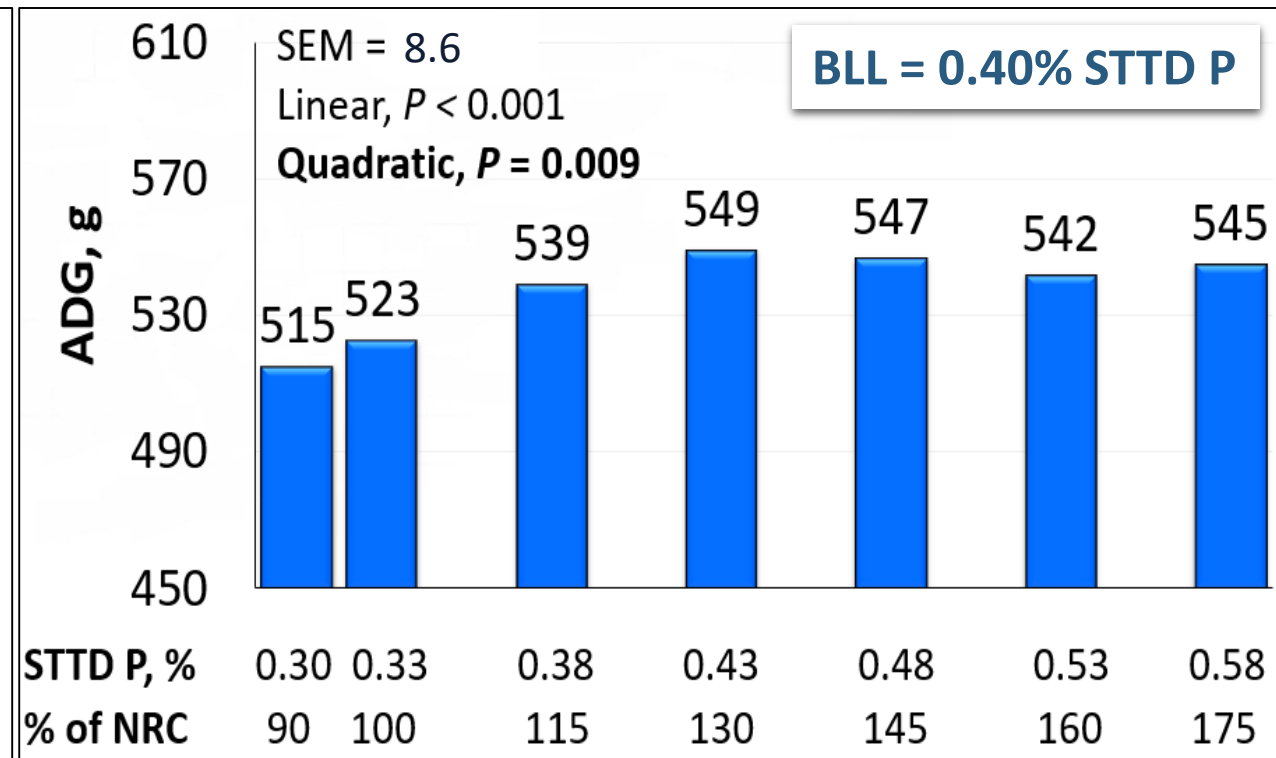


### Average Daily Gain

#### Exp. 1: no added phytase

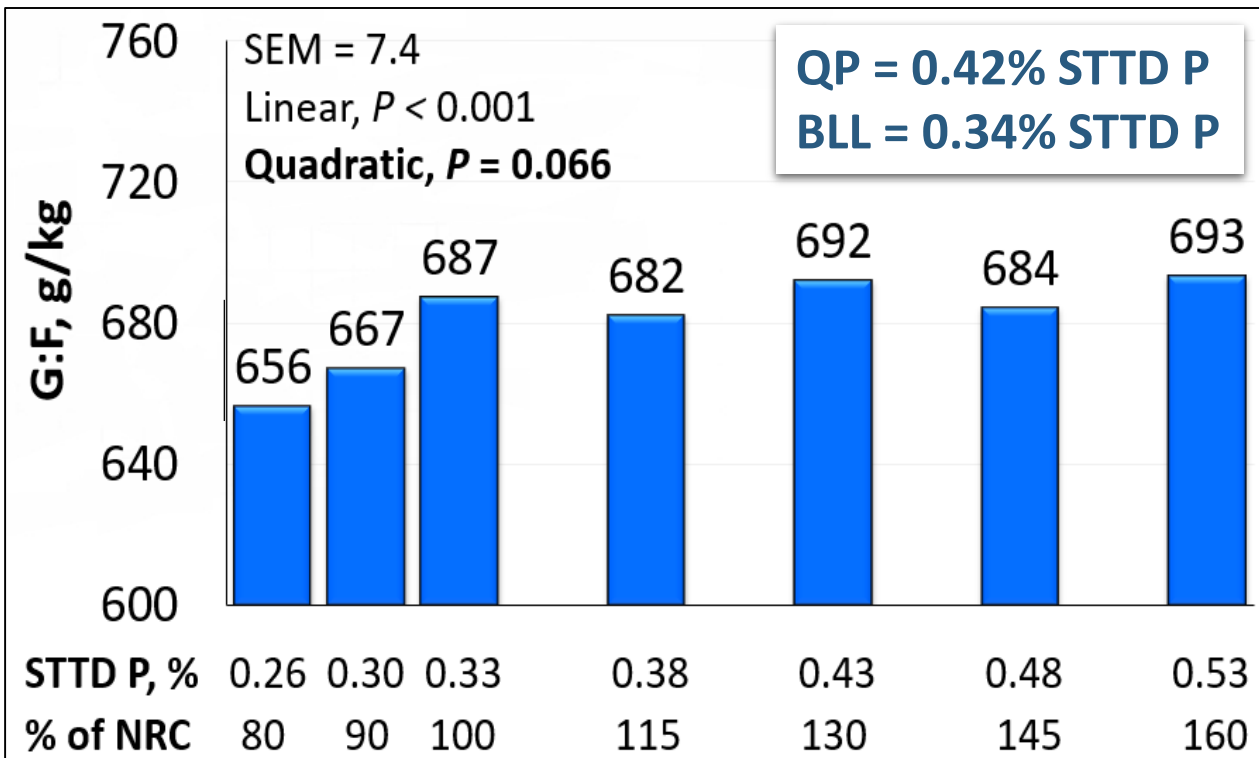


#### Exp. 2: added 1000 FTU/kg phytase

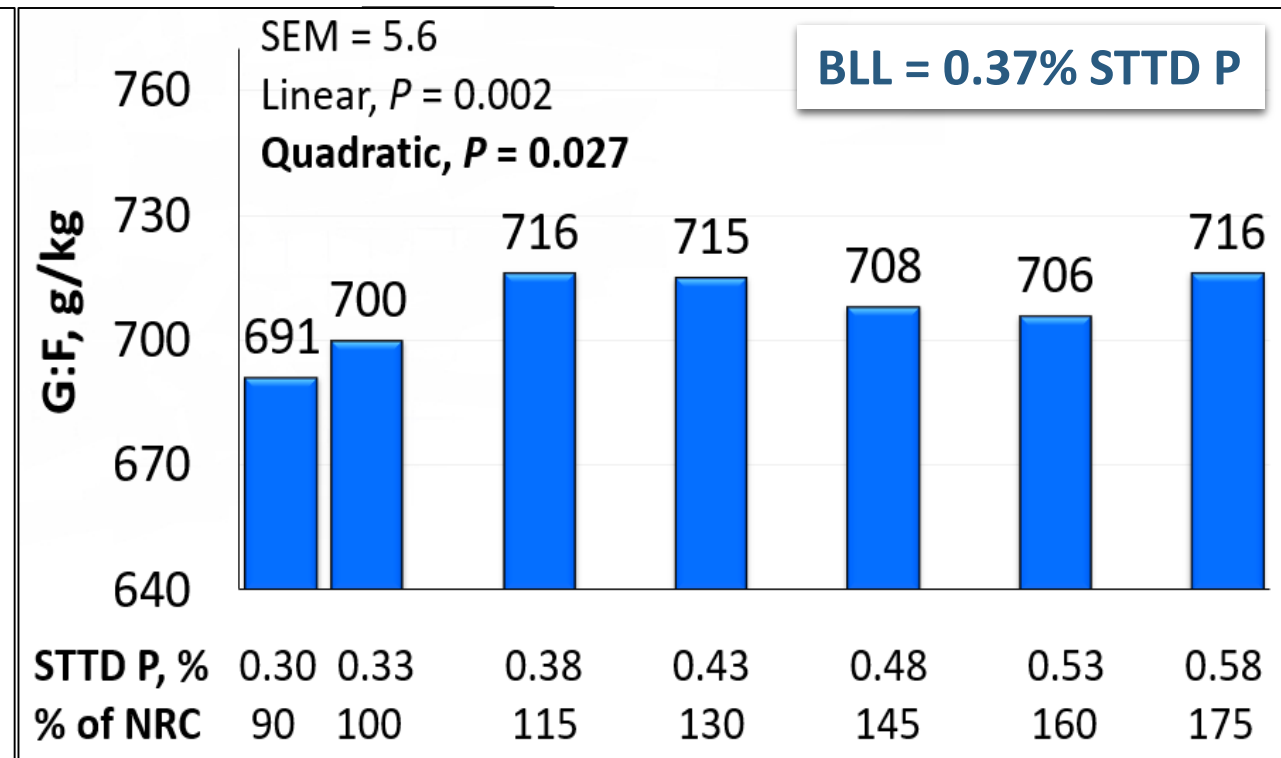


### Feed Efficiency

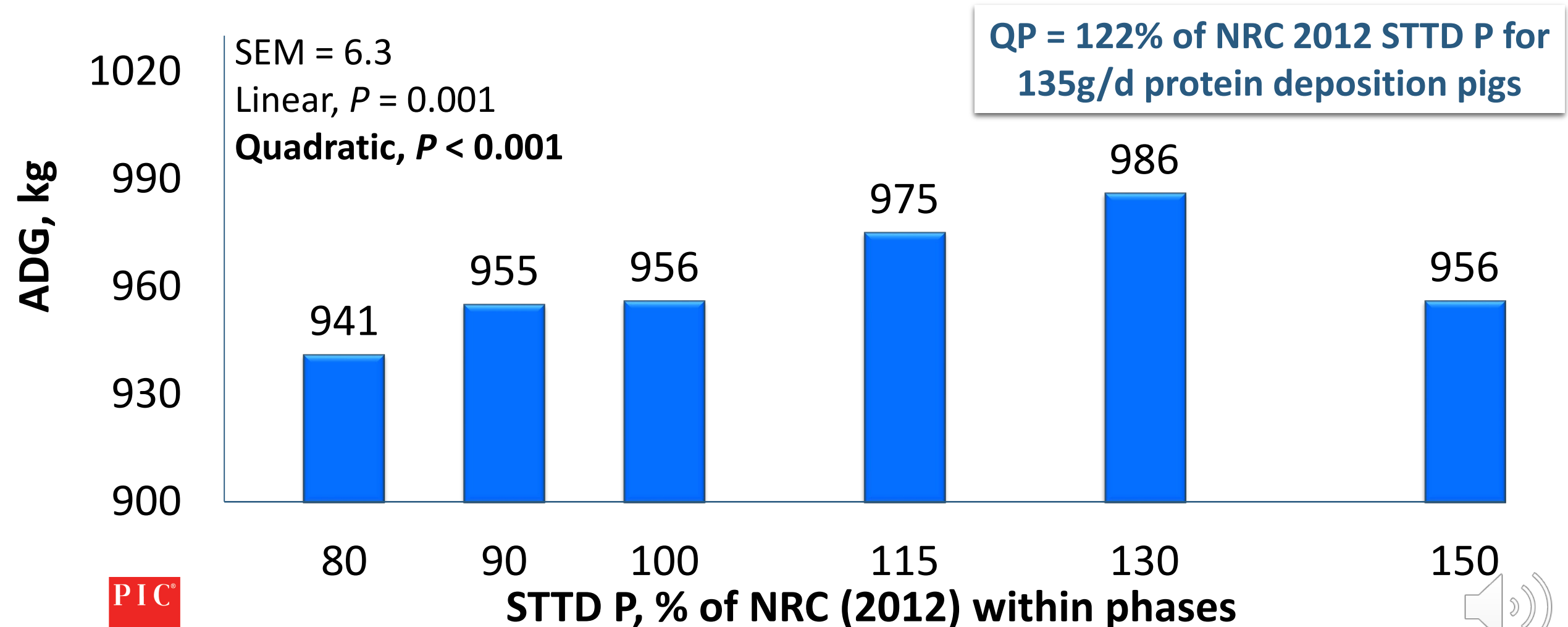
Exp. 1: no added phytase



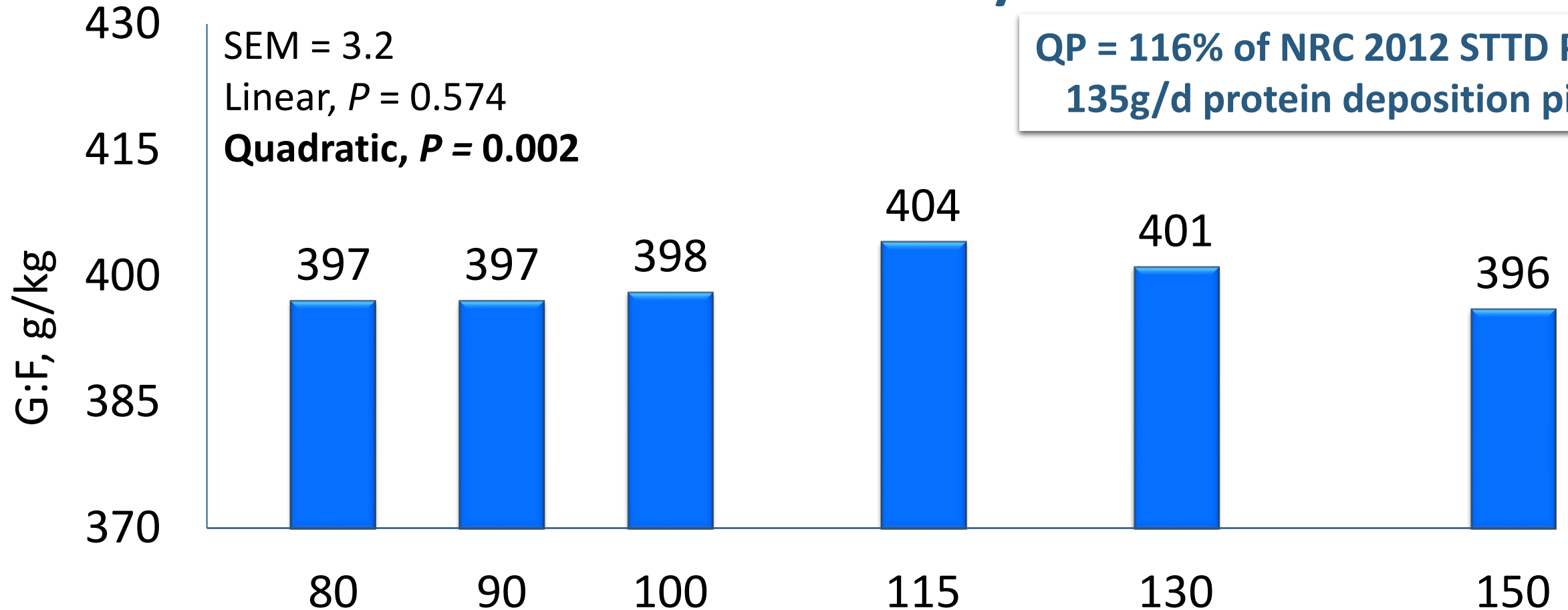
Exp. 2: added 454 FTU/lb phytase



### Average Daily Gain



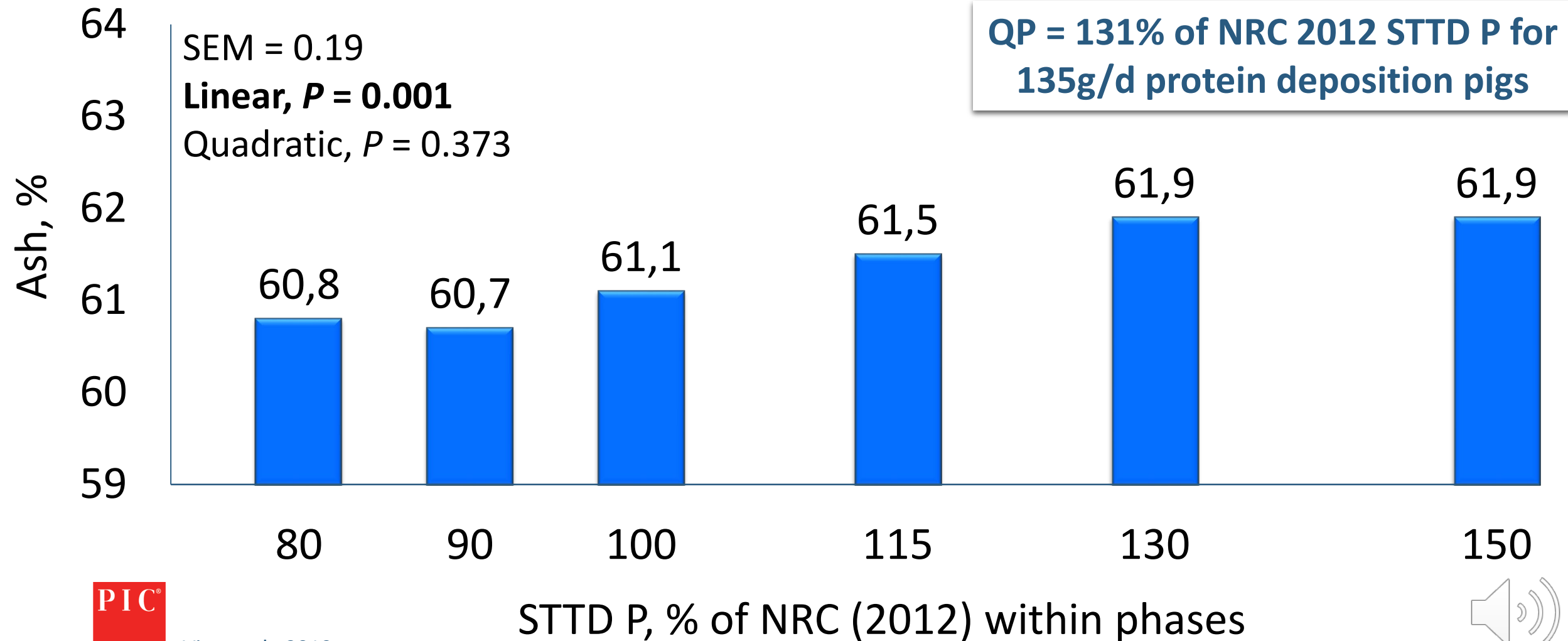
### Feed Efficiency



QP = 116% of NRC 2012 STTD P for  
135g/d protein deposition pigs



### Bone mineralization



# Calcium and phosphorus

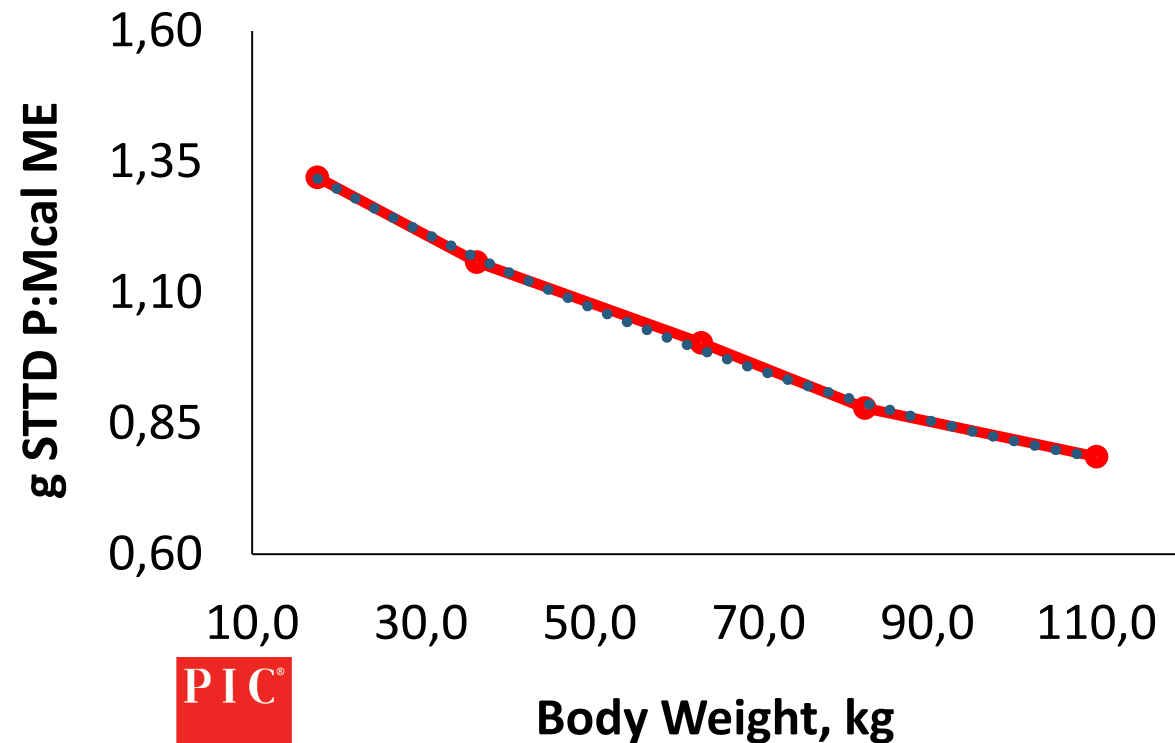
## Effects of STTD P levels on growth performance of 24- to 130- kg pigs

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### Grams of STTD P per Mcal of Energy

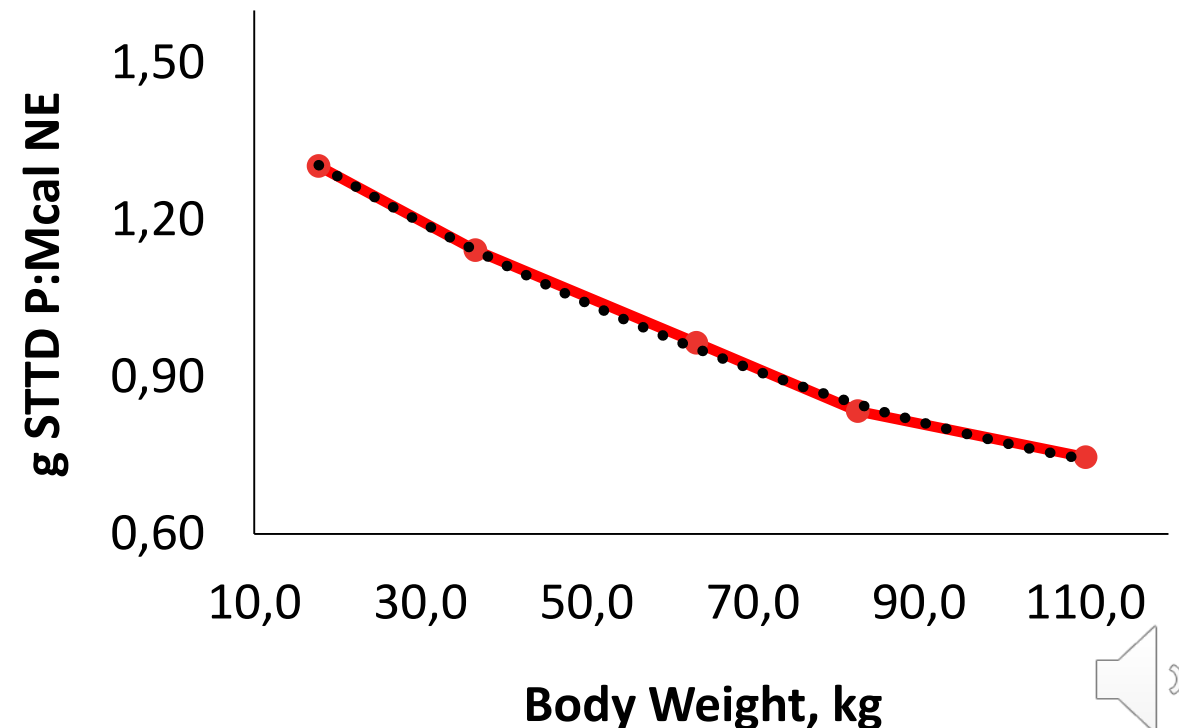
#### Metabolizable Energy Basis

$$\text{g STTD P:ME} = 0.000031 \times (\text{BW, kg})^2 - 0.009664 \times (\text{BW, kg}) + 1.476751$$



#### Net Energy Basis

$$\text{g STTD P:NE} = 0.000047 \times (\text{BW, kg})^2 - 0.014391 \times (\text{BW, kg}) + 2.027515$$



PIC®

Vier et al., 2021



# Wean to finish – STTD Phosphorus

## Example biological STTD P tool



### Economic model for optimum phosphorus levels v2.0<sup>α</sup>



## STTD Phosphorus Biological Requirement for PIC Pigs<sup>α</sup>



Energy level, NRC ME kcal/kg  
Weight In, kg  
Weight Out, kg

3300	3300	3300	3300	3300	3300		
11	23	41	59	82	104		
23	41	59	82	104	129		

STTD P, grams:Mcal ME  
Commercial Barrows  
Commercial Gilts  
Commercial Boars  
Barrows and Gilts  
Developing Gilts

1.32	1.20	1.05	0.91	0.81	0.74		
1.32	1.20	1.09	0.99	0.87	0.79		
1.32	1.24	1.14	1.02	0.89	0.81		
1.32	1.20	1.07	0.95	0.84	0.77		
1.43	1.30	1.18	1.06	0.94	0.85		

STTD P, % of the diet  
Commercial Barrows  
Commercial Gilts  
Commercial Boars  
Barrows and Gilts  
Boars and Gilts  
Developing Gilts

0.44	0.40	0.35	0.30	0.27	0.24		
0.44	0.40	0.36	0.33	0.29	0.26		
0.44	0.41	0.38	0.34	0.30	0.27		
0.44	0.40	0.35	0.31	0.28	0.25		
0.44	0.40	0.37	0.33	0.29	0.26		
0.47	0.43	0.39	0.35	0.31	0.28		

The STTD P to energy ratios meet the biological requirements for PIC 327, 337, and 359 sired pigs. PIC suggests to utilize 99% of the tool estimates for PIC 380, 408, and 410 sired pigs; and 97% for PIC 800 sired pigs to achieve the biological requirements of these sirelines.

α



Input (please fill yellow cells)

Economic evaluation criteria	Carcass
Carcass price, \$/kg	\$1.43
Current carcass yield, %	73.4
Facility cost, \$/pig/day	\$0.16
Number of phases	6

	Current diets				
	BW, kg	Energy, kcal NE/kg	STTD P, %	\$/ton	
Phase 1	25.0	34.0	2,425	0.33	\$173.65
Phase 2	34.0	50.0	2,449	0.30	\$166.98
Phase 3	50.0	64.0	2,482	0.27	\$160.96
Phase 4	64.0	84.0	2,509	0.26	\$155.51
Phase 5	84.0	107.0	2,549	0.23	\$153.23
Phase 6	107.0	129.0	2,564	0.21	\$152.78

Maximal growth	
STTD P, %	\$/ton
0.40	\$174.03
0.37	\$167.22
0.34	\$161.15
0.31	\$155.65
0.28	\$153.32
0.25	\$152.92

Performance Output	
Performance difference between maximal growth and current diets, %	
Fixed Weight (space long)	
Growth rate	-1.13%
Feed efficiency	-0.29%
Carcass yield	0.34%
Fixed Time (space short)	
Growth rate	-1.13%
Feed efficiency	-0.29%
Carcass yield	0.34%

Economics Output	
Net profit difference between maximal growth and current diets, \$/pig	
Fixed Weight (space long)	
IOFFC	-\$0.04
Fixed Time (space short)	
IOFC	\$0.36

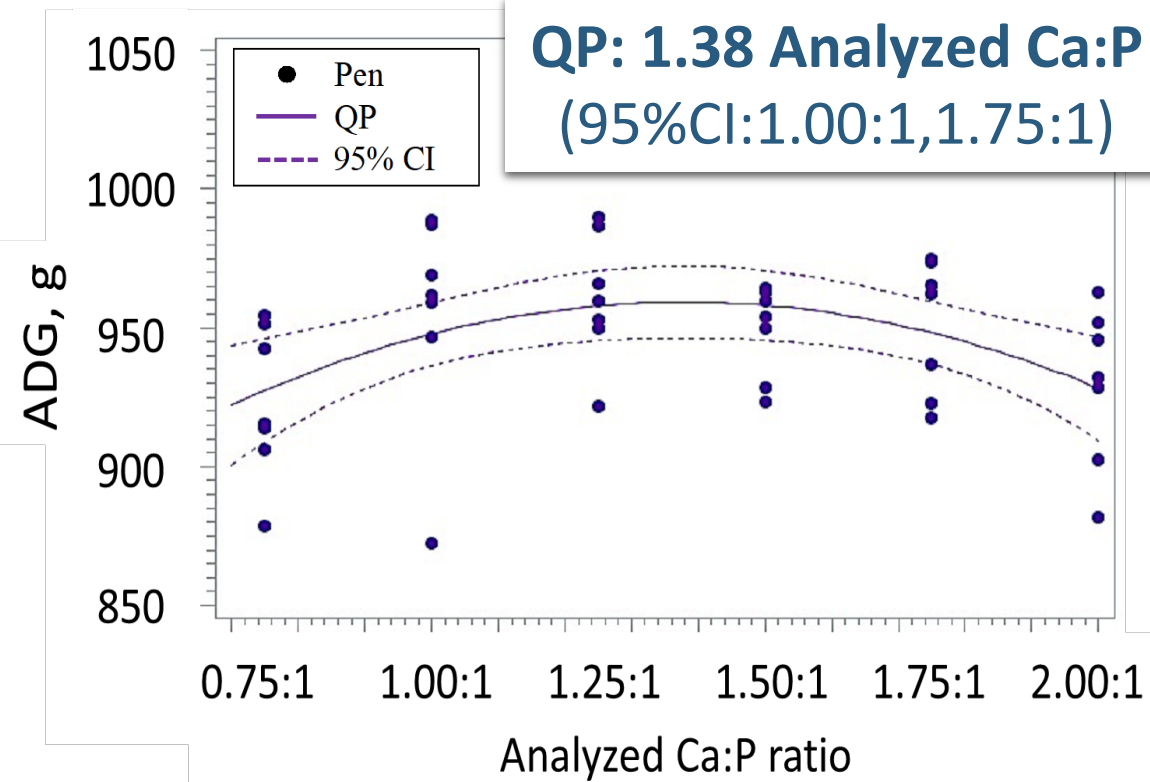
α The STTD P to energy ratios meet the biological requirements for PIC 327, 337, and 359 sired pigs. PIC suggests to utilize 99% of the tool estimates for PIC 380, 408, and 410 sired pigs; and 97% for PIC 800 sired pigs to achieve the biological requirements of the sirelines.



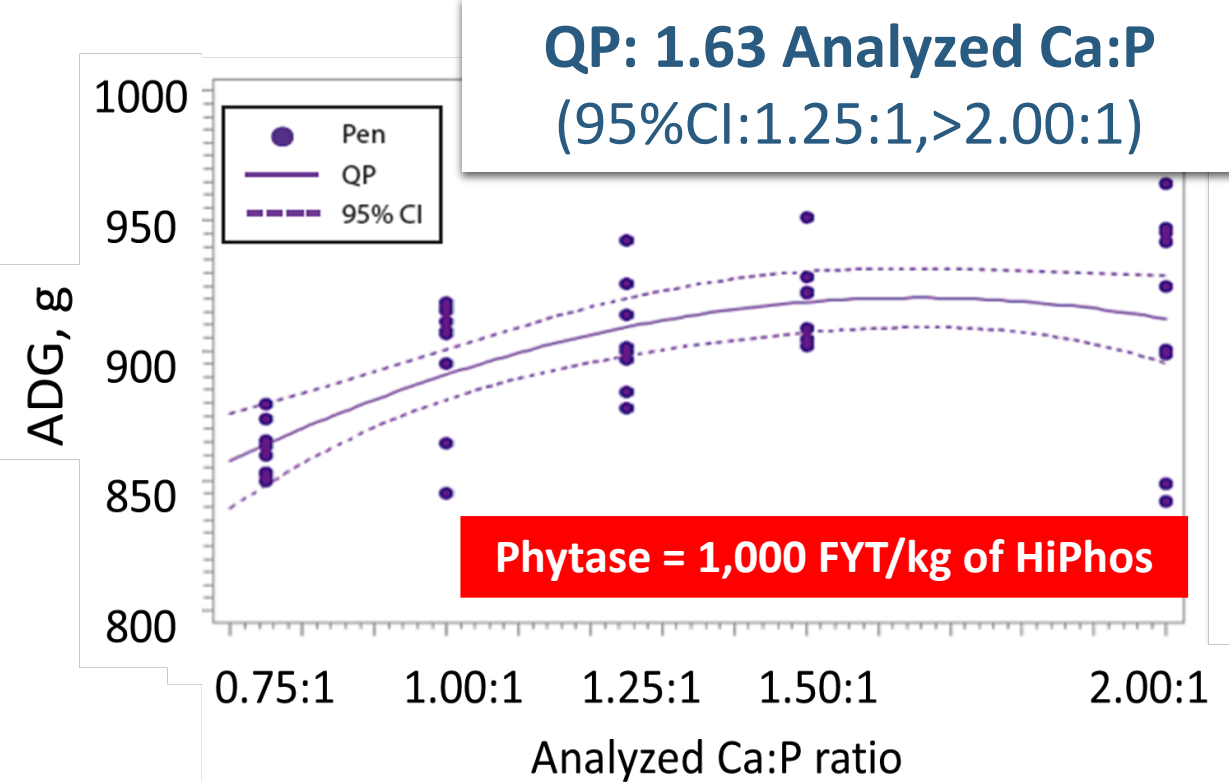
# Growing to finish – Calcium and phosphorus

## Calcium to phosphorus ratio requirement of 26- to 127-kg pigs

Exp. 1 Average Daily Gain, 26- to 127-kg pigs, w/o phytase



Exp. 1 Average Daily Gain, 26- to 127-kg pigs, w/ phytase

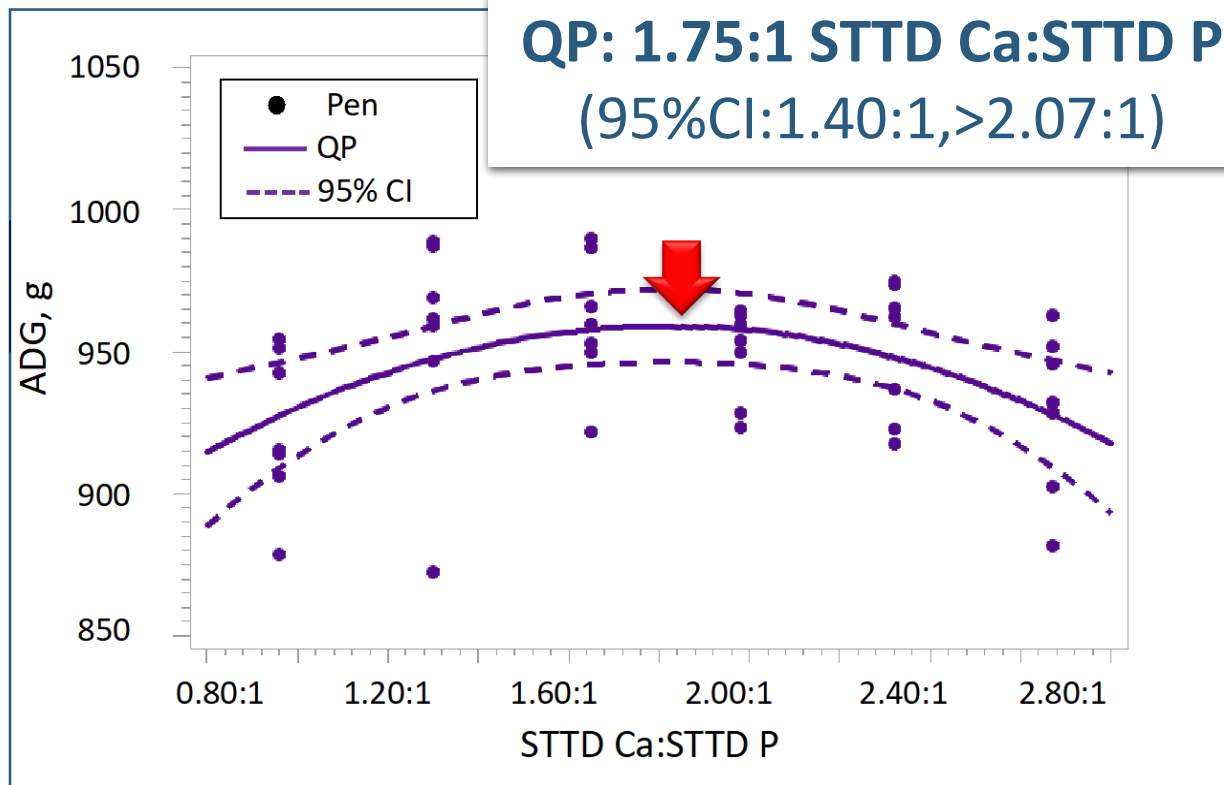




# Growing to finish – Calcium and phosphorus

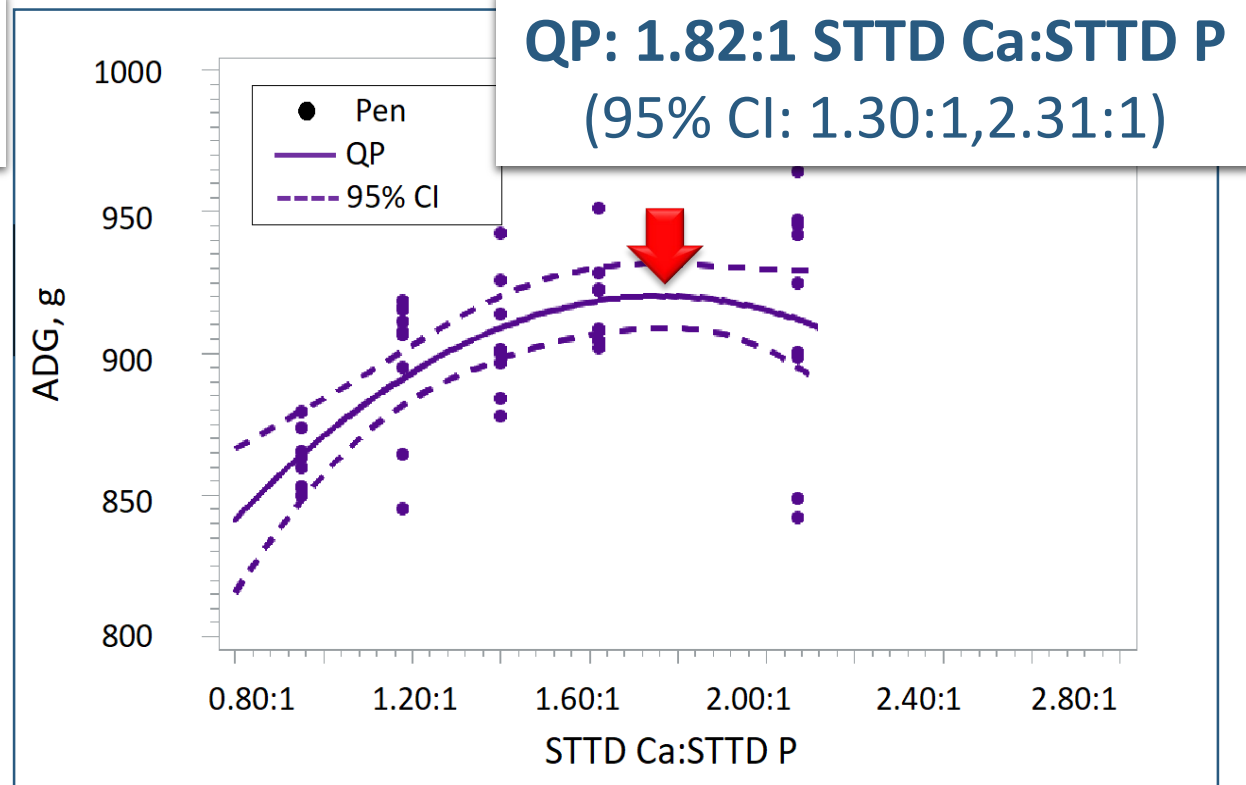
## Calcium to phosphorus ratio requirement of 26- to 127-kg pigs

### Exp. 1 Average Daily Gain, 26- to 127-kg pigs, w/o phytase



Bone: 99.5%

### Exp. 1 Average Daily Gain, 26- to 127-kg pigs, w/ phytase



Bone: 100%



# Wean to finish – Vitamins and trace minerals

## Literature review

### Key points:

- Highly questioned in 2017
  - BASF suspend part of production

### 7 References:

- NRC 2012
- KSU 2018
- Pork producer in NAM
- Research Farm – University of Wisconsin
- Brazilian Requirement Tables 2017
- Pork Producer in Brazil
- PIC North America 2016 and 2020
- Data from ~700 K Sows herd (Wean-to-finish)

### Trials conducted

- KSU run a trial in 2018
- PIC & CISS in Nursery and Grow to Finish



# Wean to finish – Vitamins and trace minerals

## Effects of different added vitamin levels on growth performance of 5 to 130 kg pigs

- A total of 900 PIC (PIC337 X Camborough) barrows and gilts

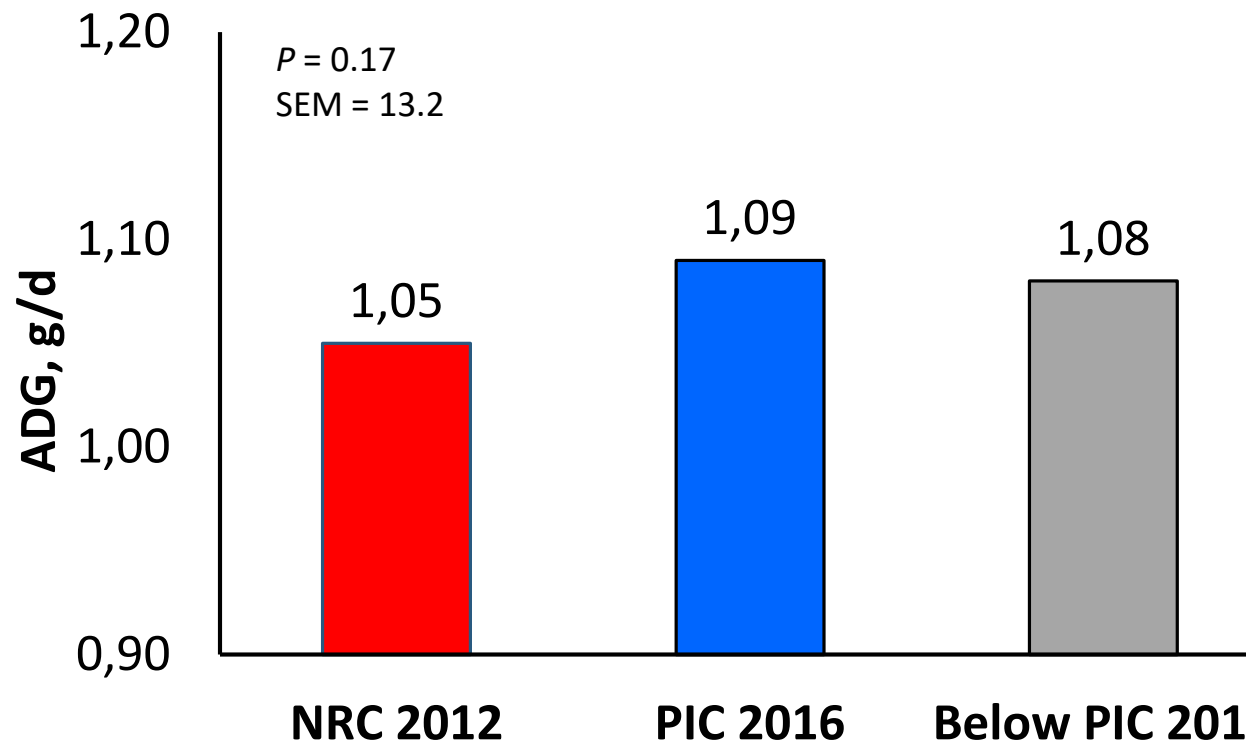
Treatment	NRC 2012		PIC 2016			Below PIC 2016		
	5-25	25-130	5-25	25-80	80-130	5-25	25-80	80-130
Bodyweight range, kg								
Vitamin A, IU	2,200	1,300	11,025	6,615	5,510	4,200	2,800	2,800
Vitamin D <sub>3</sub> , IU	220	150	1,765	1,215	1,015	1,600	800	640
Vitamin E, IU	16	11	85	33	28	16	11	11
Vitamin K, mg	0.5	0.5	5.5	3.3	2.8	3.0	1.5	1.2
Thiamin, mg	1.0	1.0	3.5	---	---	---	---	---
Riboflavin, mg	3.5	2.0	13.0	5.7	4.9	8.0	4.0	3.0
Pyridoxine, mg	7.0	1.0	3.5	---	---	---	---	---
Vitamin B <sub>12</sub> , µg	17.5	5.0	55.0	26.0	22.0	39.0	19.0	15.0
Niacin, mg	30	30	70	40	31	50	25	20
d-Pantothenic acid, mg	10	7	40	20	17	28	14	11
Folic acid, mg	0.30	0.30	1.05	---	---	---	---	---
Biotin, mg	0.050	0.050	0.275	---	---	---	---	---



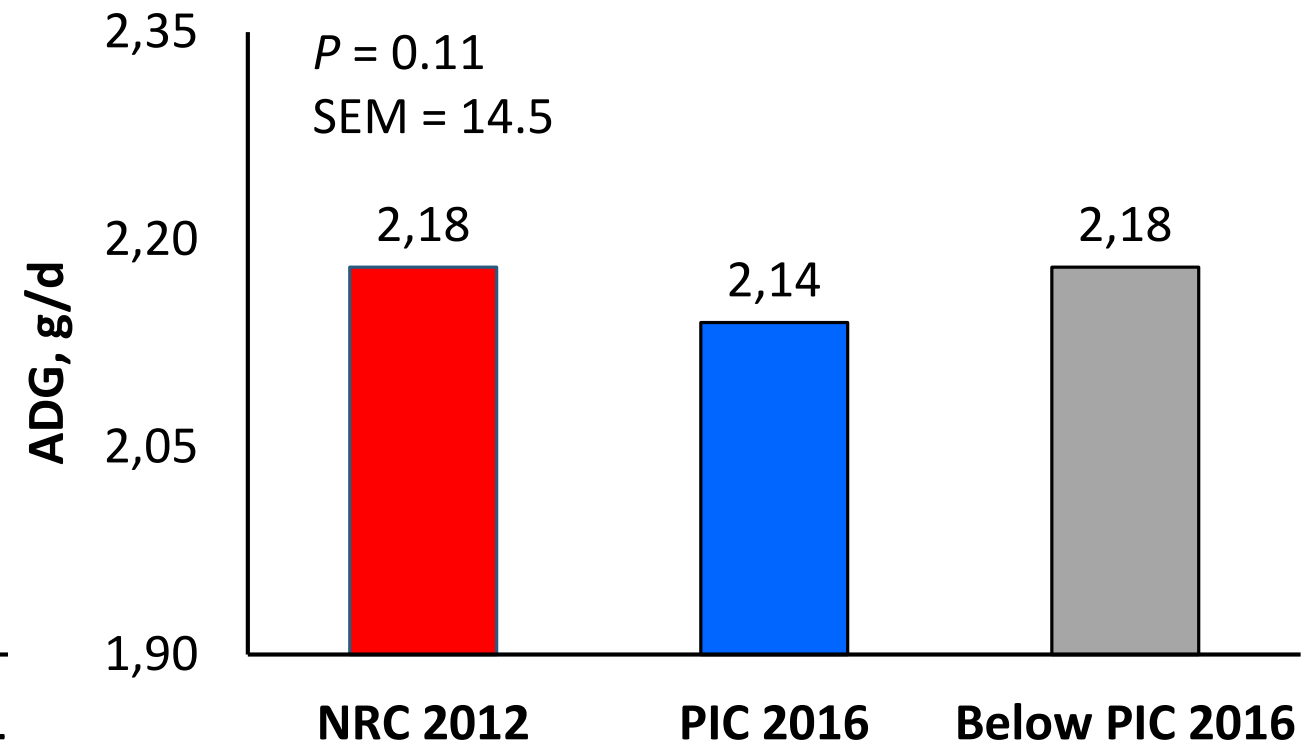
# Wean to finish – Vitamins and trace minerals

## Effects of different added vitamin levels on growth performance of 5 to 130 kg pigs

### 5- to- 25 kg



### 25- to- 130 kg



# Wean to finish – Vitamins and trace minerals

## Updated vitamin and trace mineral recommendations

Item		Body weight, kg							
		weaning-7.5	7.5-11.5	11-23	23-41	41-59	59-82	82-104	104-market
Added trace minerals <sup>a</sup>									
Zinc	ppm	130	130	130	111	98	78	65	65
Iron	ppm	130	130	130	111	98	78	65	65
Manganese	ppm	50	50	50	43	38	30	25	25
Copper	ppm	18	18	18	15	14	11	9	9
Iodine	ppm	0.65	0.65	0.65	0.55	0.49	0.39	0.33	0.33
Selenium	ppm	0.30	0.30	0.30	0.30	0.30	0.30	0.25	0.25
Added vitamins <sup>a</sup>									
Vitamin A	IU/kg	5000	5000	5000	4250	3750	3000	2500	2500
Vitamin D	IU/kg	1600	1600	1600	1360	1200	960	800	800
Vitamin E	IU/kg	50	50	51	44	37	31	26	26
Vitamin K	mg/kg	3.0	3.0	3.1	2.6	2.4	1.8	1.5	1.5
Niacin	mg/kg	50	50	51	44	37	31	26	26
Riboflavin	mg/kg	8.0	8.0	8	7	7	4	4	4
Pantothenic acid	mg/kg	28	28	28	24	22	18	14	14
Vitamin B <sub>12</sub>	mcg/kg	38	38	38	33	29	22	20	20
Choline <sup>b</sup>	mg/kg	---	---	---	---	---	---	---	---


<sup>a</sup>The values represent micronutrient supplementation without giving credit for ingredient content.

<sup>b</sup>For nursery pigs, a total level of 600 mg of choline per pound should be achieved.



Thank you!



A person wearing a blue work jacket is holding a small, light-colored piglet. The background is a blurred indoor setting, likely a farm or a laboratory.

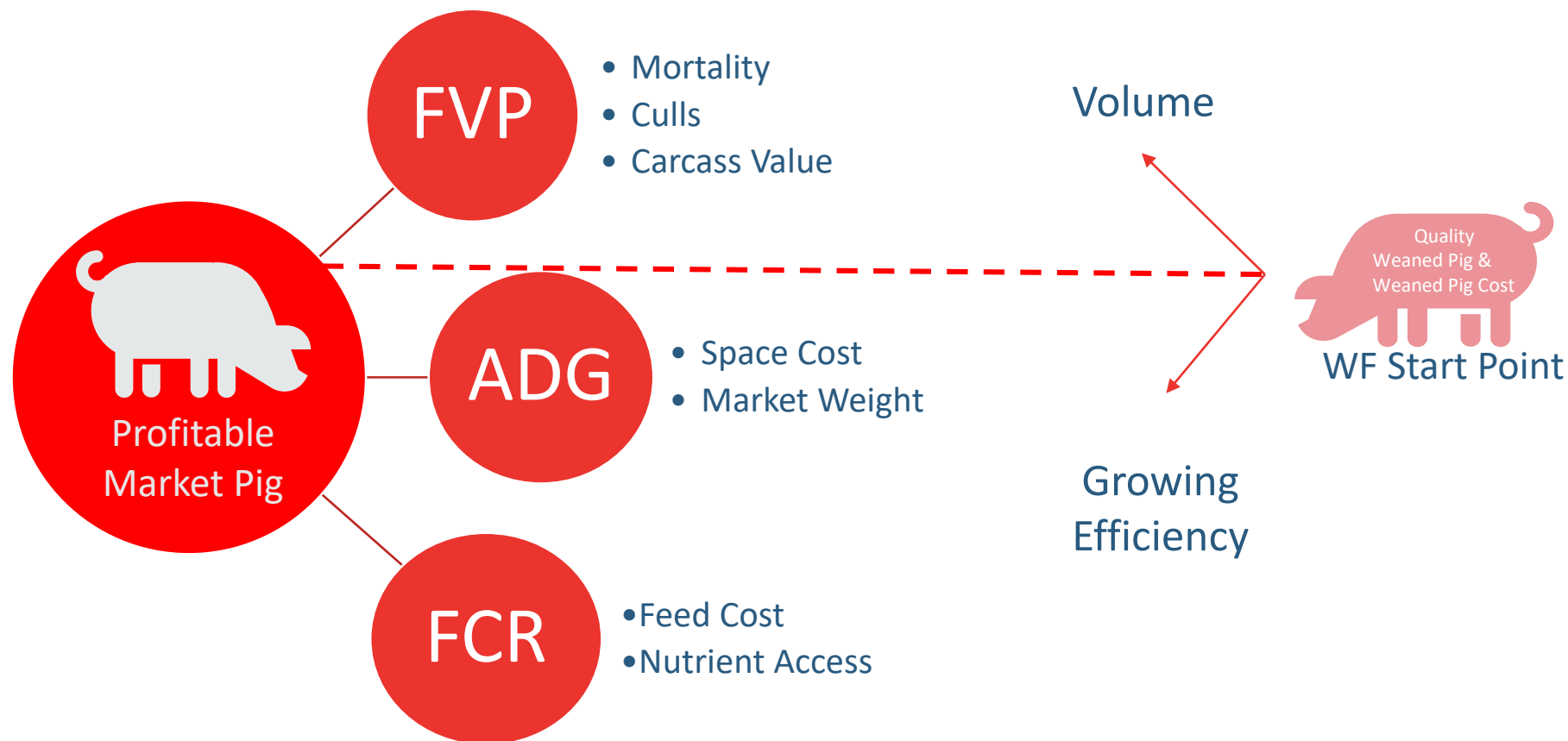
## Nutrient Intake, One of Four Cornerstones to Achieve Wean-to-Finish Excellence



# Nutrient access to Achieve Wean-to-Finish Excellence

## A Pig Business Model

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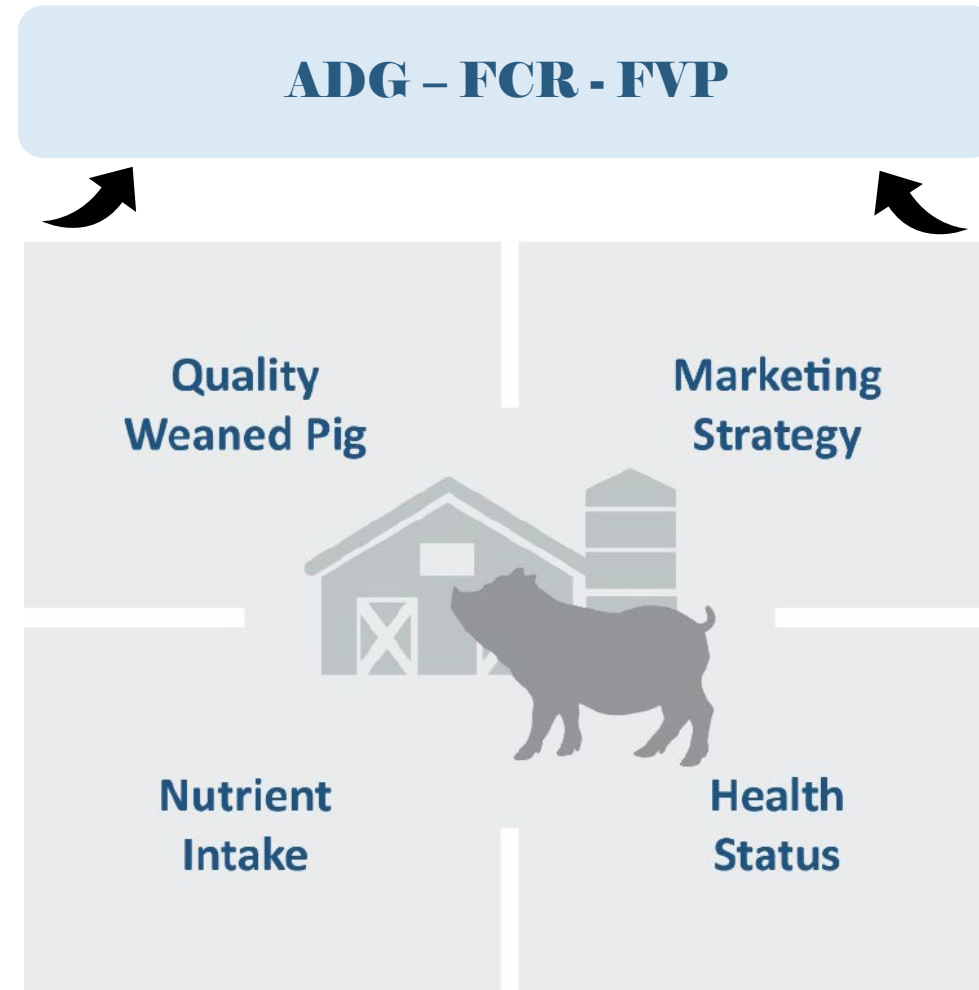




# Nutrient access to Achieve Wean-to-Finish Excellence

## The Cornerstones of Growing Pig Excellence Journey

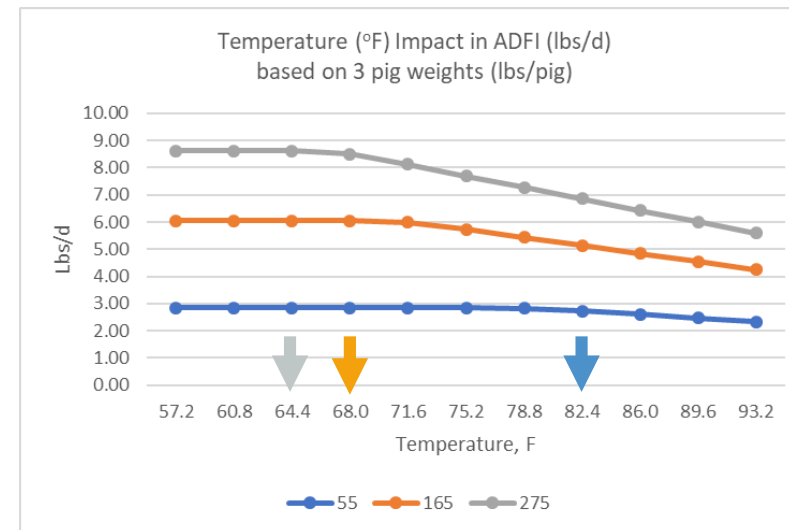
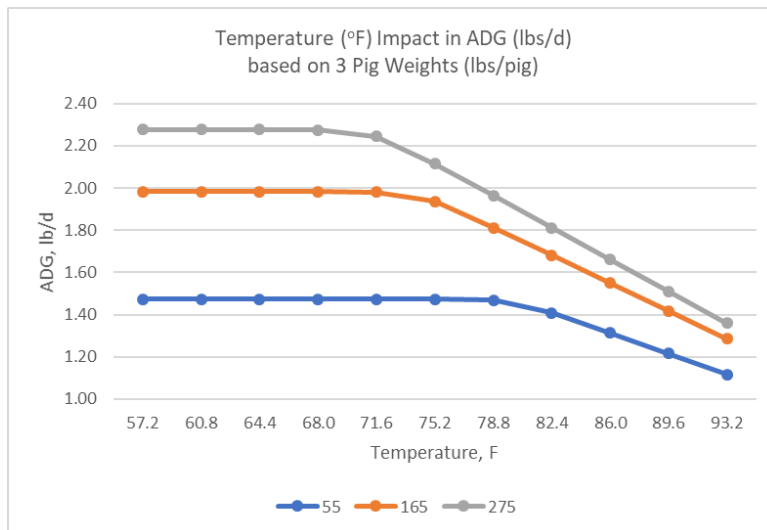
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# Nutrient access to Achieve Wean-to-Finish Excellence

## Understanding Nutrient Intake

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↓ Critical Temperatures

“Temperature Impacts ADG”



Result

“Temperature Impacts ADFI”

Nutrient  
Intake



Work Point or Driver



# Nutrient access to Achieve Wean-to-Finish Excellence

## Understanding Nutrient Intake

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*How a  
Multifactorial  
Work Point as  
Nutrient Intake  
Can Be  
Represented?*

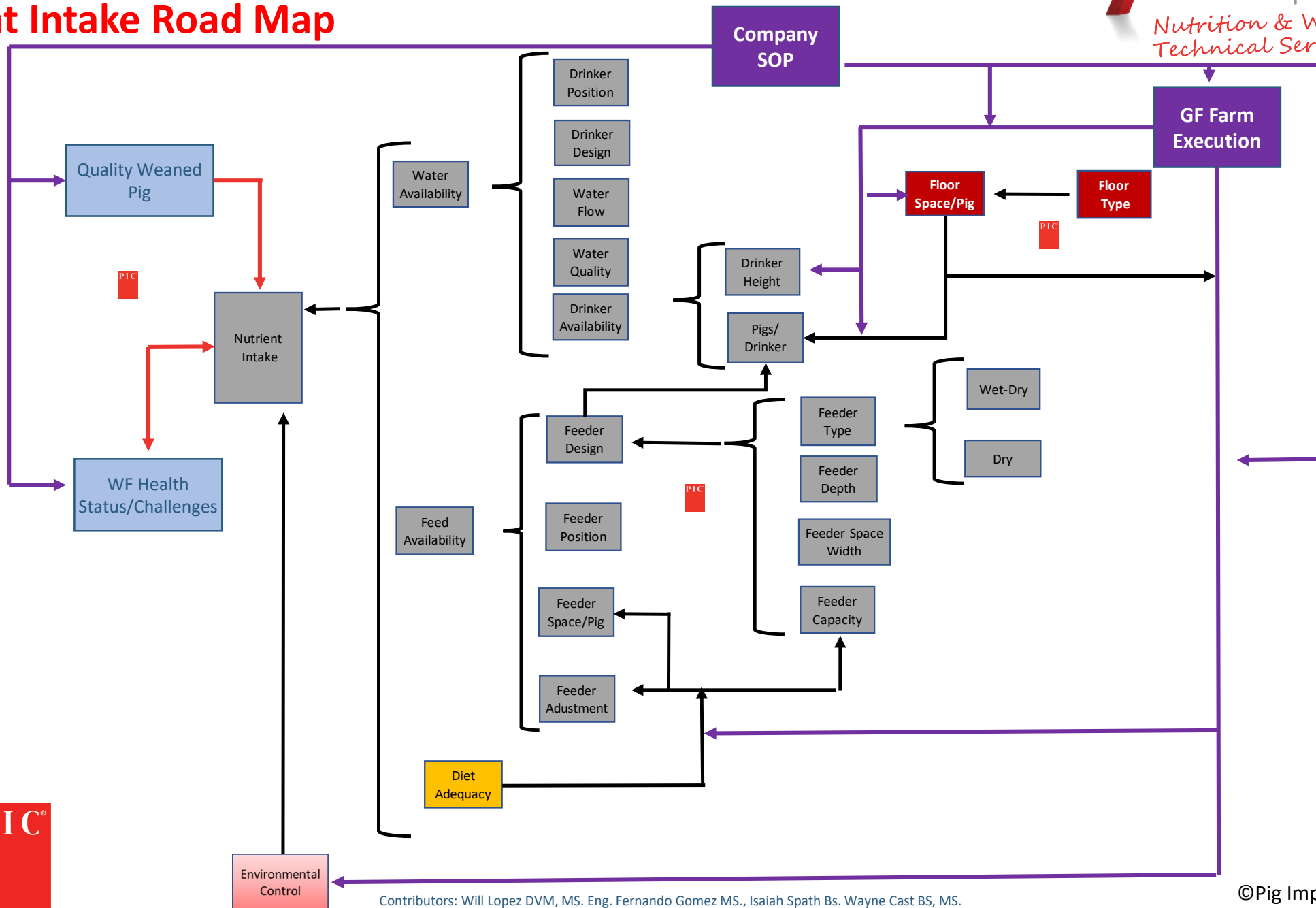




# Nutrient access to Achieve Wean-to-Finish Excellence

## Nutrient Intake Road Map

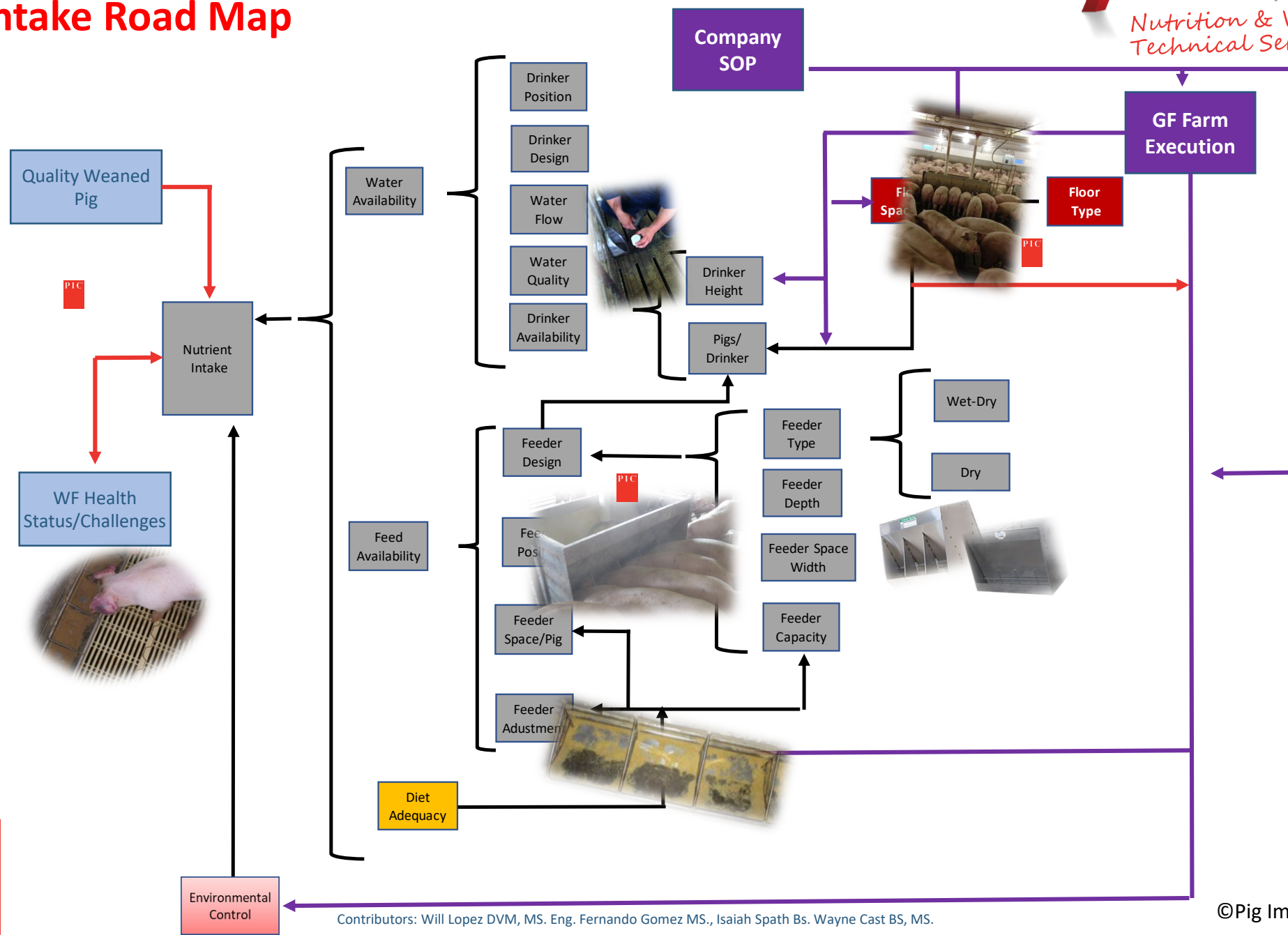
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Technical Services*



# Nutrient access to Achieve Wean-to-Finish Excellence

## Nutrient Intake Road Map

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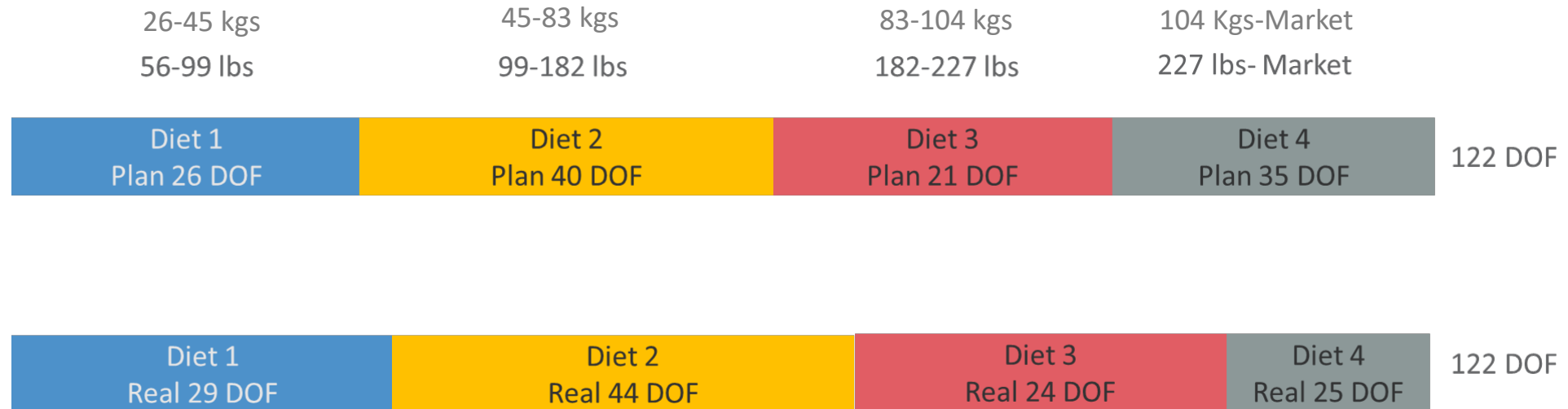


# Nutrient access to Achieve Wean-to-Finish Excellence

## Nutrient Intake Expectative



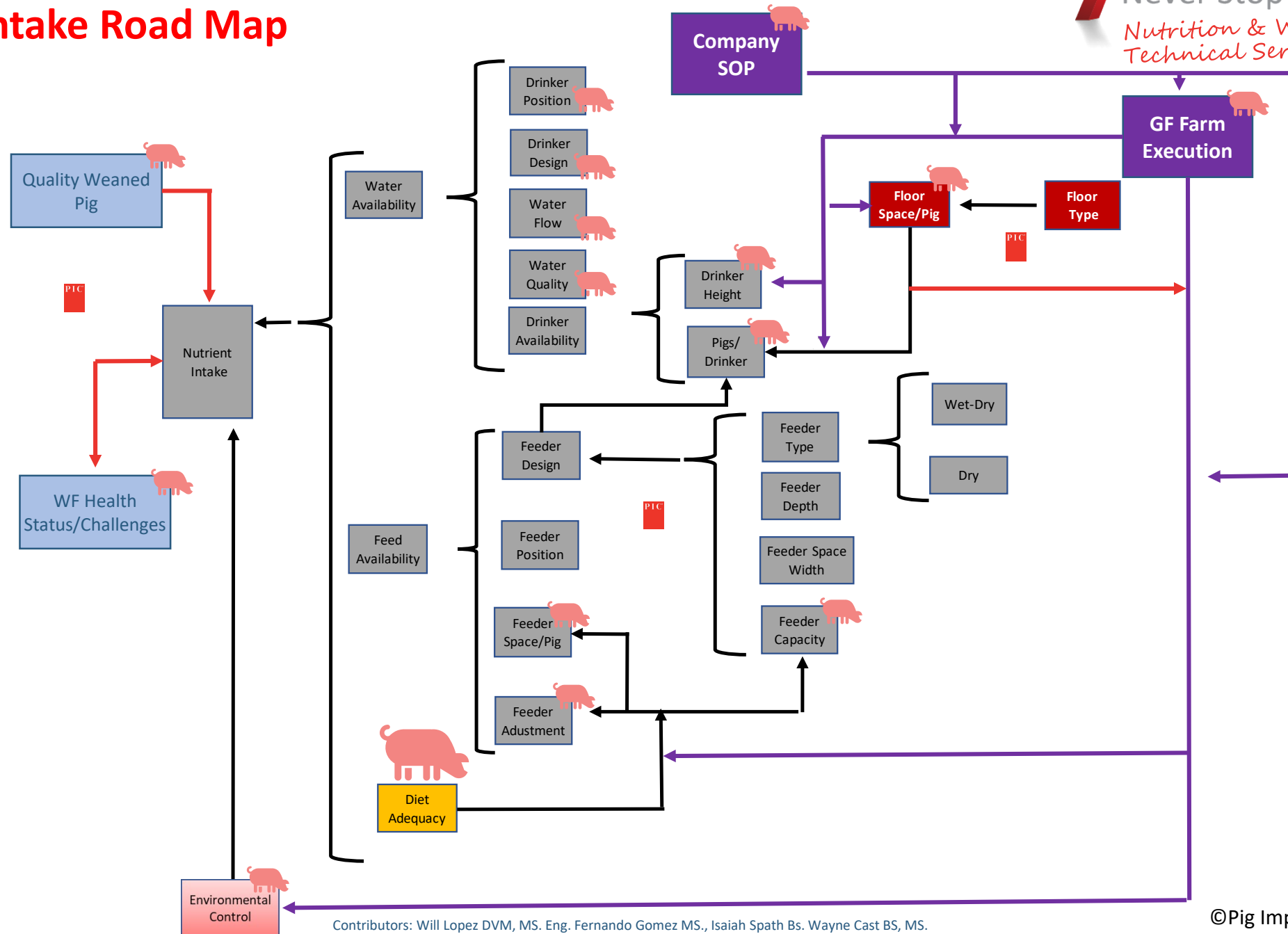
**“ Right feed, Right amount at the Right time”**



# Nutrient access to Achieve Wean-to-Finish Excellence

## Nutrient Intake Road Map

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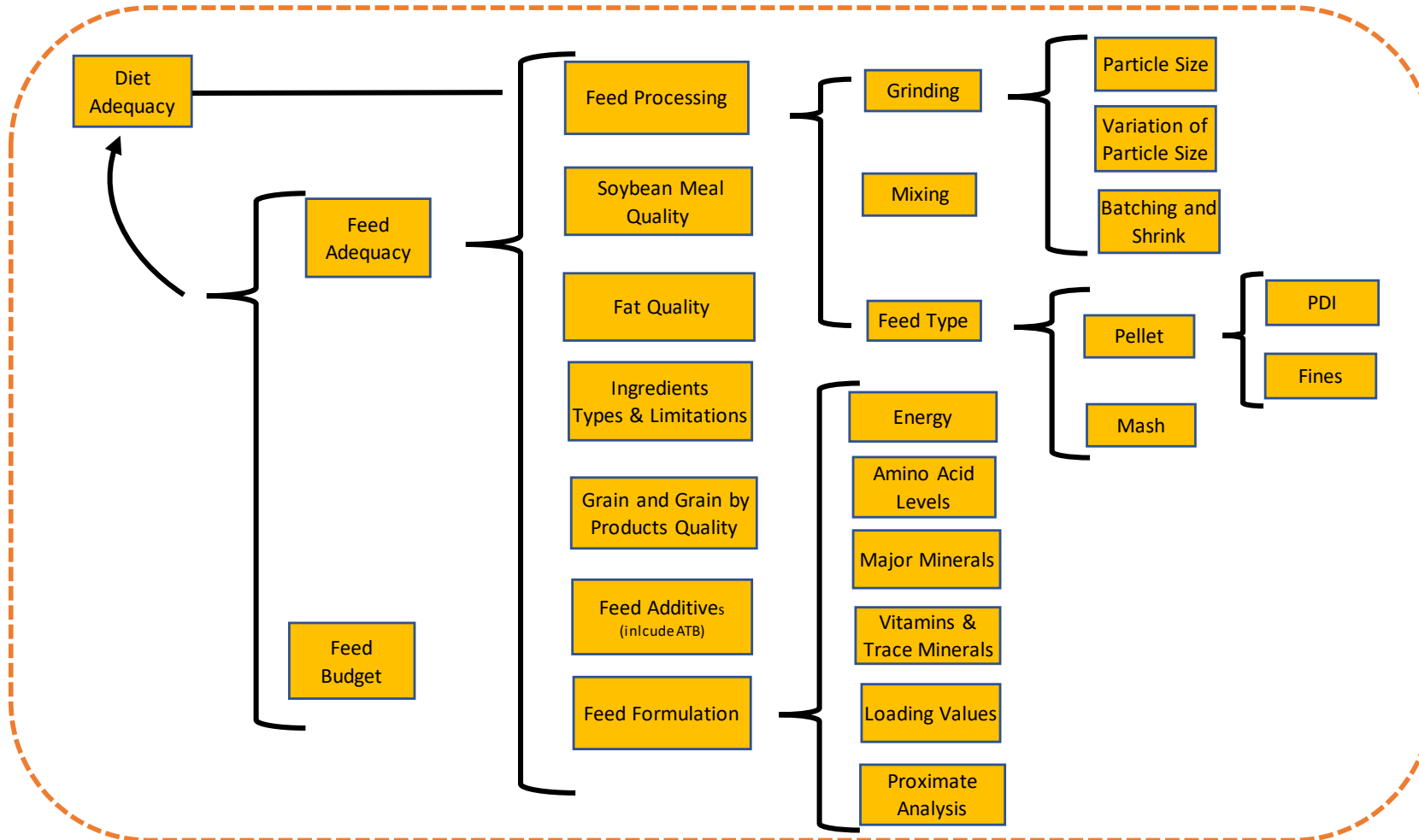




# Nutrient access to Achieve Wean-to-Finish Excellence

## Nutrient Intake Expectative

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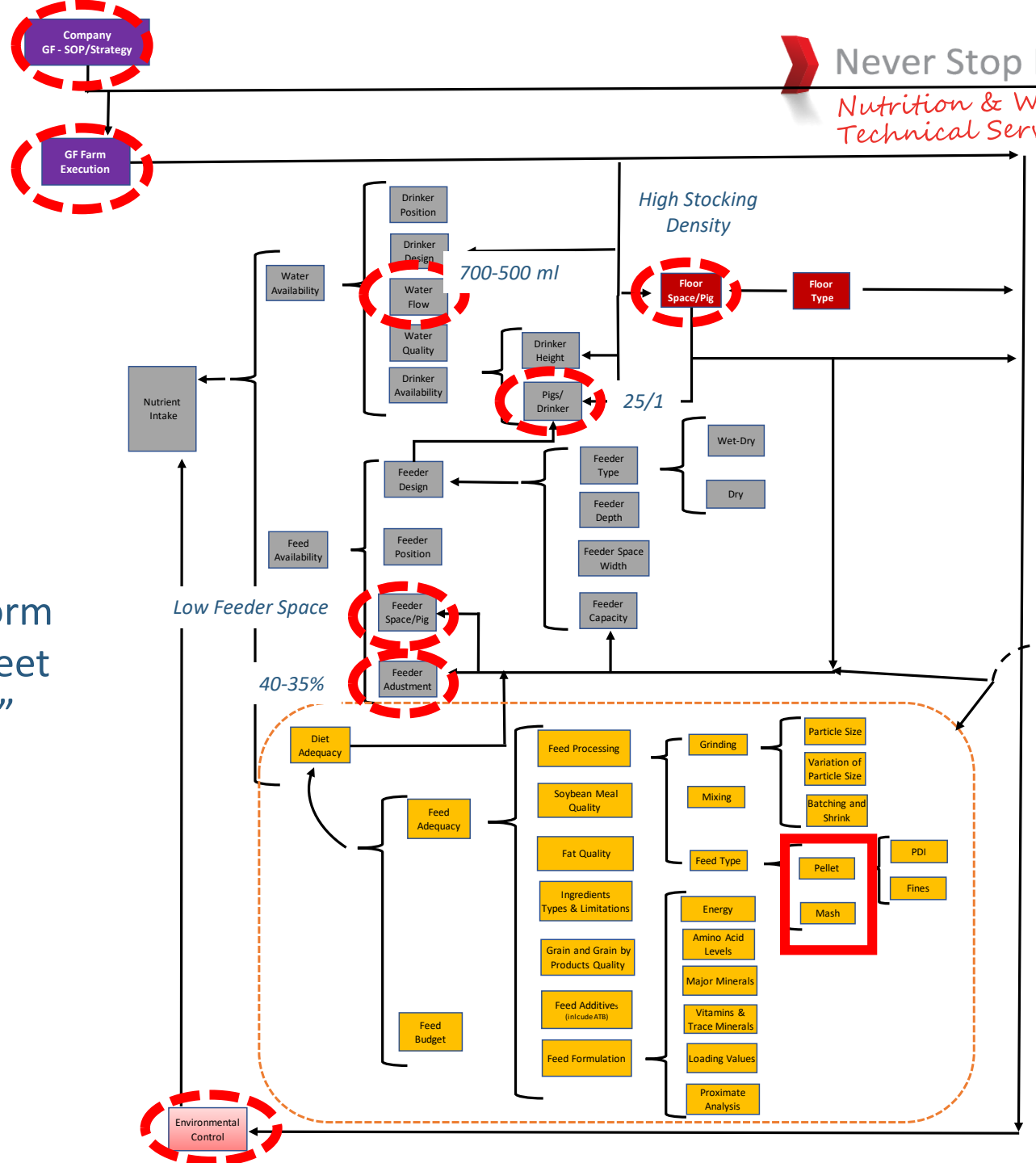


# Nutrient access to Achieve Wean-to-Finish Excellence

## Example: Pellet Impact

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“Long way from feed form to nutrient intake to meet the pellet expectations”



# Nutrient access to Achieve Wean-to-Finish Excellence

## Summary



- Nutrient intake is a multifactorial work point and diets adequacy is just one of our components to achieve WF excellence.
- At farm level, it is key to ensure the right feed, right amount at the right time and this is an important feedback to the nutritionists and a work point at production level
- Relevant change in diets should be reported to the production system to see if any farm procedures need to be changed.



Thank you!

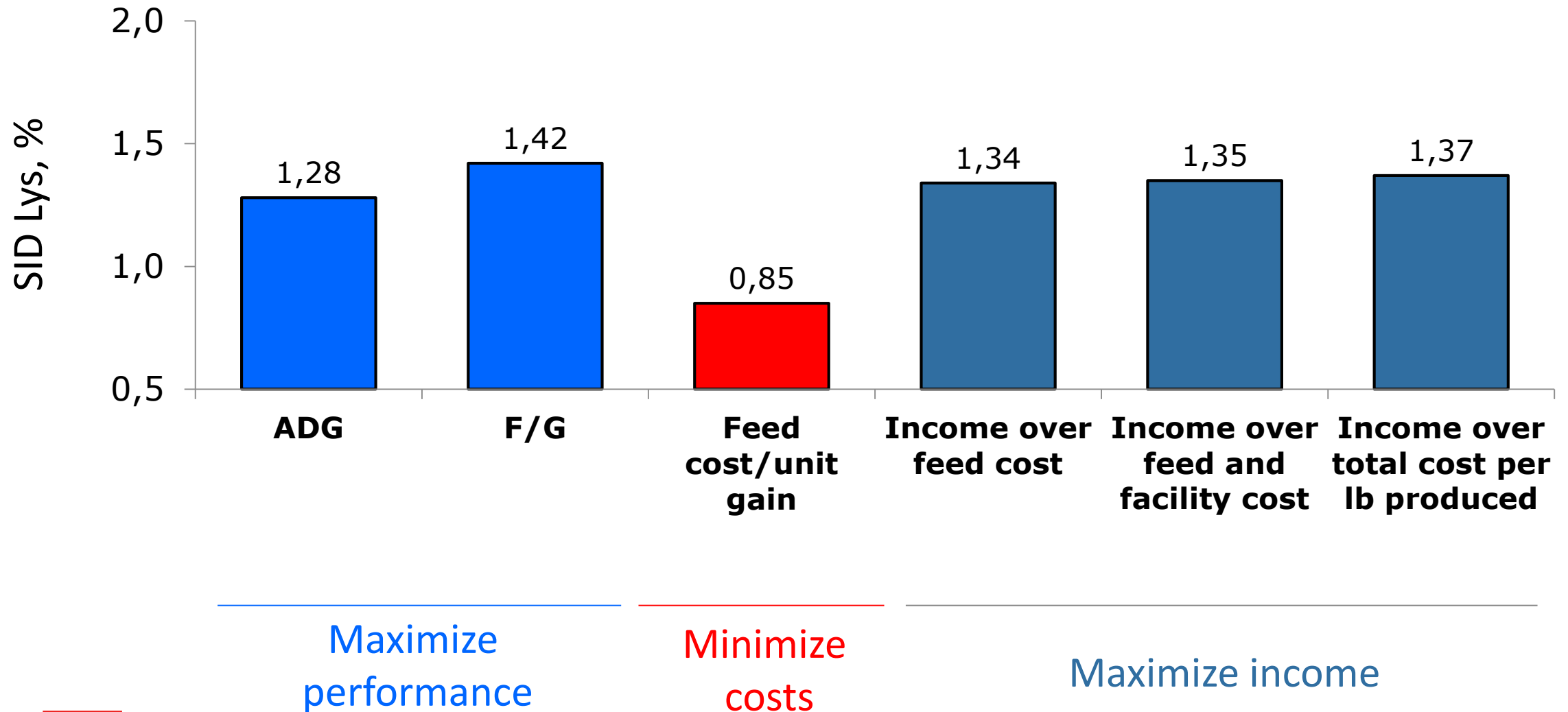


# Taking Nutrient Recommendations and Making it Into a Feeding Program for PIC Pigs



# Strategies in diet formulation

## Many ways to make a nutrition plan



# Strategies in diet formulation



The PIC SID Lysine Biological too can be used to identify the Lys to Calorie ratios for each specific weight break.

## Section R

### PIC® Nutrient Specifications for Late Nursery and Grow-Finish Gilts and Barrows (As-Fed)

ITEM <sup>a</sup>	UNIT	Body Weight, kg					
		11 - 23	23 - 41	41 - 59	59 - 82	82 - 104	104 - Market
Standardized Ileal Digestible amino acid							
Lys:Calorie NE <sup>b</sup>	g/Mcal	5.32	4.74	4.11	3.54	3.06	2.72
Lys:Calorie ME <sup>b</sup>	g/Mcal	3.90	3.47	3.03	2.62	2.29	2.08

PIC <sup>®</sup> SID Lysine Biological Requirement for PIC Pigs <sup>α</sup>		Never Stop Improving Your Success.						
Energy level, NRC NE kcal/kg		2491	2491	2491	2491	2491	2491	
Weight In, kg		11	23	41	59	82	104	129
Weight Out, kg		23	41	59	82	104	129	150
SID Lys, grams:Mcal NE								
Barrows		5.32	4.74	4.02	3.40	2.94	2.63	2.50
Gilts		5.32	4.74	4.21	3.68	3.17	2.81	2.65
Gilts development **		5.16	4.59	4.08	3.57	3.07	2.51	2.51
Boars		5.34	4.91	4.34	3.83	3.47	3.25	3.22
Barrows and Gilts		5.32	4.74	4.11	3.54	3.06	2.72	2.58
SID Lys, % of the diet								
Barrows		1.33	1.18	1.00	0.85	0.73	0.66	0.62
Gilts		1.33	1.18	1.05	0.92	0.79	0.70	0.66
Gilts development **		1.29	1.14	1.02	0.89	0.77	0.63	0.63
Boars		1.33	1.22	1.08	0.95	0.86	0.81	0.80
Barrows and Gilts		1.33	1.18	1.02	0.88	0.76	0.68	0.64
Boars and Gilts		1.33	1.20	1.06	0.93	0.83	0.76	0.73
<sup>α</sup>		The SID Lys to energy ratios meet the biological requirements for PIC 327, 337, and 359 sired pigs. PIC suggests to utilize 99% of the tool estimates for PIC 380, 408, and 410 sired pigs; and 97% for PIC 800 sired pigs to achieve the biological requirements of these sirelines.						
**		if desired weight at breeding is not met, PIC recommends using 97% of SID Lysine requirement for commercial gilts above 90 kg						

However, the biological requirement may not always result in maximum profitability



# Strategies in diet formulation

## Section R

### PIC® Nutrient Specifications for Late Nursery and Grow-Finish Gilts and Barrows (As-Fed)



Most amino acid ratios are estimated to achieve 100% of maximum performance, but economics will dictate the ideal ratio to maximize profitability

ITEM <sup>a</sup>	UNIT	Body Weight, kg					
		11 - 23	23 - 41	41 - 59	59 - 82	82 - 104	104 - Market
<b>Standardized Ileal Digestible amino acids</b>							
Lys:Calorie NE <sup>b</sup>	g/Mcal	5.32	4.74	4.11	3.54	3.06	2.72
Lys:Calorie ME <sup>b</sup>	g/Mcal	3.90	3.47	3.03	2.62	2.29	2.08
Methionine + cysteine:Lys	Ratio	58	58	58	58	58	58
Threonine:Lys	Ratio	65	65	65	65	65	66
Tryptophan:Lys <sup>c</sup>	Ratio	19	18	18	18	18	18
Valine:Lys	Ratio	68	68	68	68	68	68
Isoleucine:Lys	Ratio	55	56	56	56	56	56
Leucine:Lys <sup>d</sup>	Ratio	100	101	101	101	101	102
Histidine:Lys	Ratio	32	34	34	34	34	34
Phenylalanine + tyrosine:Lys	Ratio	92	94	94	94	95	96
L-Lys-HCl, max <sup>e</sup>	%	---	0.45	0.40	0.35	0.28	0.25
Max. SID Lys:CP <sup>g</sup>	Ratio	6.4	---	---	---	---	---
Min. crude protein <sup>h</sup>	%	---	---	---	---	---	13





# Strategies in diet formulation

## Section R

### PIC® Nutrient Specifications for Late Nursery and Grow-Finish Gilts and Barrows (As-Fed)

ITEM <sup>a</sup>	UNIT	Body Weight, kg					
		11 - 23	23 - 41	41 - 59	59 - 82	82 - 104	104 - Market
<b>Minerals</b>							
STTD P:Calorie NE <sup>ij</sup>	g/Mcal	1.80	1.62	1.43	1.25	1.10	0.99
STTD P:Calorie ME <sup>ij</sup>	g/Mcal	1.32	1.20	1.07	0.95	0.84	0.77
Av. P:Calorie NE <sup>ij,k</sup>	g/Mcal	1.54	1.39	1.23	1.07	0.94	0.85
Av. P:Calorie ME <sup>ij,k</sup>	g/Mcal	1.14	1.03	0.92	0.82	0.72	0.66
Analyzed Ca:Analyzed P, range <sup>l</sup>	Ratio	1.25- 1.50	1.25- 1.50	1.25- 1.50	1.25- 1.50	1.25- 1.50	1.25- 1.50
Sodium <sup>m</sup>	%	0.28	0.25	0.25	0.25	0.25	0.25
Chloride	%	0.32	0.25	0.25	0.25	0.25	0.25

The recommendations for Available P are estimated as 86% of the STTD P recommendations in a corn-soybean meal-diet using STTD P coefficient and P bioavailability from NRC (1998 and 2012).



Thank you!



# Questions?

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