Abstract 31473

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Variability in gestating sows' nutrient requirements

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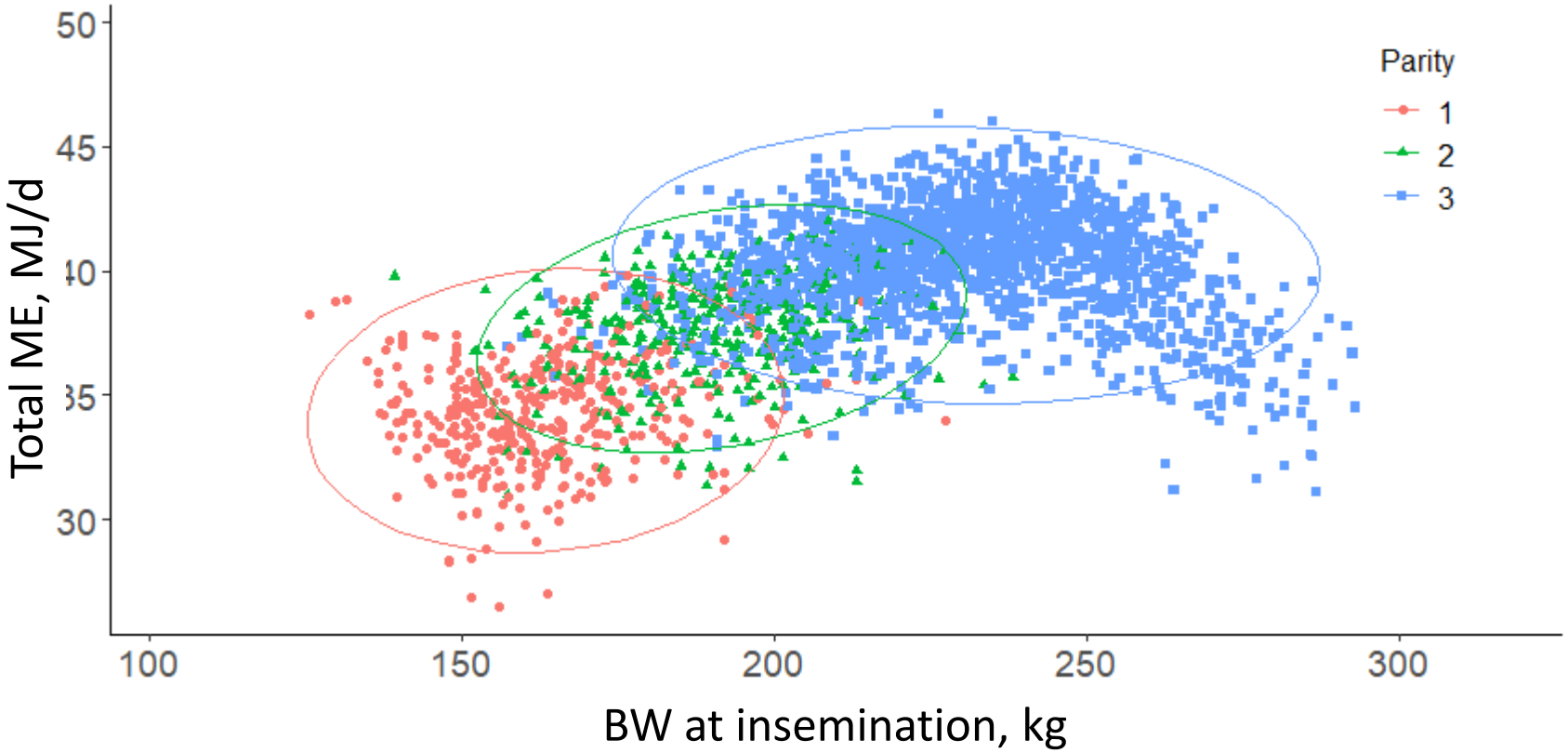
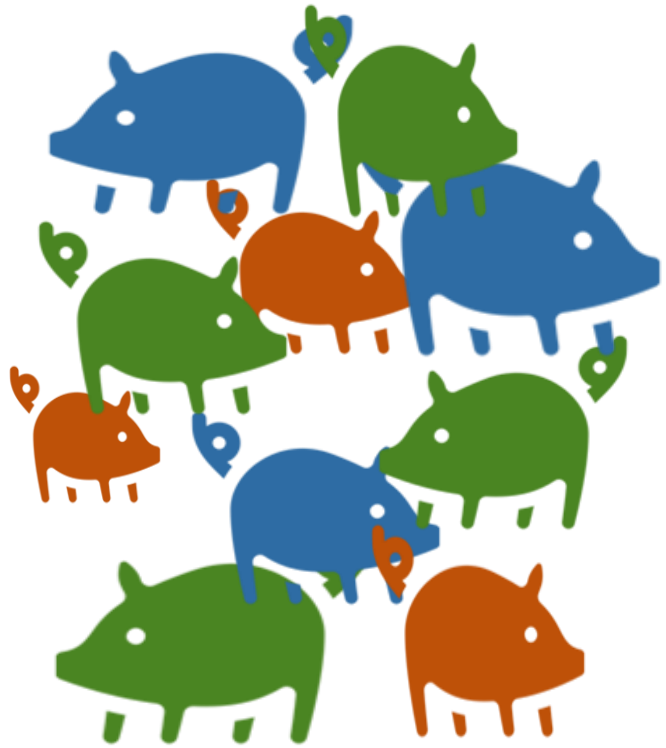
- Variation of sows' nutritional requirements **among sows** and over **gestation**



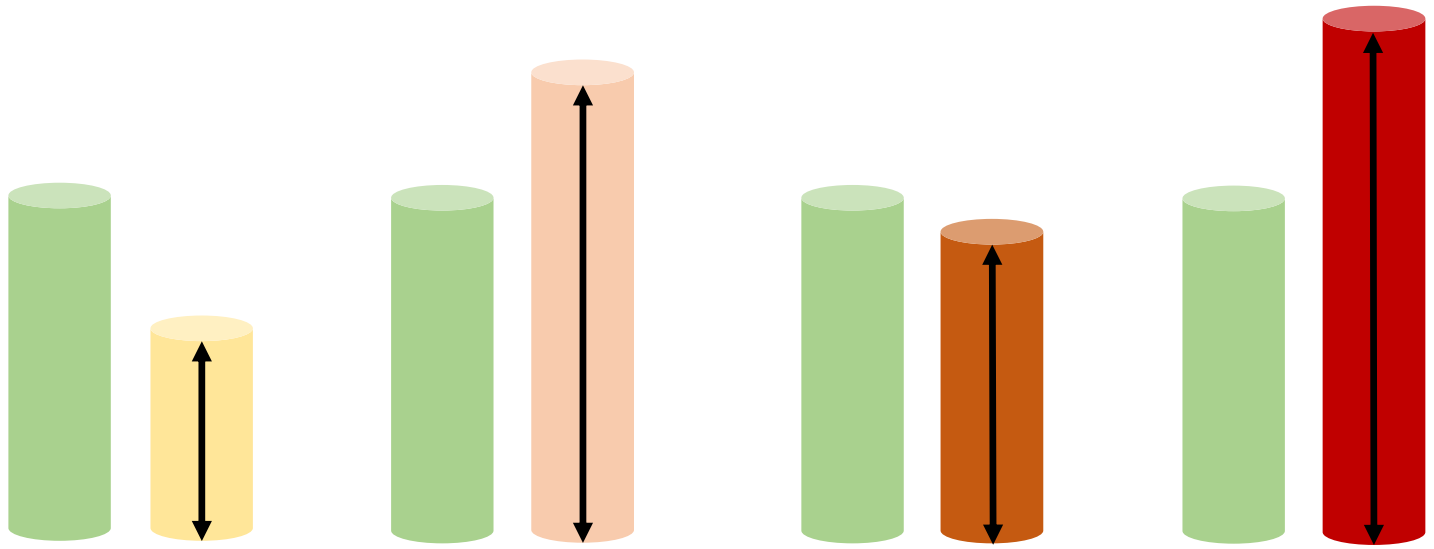


ME: Metabolizable Energy, BW: Body Weight

Gestating sows

In practice :

- Restricted feed allowance
- 1 diet for all the sows during the gestation
- Fixed amount of energy and nutrients in diet



New technologies (feeders, sensors) characterize <u>in real-time</u> sows & environment
=> Use in real time the prediction model of nutrient requirements

Perspective : to improve feed efficiency, reduce production costs and decrease environmental impacts

Feed-a-Gene

OBJECTIVE

To explore the variability in nutrient requirements among sows and over time, in order to develop a precision feeding tool that can be included in the sows' feeders

STEP 3 / Compare the effects of feeding strategies (conventional feeding, group feeding, precision feeding)

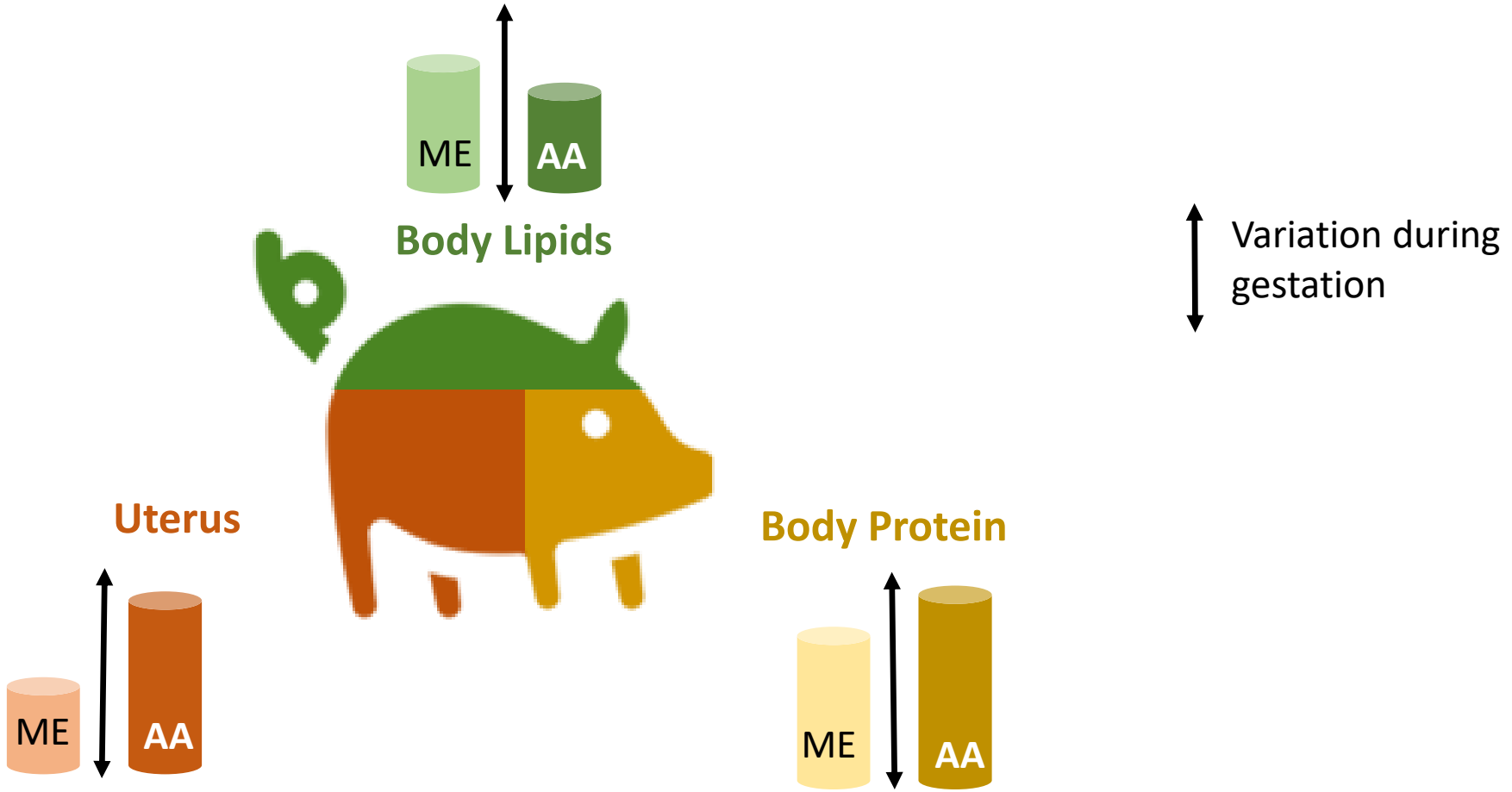
STEP 2 / Determine and characterize the effects of factors (week, parity, litter size, temperature) on sows nutrients requirements during gestation

STEP 1 / Build a prediction model of the sows' requirements

Horizon 2020 EU Feed-a-Gene program (grant agreement n°633531)

STEP 1 / Build a prediction model of the sows' requirements

- Description of the gestating sow model (Adapted from InraPorc *)



ME: Metabolizable Energy, AA: Amino Acid

** Dourmad et al. / Animal Feed Science and Technology 143 (2008) 372-386*

- Model inputs

Sow
- Parity
- Litter size
- Average litter BW
- BW at AI and objective at farrowing
- BT at AI and objective at farrowing

Feed
- AA content
- Mineral content
- Energy content

Environment
- Housing
- Temperature

Calculate **total ME** requirement per sow, regarding BW and BT at AI

Calculate **feed supply** per sow

For each sow, prediction of the **daily nutrient requirements** based on simulated BW from previous day

BW: Body Weight, BT: Backfat Thickness, AI: Artificial Insemination, ME: Metabolizable Energy

- Data set and analysis

2511 gestations

Python model

Statistical analysis : linear mixed model

Variables:
- requirements in ME
- requirements in SID Lys
- requirements in STTD-P

Fixed factors:
- week of gestation
- parity (1, 2, 3+)
- litter size (S, M, L)
- temperature (in °C)

Random factor : sow

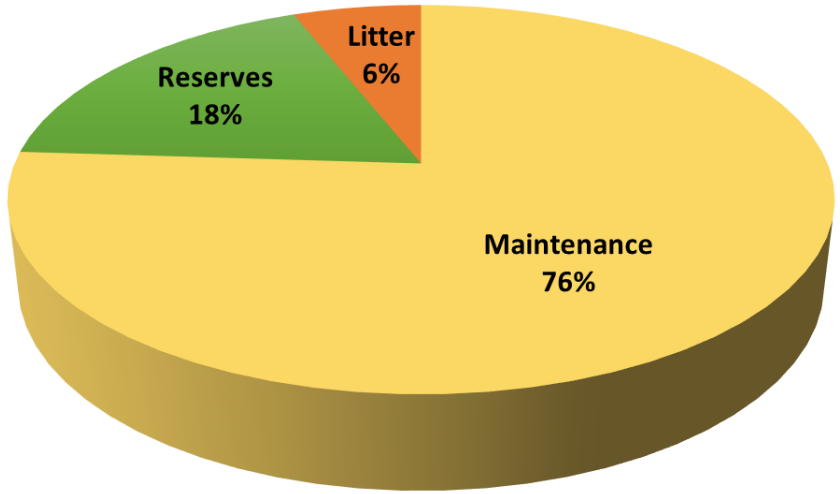
S: < 12 piglets
M: ≥ 12 & < 16 piglets
L: ≥ 16 piglets

ME: Metabolizable Energy, SID Lys: Standardized ileal digestible lysine, STTD-P: Standardized total tract digestible phosphorus

STEP 2 / Determine and characterize the effects of different factors (week of gestation, parity, litter size, temperature) on sows nutrients requirements during gestation

- Allocation of metabolizable energy (ME)

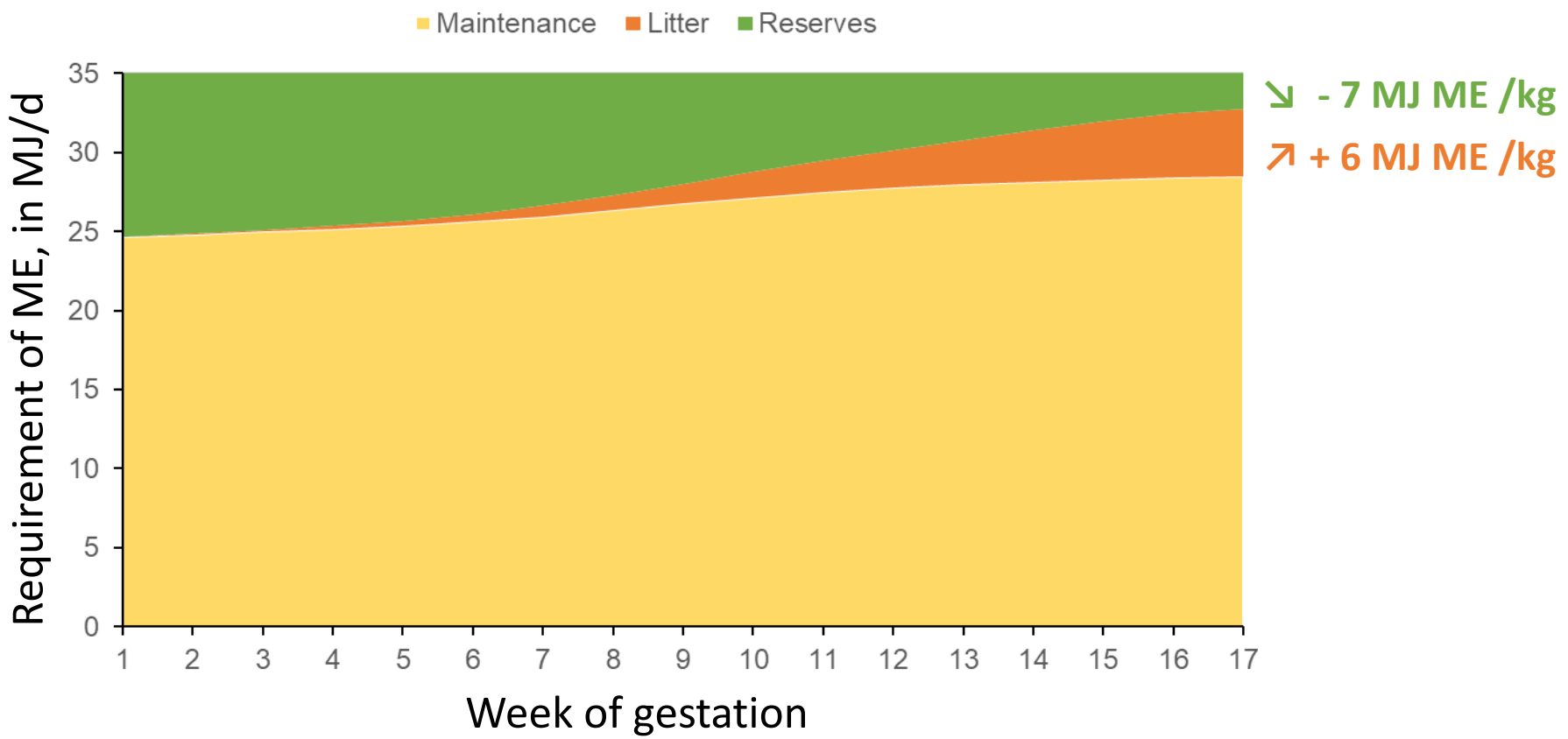
Maintenance (requirement) + Thermo-regulation (requirement) + Litter (requirement) + Maternal reserves (allocation) = Total ME



Average ME allocation in thermoneutral conditions

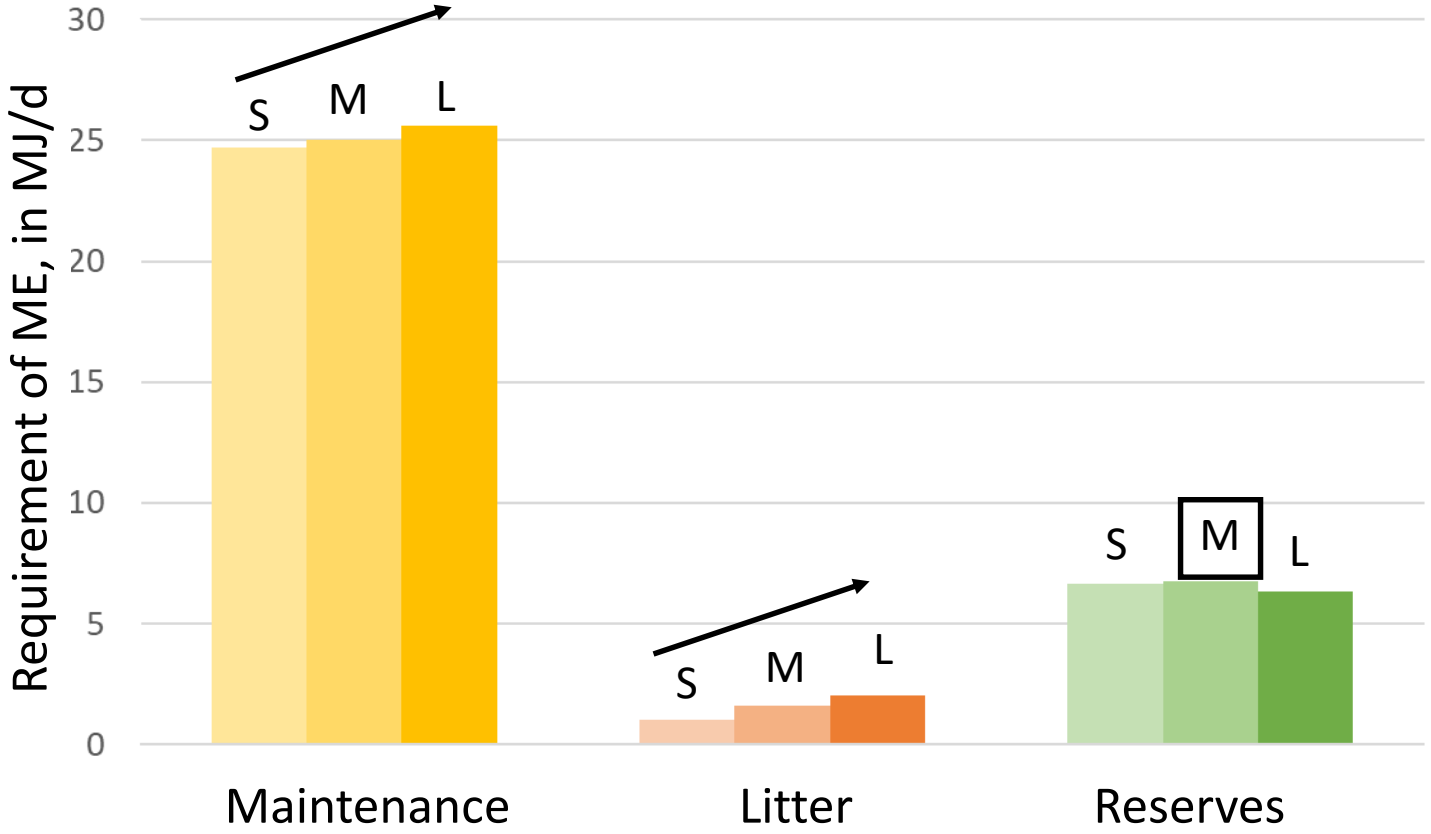
ME: Metabolizable Energy

- Variation of energy requirements over gestation



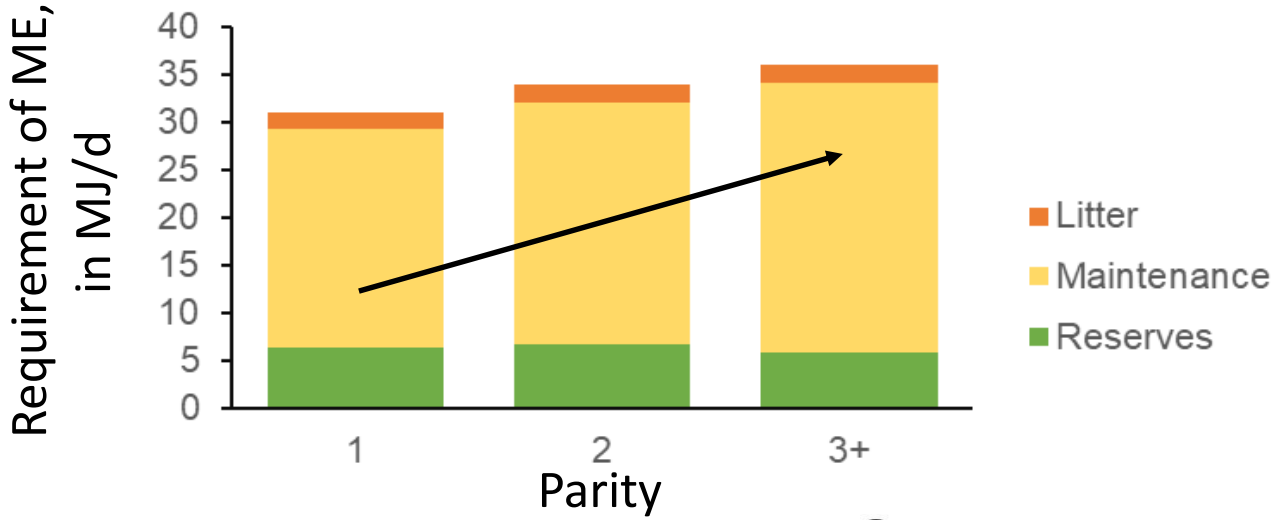
ME: Metabolizable Energy

- Variability of energy requirements with litter size



S: < 12 piglets, **M**: ≥ 12 & < 16 piglets, **L**: ≥ 16 piglets

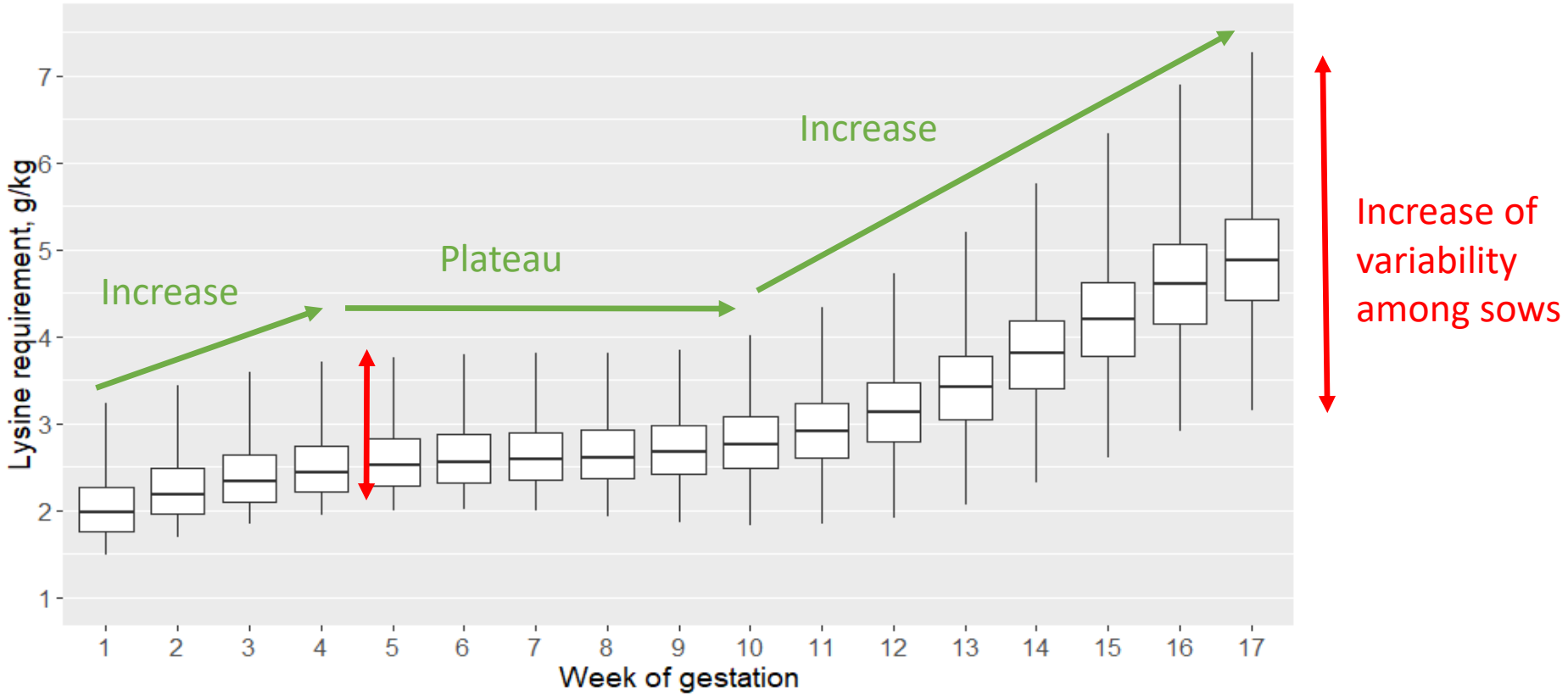
- Variability of energy requirements with parity



Difference due to different sow BW….

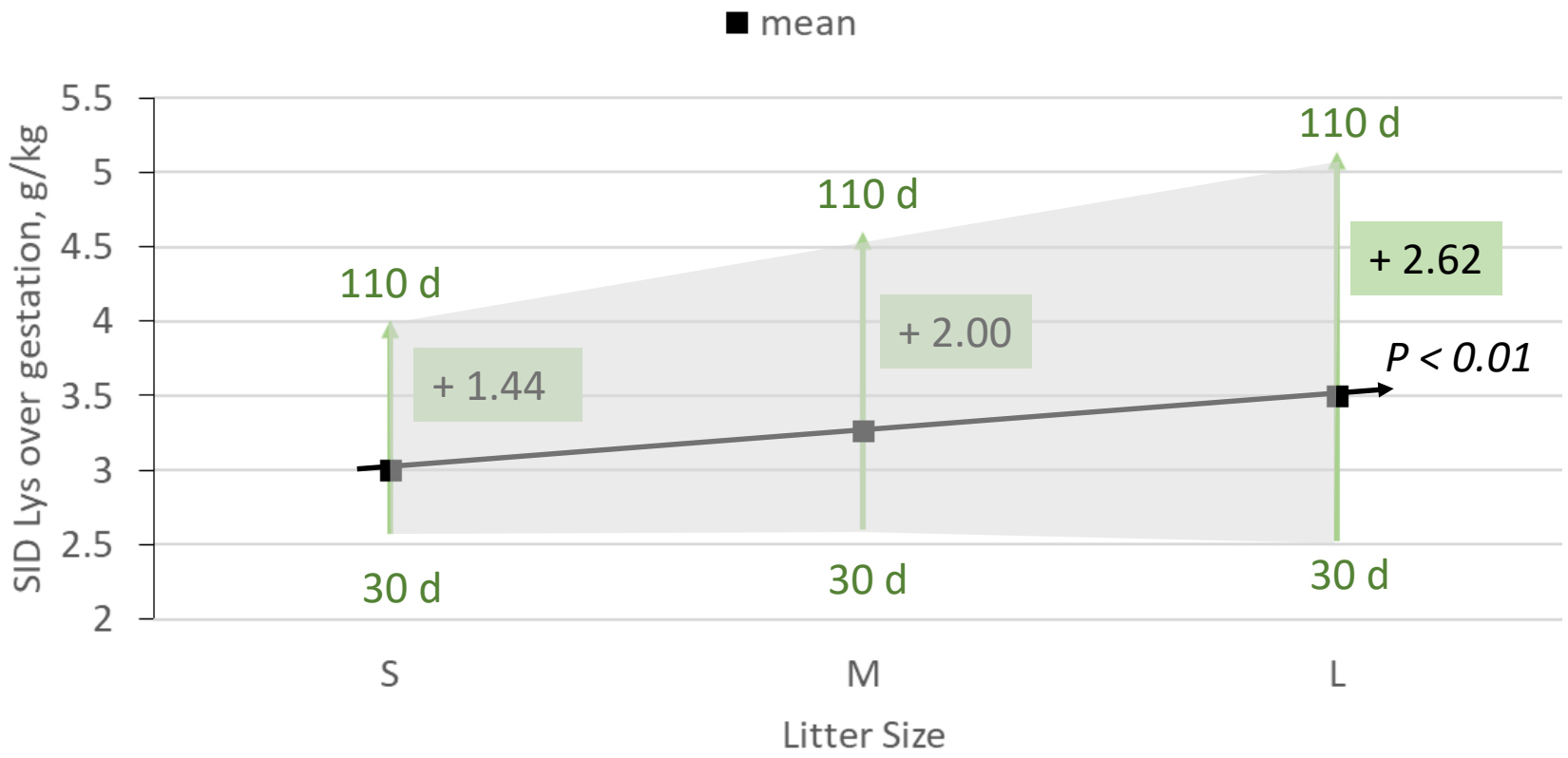
…. leading to different feed supply :

- Variation and variability in AA requirements (SID Lys) over gestation



SID Lys: Standardized ileal digestible lysine, AA: Amino Acid

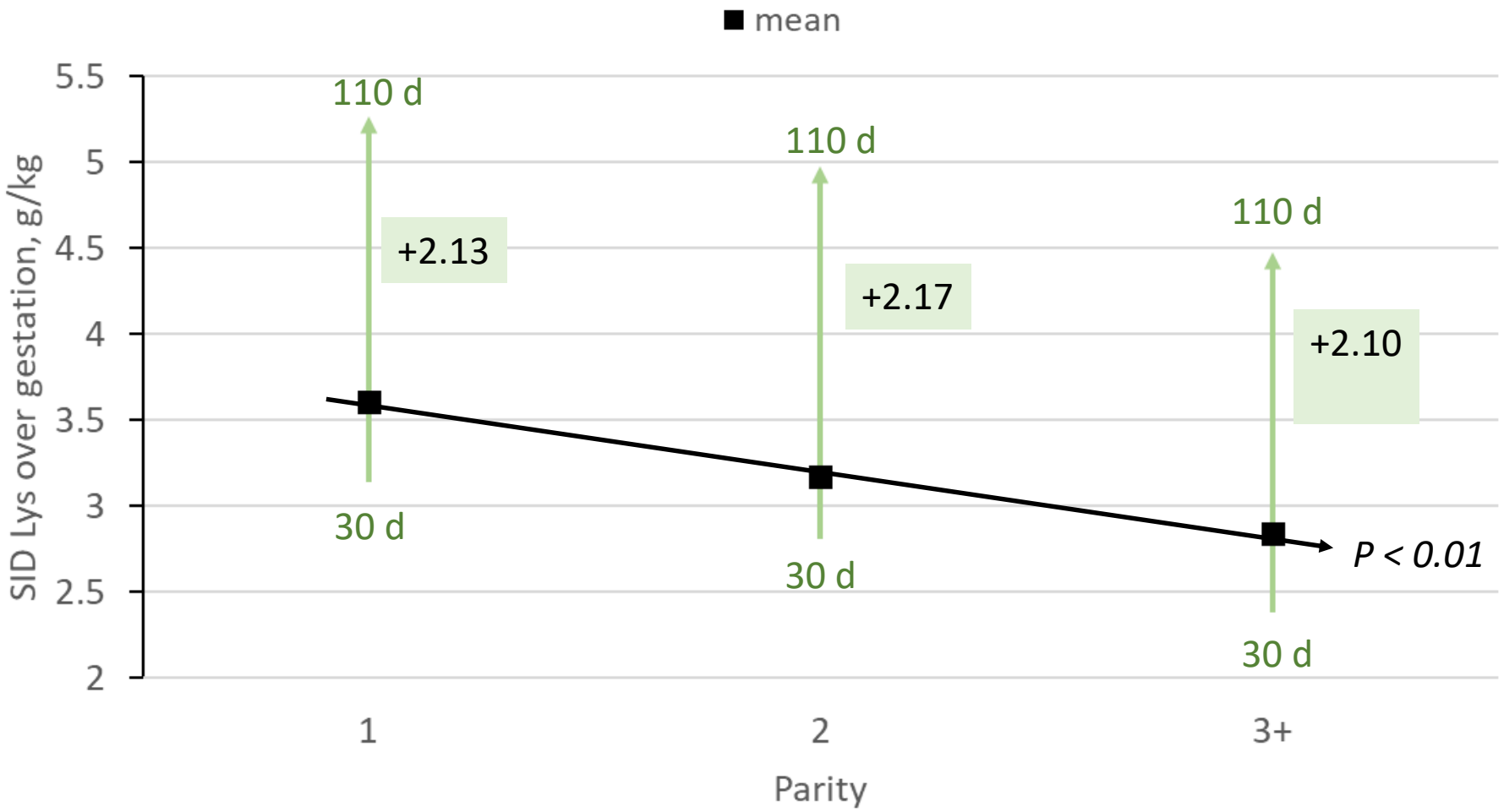
- Variability in AA requirements (SID Lys) with litter size



Variation of SID Lys from 30 to 110 d, g/kg

SID Lys: Standardized ileal digestible lysine, AA: Amino Acid

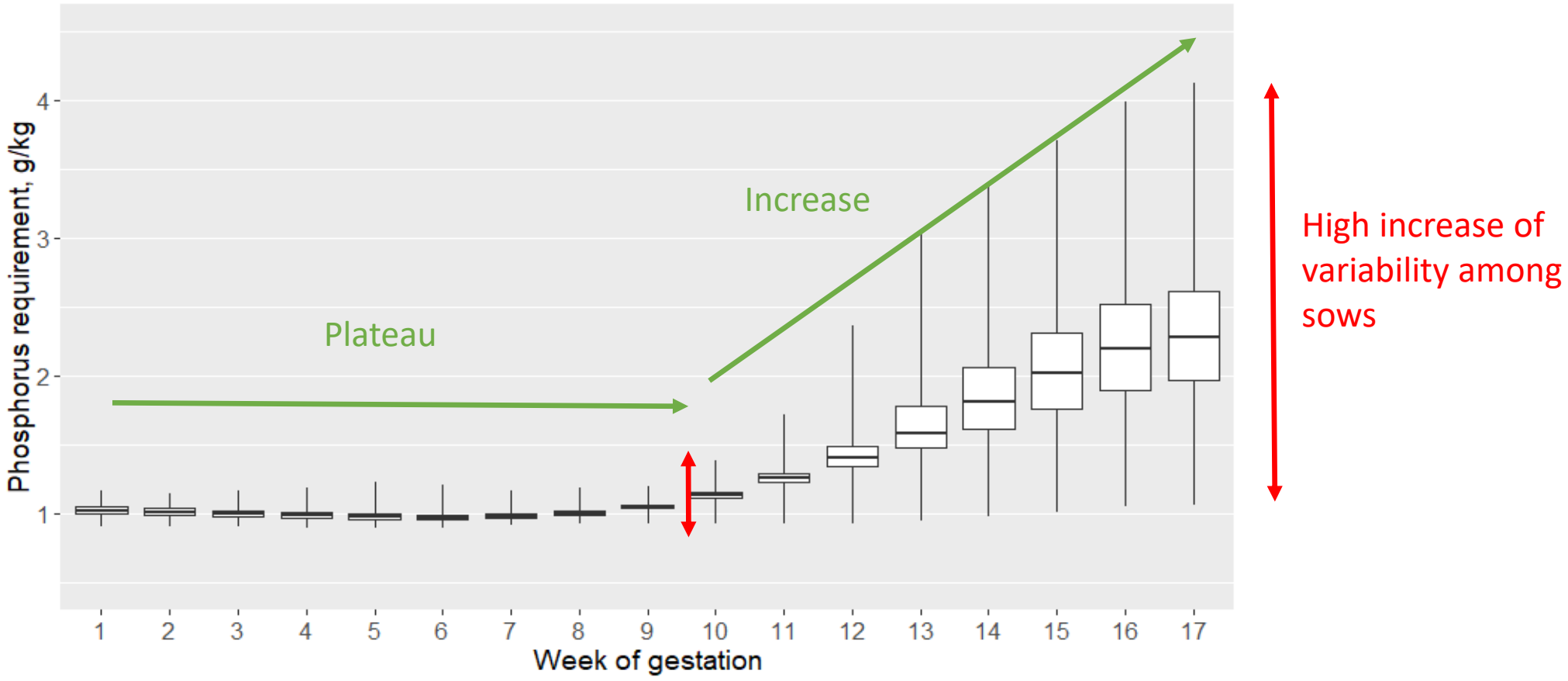
- Variability in AA requirements (SID Lys) with parity



Variation of SID Lys from 30 to 110 d, g/kg

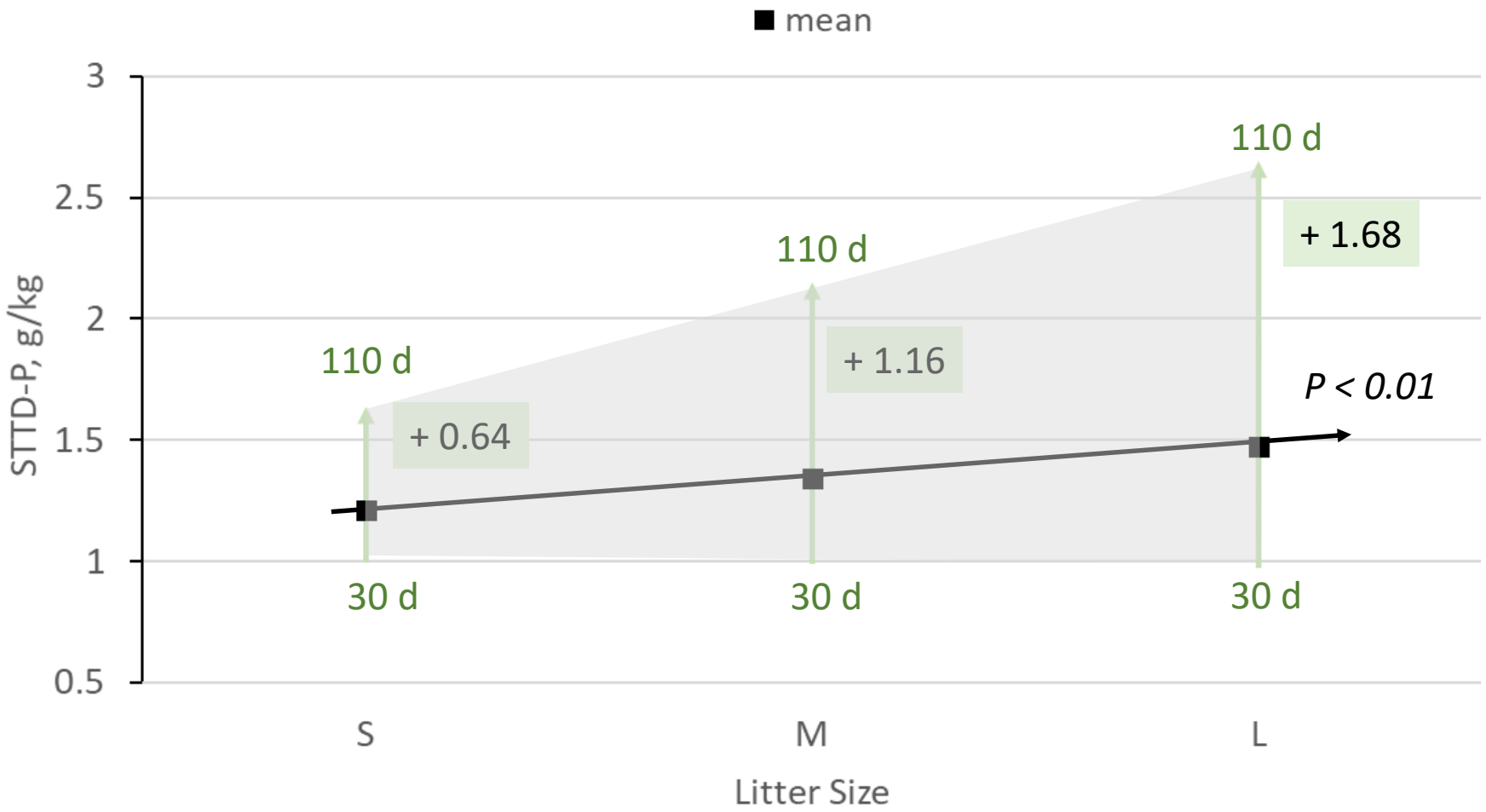
SID Lys: Standardized ileal digestible lysine, AA: Amino Acid

- Variability of mineral requirements (STTD-P) over gestation



STTD-P: Standardized total tract digestible phosphorus

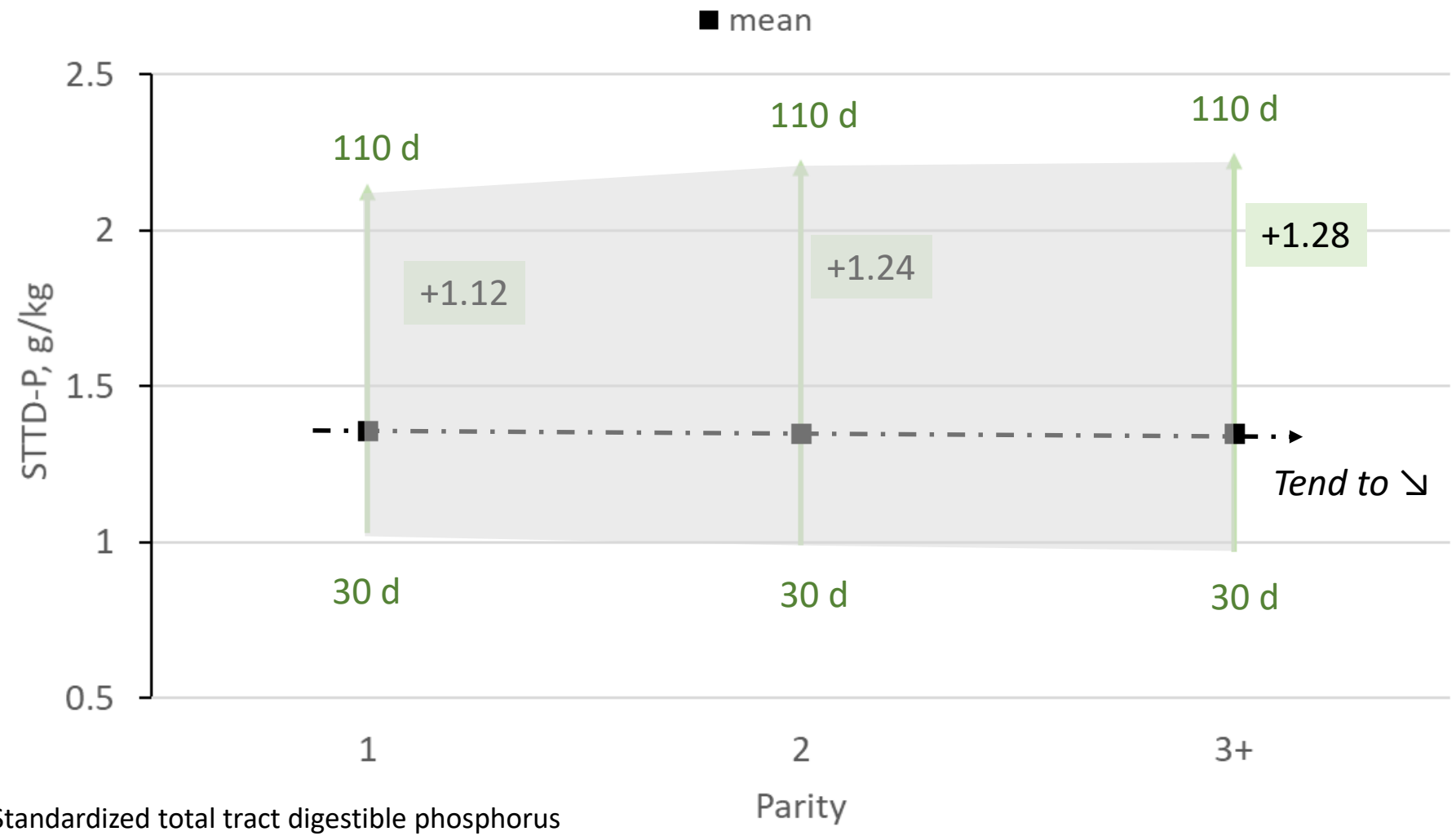
- Variability of mineral requirements (STTD-P) with litter size



Variation of STTD-P from 30 to 110 d, g/kg

STTD-P: Standardized total tract digestible phosphorus

- Variability of mineral requirements (STTD-P) with parity



Variation of STTD-P from 30 to 110 d, g/kg

STTD-P: Standardized total tract digestible phosphorus

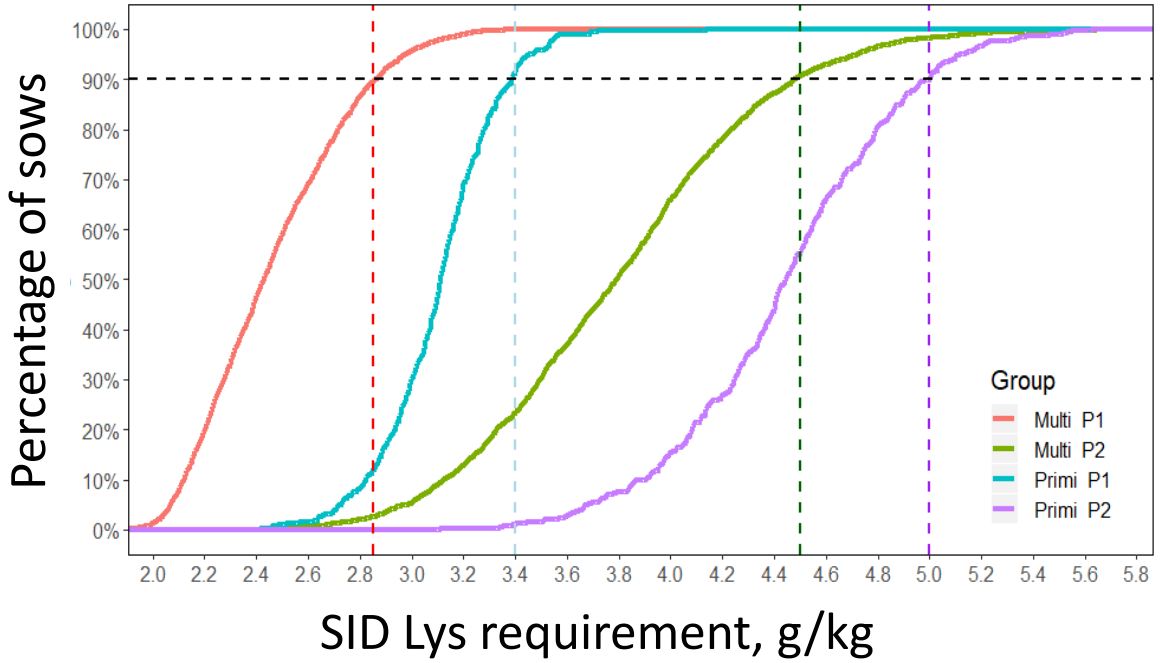
- Temperature effects

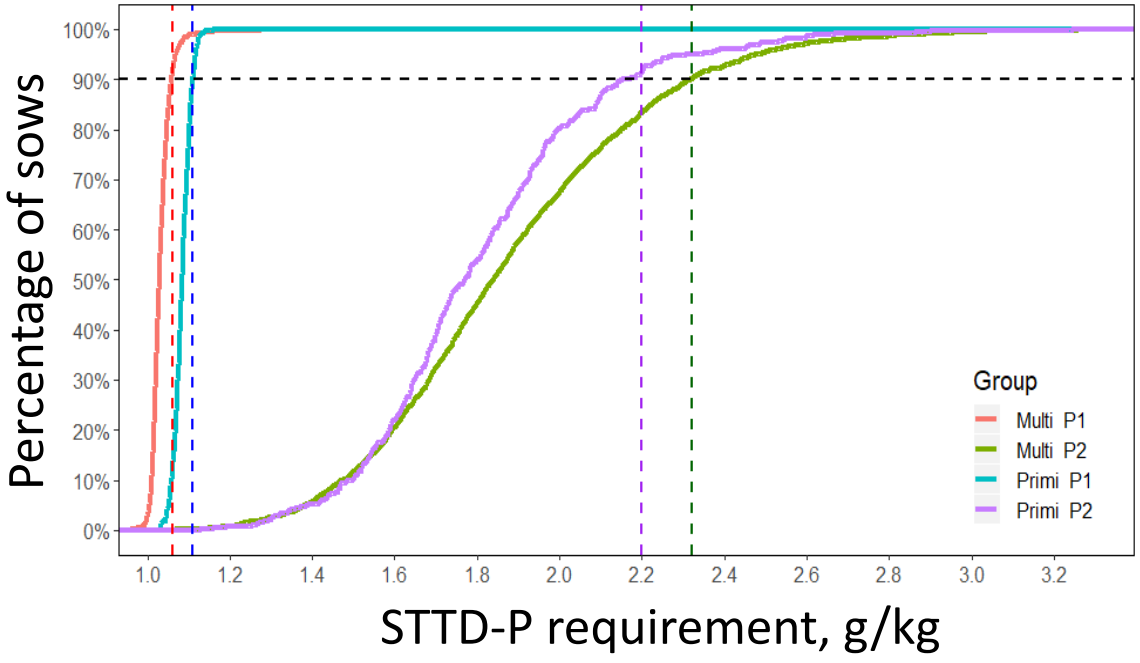
	Means at 16°C	Means at 12°C	SE	P-value
Thermoregulation, MJ ME/d	0	1.96	0.01	< 0.01
Average requirements in g/d				
SID Lys	8.25	8.29	0.03	< 0.01
STTD-P	3.62	3.64	0.01	< 0.01
Average requirements in g/kg				
SID Lys	3.08	2.92	0.01	< 0.01
STTD-P	1.35	1.28	0.51	< 0.01

SID Lys and STTD-P decrease of 0.04 and 0.02 g/kg per °C below LCT, respectively

EM thermo : Metabolizable Energy required for thermoregulation, SID Lys: Standardized ileal digestible lysine, STTD-P: Standardized total tract digestible phosphorus, LCT: lower critical temperature (16°C)

- **Summary** : nutrient requirements vary with gestation period and parity. Variability of litter size can't be predicted yet in practice.

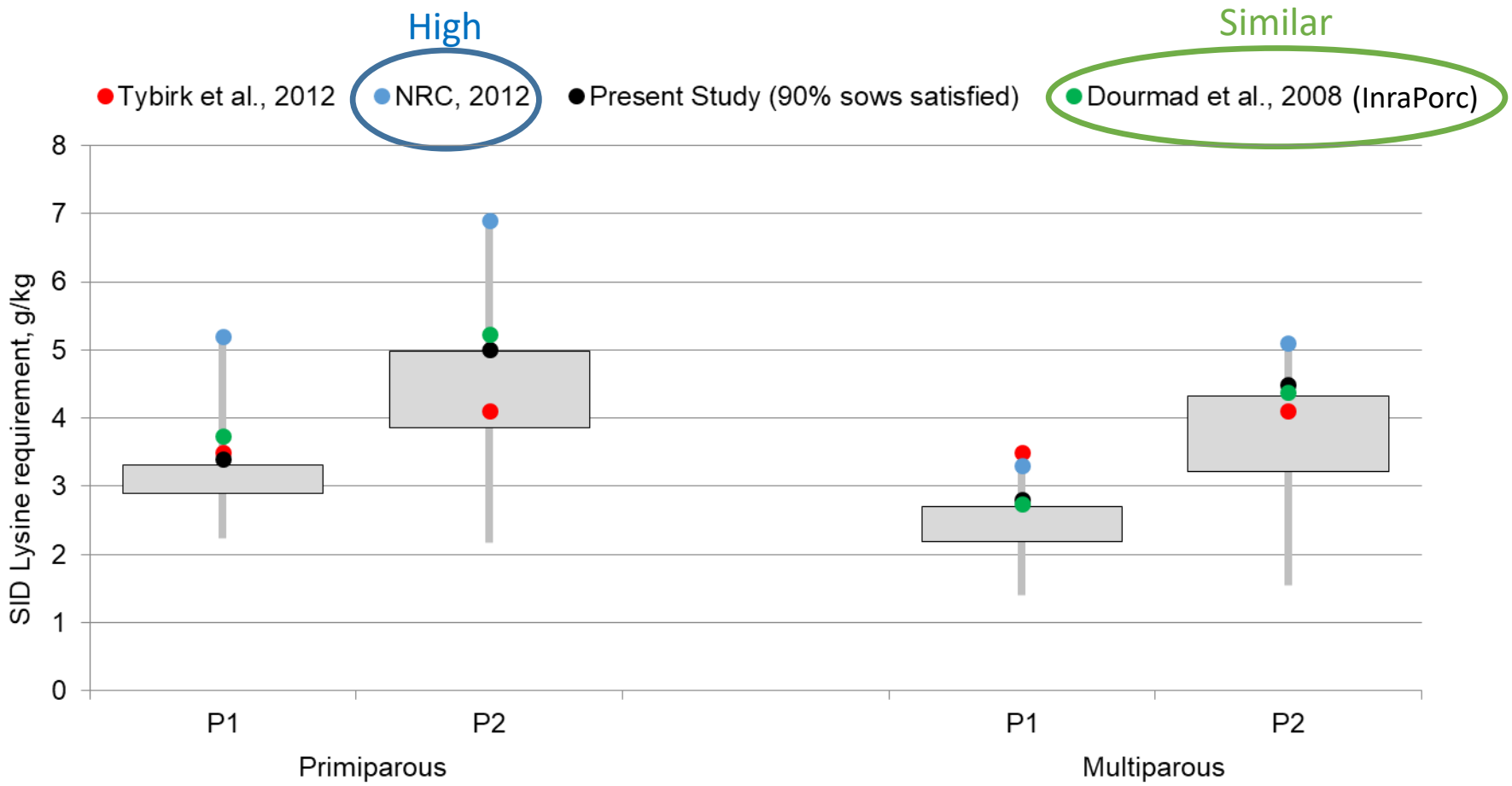




4 diets based on gestation period and parity to satisfy the requirements of 90% of the sows

Multi : multiparous, Primi : primiparous, P1: week 0 to 11, P2: week 12 to 17

- Results compared with recommandations



P1: **early** gestation, P2**: late** gestation [different days of diet shift between studies from 77 to 108 d]

STEP 3 / Evaluation of different feeding strategies

Feeding strategies

Conventional feeding [CF]

1 diet 4.8 g SID Lys/kg

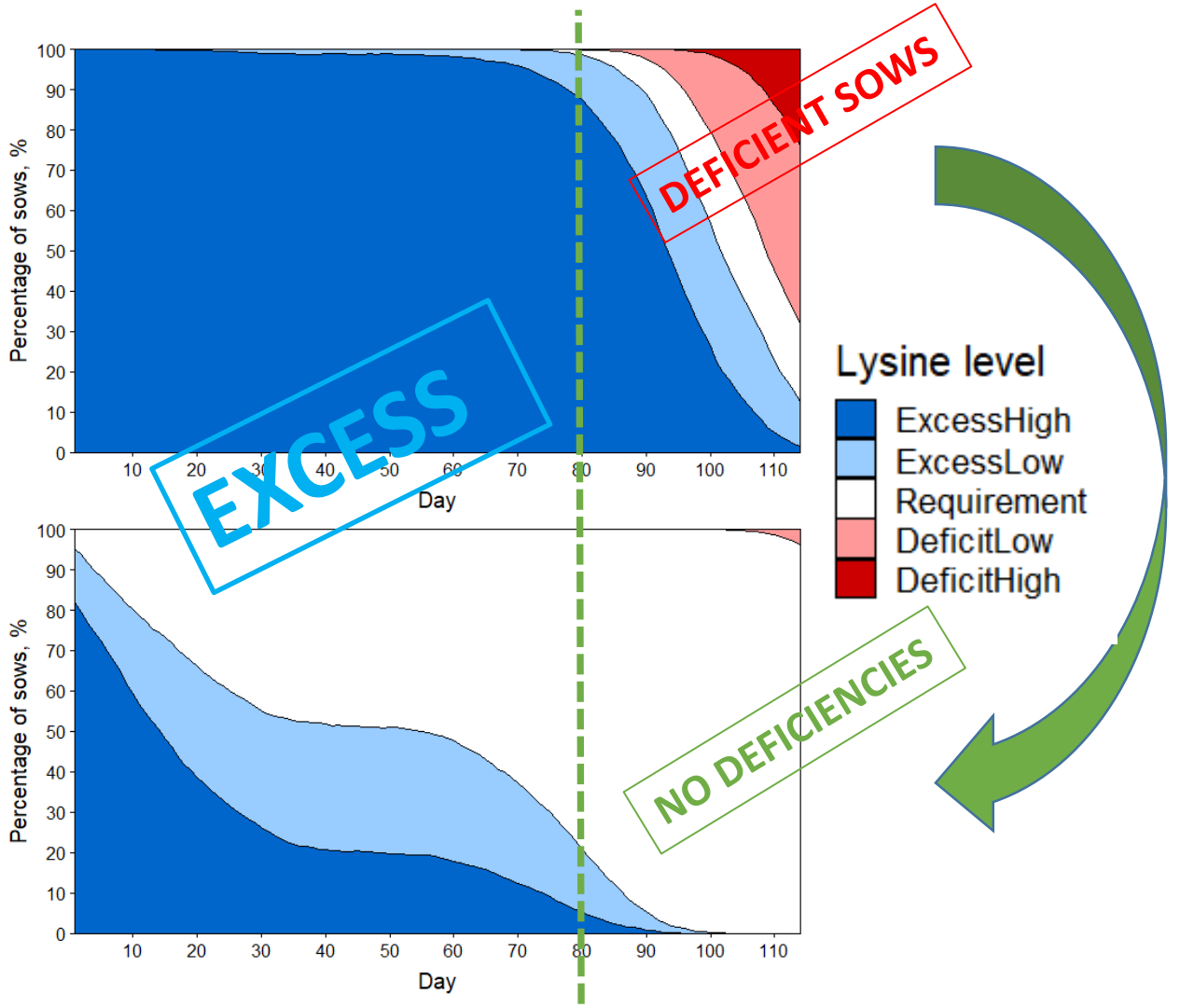
Precision feeding [PF]

Daily Mix of 2 diets:

- *Diet A 3.0 g SID Lys/kg*
- *Diet B 6.5 g SID Lys/kg*

SID Lys: Standardized ileal digestible lysine

ALL SOWS group-housed at 20°C



diet lysine content ↘ of 27%

Feeding strategies

PRIMIPAROUS SOWS group-housed at 20°C

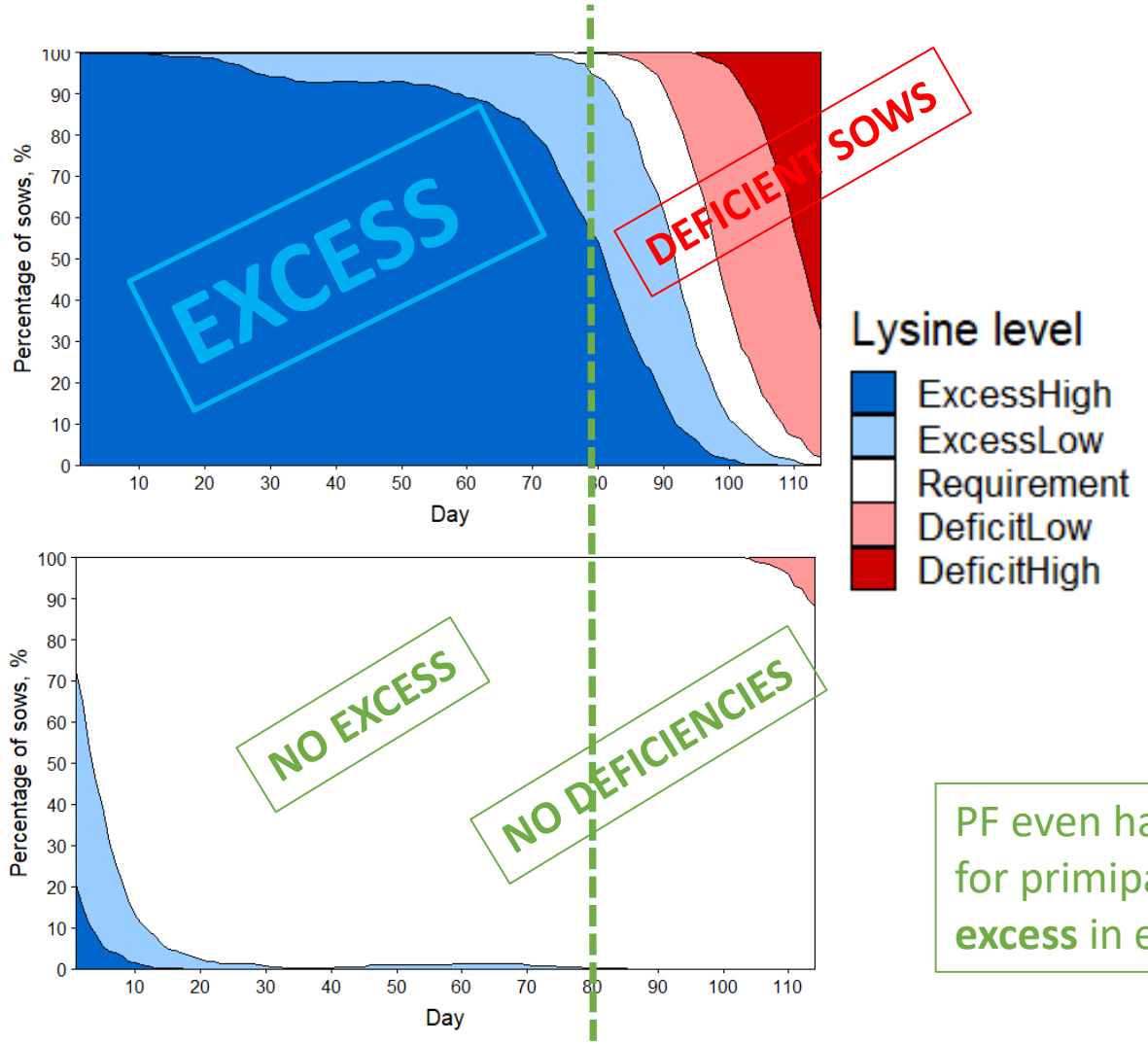
Conventional feeding [CF]

1 diet 4.8 g SID Lys/kg

Precision feeding [PF]

Daily Mix of 2 diets:

- *Diet A 3.0 g SID Lys/kg*
- *Diet B 6.5 g SID Lys/kg*

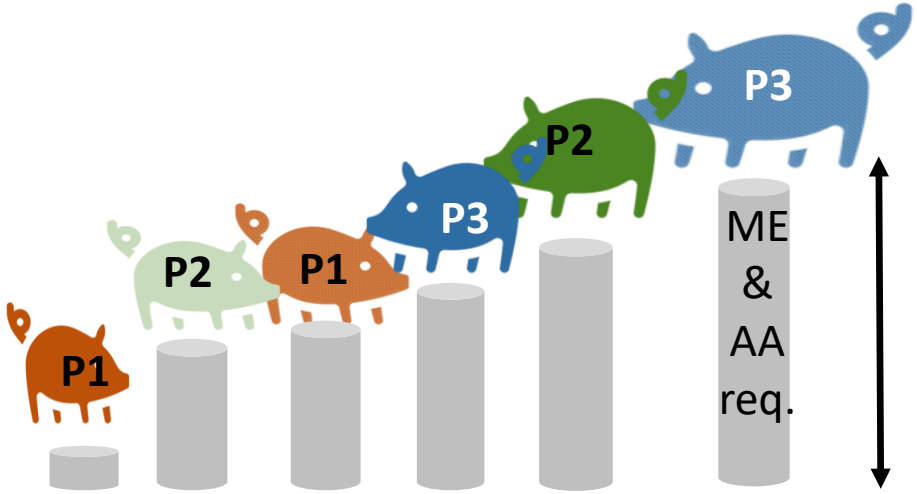


PF even has a higher benefit for primiparous sows : ↘ **excess** in early gestation

SID Lys: Standardized ileal digestible lysine

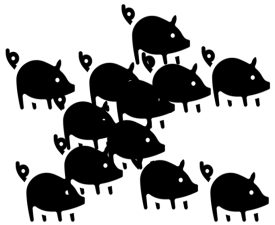
- To conclude …

MODEL predicting sows' requirements

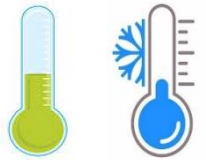


Sow's characteristics (parity, BW, BT)

Litter size



Temperature



Week of gestation

In practice, to feed sows closer to their requirements, two options:

- Feeding by group (**week, parity**)
- Individual feeding (precision feeding strategy)

=> reduce excess and avoid deficiencies in nutrients during gestation

- Perspectives
  - Include this decision system tool in experimental station (UEPR, INRA Saint-Gilles, France) in 2019-2020 to use real-time data
  - Thanks to the development of activity and temperature sensors, the model will also be improved taking into account these real-time information in the calculations

Thank you for your attention