RMT Elevages et environnement

Environmental impacts of different innovative feeding strategies in pig and broiler farms

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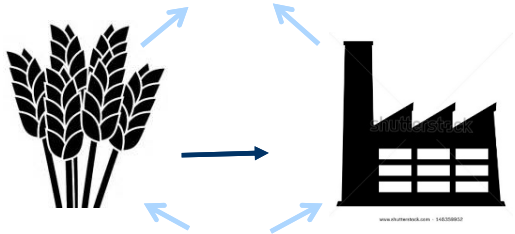
EAAP 68th ANNUAL MEETING Tallinn, Estonia 2017

Feeding strategies are central in livestok production

❶ The production of feedstuffs used in feed is responsible for several environmental impacts

❷ Nutrient excretion & manure management are associated with environmental impacts

Pollutant emissions



Non-renewable resources

70% of the agricultural area in Europe is dedicated to feed production

Feeding strategies (number of feed, characteristics of feed)

Feed

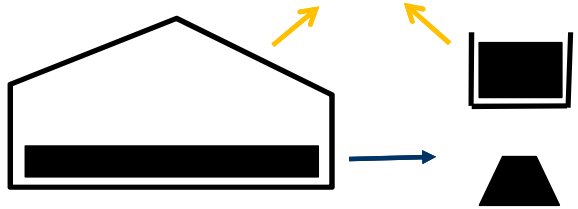
Feed intake

Excretion

Manure

Animal performance (growth rate), Retention

Pollutant emissions



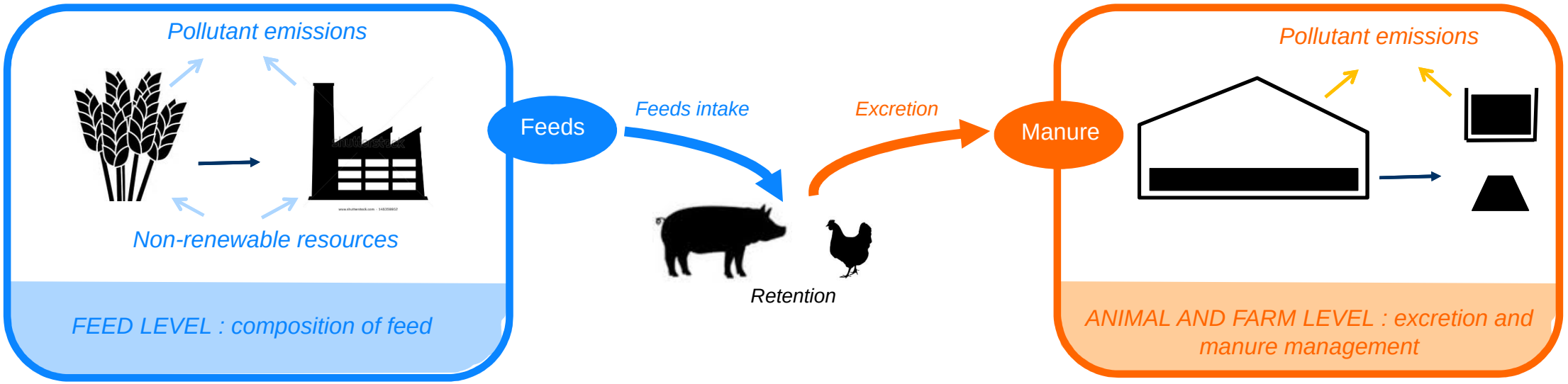
Half of the nitrogen excreted could be lost by pollutant gaseous emissions (NH3, N2O)

✓ By choosing feedstuffs with lower environmental impacts

How to reduce the environmental impacts of animal production ?

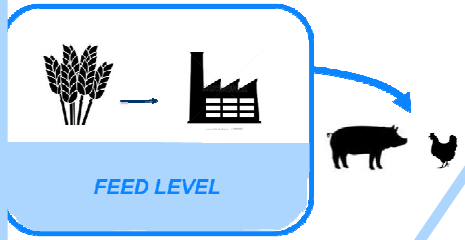
✓ By adapting the feed to the requirements of the animal (phase feeding) to optimize feed intake and reduce nutrient excretions

Question



- **How the combination of the two levels of feeding improvement (feed level, animal level) modifies the environmental impacts of animal product for pig and broiler production ?**

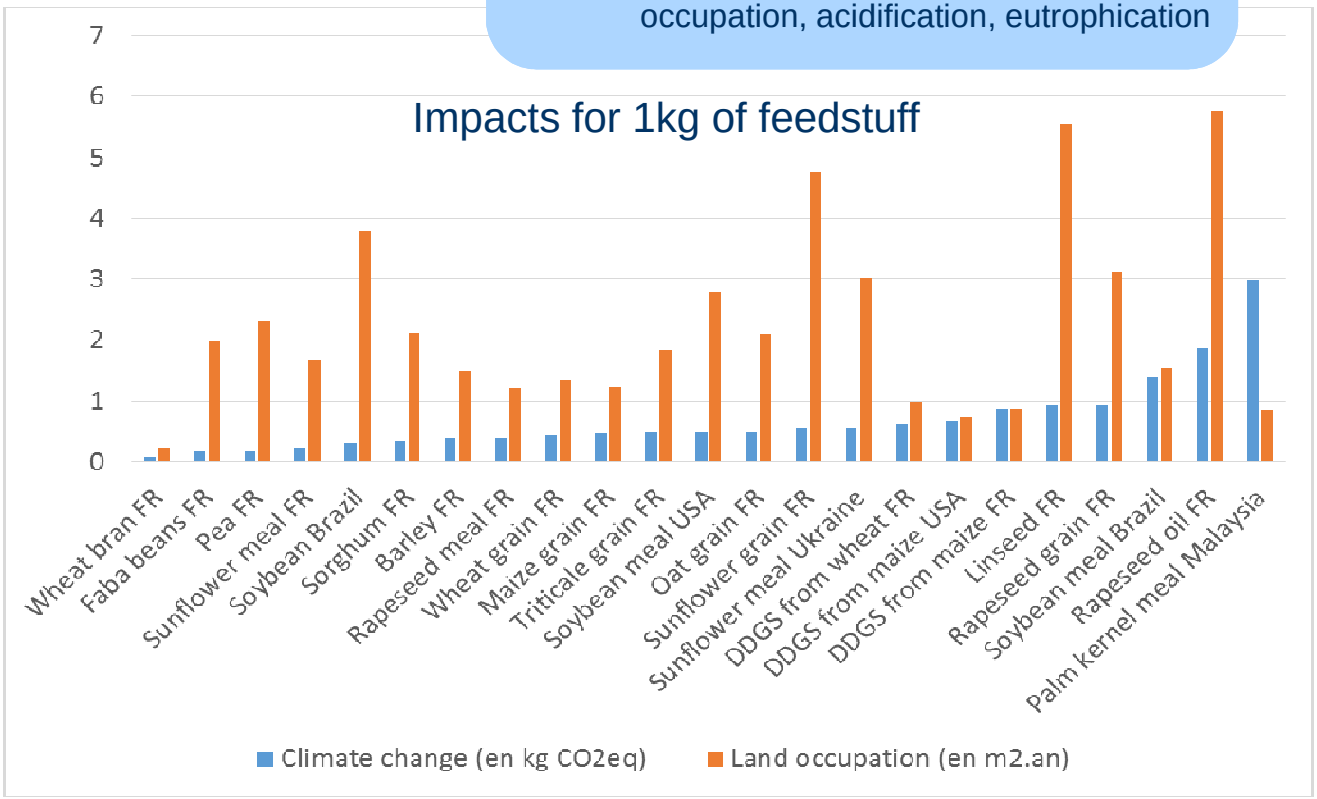
Methodology – Production of eco-feed



ECOALIM DATA SET

- **60 different feedstuffs**
- **150 data (different production processes)**
- **6 environmental impacts**
  - Climate change, energy consumption, phosphorus consumption, land occupation, acidification, eutrophication

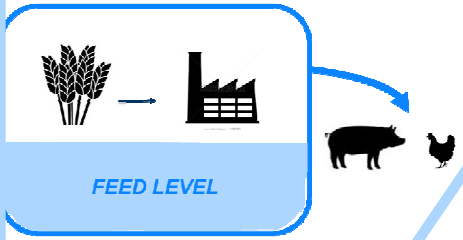
- Cereals
- Wheat coproducts
- Proteins
- Meals
- Fats
- Amino acids
- Minerals
- Vitamins
- Others coproducts



Wilfart et al., 2016

Methodology – Formulation of feeds with a multi-objective function

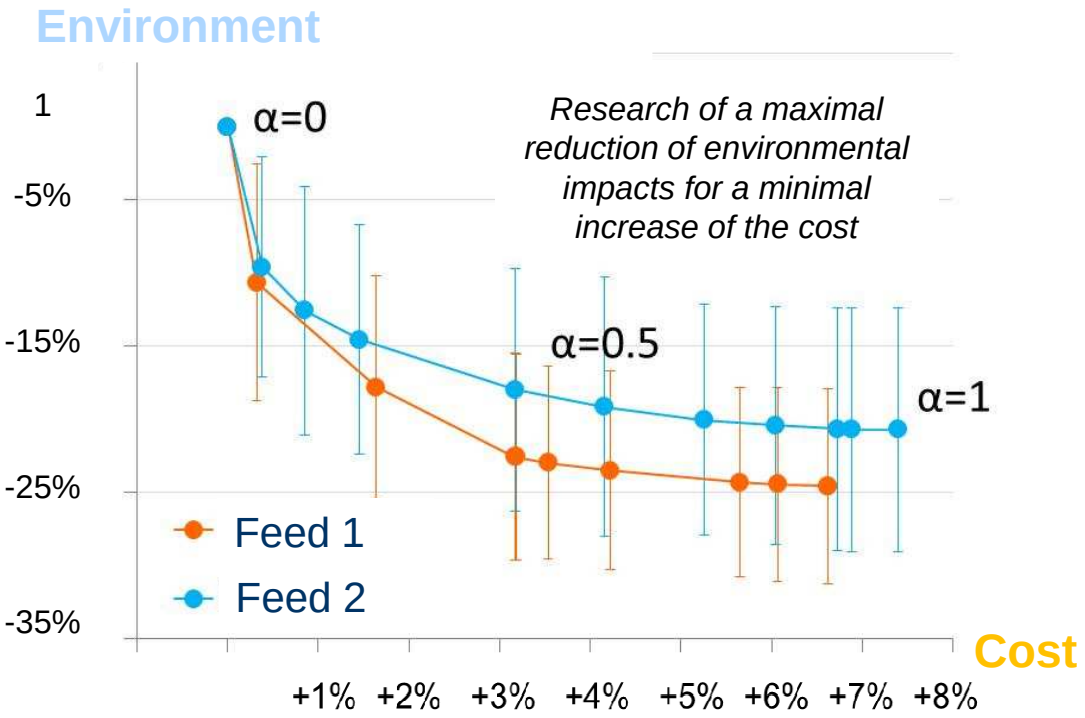
ECOALIM DATA SET



Multi objective function (MO)

$$= (1 - \propto)\frac{\textbf{Cost}}{\textbf{Cost}_{\textbf{ref}}\ *} + \propto \left(\frac{2\beta \times \textbf{CC}}{\textbf{CC}_{\textbf{ref}*}} + \frac{\beta \times \textbf{PD}}{\textbf{PD}_{\textbf{ref}*}} + \frac{\beta \times \textbf{EN}}{\textbf{EN}_{\textbf{ref}*}} + \frac{\beta \times \textbf{LO}}{\textbf{LO}_{\textbf{ref}*}}\right)$$

Cost — Environment



4 environmental impacts :
- Climate change (CC)
- Phosphorus demand (PD)
- Energy consumption (EC)
- Land occupation (LO)

ECO feed

(Méda *et al.*, EAAP 2017 Session 4)

Methodology - Different feeding strategies

Fattening period

MO

2-phases feeding

2-phases EG- with reduction of energy amount

EG : energy

Multiphase feeding

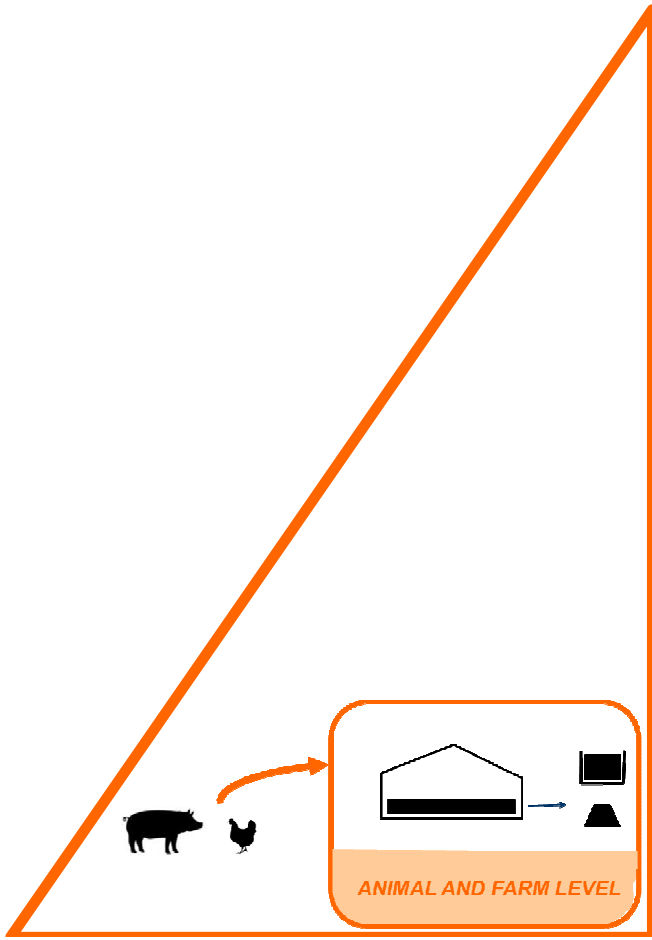
MO : multi-objective formulation

MO

3-phases

3-phases AA+ME- with increase of lysine content and decrease of energy content

AA: amino acid ; ME: Metabolisable energy



Methodology - Different feeding strategies

Fattening period

MO

2-phases feeding

2-phases EG- with reduction of energy amount
EG : energy

Multiphase feeding

MO : multi-objective formulation

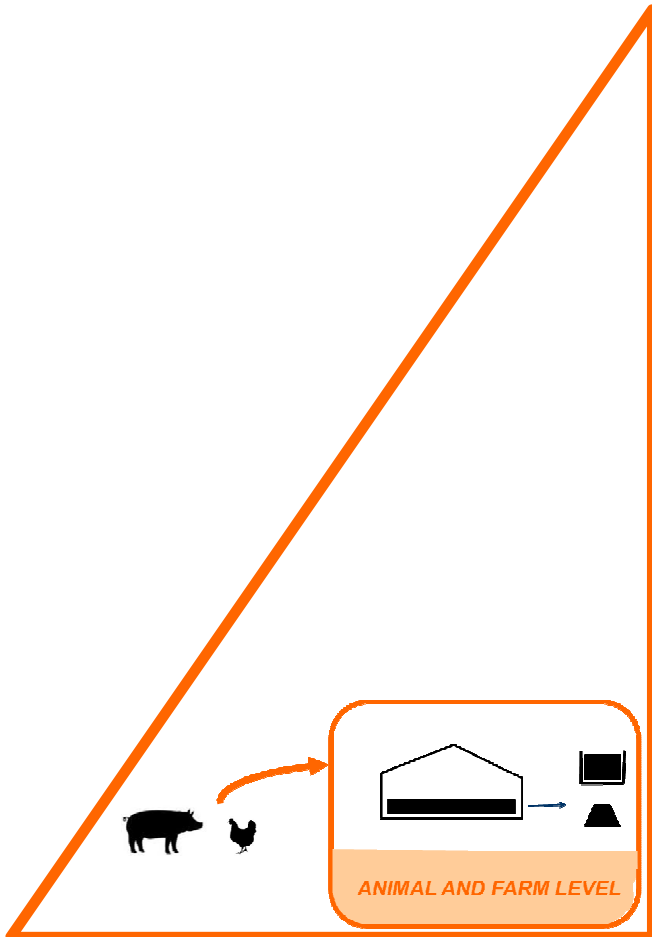
Feed level (/t)	2-phases feeding	2-phases EG- with reduction of energy amount	Multiphase feeding
Feed impacts	↘	↘↘	↘
Protein content	-	-	↘

MO

3-phases

3-phases AA+ME- with increase of lysine content and decrease of energy content
AA: amino acid ; ME: Metabolisable energy

Feed level (/t)	3-phases	3-phases AA+ME- with increase of lysine content and decrease of energy content
Feed impacts	↘	↘
Protein content	-	↗



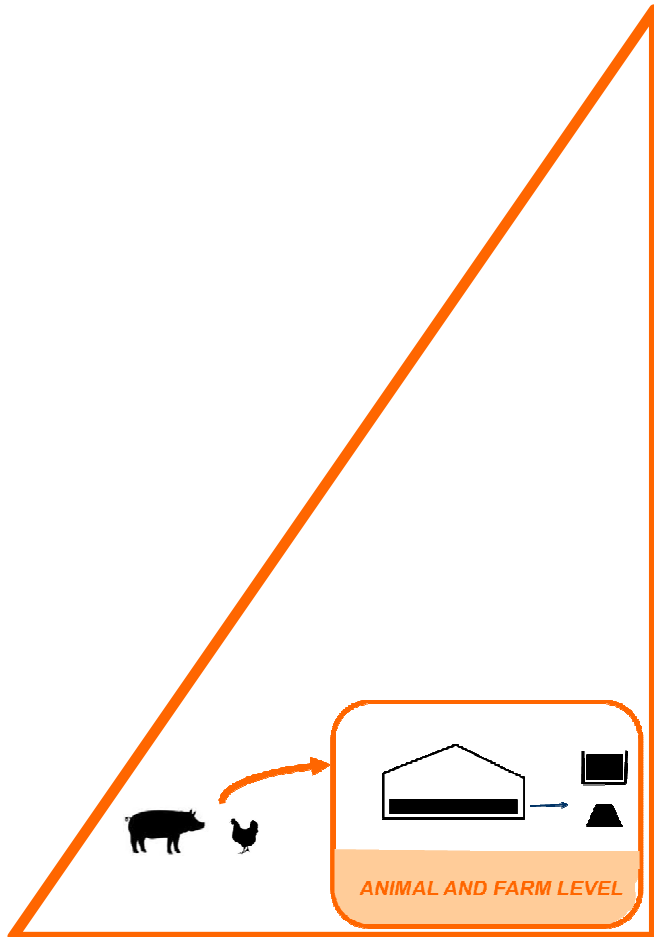
Methodology - Different feeding strategies

Fattening period

MO : multi-objective formulation

		2-phases feeding	2-phases EG- with reduction of energy amount (EG : energy)	Multiphase feeding
Feed level (/t)	Feed impacts	↘	↘↘	↘
	Protein content	-	-	↘
Farm level	Animal product impacts	↘		
	Feed conversion ratio	-		
	N excretion	-		

		3-phases	3-phases AA+ME- with increase of lysine content and decrease of energy content (AA: amino acid ; ME: Metabolisable energy)
Feed level (/t)	Feed impacts	↘	↘
	Protein content	-	↗
Farm level	Animal product impacts	↘	
	Feed conversion ratio	-	
	N excretion	-	



Methodology - Different feeding strategies

Fattening period

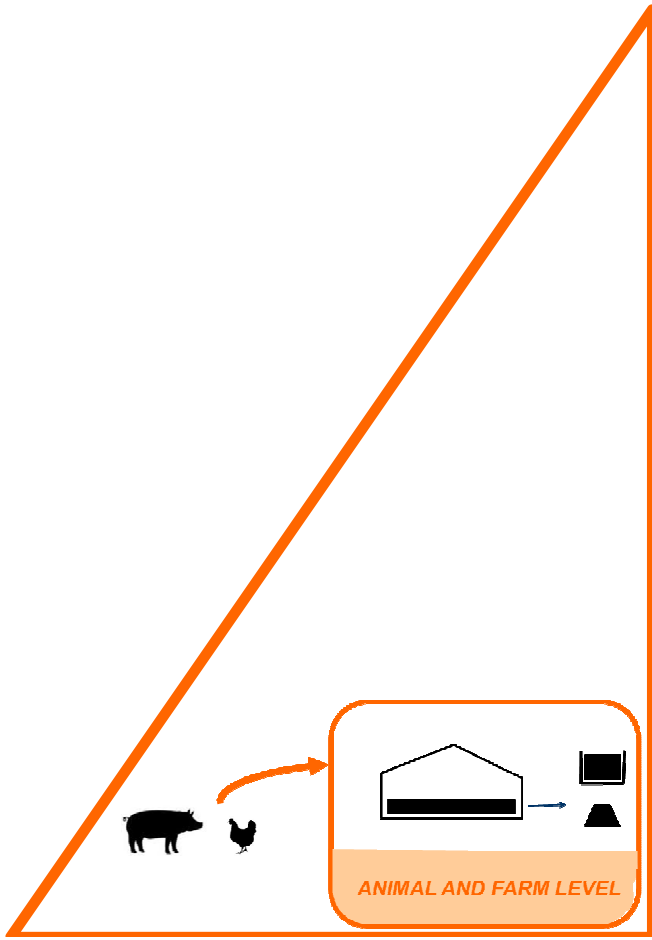
MO

		2-phases feeding	2-phases EG- with reduction of energy amount EG : energy	Multiphase feeding
Feed level (/t)	Feed impacts	↘	↘↘	↘
	Protein content	-	-	↘
Farm level	Animal product impacts	↘	?	?
	Feed conversion ratio	-	↗	?
	N excretion	-	↗	↘

MO

		3-phases	3-phases AA+ME- with increase of lysine content and decrease of energy content AA: amino acid ; ME: Metabolisable energy
Feed level (/t)	Feed impacts	↘	↘
	Protein content	-	↗
Farm level	Animal product impacts	↘	?
	Feed conversion ratio	-	↘
	N excretion	-	?

MO : multi-objective formulation



Methodology - Different feeding strategies

Fattening period

LC / M

2-phases feeding = REFERENCE

2-phases EG- with reduction of energy amount
EG : energy

Multiphase feeding

MO : multi-objective formulation
LC : Least cost formulation

		2-phases feeding	2-phases EG-	Multiphase feeding
Feed level (/t)	Feed impacts	↘	↘↘	↘
	Protein content	-	-	↘
Farm level	Animal product impacts	↘	?	?
	Feed conversion ratio	-	↗	?
	N excretion	-	↗	↘

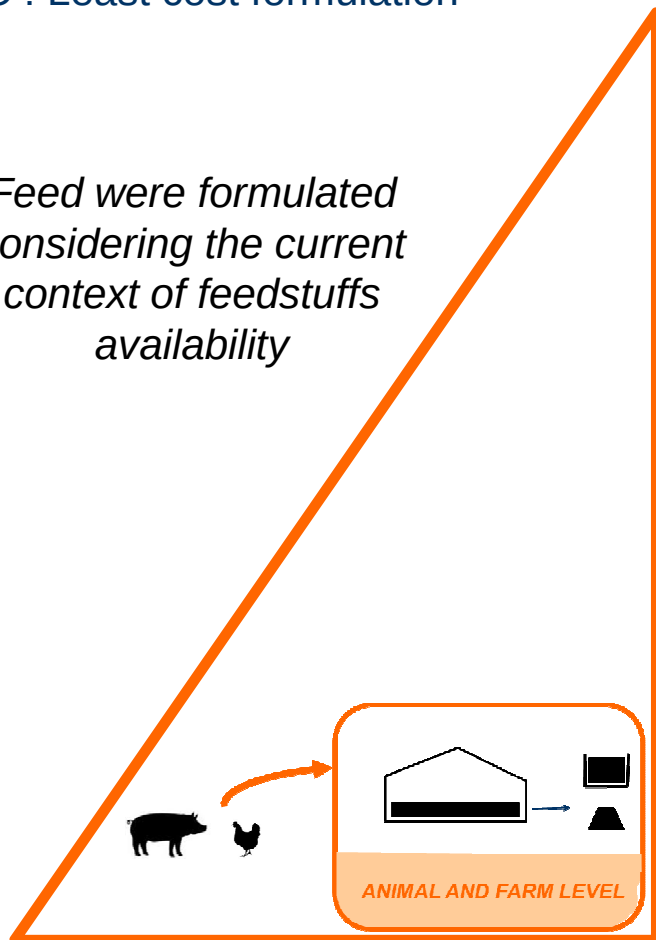
LC / M

3-phases = REFERENCE

3-phases AA+ME- with increase of lysine content and decrease of energy content
AA: amino acid ; ME: Metabolisable energy

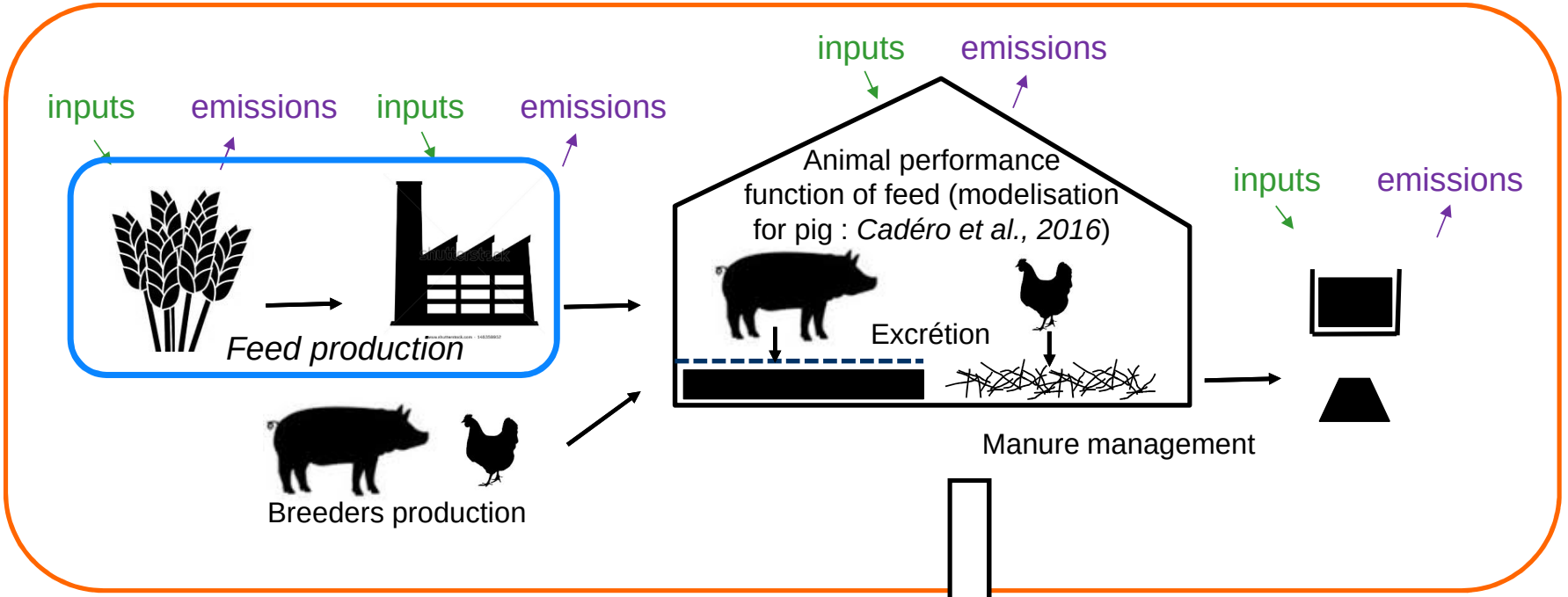
		3-phases	3-phases AA+ME-
Feed level (/t)	Feed impacts	↘	↘
	Protein content	-	↗
Farm level	Animal product impacts	↘	?
	Feed conversion ratio	-	↘
	N excretion	-	?

Feed were formulated considering the current context of feedstuffs availability



Methodology - Different feeding strategies

LCA perimeter

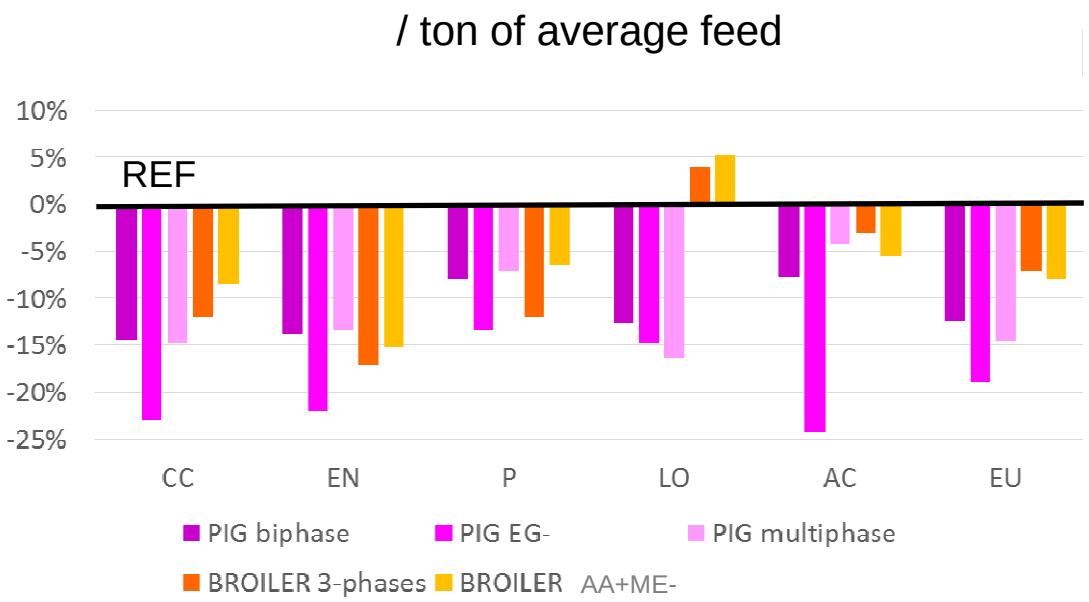


Animal products

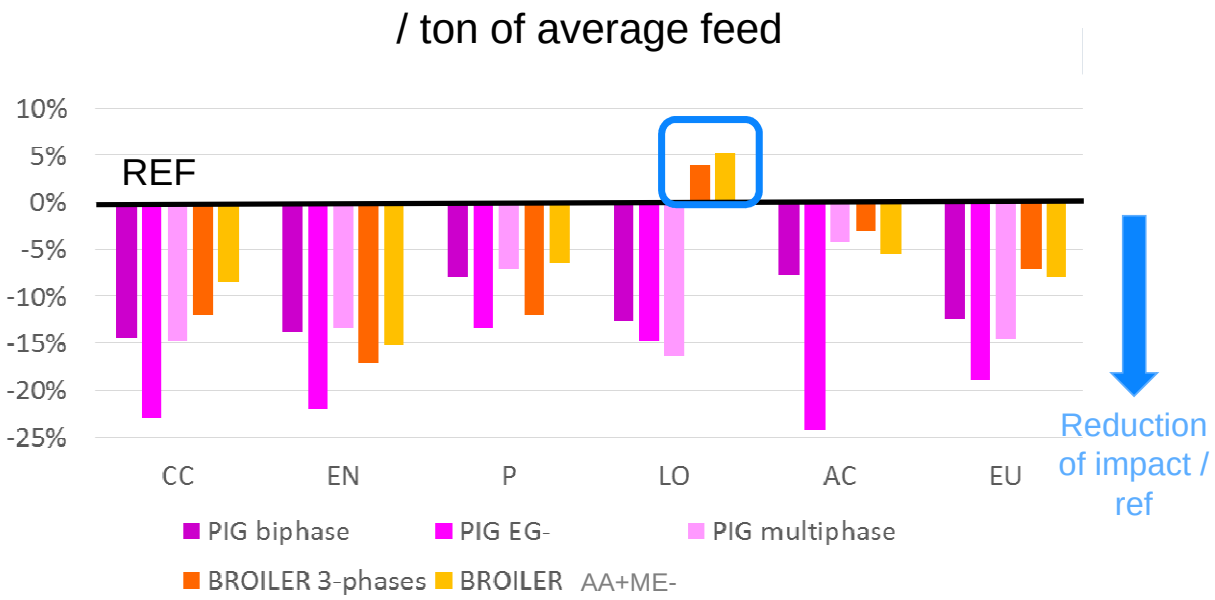
LCA impacts / kg live weight

Climate change / Energy consumption / Phosphorus consumption / Land occupation / Eutrophication / Acidification

LCA impacts / ton of feed

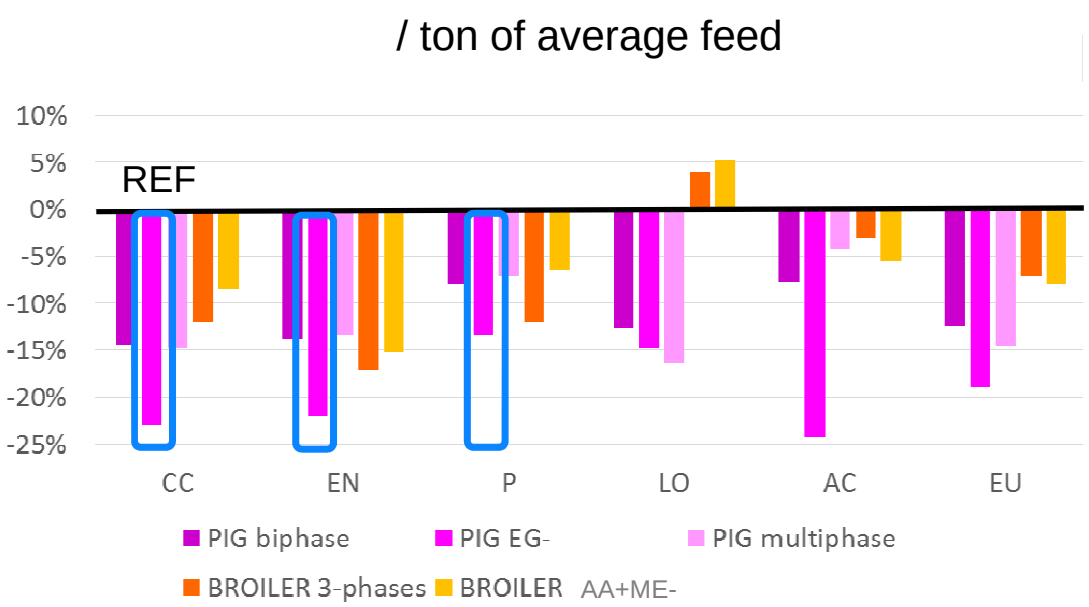


LCA impacts / ton of Eco-feed



- As expected, all Eco-feed have lower environmental impacts compared to the references, except for the impact Land Occupation in case of broiler feed (the interesting feedstuffs for eco-feed have smaller yield)

LCA impacts / ton of feed

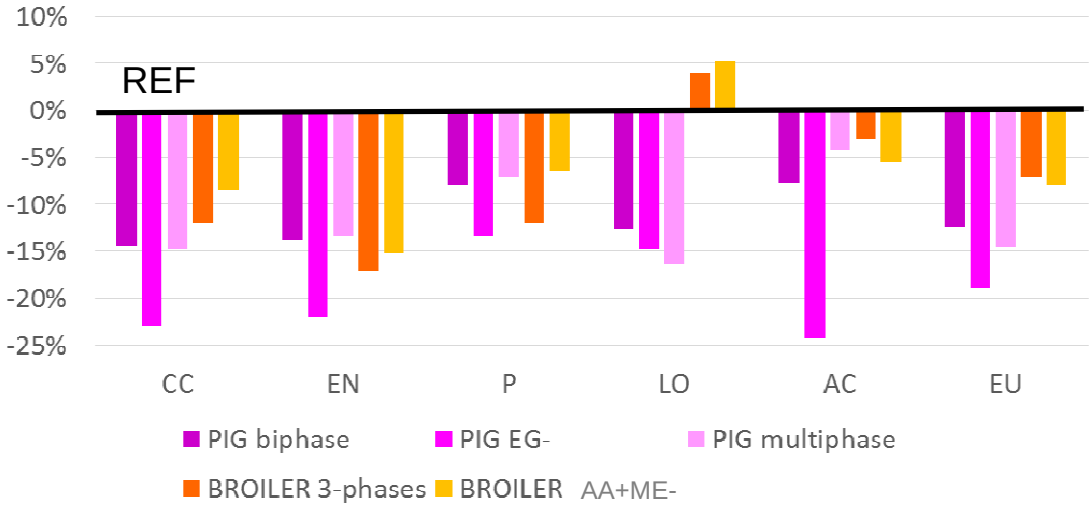


- As expected, all Eco-feed have lower environmental impacts compared to the references, except for the impact Land Occupation for broiler feed (the interesting feedstuffs for eco-feed have smaller yield)

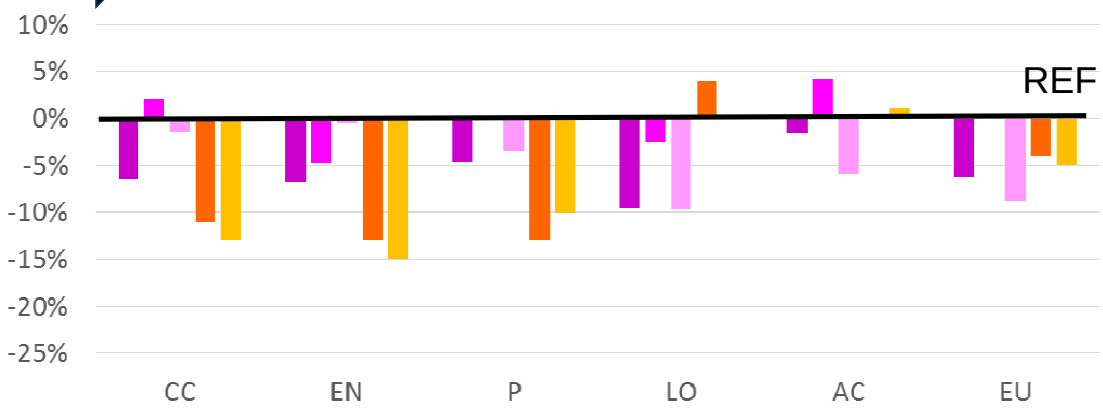
- The main impact reductions were obtained for the fattening feed of pig with lower energy content => less formulation constraints

LCA impacts / kg of animal product

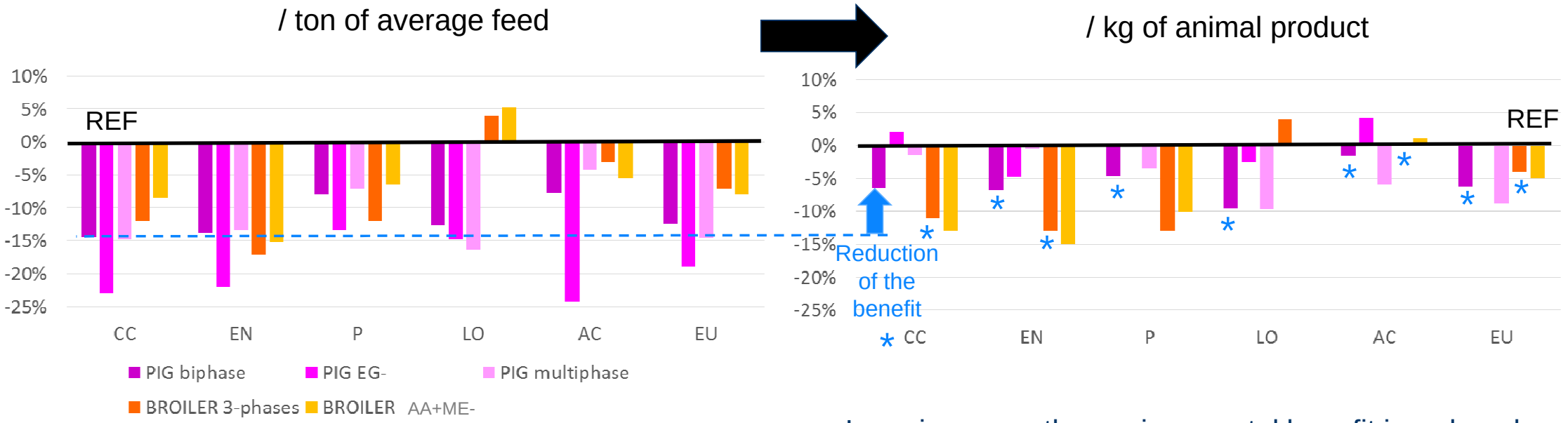
/ ton of average feed



/ kg of animal product

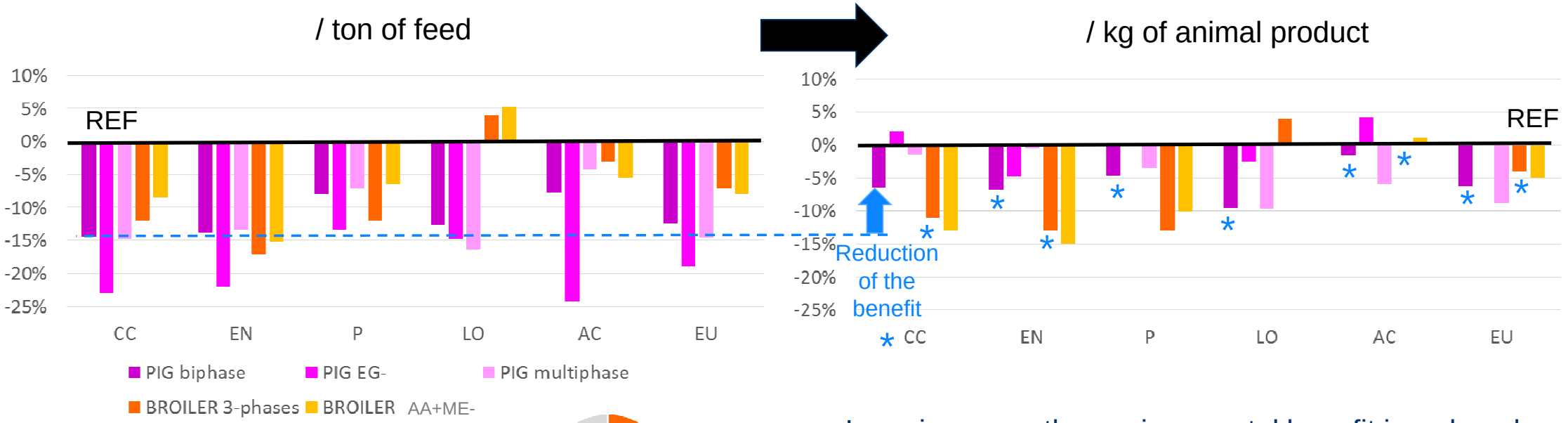


LCA impacts / kg of animal product



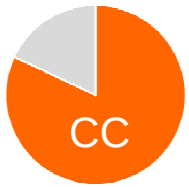
- In main cases, the environmental benefit is reduced at product level: more in pig situation than in broiler situation

LCA impacts / kg of animal product



Part of feed of LCA impact / kg of animal product

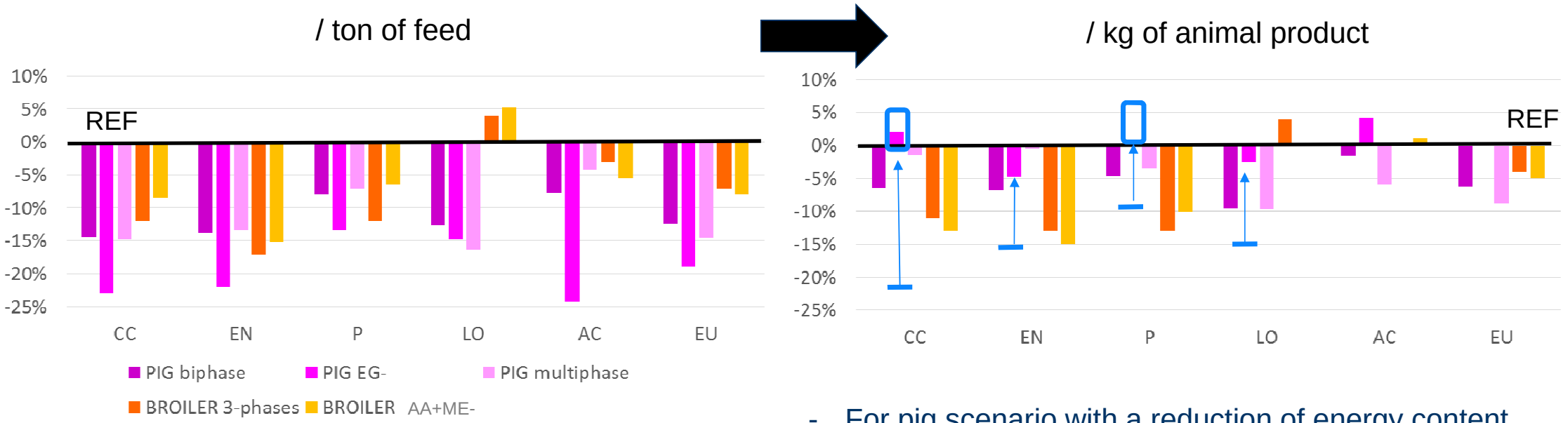
broiler



pig

- In main cases, the environmental benefit is reduced at product level: more in pig siutation than in broiler situation
  => importance of the feed in the life cycle
  => for pig only MOF for growing-finishing feeds (60% of the global tonnage)

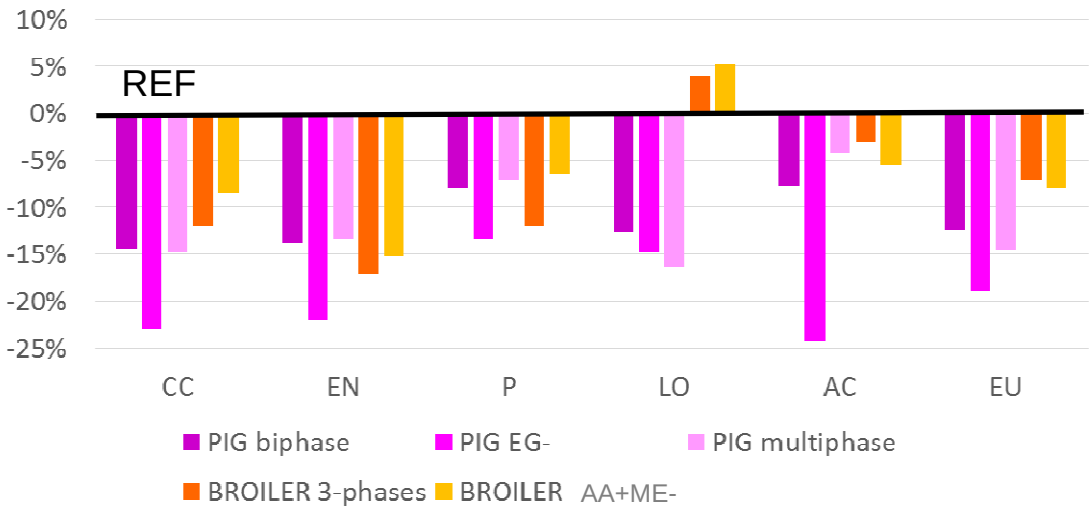
LCA impacts / kg of animal product



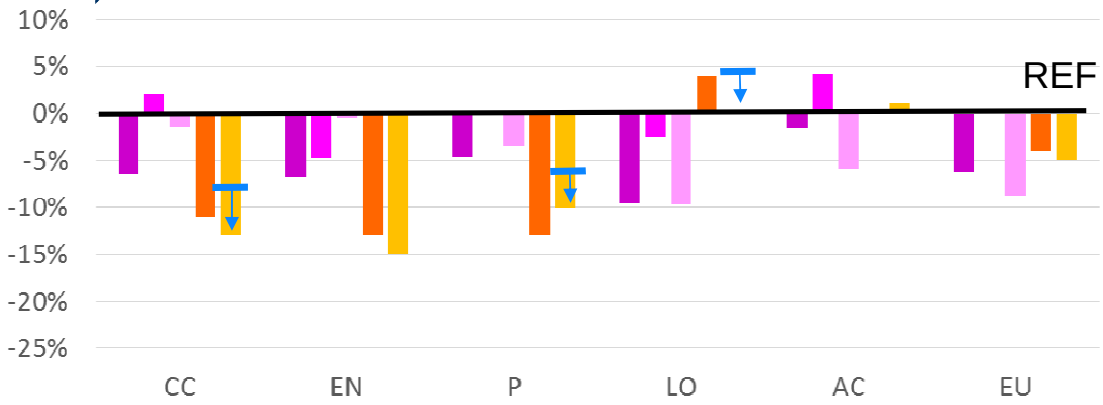
- For pig scenario with a reduction of energy content, the benefit is strongly reduced or totally lost at product level because of adverse effect on animal performance (increase of FCR).

LCA impacts / kg of animal product

/ ton of feed

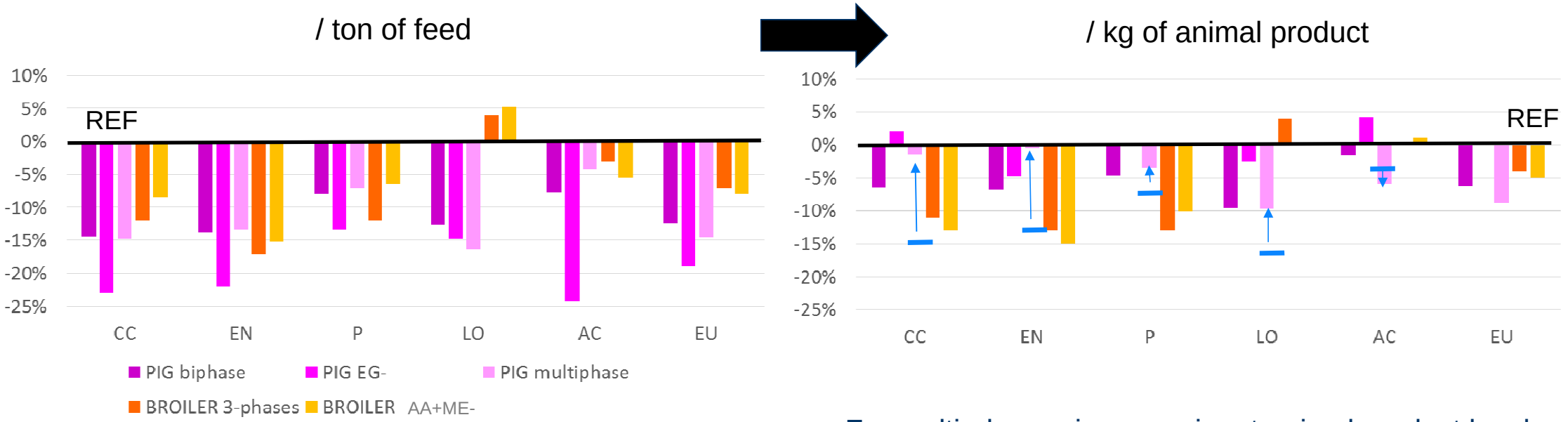


/ kg of animal product



- For pig scenario with a reduction of energy content, the benefit is totally lost at product level because of adverse effect on animal performance (increase of FCR).
- On the opposite, for the BROILER AA+ME- scenario, there is an additionnal positive effect at animal product level due to improvement of animal performance

LCA impacts / kg of animal product



- For multi-phase pig scenario, at animal product level
  - Reduction of the benefit because of a slight degradation of animal performances
  - The benefit is more preserved for EU and enhanced for AC (not included in MOF) because of a reduction of protein content of the feeds in this strategy

Conclusion

- **Eco-feeds allow the reduction of environmental impacts of animal products**
  - Moderate reduction for pig production in the current context of availability for feedstuffs (-6% for 2-phases strategy and climate change) => *possible improvement by including sows and piglets in Eco-feed feeding strategies*
  - Higher benefit for broiler production (-13% for climate change)
- **With synergies or compensations when switching from feed to product level : important criteria**
  - Nutritional quality => animal performance

    Win-Win situation when the feeding strategies improve the animal perfomance : broiler strategy AA+ME-

    Reduction or cancellation of the environmental benefit when the feeding strategy degrade the animal performance (even if the benefit is higher at feed level) : case of pig strategy EG-
  - Dietary protein content

    For strategies dedicated to the reduction of N excretions (pig strategy multiphase), the benefit is mainly on the acidification impact because of the reduction of nitrogen excretion (no link with eco-feed). The other impacts could be not improved at product level because of a degradation of the animal performance
  - Part of feed in impacts : the higher the part is, the more the benefit are preserved between feed and animal levels.
- **Necessity to optimize FS globally including the feed production, the animal performance and the manure management**

Efficiency

Feed conversion ratio

- At animal level

  When FCR is improved (with the same protein content), the excretion is reduced and all the gaseous emissions also. The cost is also reduced.

- At life cycle level

  When the FCR is improved, all the impacts of animal product decrease (LCA / kg of animal product)

  LCA / kg of product could be seen as a methodology which assesses efficiency. But all the important aspects of environment are not included (soil quality, biodiversity, pressure/ha). Other criteria must be considered in environmental assessment.

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Thank you for your attention!

Any questions?

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