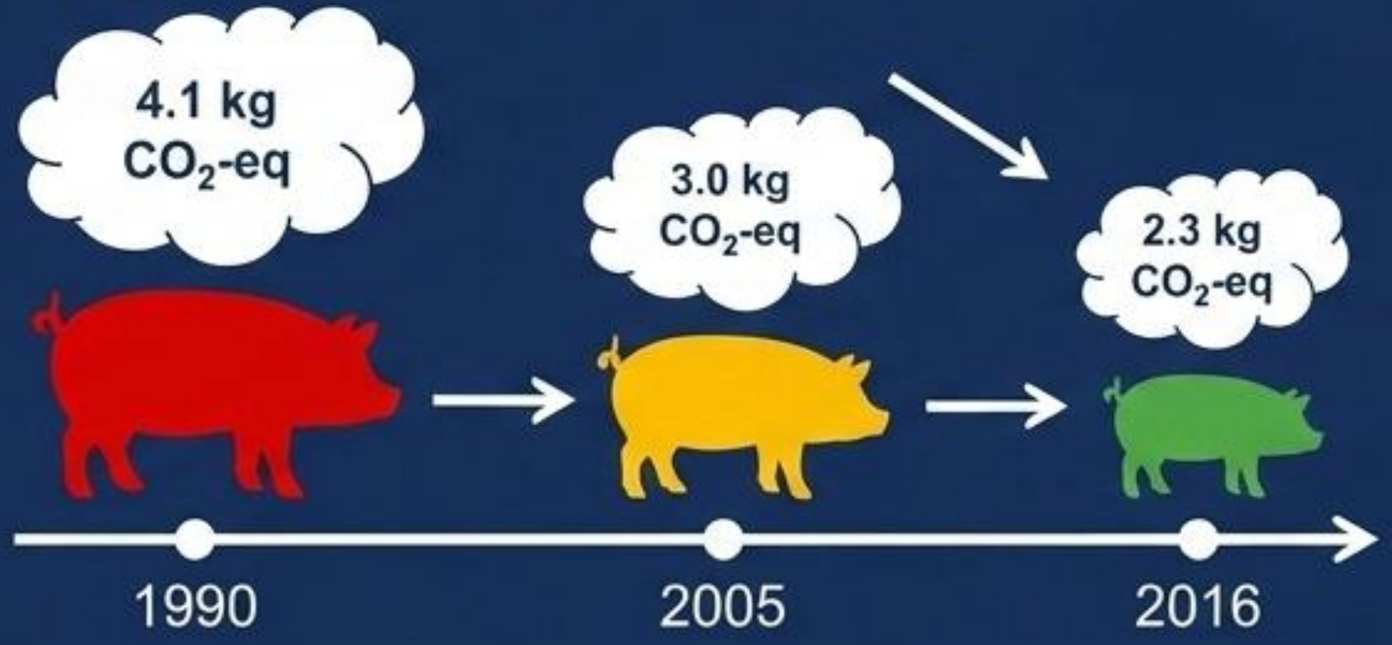
Precision Biology: Using Feed Additives to Enable Lower Nitrogen and Phosphorus Excretion

Unlocking EU Food Security and Climate Goals through Monogastric Nutrition

Climate Footprint per kg Danish Pig
(Birth to Slaughter)



Jan Værum Nørgaard

Professor in Sustainable Pig Production / Head of Monogastric Nutrition

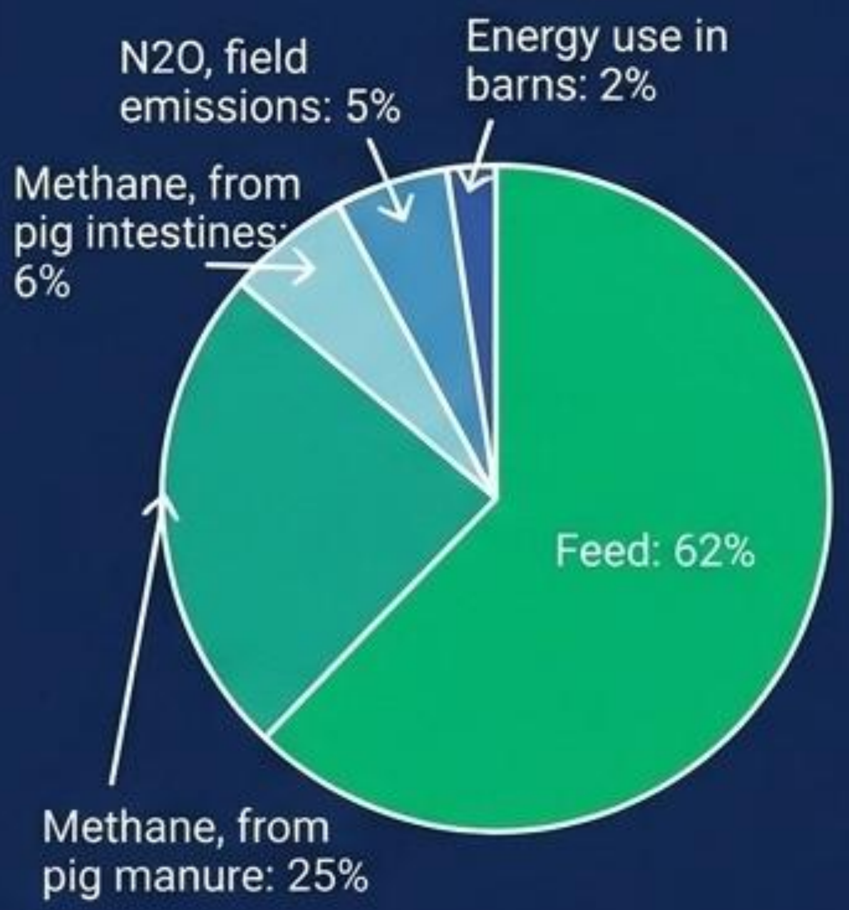
Dept. of Animal and Veterinary Sciences, Aarhus University, Denmark

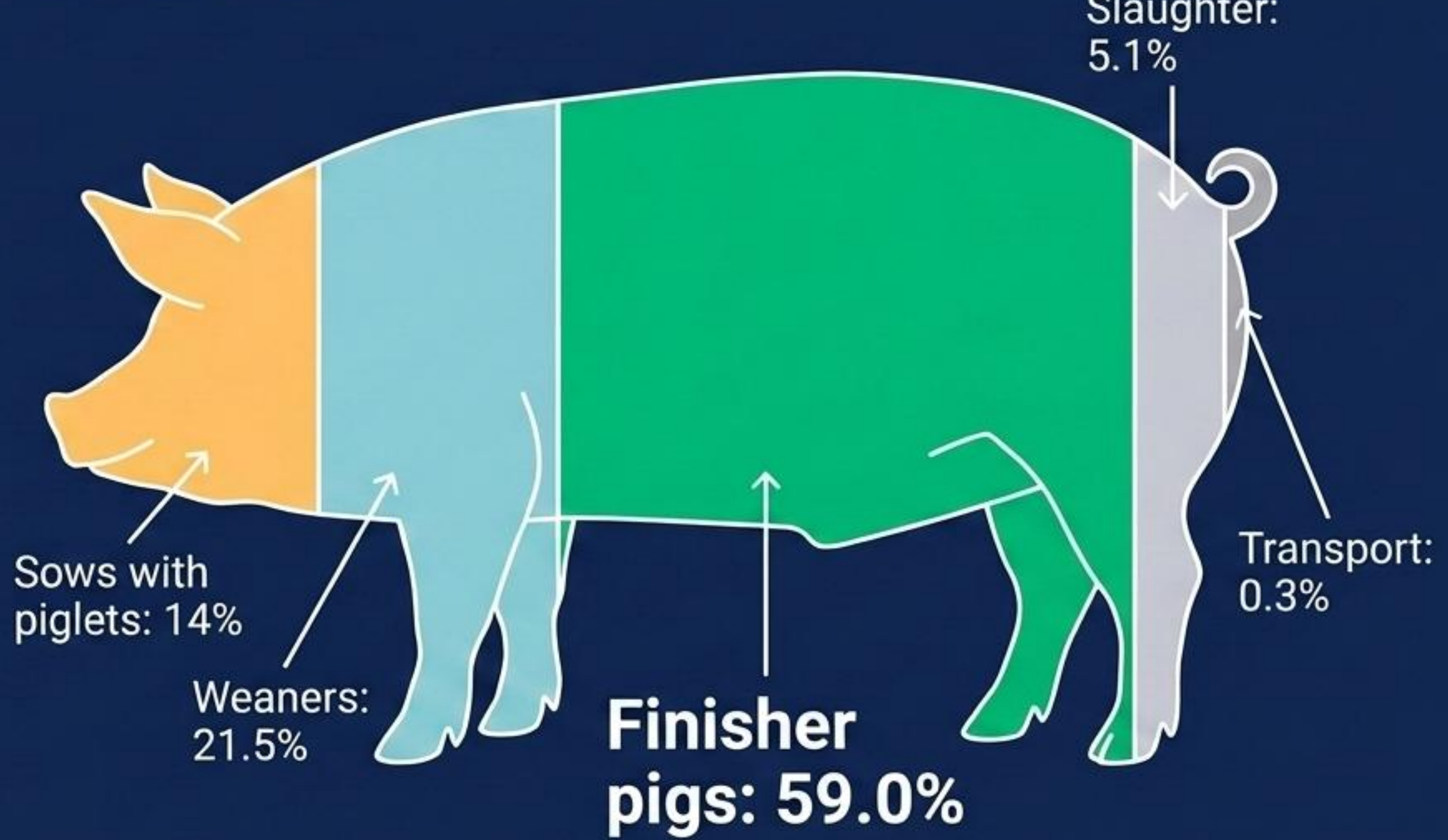
AARHUS UNIVERSITY

Sustainable Livestock Intergroup | European Parliament

Feed is the main carbon footprint in monogastric production

Climate Footprint Contribution by Source





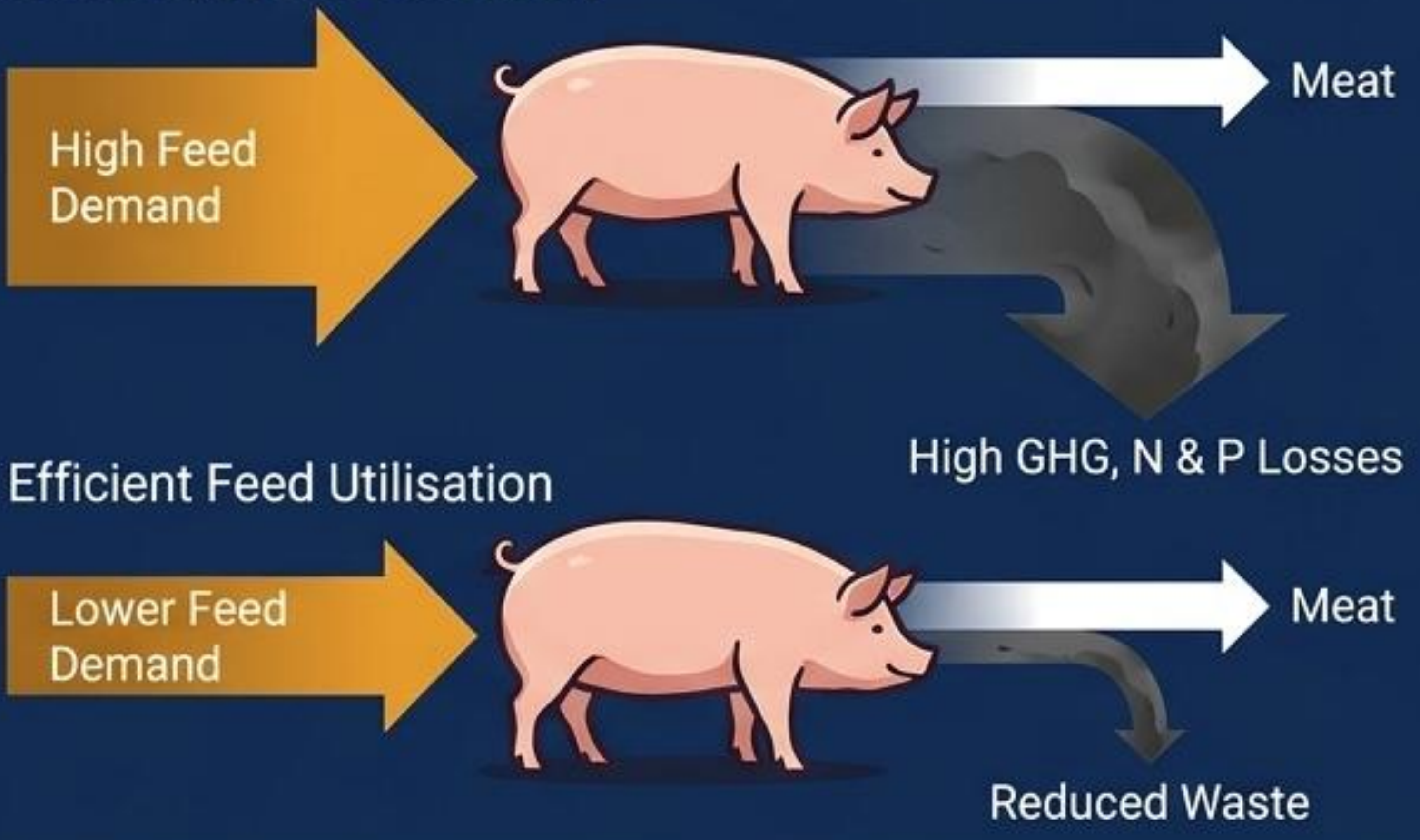
Note: Data represents the climate footprint of a pig from birth to slaughter at 115 kg live weight.

Feed utilisation is a key environmental driver

It's not only what we feed, but how efficiently animals use it. FCR integrates growth, health, digestion, and nutrient use.

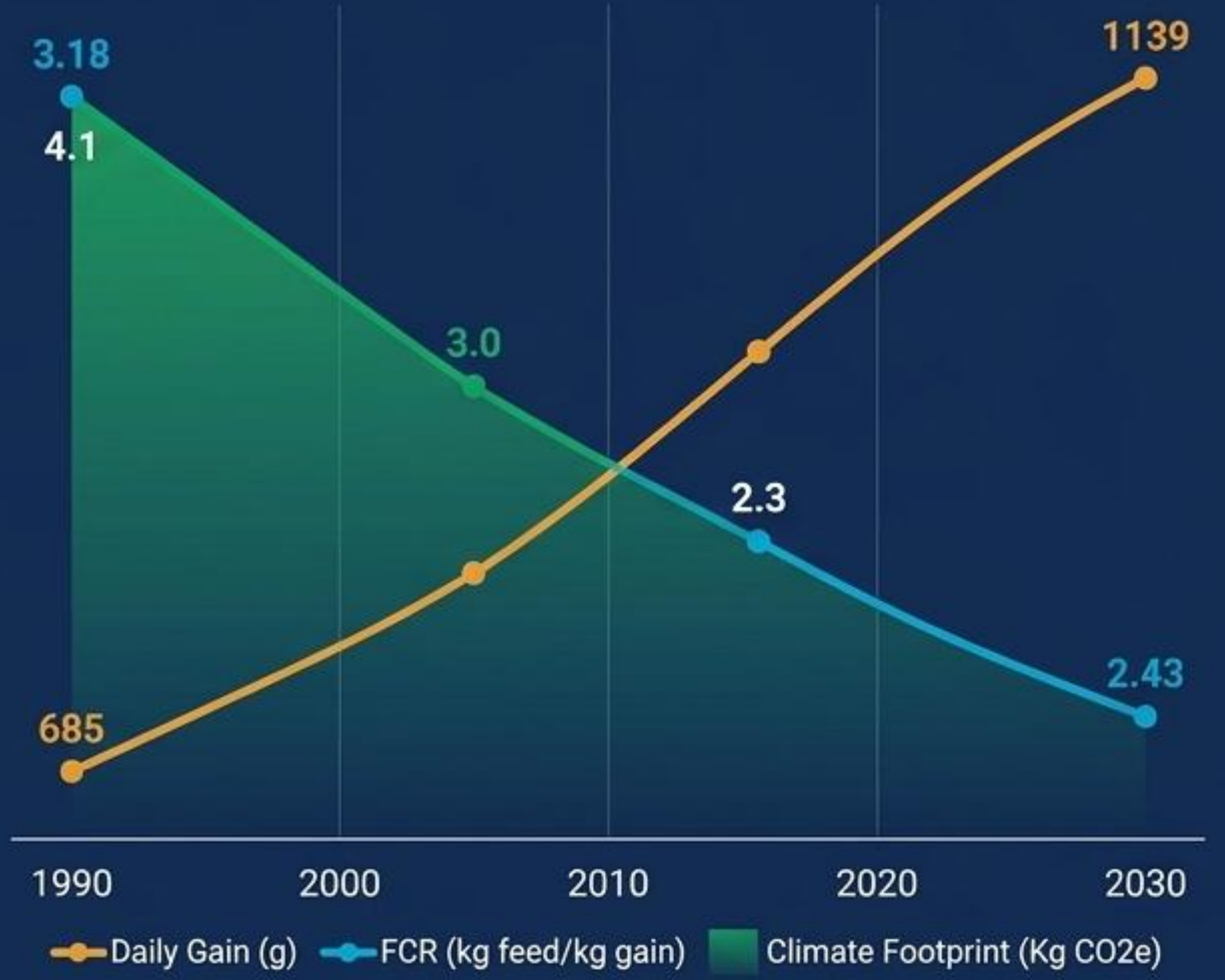
Sankey Mechanism

Inefficient Feed Utilisation



1. Poor feed utilisation → higher feed demand.
2. Higher feed demand → higher GHG, N & P losses.

X-Graph Synthesis

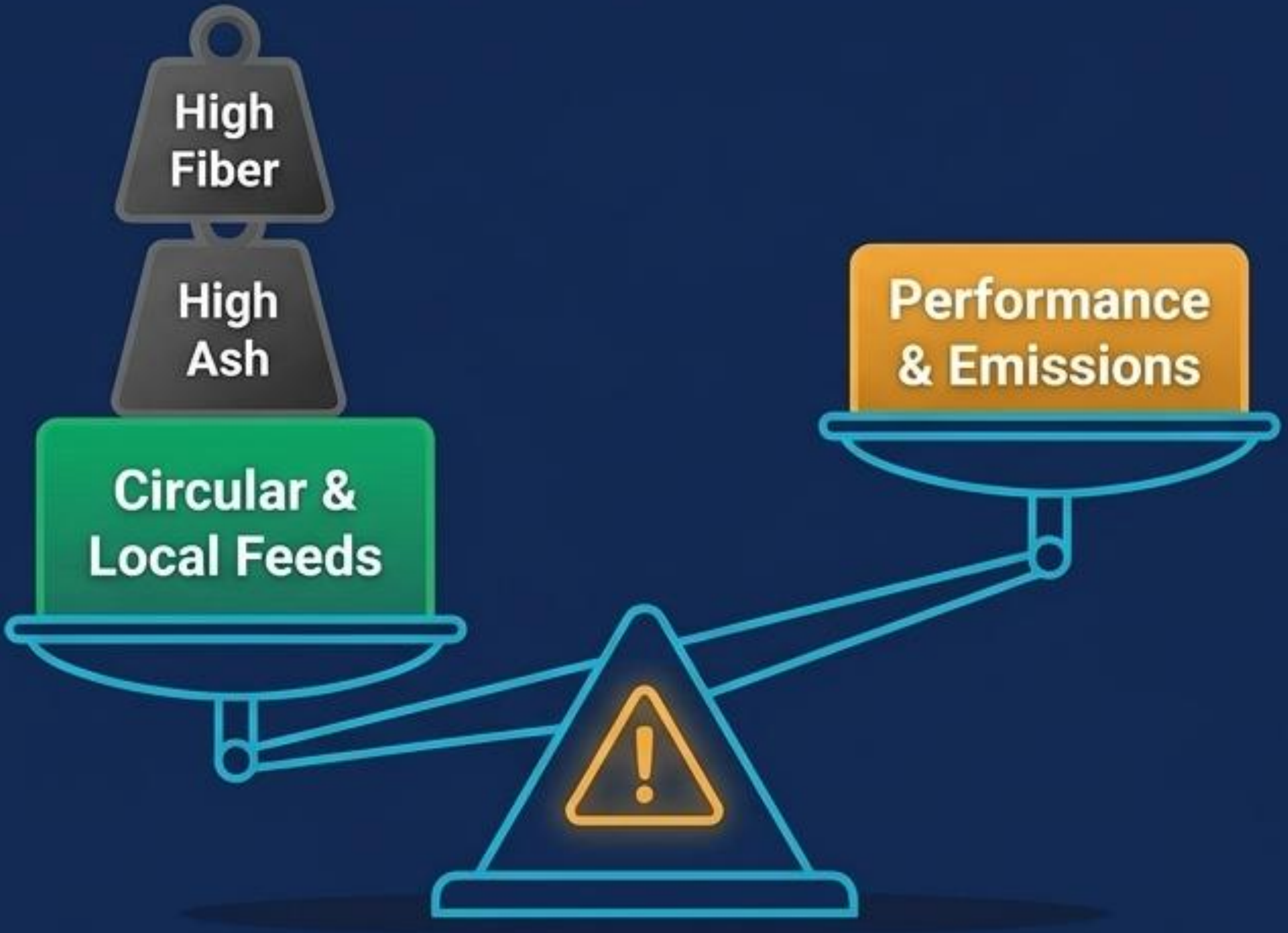


Sustainable feedstuffs can challenge FCR

More sustainable feedstuffs often **reduce performance** if not managed. Lower-carbon ingredients may reduce feed efficiency if diets are not carefully optimized.

Digestibility Risk

Local or circular feedstuffs often contain more fiber or ash. This reduces digestibility, increases nutrient excretions, and drives up enteric methane emissions.



Nutrient Gap

Circular feeds differ heavily from exact animal requirements, necessitating the supplementation of crystalline amino acids to prevent biological waste.

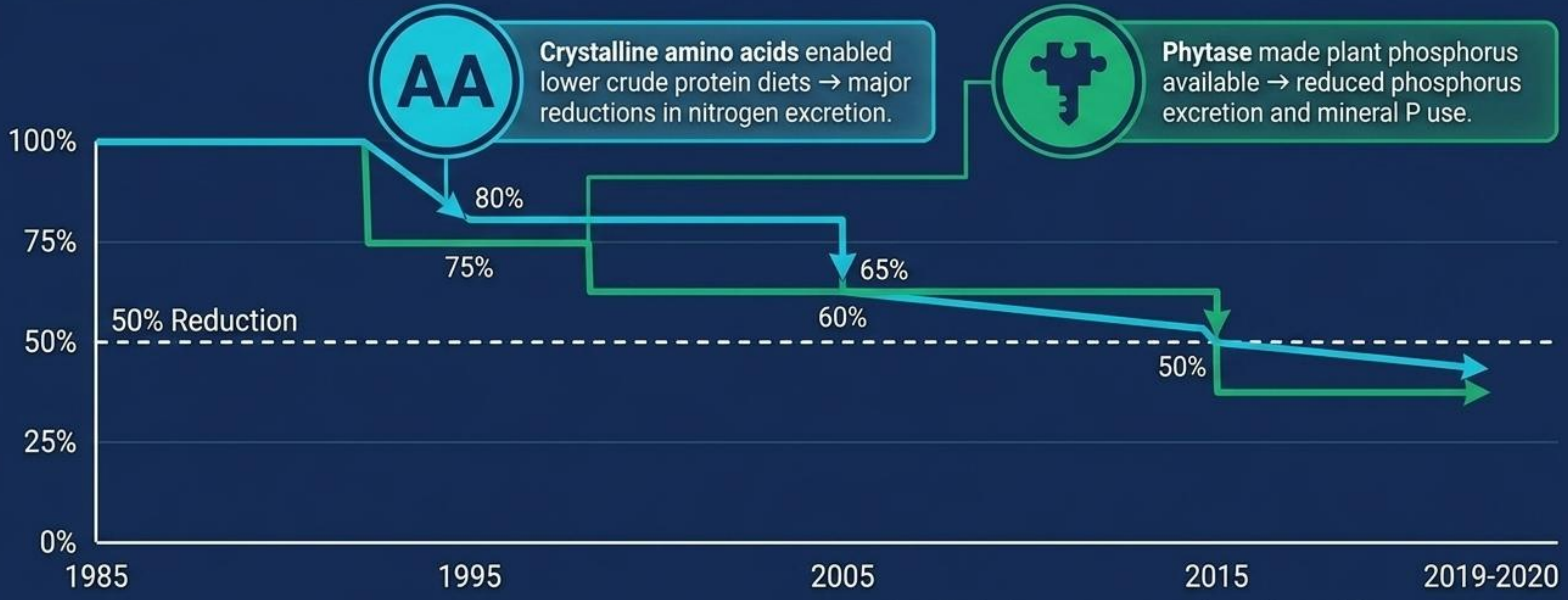
Feed efficiency, sustainability and EU supply security are linked

EU pig production depends on global supply chains. If we want EU self-sufficiency and resilience, we must secure both feed ingredients and the biological tools that allow us to use them efficiently.

1. EU pig production relies heavily on overseas soybean meal.
2. Key feed additives and amino acids are largely produced outside the EU.
3. Without crystalline amino acids, modern pig and poultry feeding is impossible without compromising production, welfare, climate, or environmental impact.

Feed additives have driven major reductions in N and P losses

Over the last decades, amino acids have been the key driver behind nitrogen reductions, and phytase behind phosphorus reductions. These are enabling technologies essential for using sustainable feed ingredients.



Note: This development is ongoing as diets and sustainability requiremen

Crystalline amino acids reduce crude protein and nitrogen losses

Precision matching of **protein supply** to animal requirements reduces the need for excess crude protein, directly lowering nitrogen emissions.

If the 20 amino acids do not have the correct distribution according to the pig's needs, the protein cannot be utilized.

Amino acids allow lower crude protein levels while perfectly meeting requirements.

Less surplus protein = less nitrogen excreted in manure.

Lower N excretion heavily reduces ammonia emissions and environmental nitrogen losses.

Crystalline AA → Lower CP diet → Less surplus amino acids → Lower N excretion to marine waters → Lower N2O emissions

Phytase improves P utilisation and reduces phosphorus excretion

Phytase unlocks phosphorus already present in plant feedstuffs, nearly doubling digestibility and directly reducing both phosphorus excretion and **reliance on imported mineral P**.

Most plant phosphorus is bound as phytate. Phytase increases P digestibility. Lower P excretion reduces the risk of water body pollution and improves animal bone strength.

Phytase Diagnostic Matrix

Rapeseed Cake (Locked P)	Rapeseed Cake + Phytase (Unlocked P)
Intake: 7.77 g/day	Intake: 7.60 g/day
Feces/Excretion: 5.47 g/day	Feces/Excretion: 3.61 g/day
Urine: 0.03 g/day	Urine: 0.87 g/day
Absorption: 2.28 g/day	Absorption: 3.97 g/day
Retention: 2.18 g/day	Retention: 3.05 g/day
Digestibility of P: 29.1%	**Digestibility of P: 53.2%**

Feed additives support efficiency, health and sustainability

Beyond amino acids and phytase, a broad ecosystem of feed additives routinely stabilizes digestion, improves nutrient utilization, and enables the use of diverse, local feedstuffs.

Enzymes

(e.g., carbohydrases): Improve the utilization of high-fiber and local circular feedstuffs.

Organic Acids

Support gut health, function, and pathogen control.

Efficiency, Health & Sustainability

Functional Ingredients

(Bacteria, yeast, fiber products): Stabilize digestion, secure gut health, and drive performance.

Mineral & Vitamin Optimization

Supports precision nutrition and drastically reduces excesses in excretion.

BIOFED – science-based development of future feed additives

BIOFED ensures Europe has the scientific foundation to develop the next generation of feed additives required for uncompromising, sustainable pig production.

- Develops new feed additives to improve feed efficiency in finisher pigs.
- Combines precision phenotyping and advanced omics to identify valid biological targets.
- Focuses on early-stage research to uncover the biological mechanisms behind feed efficiency.
- Lays the foundation for future commercial additives strictly aligned with EU sustainability goals.

TRL 1 → 3 (Early-Stage Scientific Credibility)

Biology
WP1 - Precision phenotyping (growth, intake, behaviour)

Targets
WP2 - Omics & pathway analysis (blood and tissues)

Concepts
WP3 - Target identification & validation

Future Additives
WP4 - Feasibility & commercialization strategy (Stop/Go)

Precision nutrition is the prerequisite for sustainable livestock policy

To deploy circular feeds and achieve our climate goals, we must empower the biological efficiency of the animal. Feed additives are not optional supplements—they are the enabling technologies of European food sovereignty.

Jan Værum Nørgaard

Professor in Sustainable Pig Production
Head of Monogastric Nutrition

Dept. of Animal and Veterinary Sciences, Aarhus University, Denmark

JanVNoergaard@anivet.au.dk

Link: BIOFED / Sustainable Livestock Intergroup resources