Field Trip Animal Nutrition

Leveraging the sustainable food chain as growth driver

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EVONIK INDUSTRIES

What if…

… the world's population grows by 83 million every year and the planet's resources remain the same?

>9 billion people need healthy and affordable food with scarcer land and water resources by 2050

Population growth

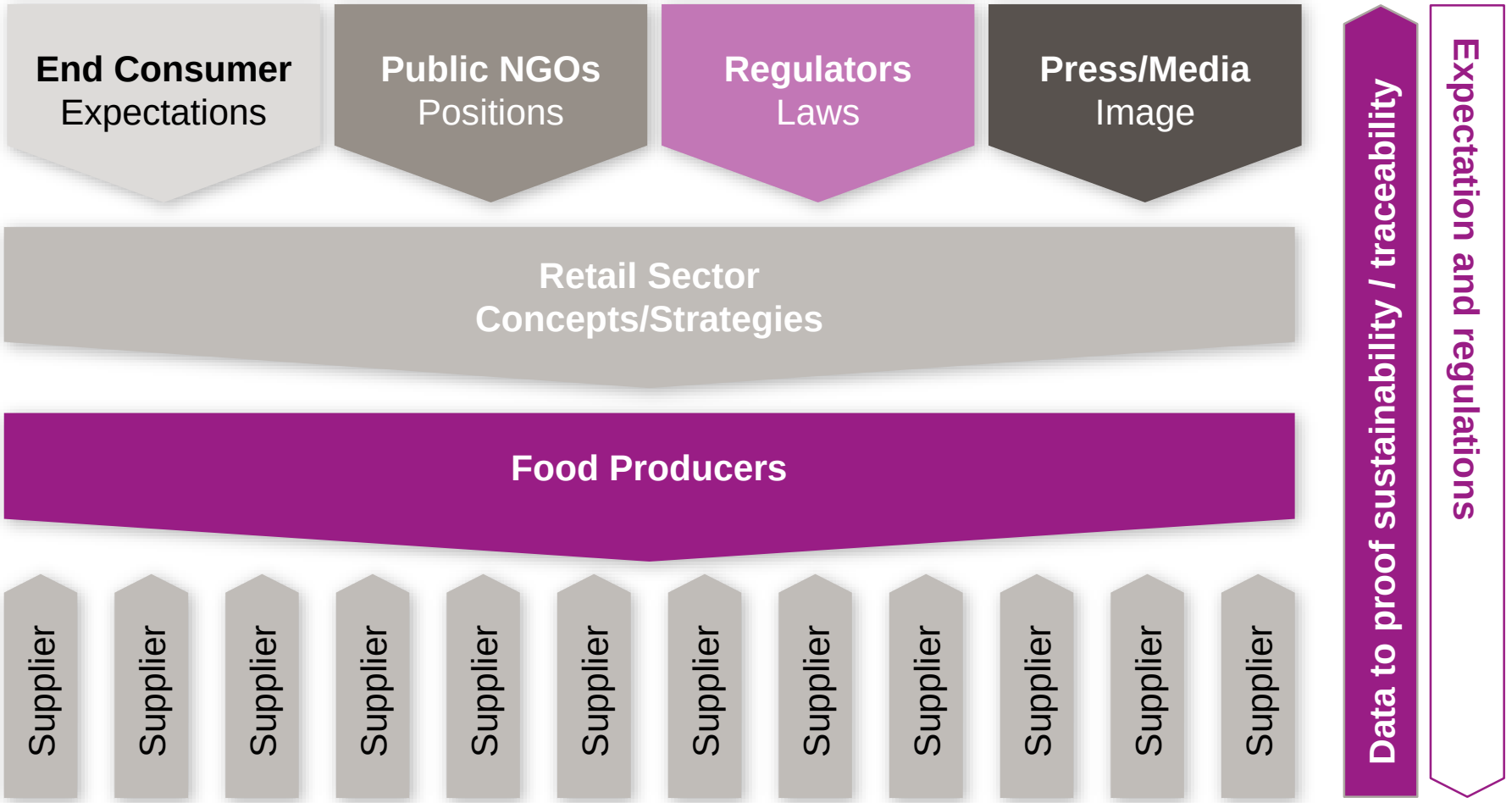
Available income for food

Resource efficiency, less landscape

Reduce ecological footprint

Higher consumption of animal protein sources, i.e. meat, eggs, milk and fish

This creates a major challenge and pressure in feed-to-food chain on food producers



Example retailers and NGOs: Clear expectations and various sustainability initiatives

Sustainability Initiatives in the Feed to Food Chain

- Casino Group Carbon Index (France)
- Tesco Carbon footprint (UK)
- REWE Pro Planet (Germany)
- Frosta Product Carbon Footprint (Germany, but supply chain from South Asia)
- Edeka and WWF Cooperation (Germany)
- Findus Group (Scandinavia)
- CP (Thailand)
- Walmart (USA)
- Tyson (USA)
- McDonald's
- Nutreco
- Cargill

Nutritional sustainability as answer to challenges in the food system

"Nutritional sustainability is the ability of a food system to **provide sufficient energy and the amounts of essential nutrients required** to maintain good health of the population **without compromising the ability of future generations** to meet their nutritional needs."

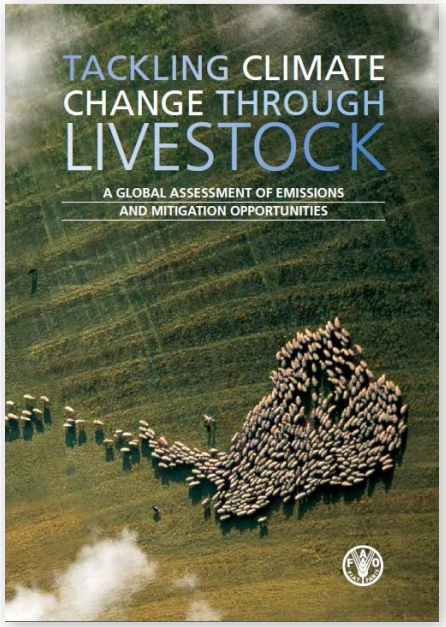
Journal of Animal Science Accepted paper, December 2015

"**Feed additives (…) play an essential role** in improving animal performance and animal health."

LEAP 2015*

United Nations / FAO Report on Climate change

- Improving production efficiency
- Improving breeding and animal health
- Using manure management practices to recycle and recover nutrients and energy contained in manure
- Sourcing low emission inputs such as feed
- **Use of modern feed additives like amino acids, enzymes and gut modulating products**



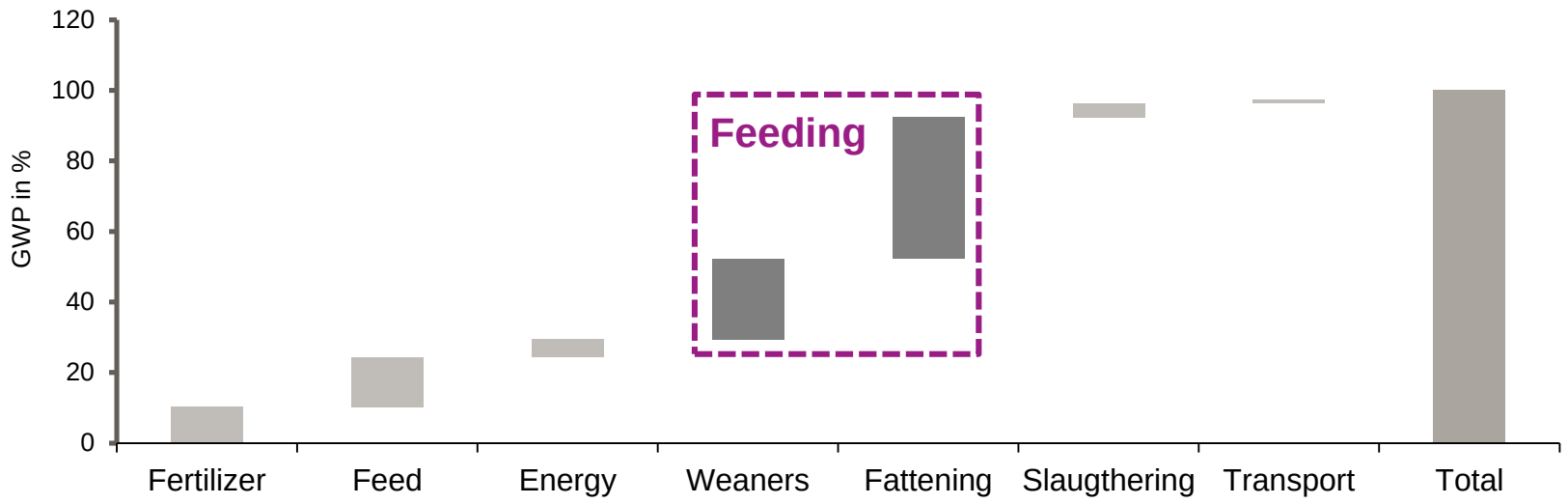
* Source LEAP, 2015. Environmental performance of animal feeds supply chains: Guidelines for assessment. Livestock Environmental Assessment and Performance Partnership. FAO, Rome, Italy

Challenge accepted

Evonik produces all four of the amino acids essential for resource-efficient animal feed.

Biggest environmental impact of meat production originates from feeding

Global Warming Potential (GWP) of Meat Production Components



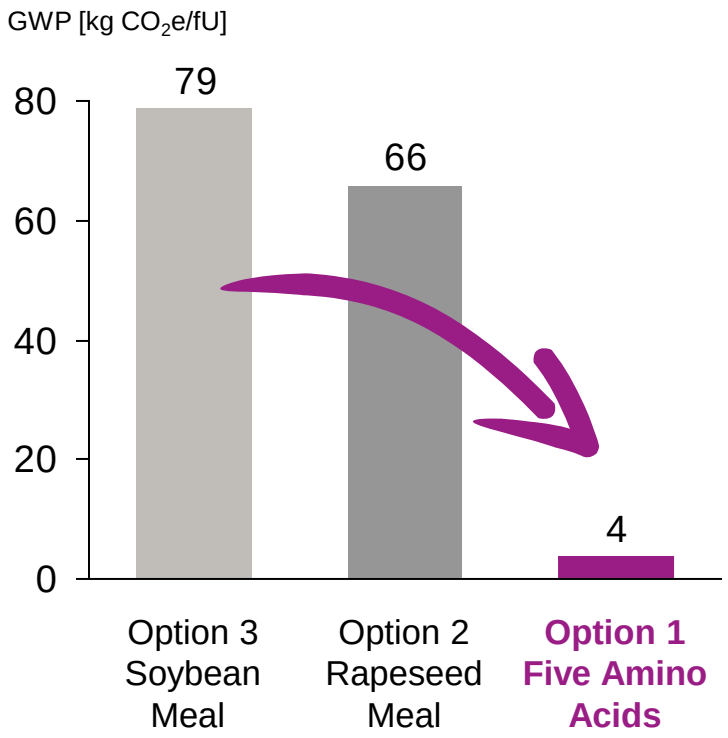
The highest contribution to the environmental burden of meat production originates from feeding the pigs on the farm

(GW global warming, EU eutrophication, AC Acidification)

Source: The environmental impact of pork production from a life cycle perspective, University of Aarhus Faculty of Agricultural Sciences Department of Agroecology and Environment, 2007

Amino acids greatly reduce the environmental impact of livestock due to low protein diets

Global warming potential of swine production



The intelligent combination of amino acids is key for economic, ecological and sustainable animal production

Example Methionine: Substantial benefit on resource consumption and emissions

With 1 kg of DL-Methionine, up to 260 kg of soybean meal can be replaced in feed.

The use of 100,000 t DL-Methionine[1] means:

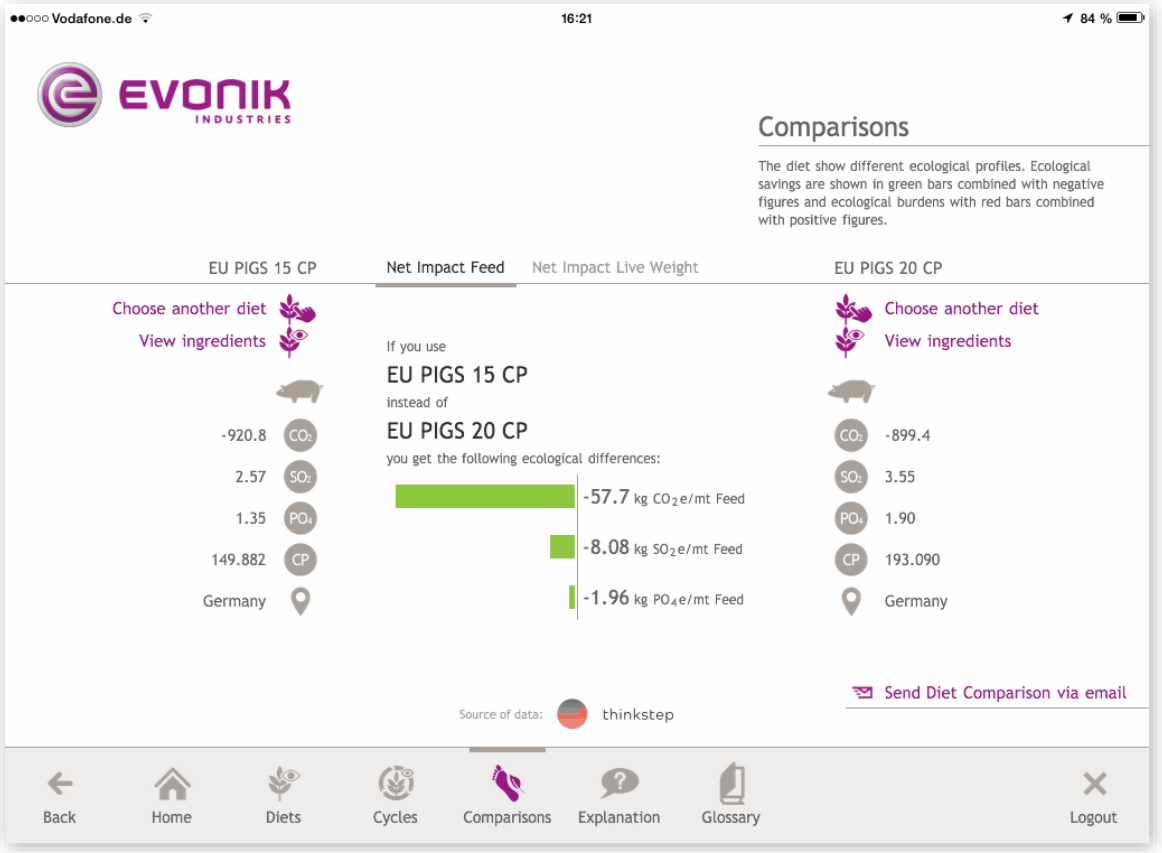
– 1,000,000 t	Less consumption of resources (**crude oil equivalents**)
– 790,000 t	Reduced nitrates (**NO_3 emissions**) into ground waters
– 800,000 t	Reduced ammonia (**NH_3 emissions**) into the air

[1] The calculation is based on the "Ökobilanz –Methionin 2003" – 1 kg of DL-methionine replaces 260 kg soybean meal.

Our Service Tool: AMINOFootprint®

Realize your sustainability potential!

AMINOFootprint® supports the fact-based decision making on ecological performance

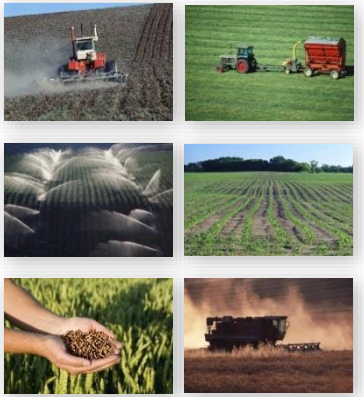


Data to proof sustainability / traceability

With AMINOFootprint® 2.0 it is possible to compare diets as well as feeding cycles with each other and choose the ecologically most friendly solution

AMINOFootprint®: The scientific backbone

Certified Input
All processing steps are included



Certified data
For all feed ingredients

Certified Information
Sound decision

GWP CO_2

SO_2 Acidification

Eutrophication PO_4^{3-}

Values of AMINOFootprint® 2.0
One solution, multiple benefits

- Certified results
- Live weight calculations
- Differentiation
- One-to-one use in further processing steps
- Easy-to-use software

The steps towards a sustainable diet

1. Feed formulation to meet the animal demand!
2. Availability of feed raw materials (basic feed ingredients)
3. Optimized cost formulation to reduce feed costs

Feed 1
Feed 2
Feed 3
Feed 4
Feed….

AMINOFootprint®:

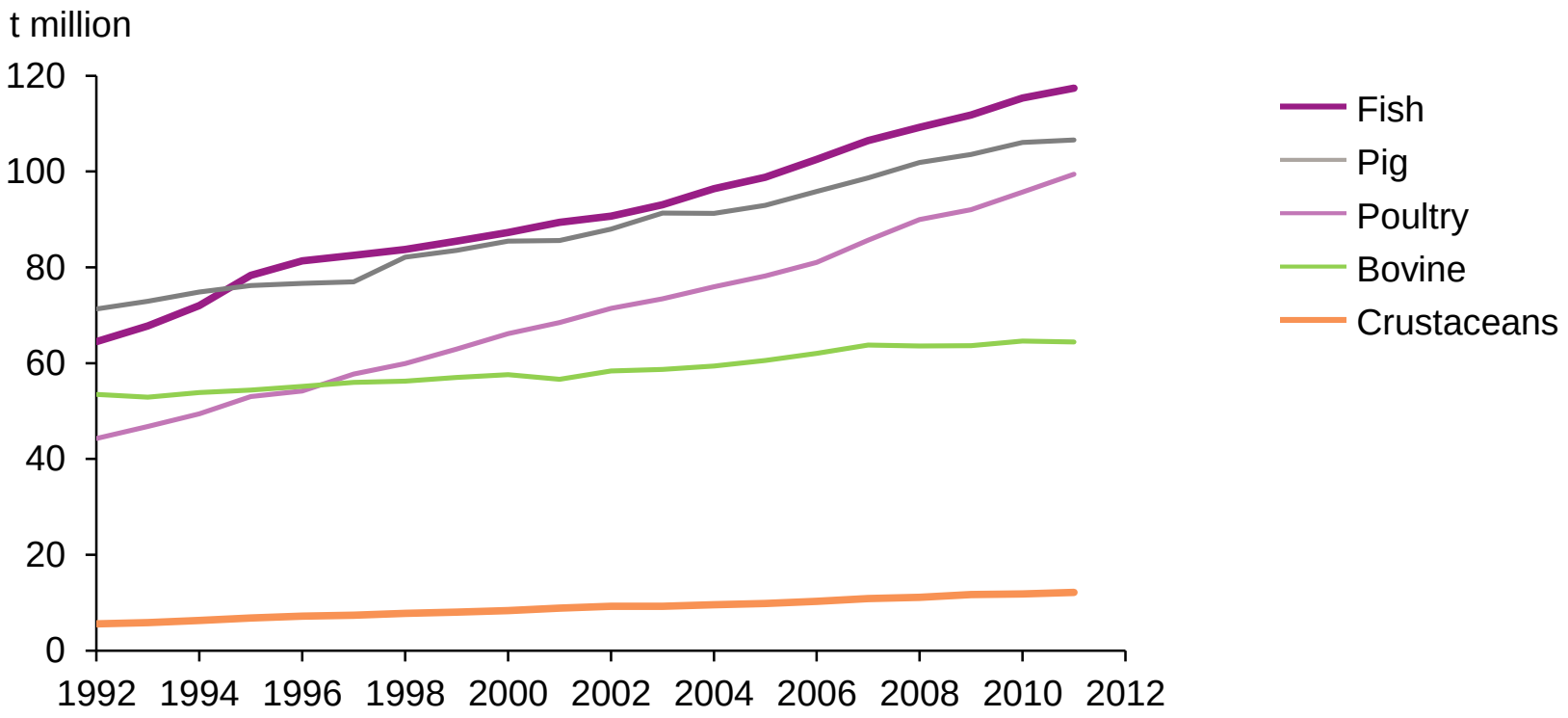
Feed 2

Nutritionally balanced
Economically balanced
Ecologically balanced

The potential of aquaculture in the feed industry

World fish consumption is steadily increasing - outpacing other meats

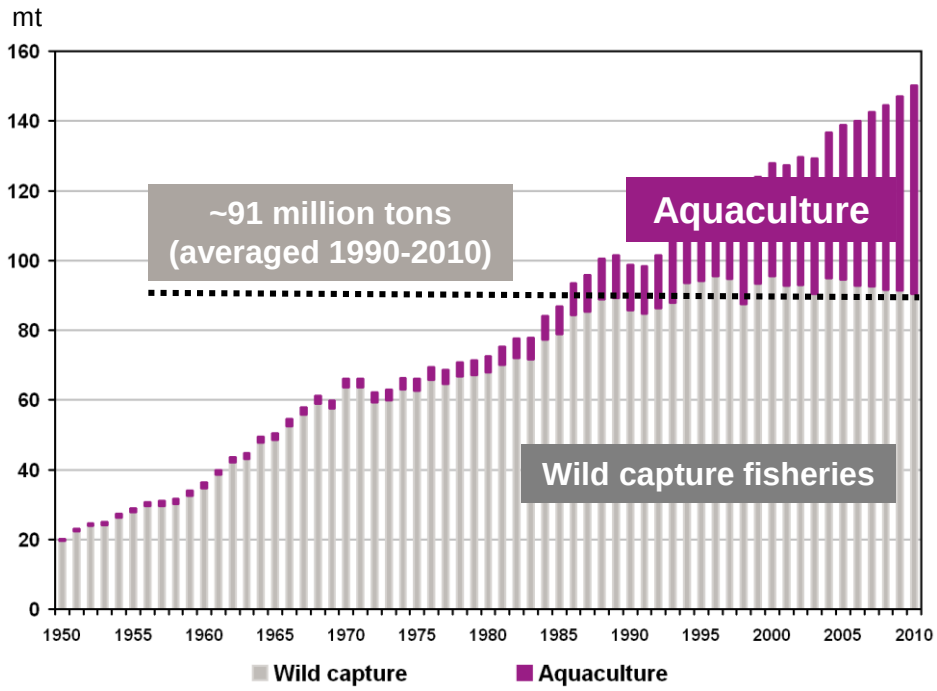
Development of global meat consumption

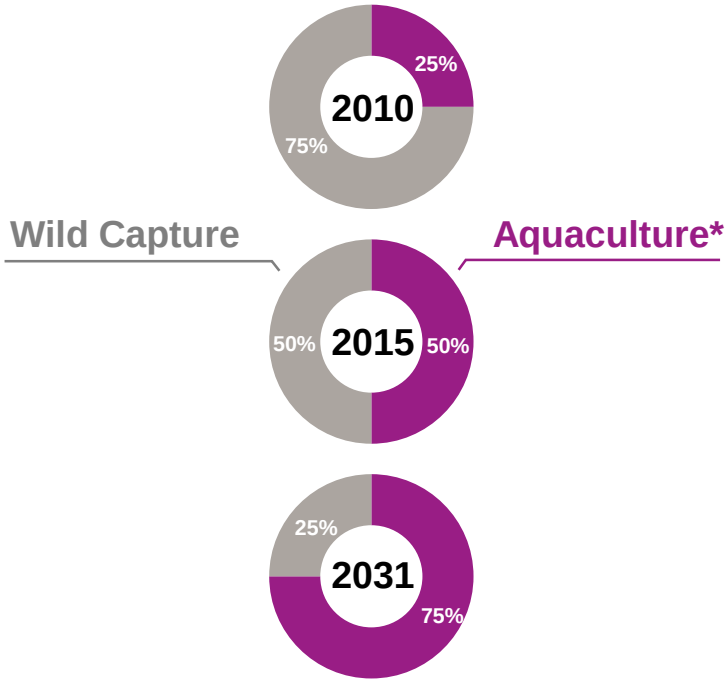


*Source: FAO 2015

Aquaculture production is required to cover the increasing global demand

Development of wild capture vs. aquaculture



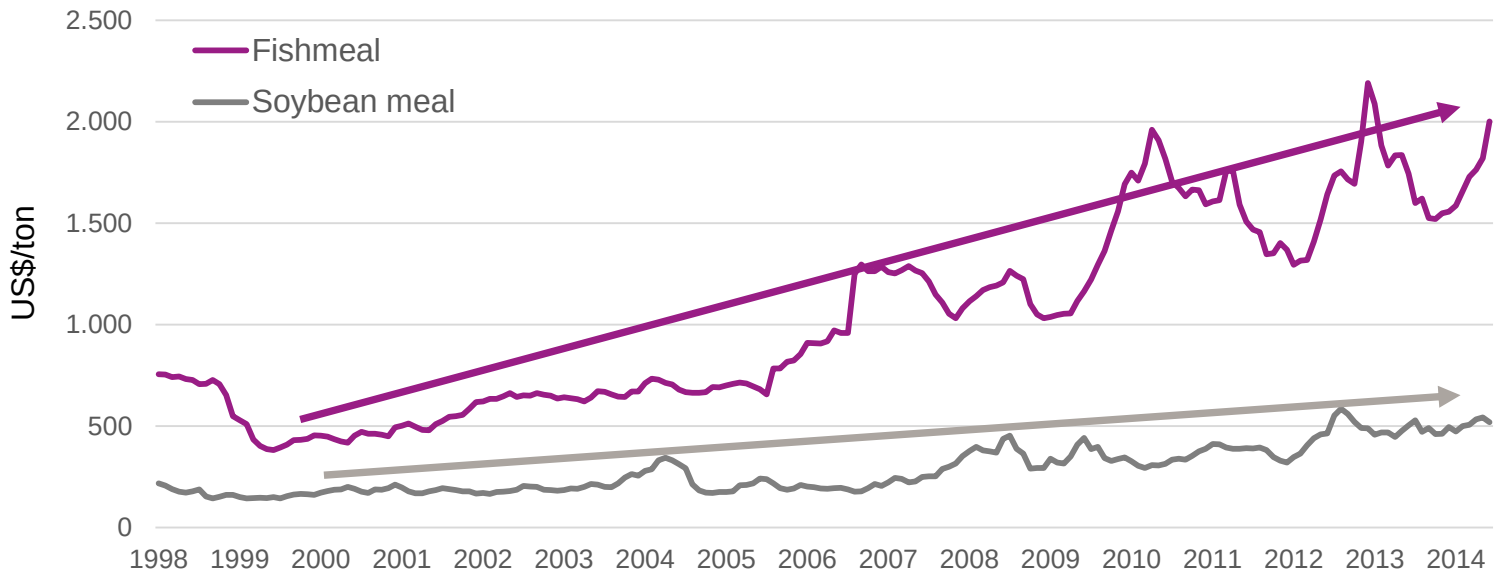


Aquaculture gaining significant importance due to limited natural marine resources

* Based on FAO stats 2014 w/o aquatic plants

1st problem: Fish meal
Fish meal prices increased sharply over last decade

Price development of fish meal and soybean meal

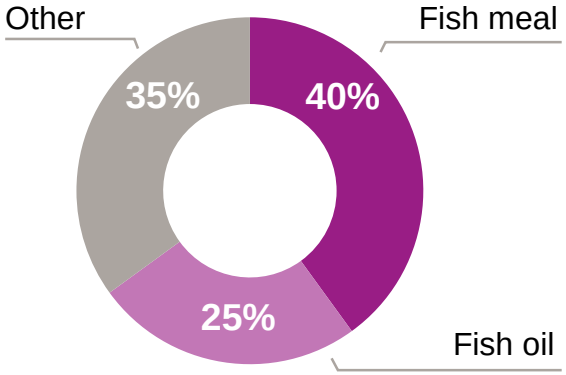


- **Scarcity of fish meal** as important crude protein source for aquaculture
- **Overfishing is not sustainable and destroys biodiversity in our oceans**
- **Expected increase of fish meal : soy meal ratio in the future**

1st solution step (modern diet):
Replacing fish meal with amino acids

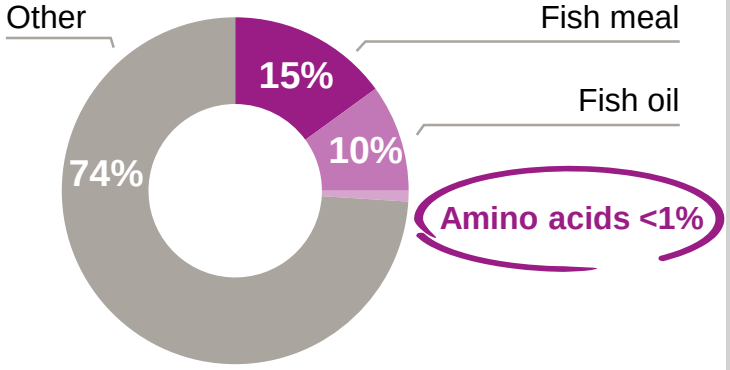
Lower fish meal by using amino acids

Traditional diet



Replacing fish meal with amino acids

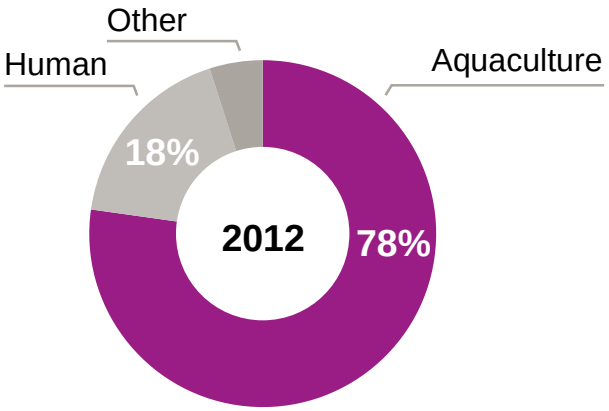
Modern diet



Less than 1% of supplemental amino acids reduces fish meal usage by more than 50%

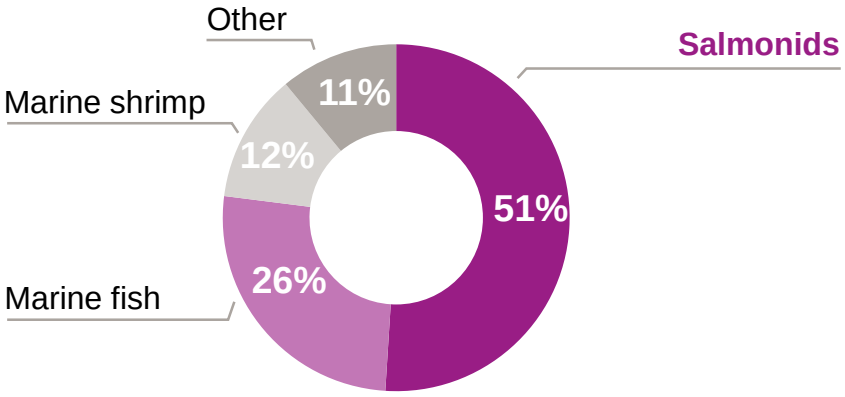
2nd problem: Fish oil
Aquaculture industry as biggest consumer of fish oil

Global fish oil consumption



Total fish oil production in 2012: ~ 1,000 kt

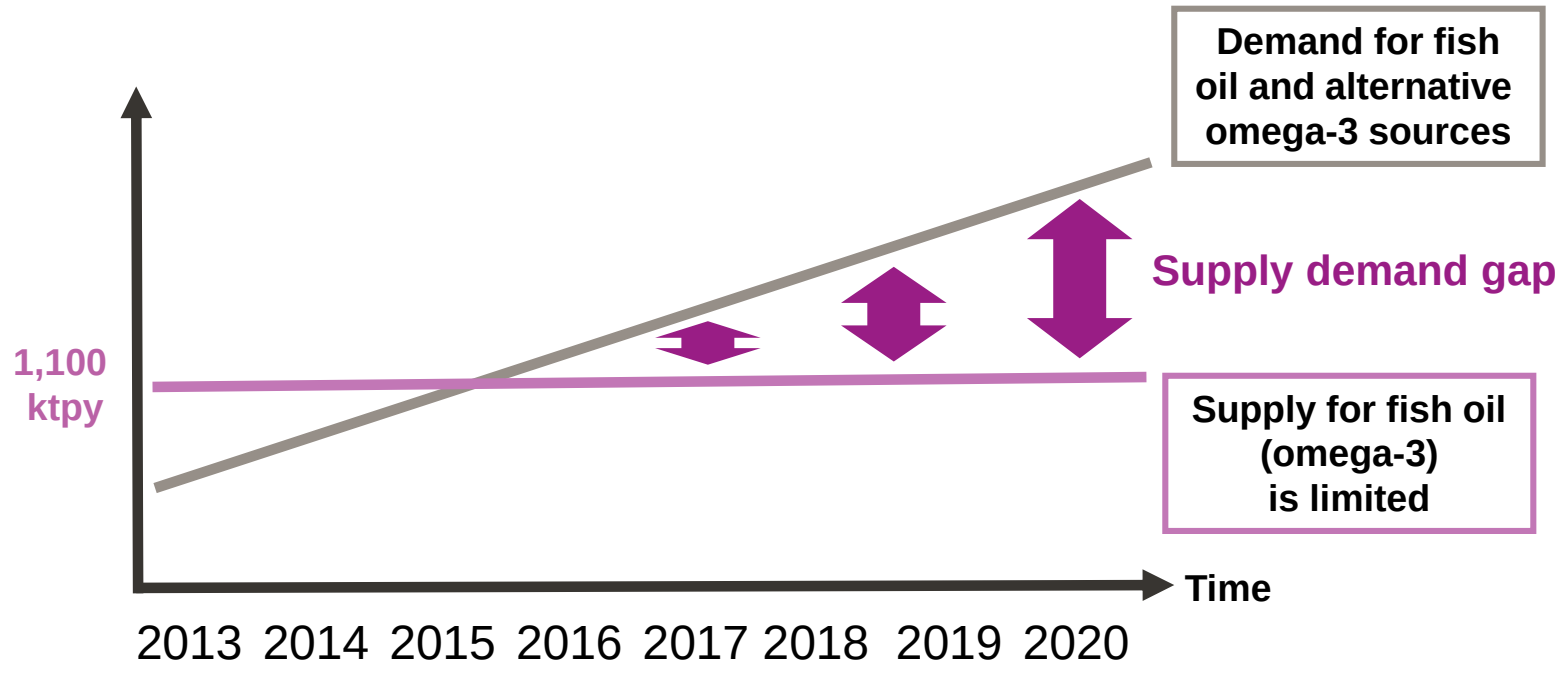
Fish oil consumption in aquaculture



400 kt fish oil used by farmed salmonids

Expected supply/demand gap for fish oil

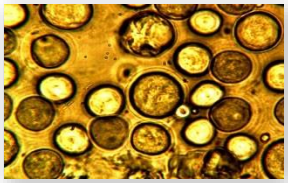
Market size of fish oil and alternatives



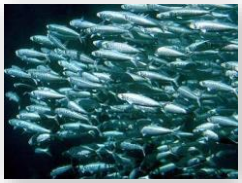
Micro algaes

Natural solution for sustainable omega-3 fatty acids supply in the future

Natural food chain (example salmon)

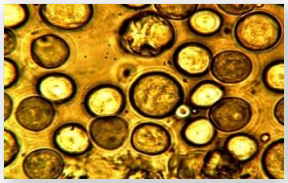

Micro algae (100x)


Krill


Small herbivorous fishes


Salmon

Current practice in aquaculture


Micro algae (100x)

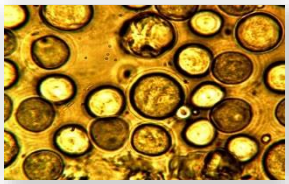

Krill


Small herbivorous fishes


Fish feed production


Salmon

Future practice: algal omega-3 fatty acids


Micro algae (100x)

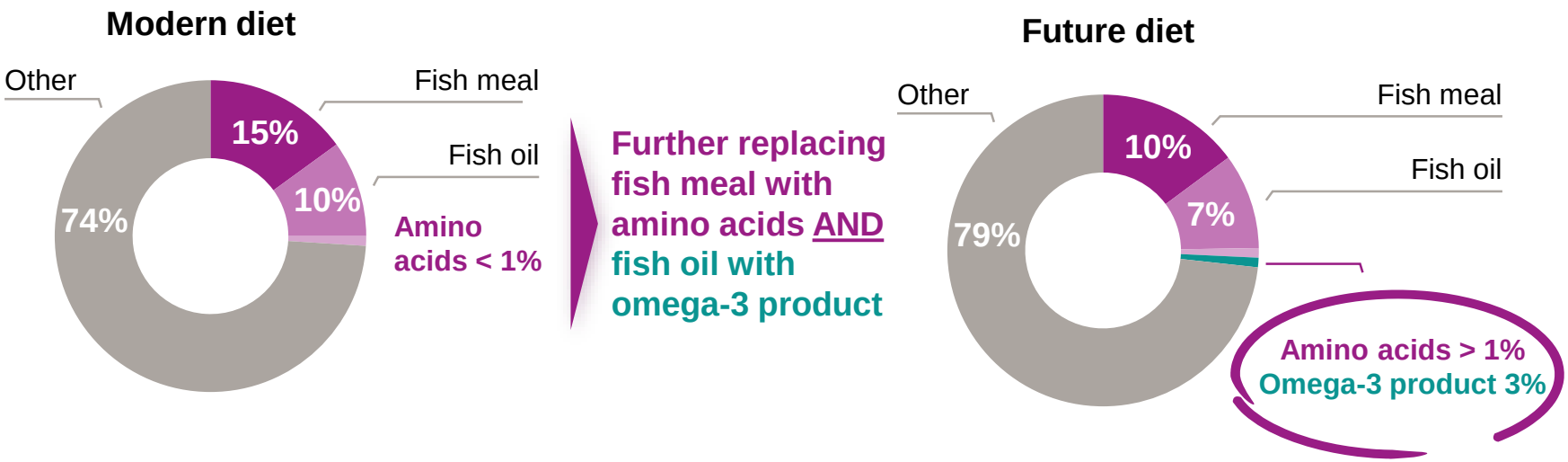

Fermentative production of algal omega-3 product


Fish feed production


Salmon

2nd solution step (future diet):
Replacing fish oil with algal omega-3 product

Lower fish meal and fish oil by using amino acids AND omega-3 product



The salmon aquaculture industry will finally become a net fish producer (today: net fish consumer!)

JDA with DSM to develop algae-based omega-3 fatty acids for animal nutrition

- Long-established biotechnology capabilities in development and operations
- Expertise in cultivation of marine organisms

- Focus on industrial amino acid biotechnology
- Expertise in large-volume fermentation

Summary

- Nutritional sustainability as answer to pressure in feed-to-food chain
- Intelligent combination of amino acids is key for economic, ecological and sustainable animal production
- Evonik service tools like AMINOFootprint® help our customers to realize full sustainability potential
- Evonik is actively addressing the significant potential of aquaculture in the feed industry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