LCA and GHG reducing measures at SINTEF Fisheries and aquaculture

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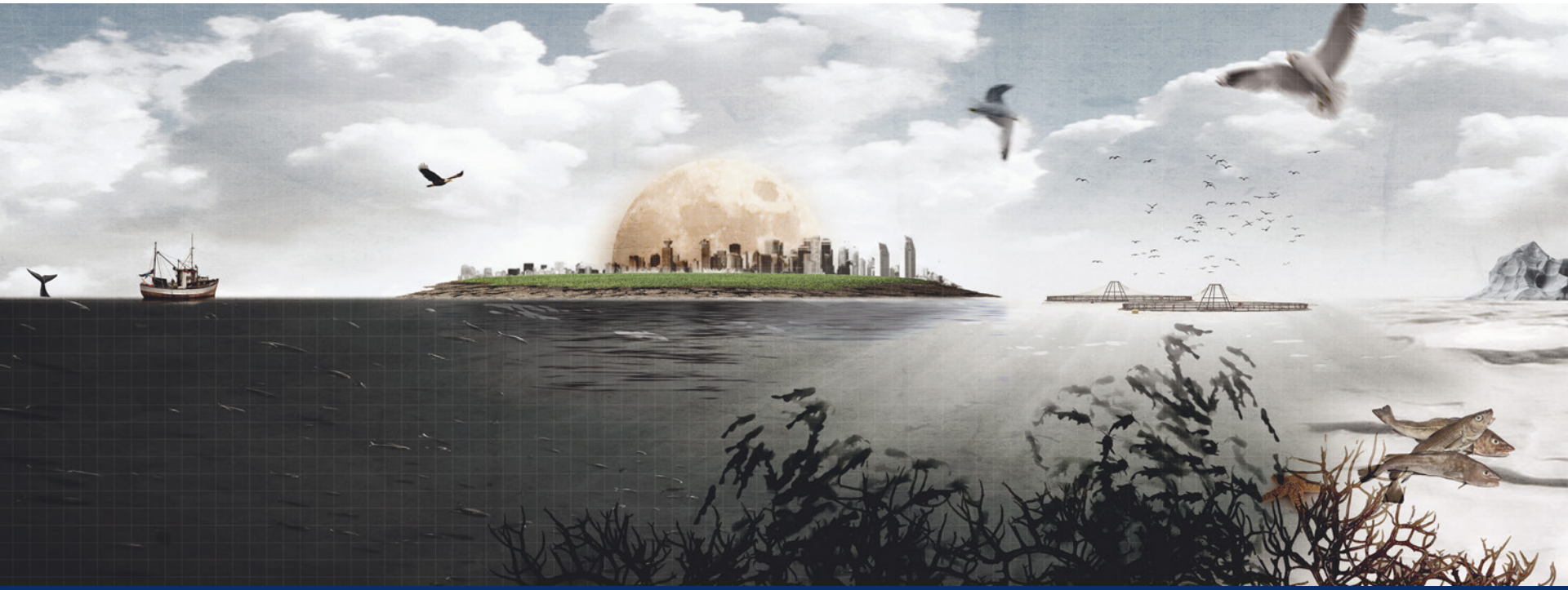


Agenda

SINTEF Fisheries and aquaculture

The LCA method

LCA in the broader picture

Climate aspects of seafood: Where, how and why?

GHG reducing technologies

Next steps

SINTEF Fisheries and aquaculture is the leading European technological research institute for the fishing and aquaculture sector - We cover the entire marine value chain

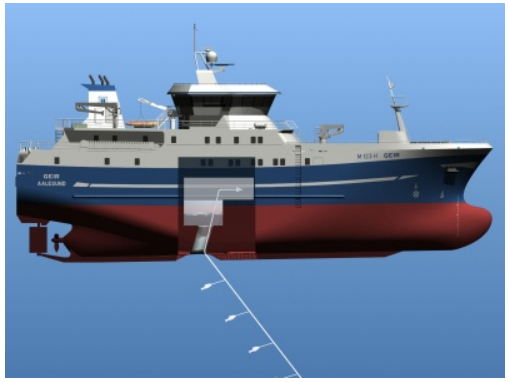
- Around 120 employees, 73% researchers, around 1/3 with a PhD
- Around 50% of research funding from industry, the rest from research funds. Almost all of it competitive bidding.

Our goal is to contribute to sustainable use of marine resources at a national and international level

Five departments

Marine Resources Technology

Fisheries Technology



Aquaculture Technology

Processing Technology

International projects and consulting

The Life Cycle Assessment Method

LCA is a quantitative and comparative method to assess the environmental impacts a product causes throughout its lifecycle and the resources it requires

LCA include not only the direct impacts from the value chain of your product, but also all impacts from everything that underpins the value chain of your product: Energy production, raw material extraction, infrastructure etc.

A complete LCA will address a complimentary set of environmental impacts.

A LCA that only assess green house gas (GHG) emissions (climate impact), is called a "GHG Assessment", "carbon footprint", "climate assessment"…

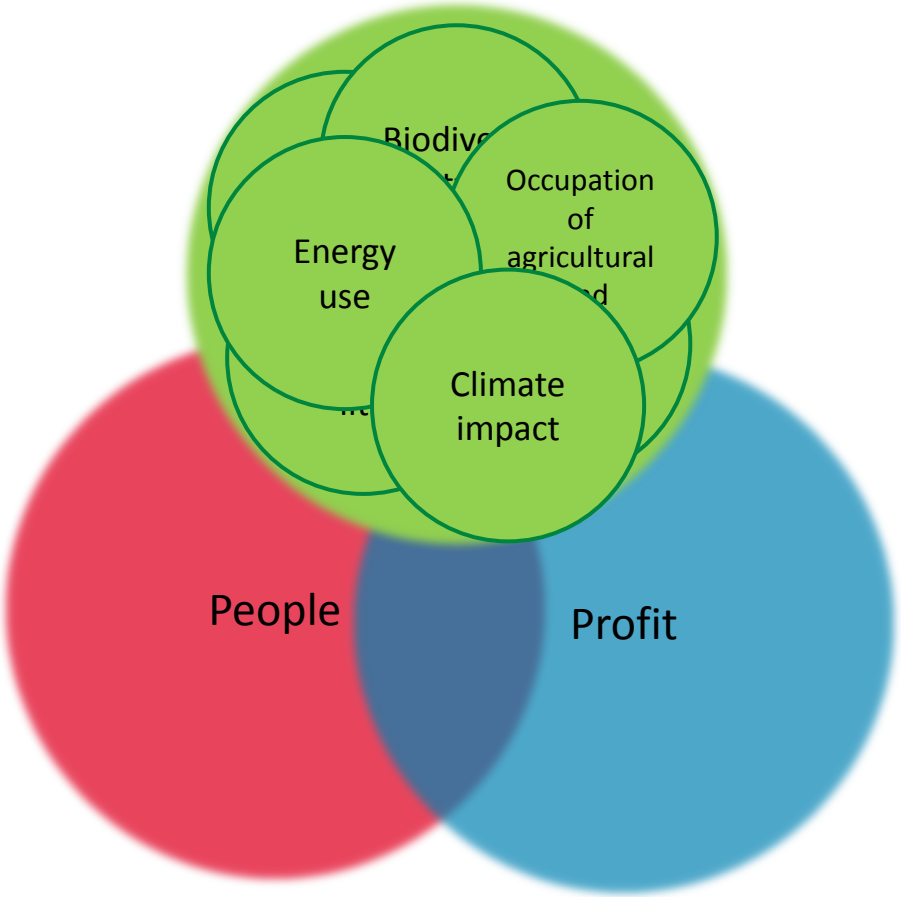
LCA is standardized by ISO in their 14 000 family about environmental management and by British Standard Institute in PAS2050:2011 (OBS! PAS only GHG assessment)

Background: Green growth and environmental assessment

Food production have several environmental challenges from many different locations

Need a quantitative management tool that can give the net sum of environmental impacts a product causes, identify ways to improve and that can measure progress

Life Cycle Assessment (LCA) is a tool that can provide us with that (for many important environmental impacts, but not all)

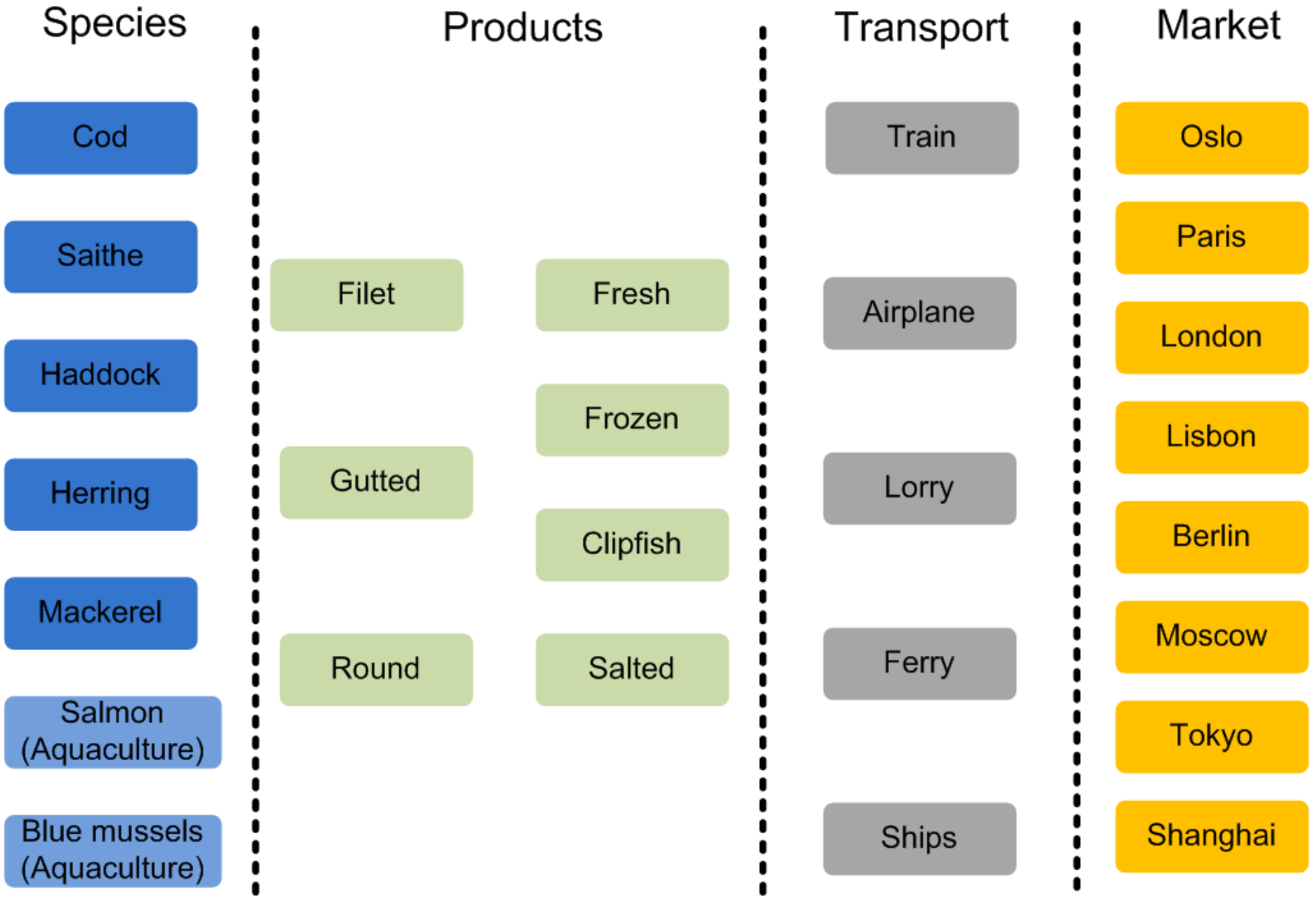


LCA/CF activities at SINTEF Fisheries and aquaculture

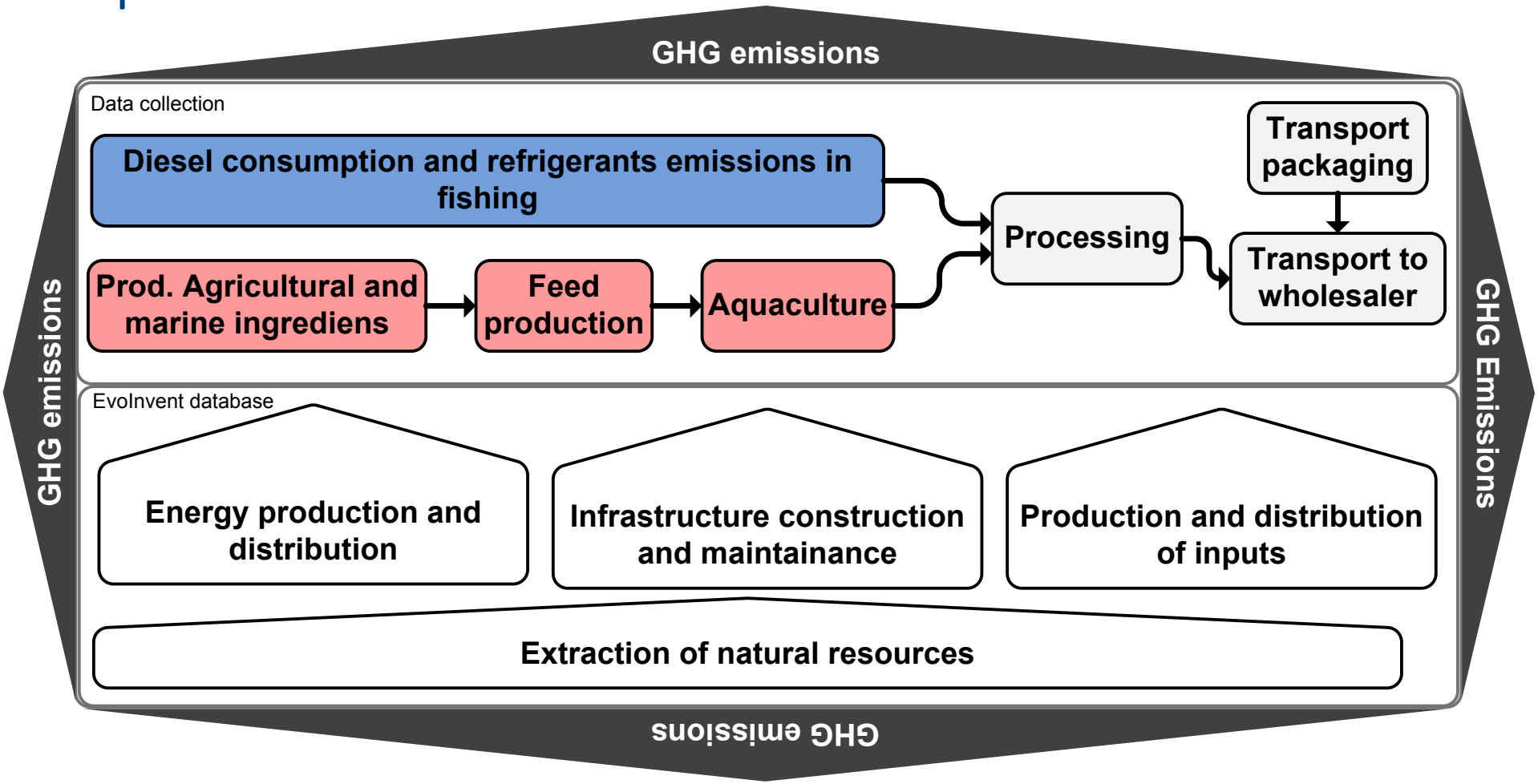
- Mapped the carbon footprint of the 22 most important Norwegian seafood products
- Detailed studies of GHG emissions form seafood transport/Exports
- Detailed studies of salmon feed development
- Participation in the development of standards for GHG assessment of seafood products
- Development of tool for GHG assessment of wild caught seafood
- LCA as design parameter in development of fishing and aquaculture technologies and in the evaluation of fisheries policy and regulations
- Implementation of LCA in environmental management systems in aquaculture and fisheries

GHG assessment of Norwegian seafood products

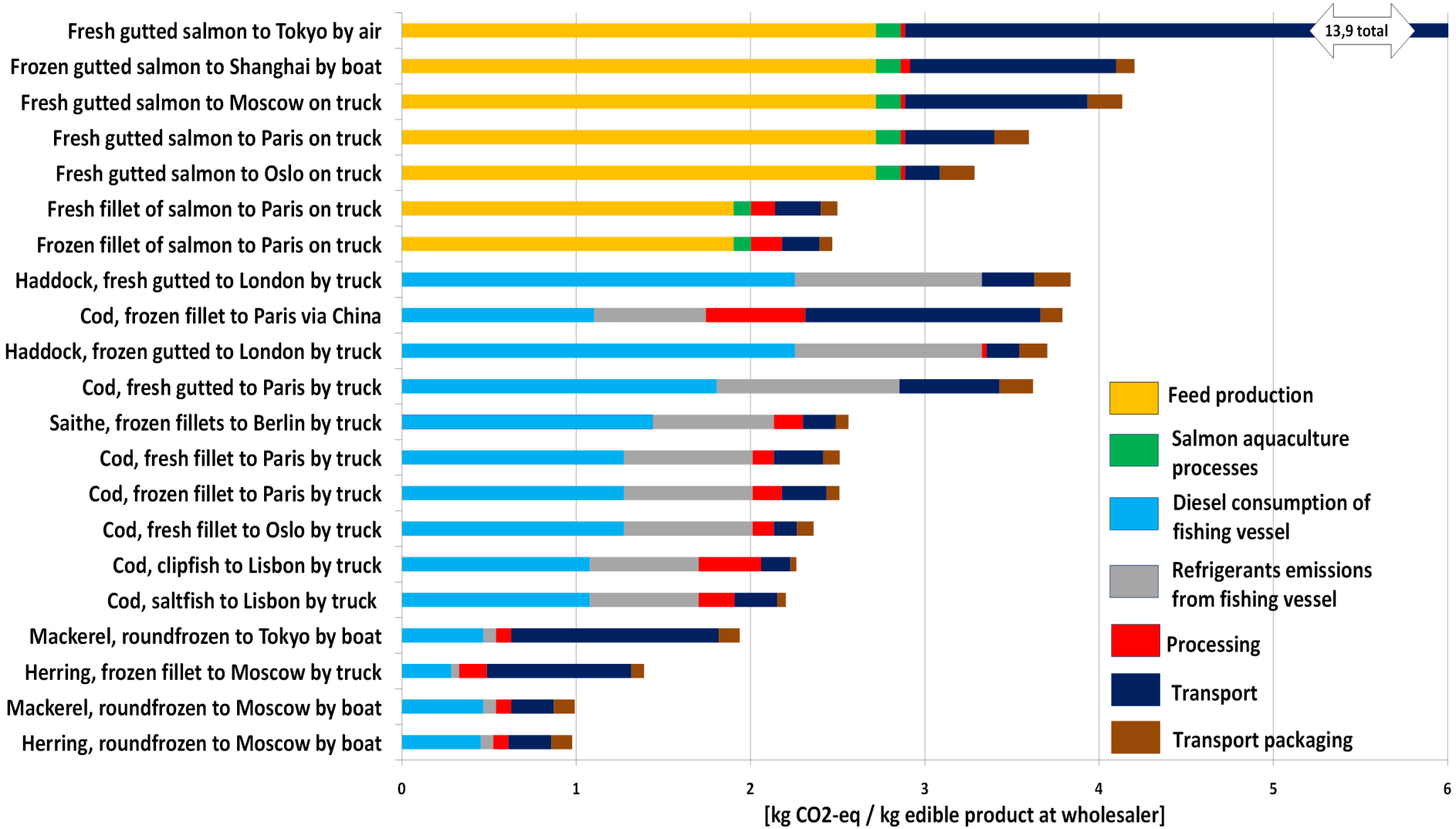
What have we looked at?



System boundaries: What is included in the carbon footprint?

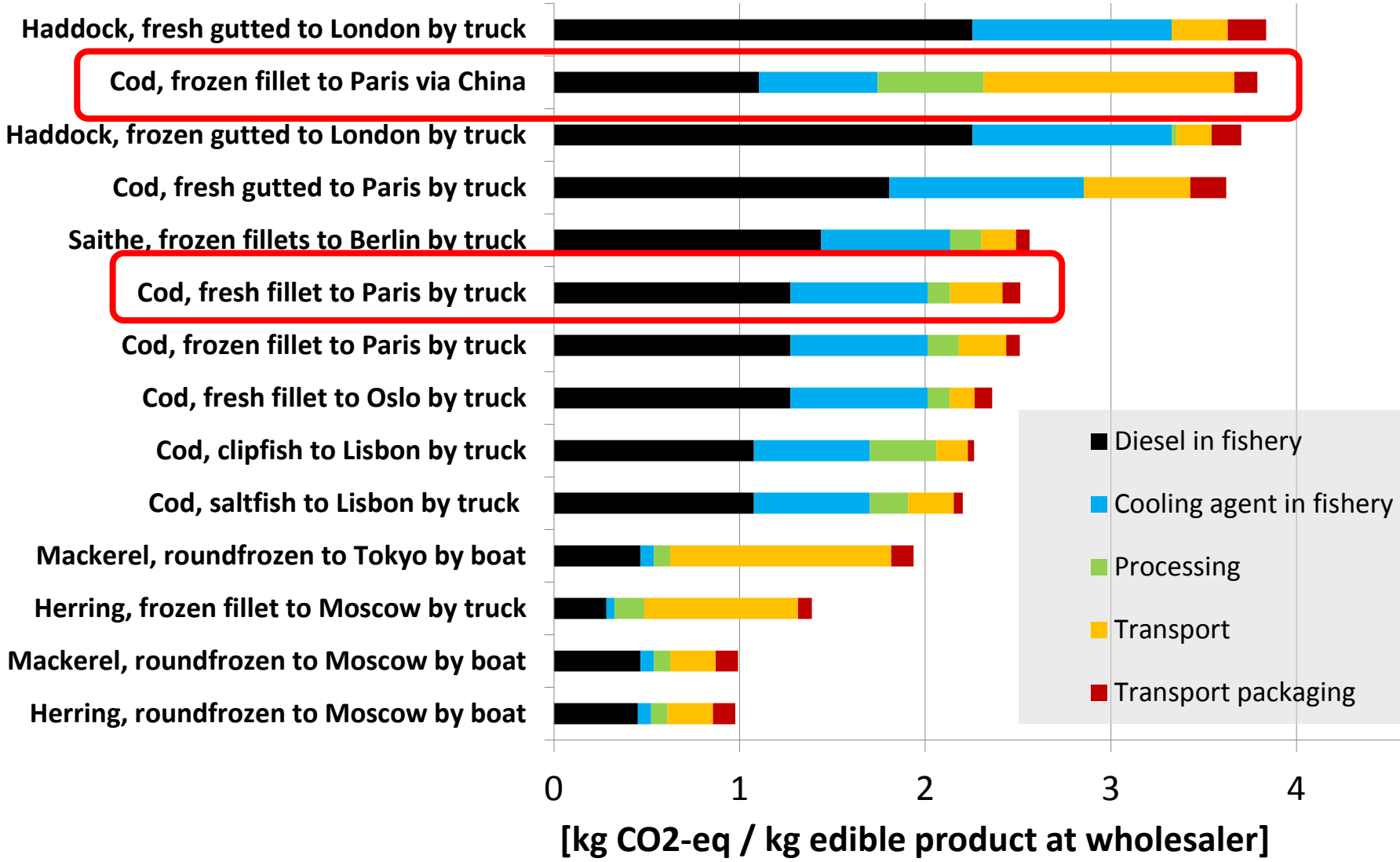


Carbon footprint of Norwegian seafood products

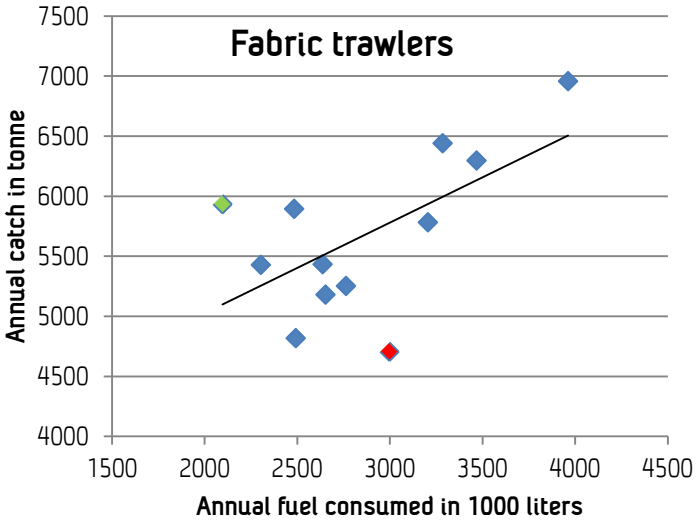


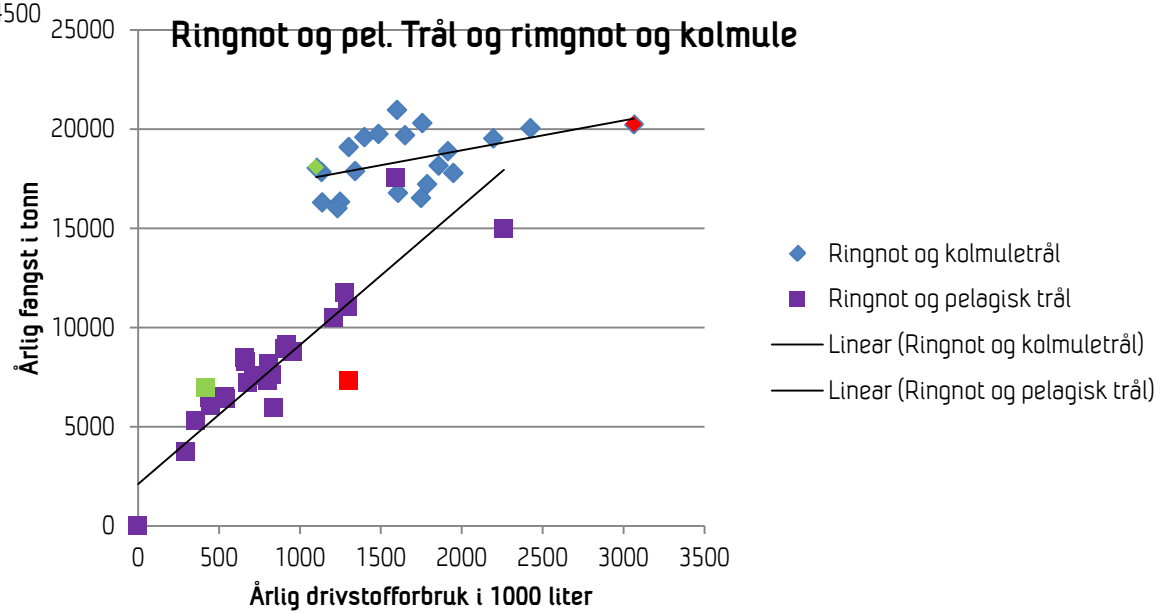
Climate aspects of wild caught seafood

Wild caught Norwegian seafood



Energy use in fisheries: High variability! (2007 data)





Wild caught products: Refrigerants

- Emissions of refrigerants from fishing vessels can account for up to 30% of the total CF
- R22 has been regulated since 2001 because of its ozone depletion potential. The Norwegian fishing fleet has been able to avoid these regulations and is now the biggest consumer of R22, around 200 tons annually
- R22 (HC-FC 22) has a climate factor of 1810 kg CO2-equ. / kg R22
- Our report put refrigerants high on the agenda for the Norwegian Fisherman's association.

GHG reducing measures in fisheries technology

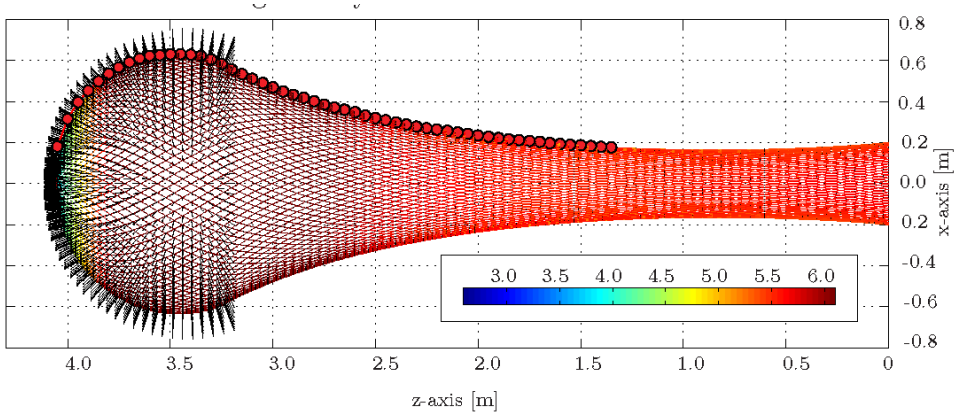
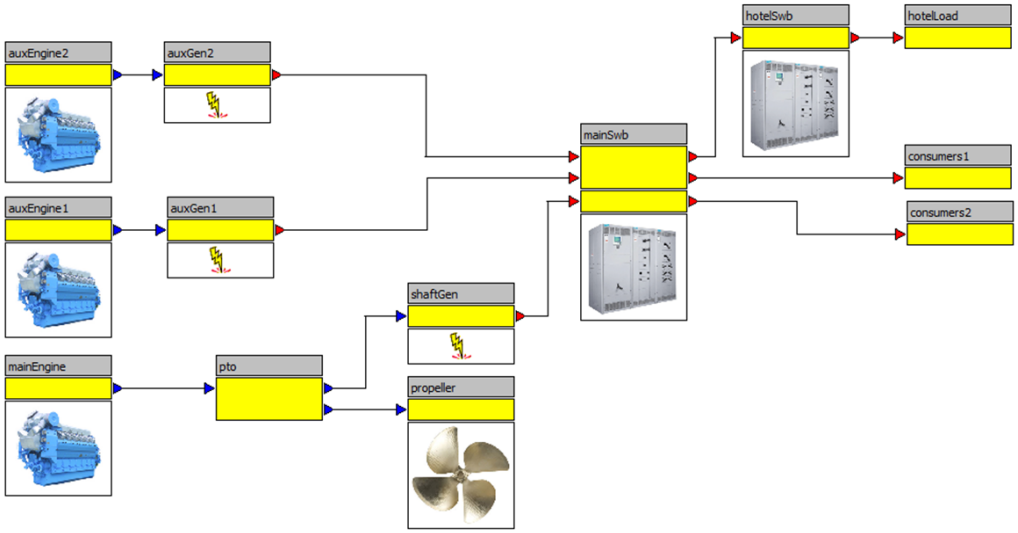


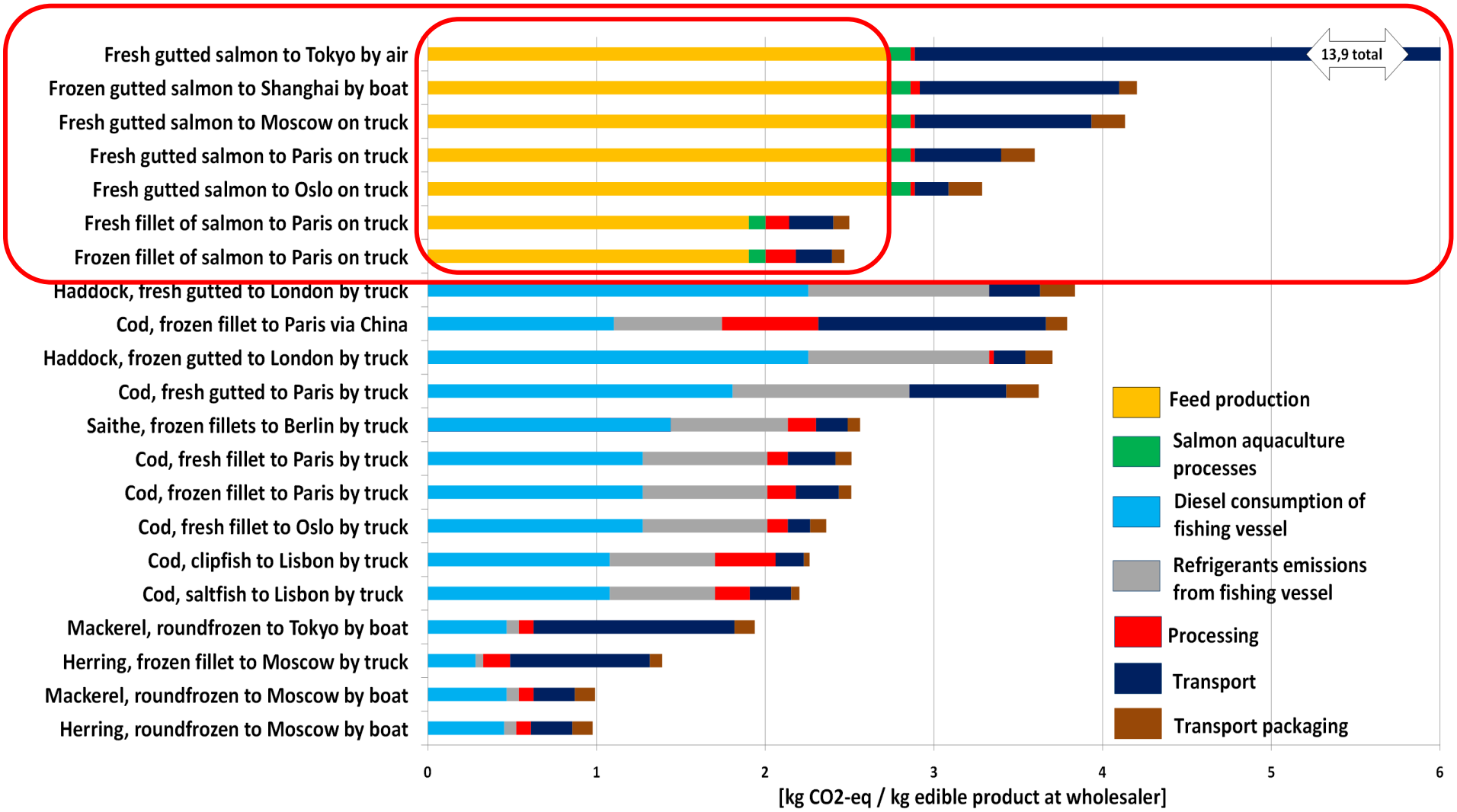
Figure 5.25: Cod-end with 900kg catch load at 0.9m/s. The red curve indicates measured geometry from the flume tank

- **Design:**
  - Operational profile as a design parameter
  - Gear
  - Hull
  - On board energy system, choice of components and configuration
- **Decision support**:
  - Gear operations
  - Vessel operation, strategic with regards to weather etc.
- **Monitoring and logging: Expanding the understanding of design and input to decision support**



Climate aspects of salmon aquaculture products

CF of Salmon aquaculture products



GHG reduction technologies within aquaculture

- Closed aquaculture systems:
  - What can be the net effects of letting the fish grow bigger before it is let into the sea?
  - Even a small reduction on mortality will increase efficiency and reduce GHG emissions
  - Land based recycling systems: How to reduce energy use in recycling systems?
  - Not a question about open or closed. We need both.

- Seafood logistics: Export and supply optimization

- Data capture and treatment for more precise and efficient environmental management systems

LCA of feed alternatives

LCA of Atlantic salmon feed diets

Studied five different feed diets with varying content of marine ingredients.

Average data for Norway in 2010 was used as a base case

Project for Nofima AS (Sunndalsøra)

Cooperation with Swedish Institute for Food and Biotechnology, SIK (Gothenburg, Sweden)

Environmental impacts assessed:

- Climate impact, expressed as sum of GHG emissions in their CO_2 equivalents
- Energy demand, expressed in MJ equivalents
- Occupation of agricultural land, expressed in square meters
- Marine primary production required (PPR). Function of each species trophic level and catch site. Expressed as square meters of ocean surface.

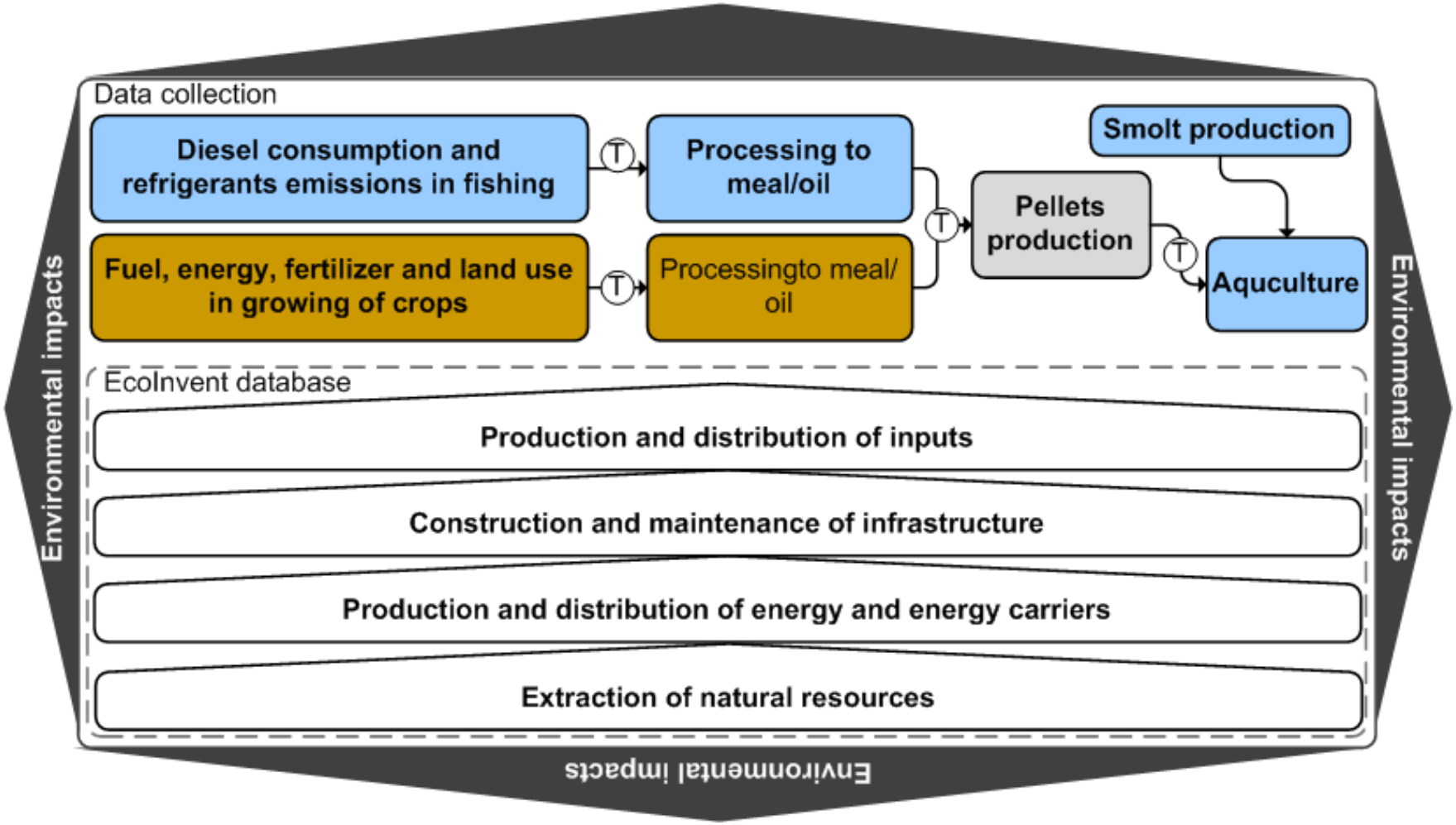
LCA of Atlantic salmon feed diets: Method

Functional unit (basis for comparison): **1 kg edible product at farm gate**

Allocation based on mass

System boundaries: **From growing of crops and catch of marine ingredients and till the salmon is ready for slaughter. From field and sea to aquaculture farm gate.**

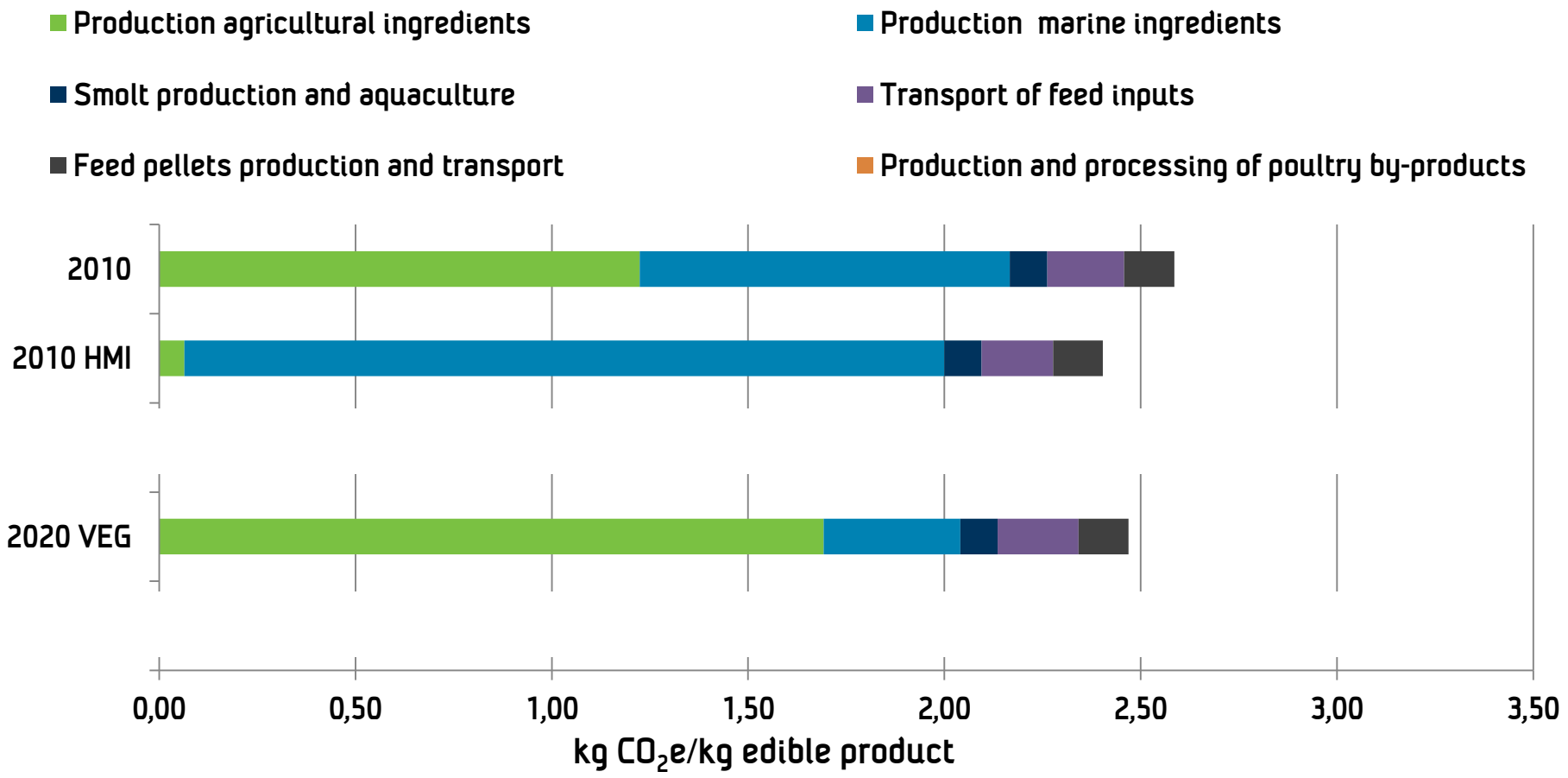
System boundaries: What was included?



- 2010: Average Norwegian diet in 2010
- 2010 HMI : High level marine ingredients
- 2020 VEG: Marine ingredients reduced by replacing them with agricultural products

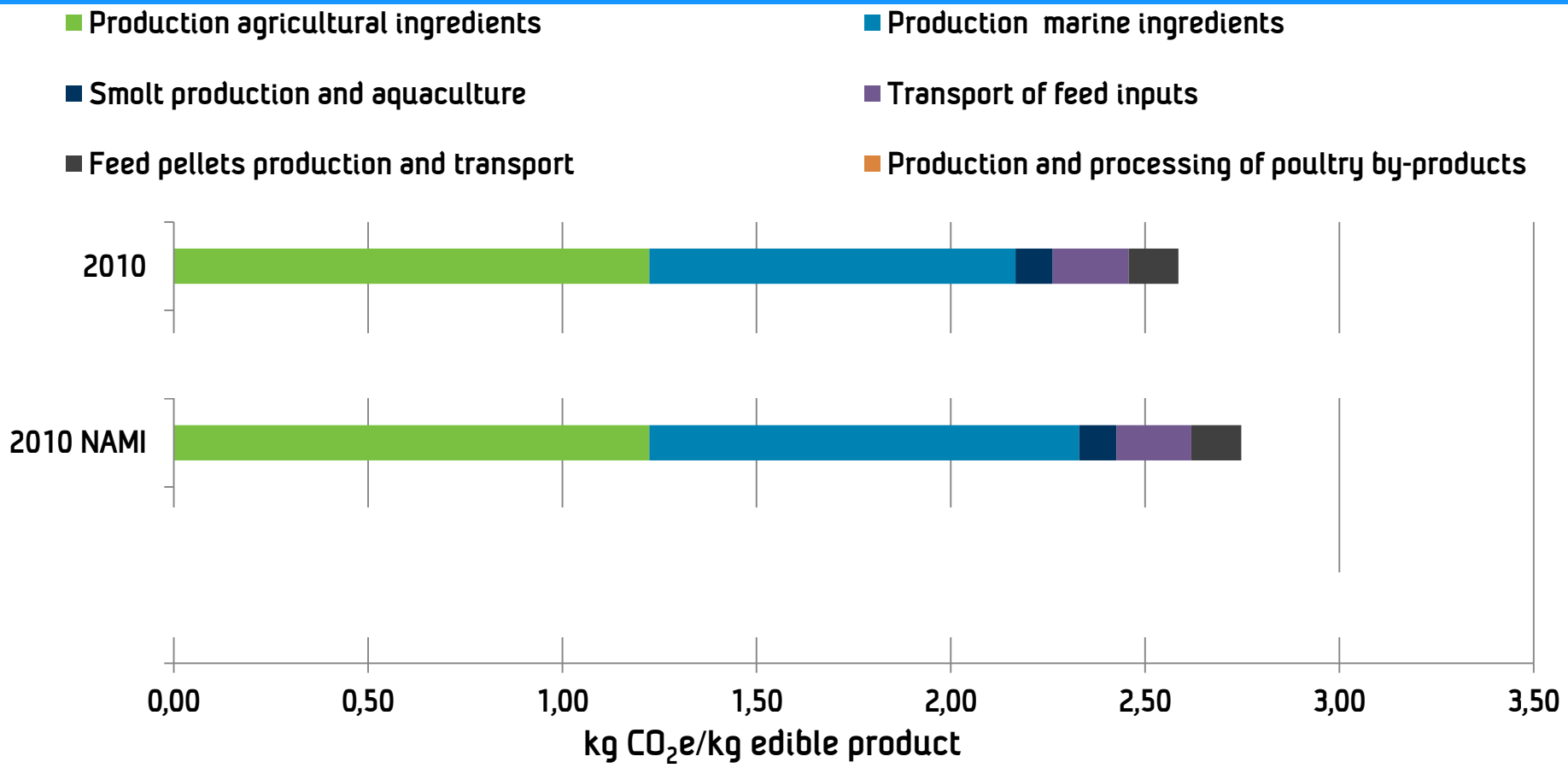
➢ Increasing or decreasing the share of marine ingredients can have more or less the same effect

➢ Marine ingredients replaced with energy and land use intensive ingredients such as soy protein concentrate



- **2010: Average Norwegian diet in 2010**
- **2010 NAMI: No American marine ingredients**

- **Excluding all marine ingredients from America (USA, Chile, Peru)**
- **Very efficient fisheries and high meal/oil yield is more important than trans Atlantic transport**

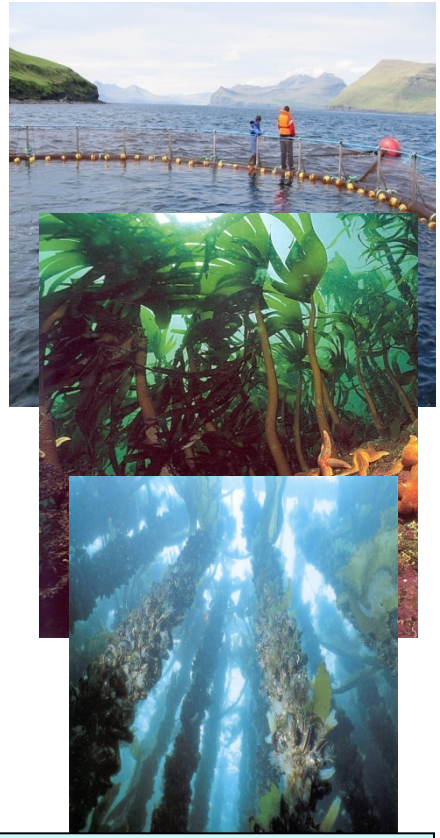


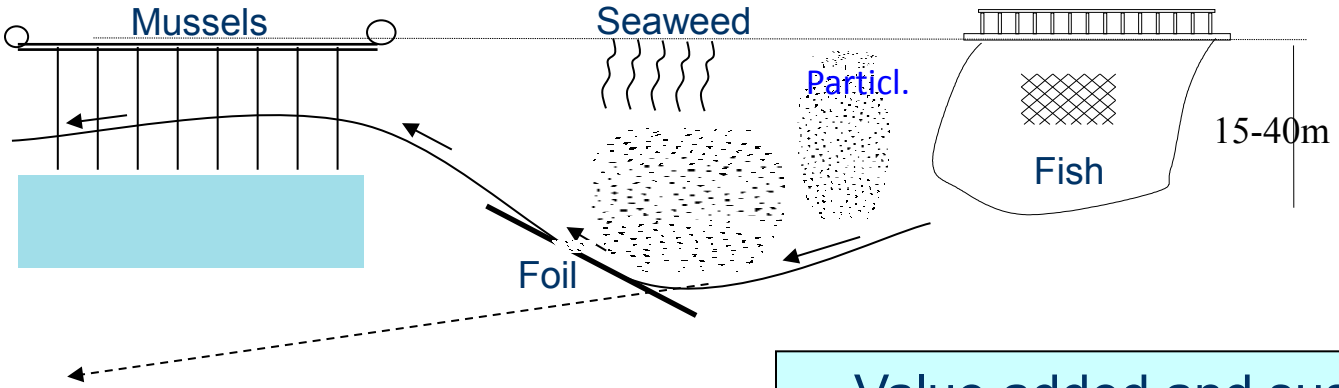
Integrated open seawater aquaculture;

technology for sustainable culture of high productive areas

Polyculture of species from different trophic levels:

- Intensively fed aquaculture (salmon)
- Photosynthetic aquaculture (seaweed)
- Filtering species culture (mussels)





Within the same location! ⟶

Value added and sustainable culture

Optimal utilisation of nutrient input

Production technology for seaweed

Species

Saccharina latissima Porphyra (nori)

Ectoarpus

Applications

Bioenergy production

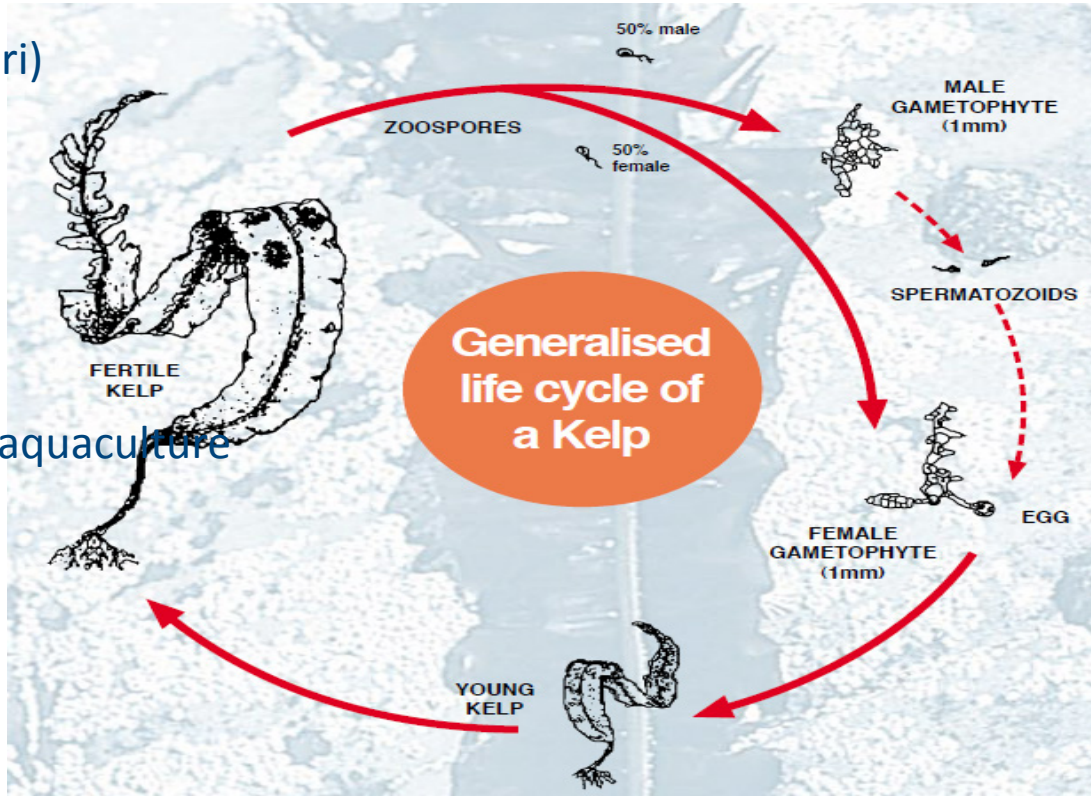
Bioactive compounds

Utilisation of nutrients from cage aquaculture

Fjord restoration

Human consumption

Fertilisers



What's on the menu?

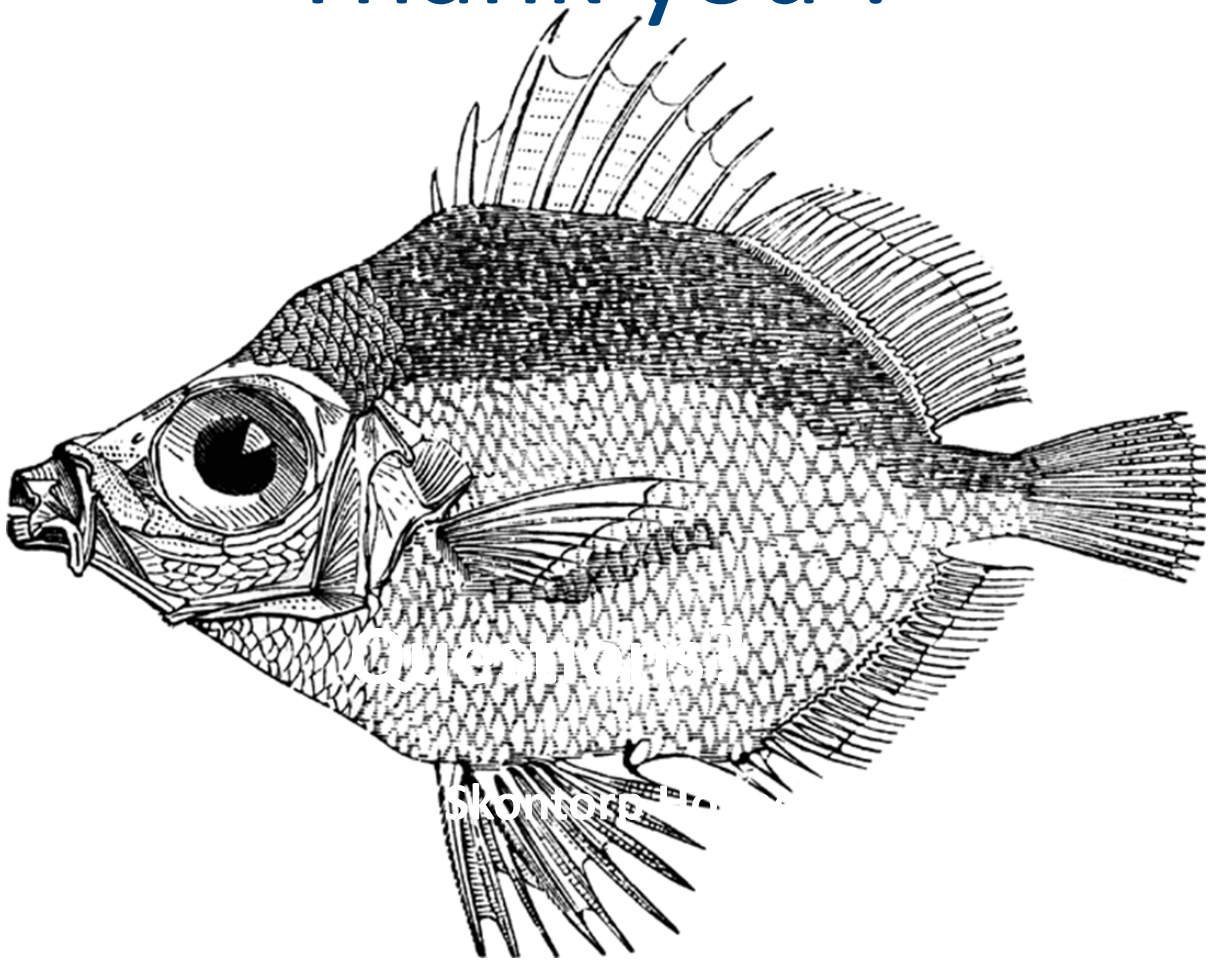
Current activities

- Development of standards for GHG assessment of seafood by BSI and Standards Norway (finished): Transparent, trusted and applicable.
- GHG profiling tool - together with Seafish and Dalhousie University: Web based tool for GHG assessment of wild caught seafood products
- Guideline/handbook on GHG assessment of seafood products together with SIK
- LCA in development of aquaculture technology, e.g. net materials and processing equipment. Techno-economic and environmental assessment.
- LCA in environmental management systems in aquaculture
- Study of alternative fisheries policies and new regulations: More liberal choice of fishing gear, discard ban
- Use of by-products from fisheries in salmon feeds
- Ecolabeling

Goals

- Develop common methodology for LCA/CF of feeds and databases for LCA data on feed ingredients
- Study energy use in closed aquaculture technologies
- Use existing ICT technologies, e.g. tracing technology, for environmental assessment (LCA)
- Expand today's assessment beyond GHGs
- Food, not just seafood

Thank you !



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How could LCA be of value for the seafood industry?

LCA provides a consistent, quantitative, transparent and trusted tool to:

1) Help you work strategically to increase efficiency by showing you where and how your products causes environmental impacts and requires resources.

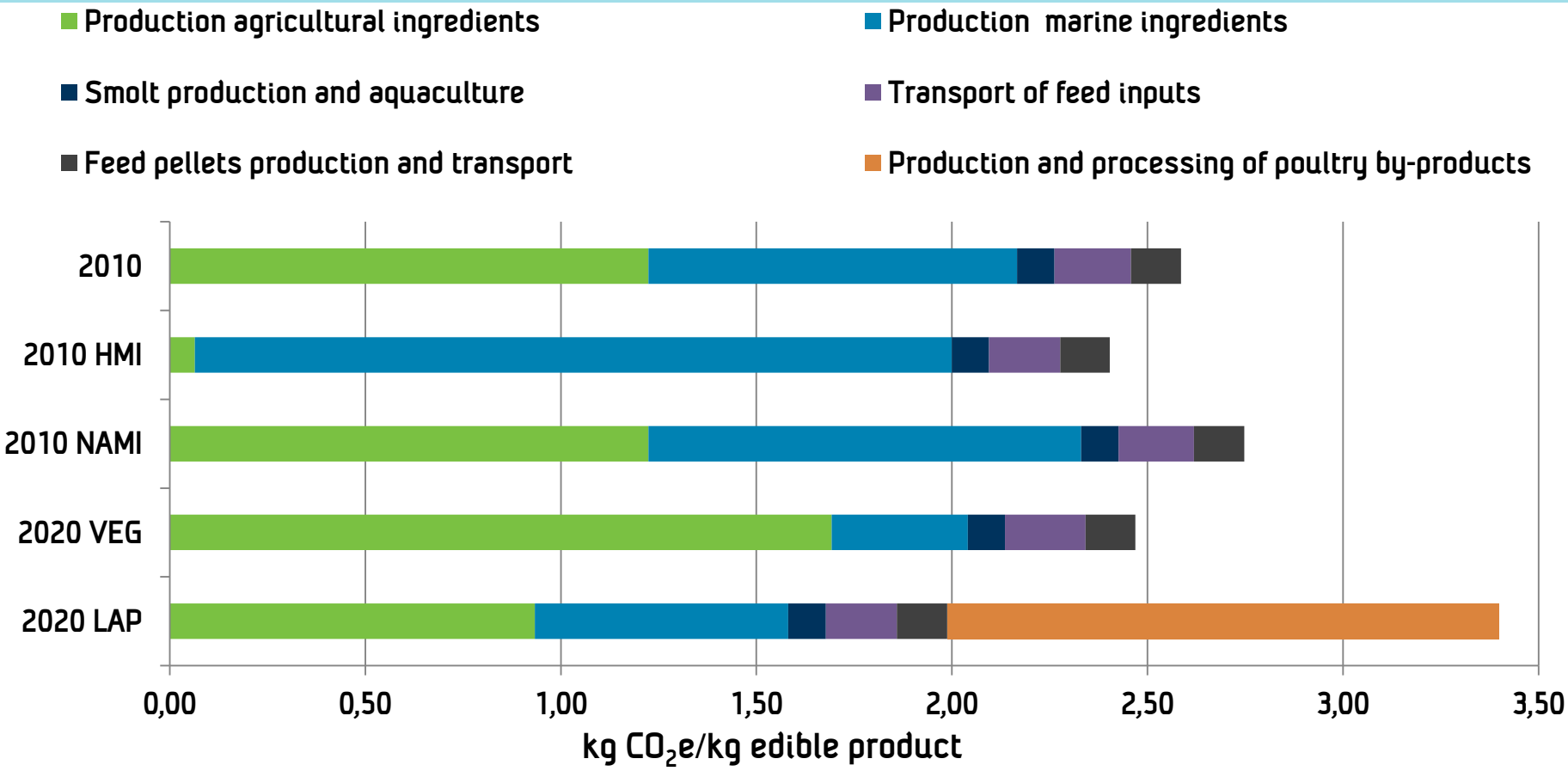
- What is measured can be improved
- Increased efficiency = produce more with less = improved profitability

2) Communicate the environmental properties of your product to retailers, consumers, regulators, investors and other stakeholders

- Example: In France the new environmental law "Grenelle 2" opt for requiring environmental documentation of products by law

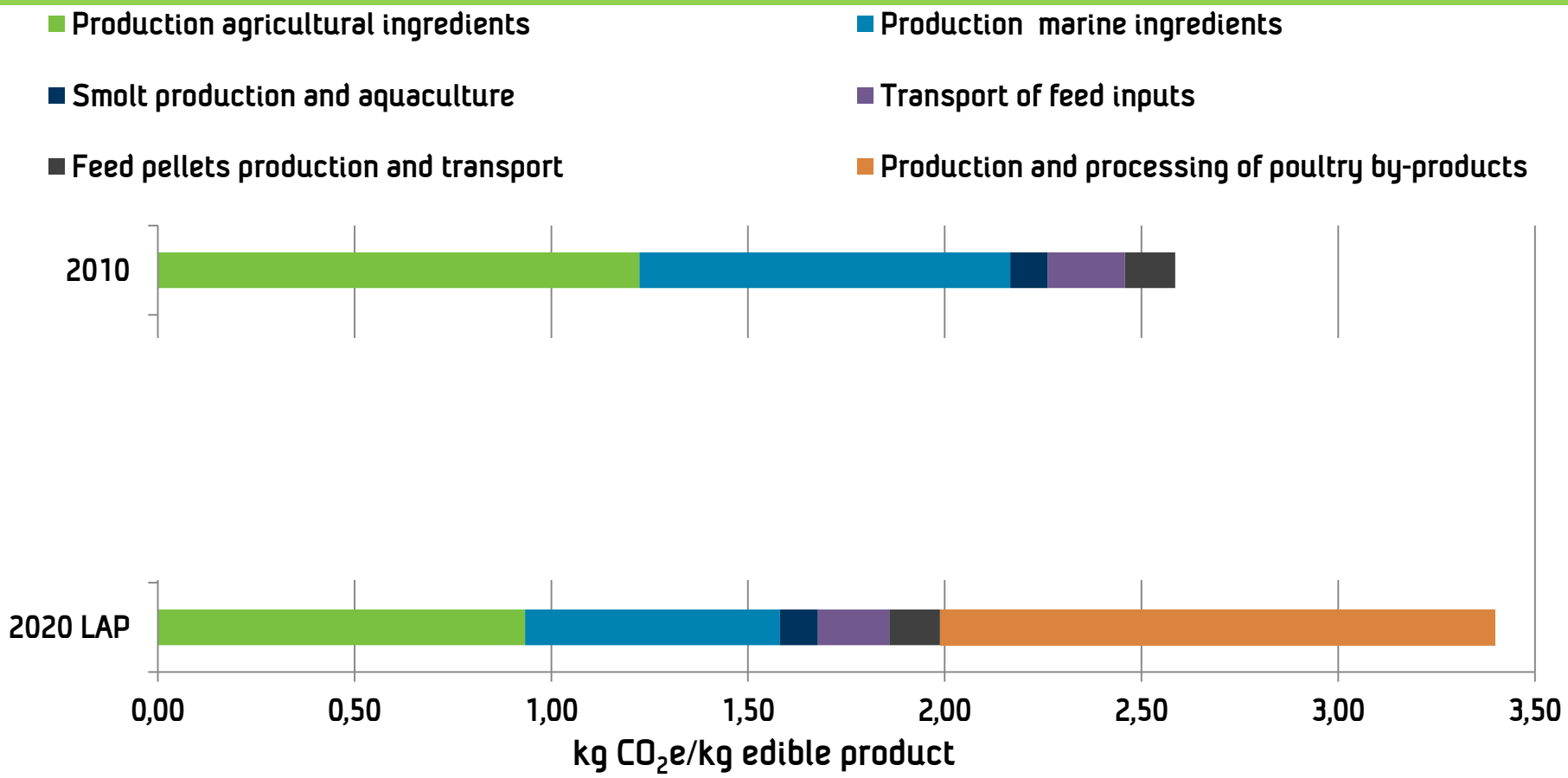
LCA can assure your future profitability by giving you a framework to improve your efficiency and by securing your access to important markets

- 2010: Average Norwegian diet in 2010
- 2010 HMI : High level marine ingredients
- 2010 NAMI: No American marine ingredients
- 2020 VEG: Marine ingredients reduced by replacing them with agricultural products
- 2020 LAP: Marine ingredients reduced by replacing them with poultry by-products

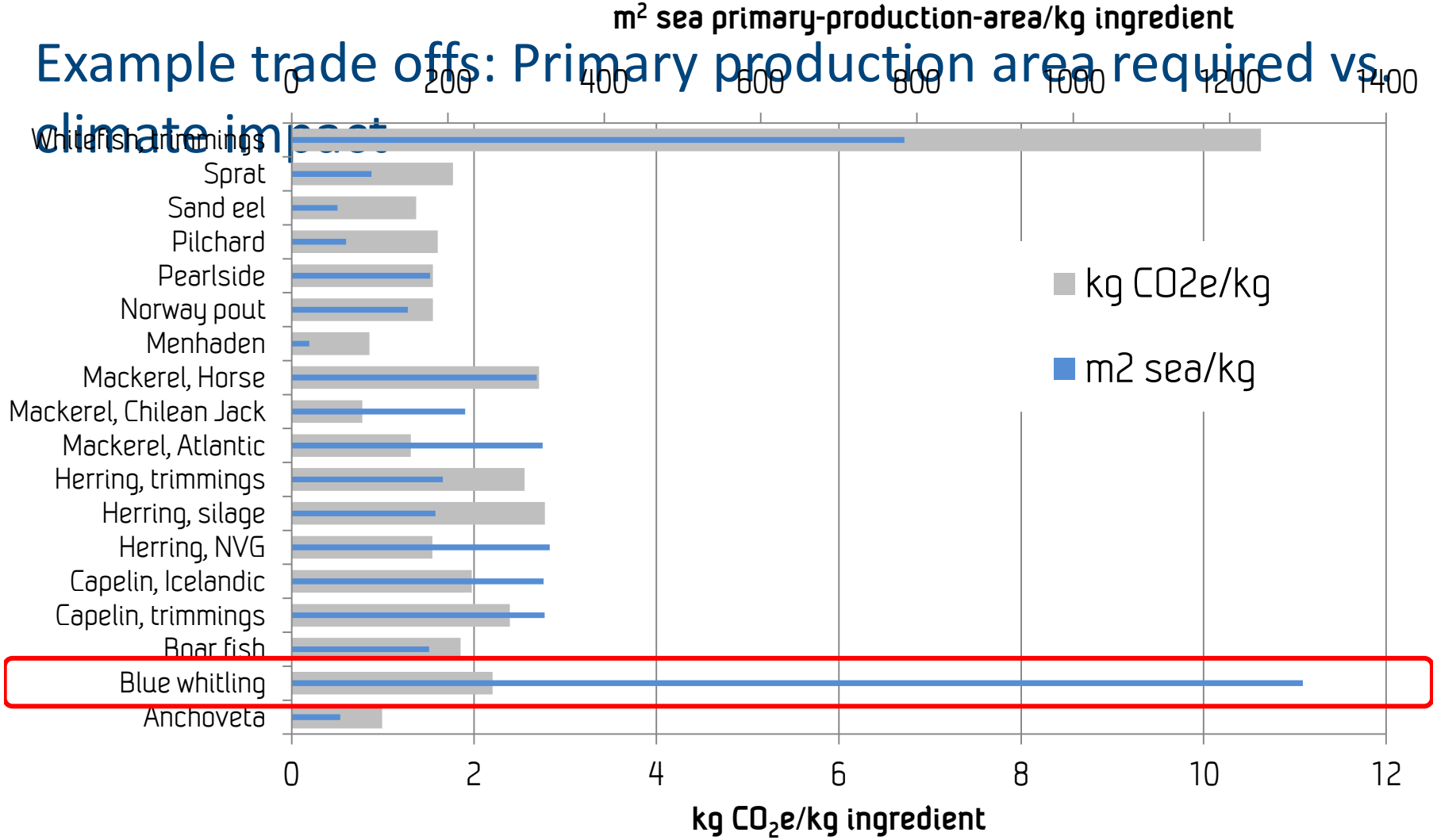


- 2010: Average Norwegian diet in 2010
- 2020 LAP: Marine ingredients reduced by replacing them with poultry by-products

- With mass allocation the poultry byproducts will be attributed with a high CF.
- A question of methodology that the industry and researchers need to discuss



Example trade offs: Primary production area required vs. climate impact



Results: Comparison Norwegian salmon and Swedish chicken and pig