



# Life Cycle Assessment in the development of a sustainable aquaculture industry

EAS conference 2014

Erik Skontorp Hognes, SINTEF Fisheries and aquaculture AS<sub>1</sub>

Mail: [erik.hognes@sintef.no](mailto:erik.hognes@sintef.no), Tlf: +47 40225577

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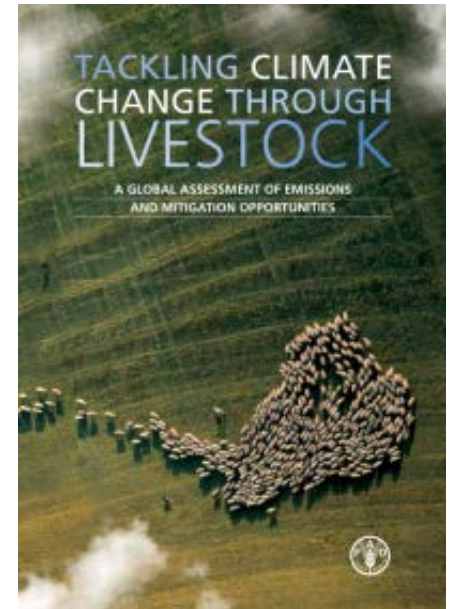




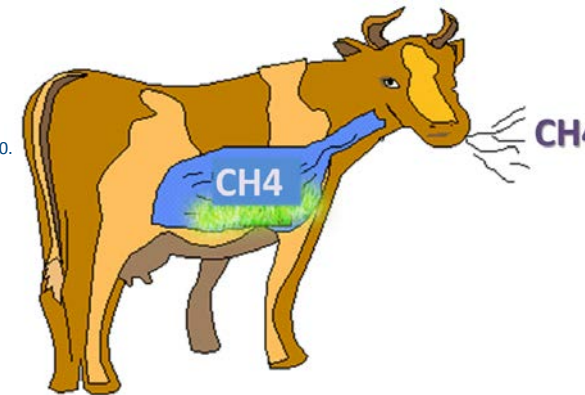
# Food and environmental challenges

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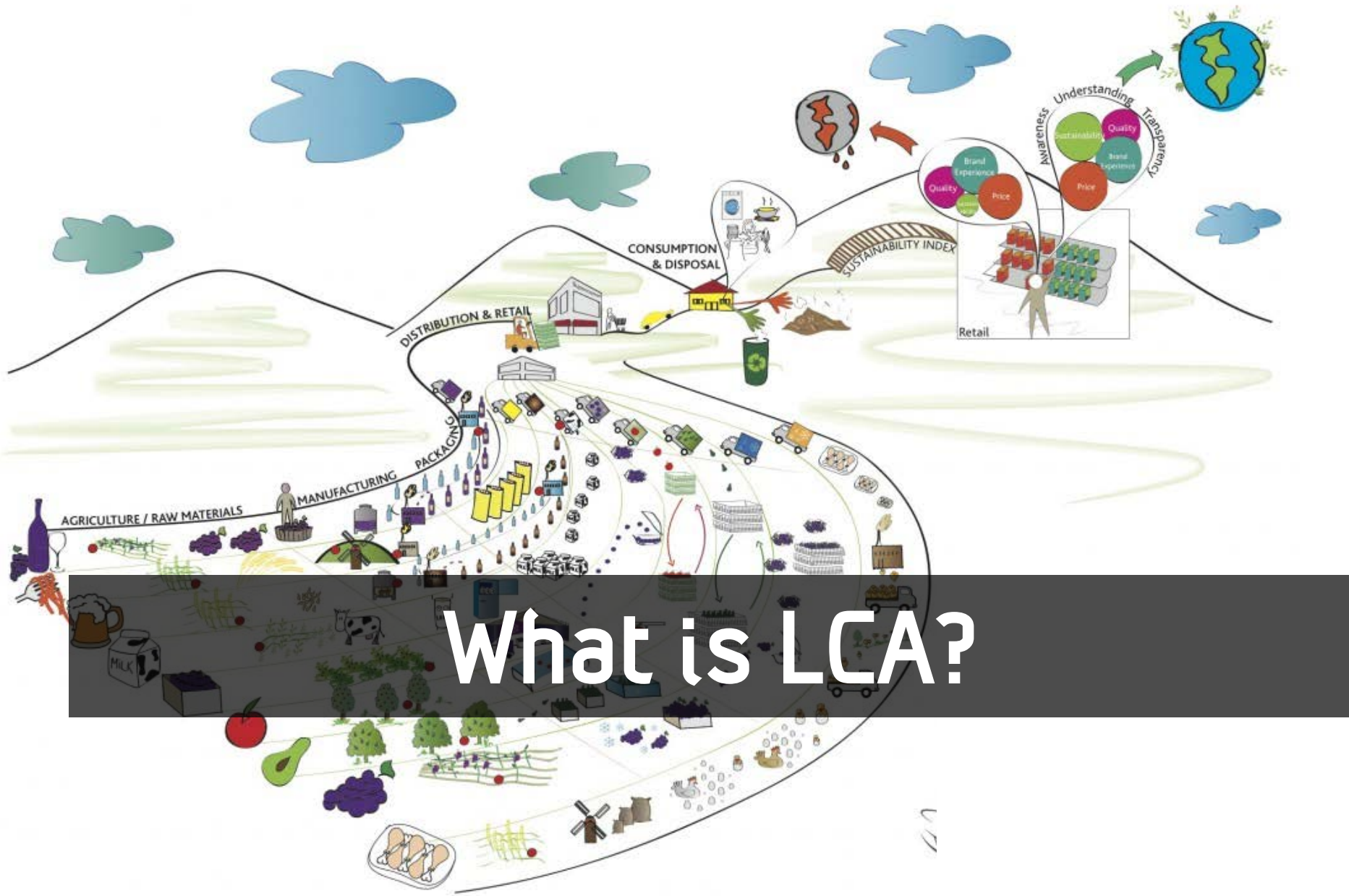
- Seafood productions and its impact on marine and freshwater ecosystems are familiar for us, but there is a bigger picture.
- More than 20% of climate impacts caused by the private consumption in Europe arise from food production [1]
- Livestock alone is behind 14,5% of human made green house gas emissions [2] (7.1 giga ton CO2-equivalents)



1. Hertwich, E.G. and G.P. Peters, *Carbon Footprint of Nations: A Global, Trade-Linked Analysis*. Environmental Science & Technology, 2009. **43**(16): p. 6414-6420.
2. FAO Tackling climate change through livestock - A Global Assessment of Emissions and Mitigation Opportunities <http://www.fao.org/news/story/en/item/197623/icode/>







# What is LCA?

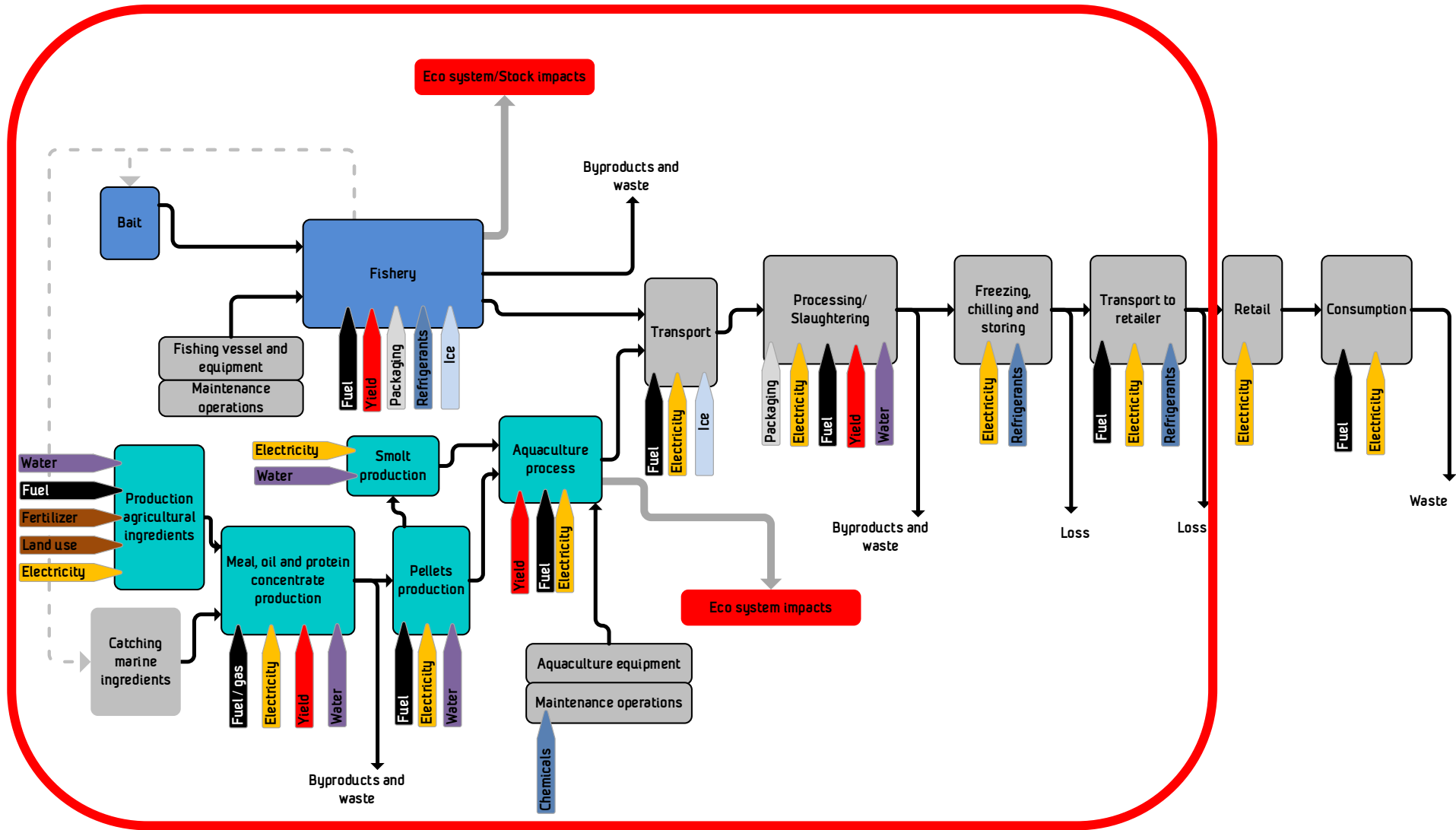
# What is Life Cycle Assessment (LCA)? (I)

A tool to map and quantify the environmental impacts that a product causes through its life cycle, from cradle-to-grave.

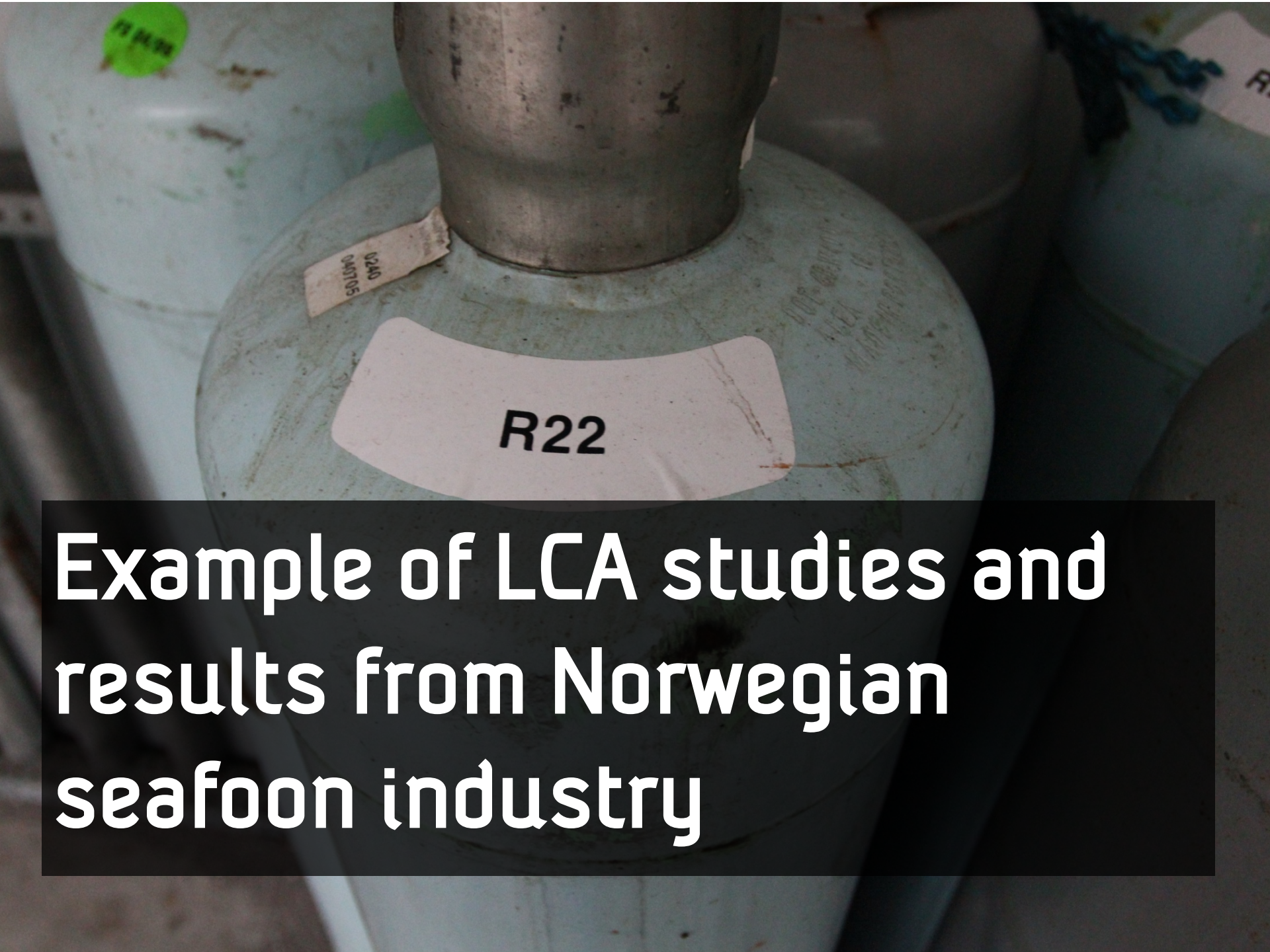
Where an economic assessment book keeps monetary flow, and map where values are generated, the LCA book keep mass and energy flows and map where environmental impacts are caused.

LCA is standardized by ISO in their 14 000 family on environmental management.

# System boundaries: What is included?



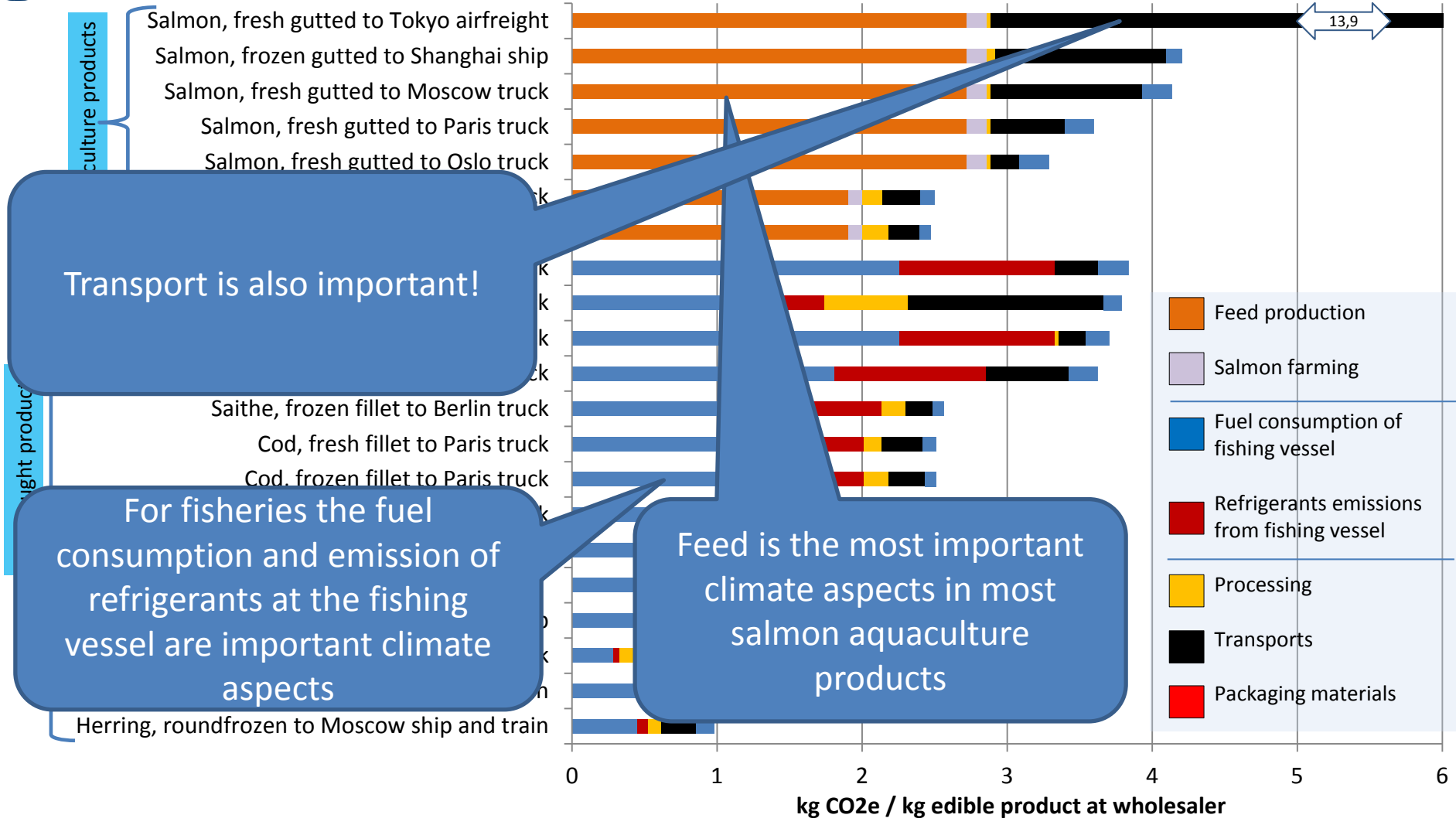




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**Example of LCA studies and results from Norwegian seafoam industry**





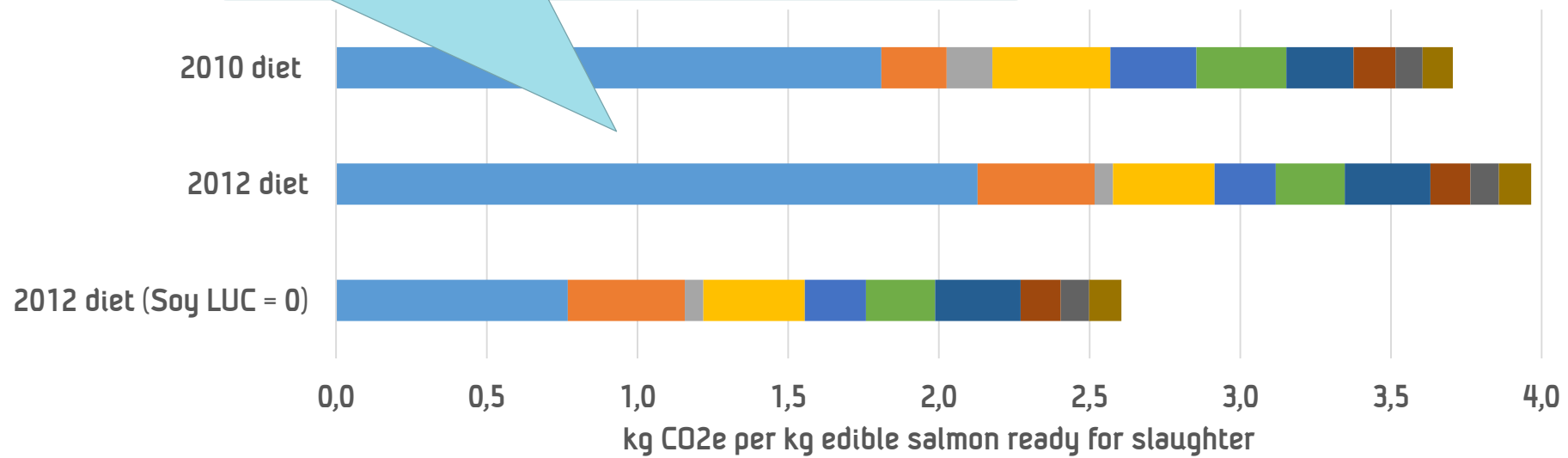
Transport is also important!

For fisheries the fuel consumption and emission of refrigerants at the fishing vessel are important climate aspects

Feed is the most important climate aspects in most salmon aquaculture products

Accumulated sum of GHG emissions caused by producing, processing and transport 1 kg edible product of different Norwegian seafood products to different markets. From the report "Carbon footprint and energy use of Norwegian seafood products" by SINTEF and SIK. Full report here:

The FCR improved, but content of Soy Protein Concentrate increased. Due to land use changes and associated climate impacts this made the carbon footprint increase



- Vegetable protein
- Vegetable oil
- Vegetable starch/carbohydrates
- Marine protein
- Marine oil
- Reduction to marine oil/meal
- Micro ingredients
- Pellets production
- Smolt production
- Salmon farming

Accumulated sum of GHG emissions per kilo of edible salmon at the stage where it is ready for slaughter. Average data for the Norwegian aquaculture industry. FCR for 2010 1,3. FCR for 2012 1,2. The case «2012 diet (Soy LUC=0) refers to a case where climate changes from land use change caused by growing of soy beans is not included.



m<sup>2</sup> agricultural land occupied/kg edible product

0 1 2 3 4 5 6 7 8 9

Pig

Chicken

Aquaculture salmon

■ kg CO<sub>2</sub>e

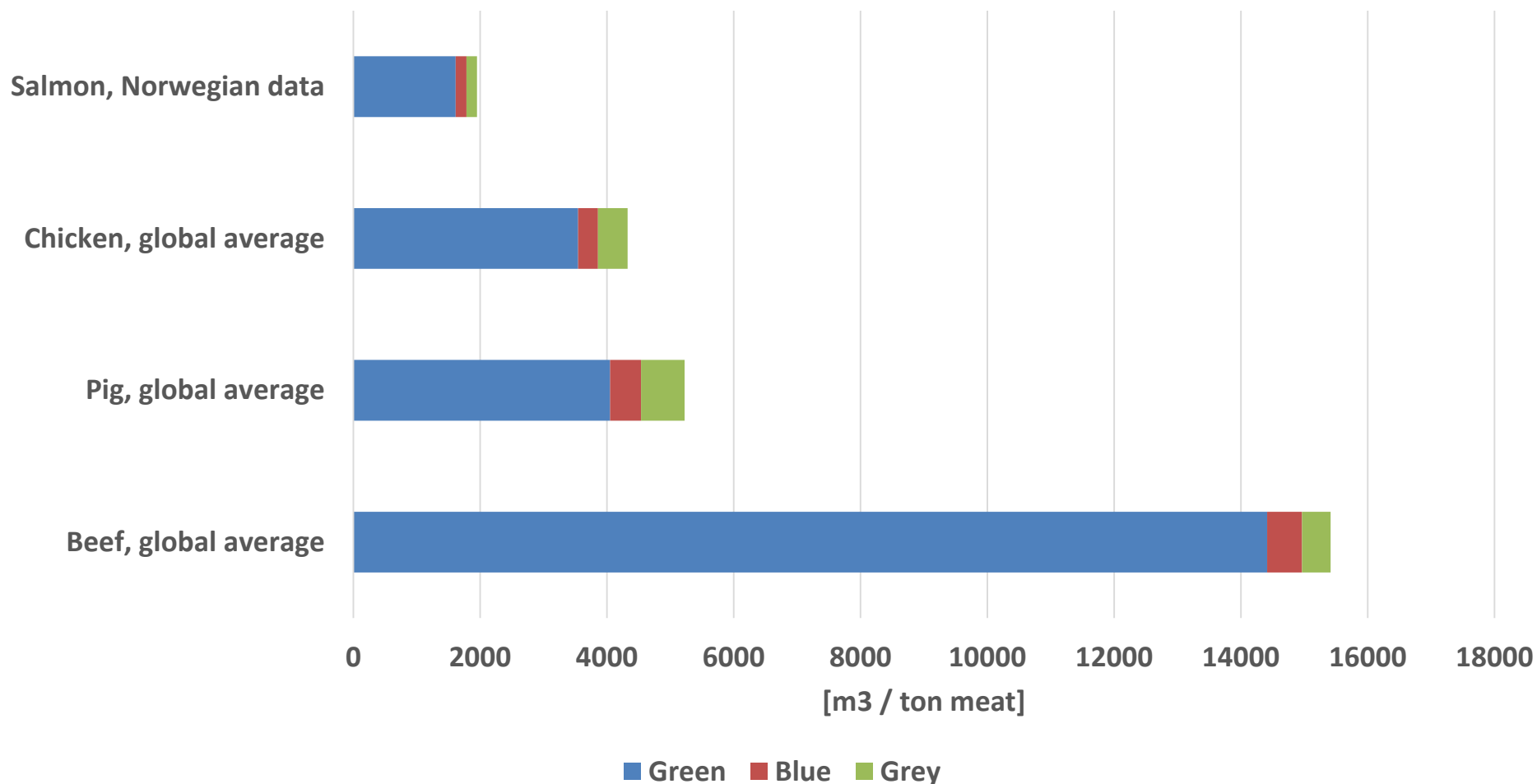
■ m<sup>2</sup> land

0 0,5 1 1,5 2 2,5 3 3,5 4 4,5

kg CO<sub>2</sub>e/kg edible product

Comparison of occupation of agricultural land (top axis) and greenhouse gas (GHG) emissions (bottom axis) from production of 1 kilo edible Norwegian aquaculture salmon and Swedish chicken and pig. From project with SIK: "Carbon footprint and area use of farmed Norwegian salmon". Full report: [www.sintef.no/miljoregnskap-sjomat](http://www.sintef.no/miljoregnskap-sjomat)

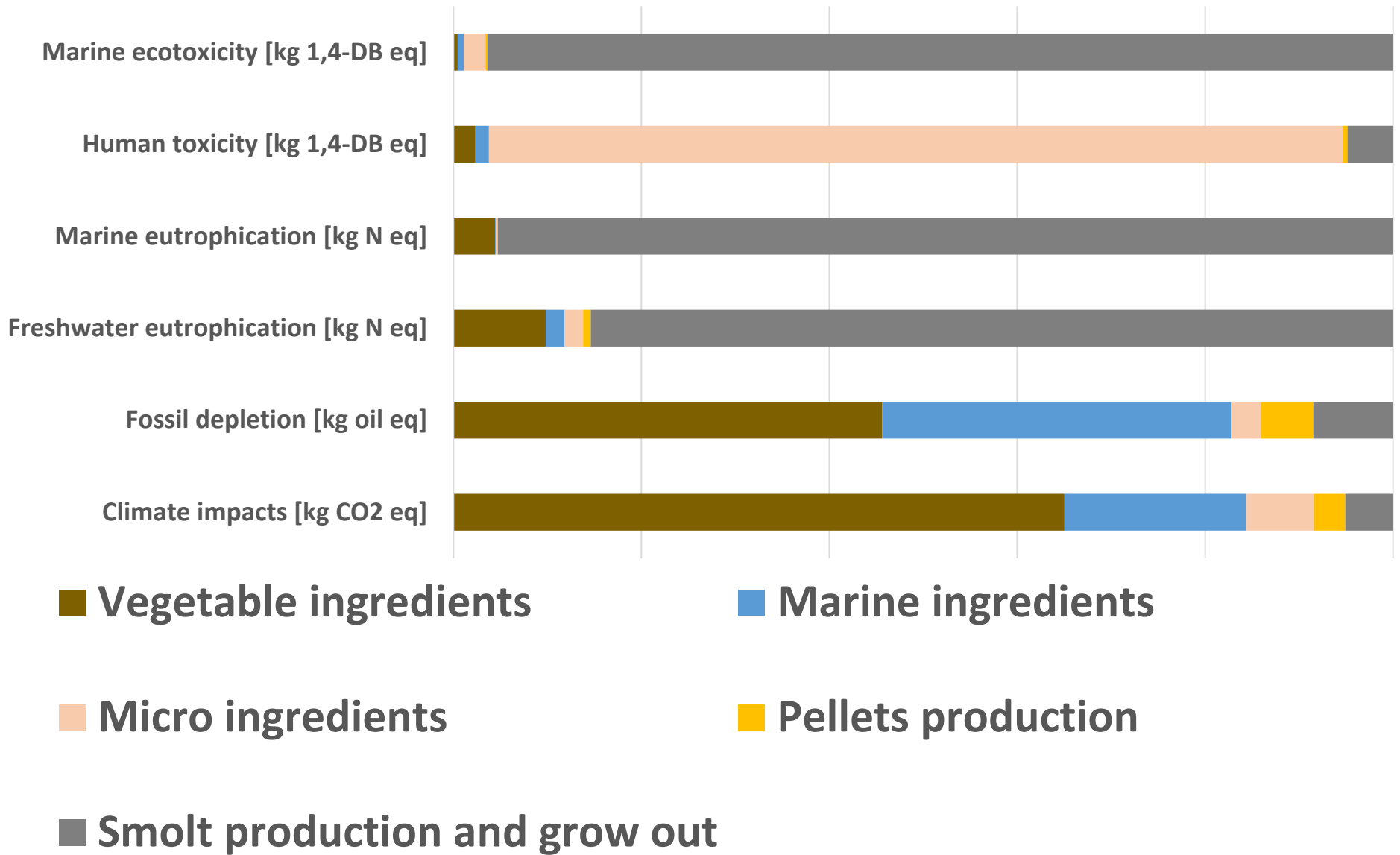
## Comparison of water footprints



Results from using the method promoted by the Water Footprint Network and demonstrated by Mekonnen et al. in their assessments of the water footprint of crops and animal products. [www.waterfootprint.org](http://www.waterfootprint.org). Data: Mekonnen, M.M. and A.Y. Hoekstra, *The green, blue and grey water footprint of crops and derived crop products*. Hydrol. Earth Syst. Sci., 2011. **15**(5): p. 1577-1600. Results for beef, chicken and pig: Mekonnen, M. and A. Hoekstra, *A Global Assessment of the Water Footprint of Farm Animal Products*. Ecosystems, 2012. **15**(3): p. 401-415.



## Holistic view of 2012 salmon production





**What can you use LCA  
for?**



# LCA in R&D

- LCA provides an established and trusted method to explore the potential environmental effects of a new product, technology, strategy etc.
- The holistic approach avoids sub optimization as it will help you discover
  - how environmental impacts might have changed location rather than been reduced
  - or how one environmental impacts has been traded off for another
  - **Clearly show how your solution has a net positive environmental effect**



# Market requirements

Retailers and governments require that their suppliers can document the environmental properties of their products with LCA

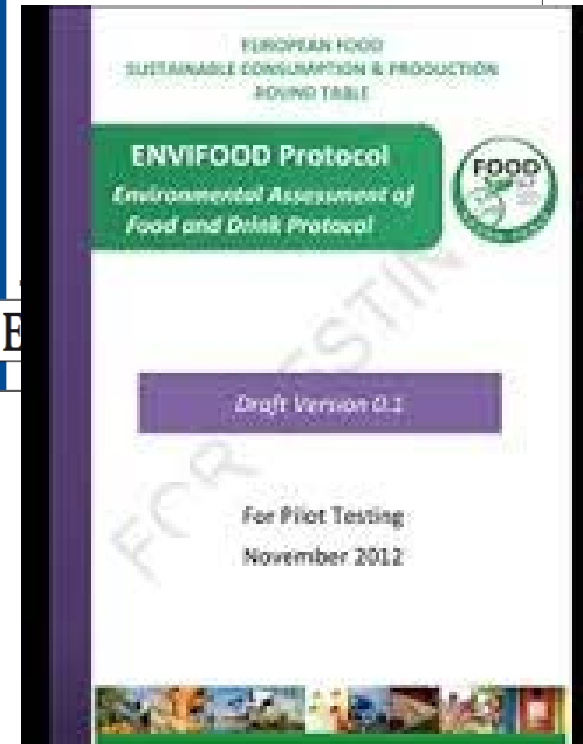
- The European Commission and their Single market for green products
- Retailer consortiums

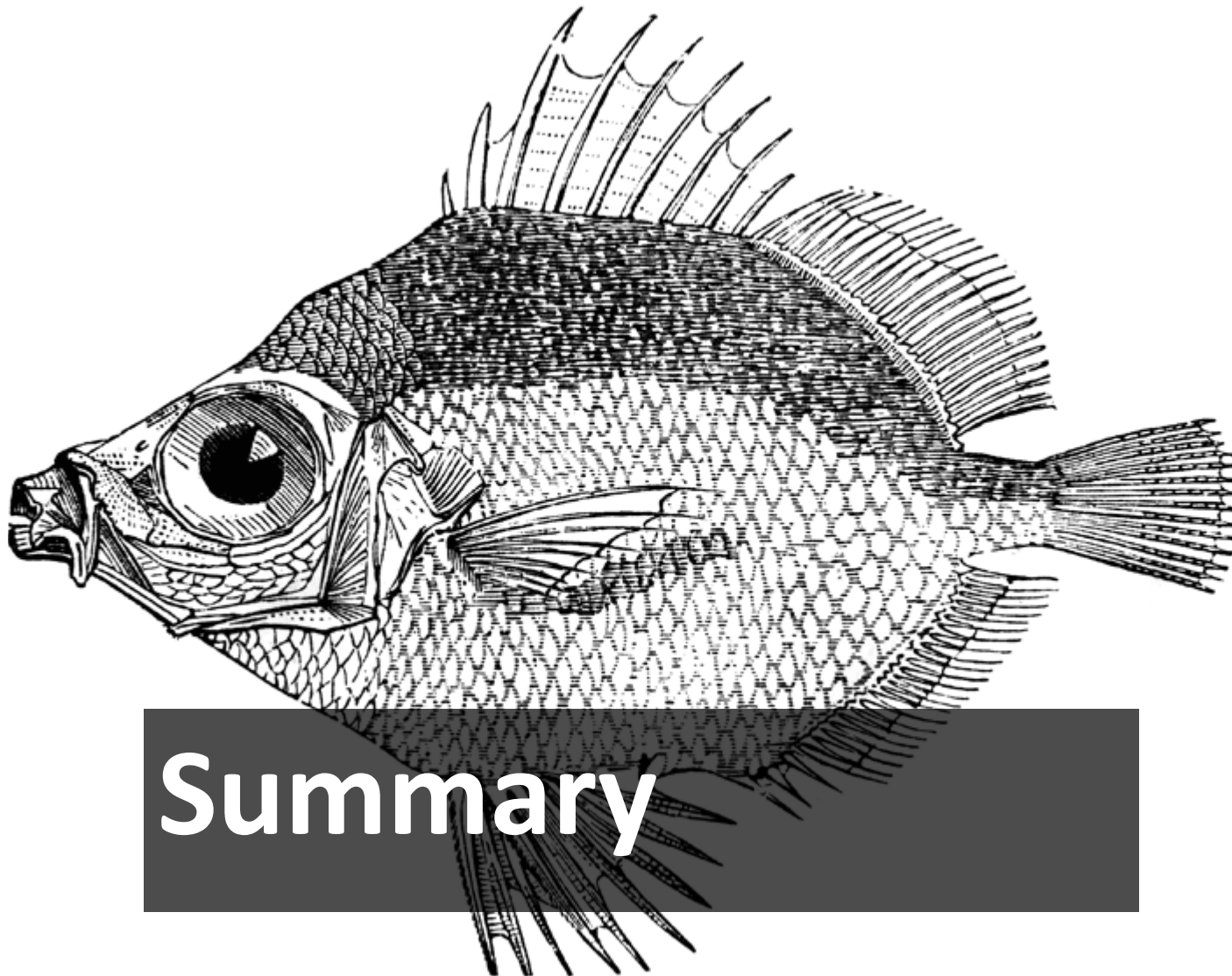




# Single market for green products

- The EC will require that all products on the European market is followed by documentation of their environmental properties.
- This documentation should be based on LCA and the Environmental Footprint Method
- In this very moment the rules for seafood products – for what the assessment should include - is developed. The Norwegian Seafood Federation is leading this task.
- **Every stakeholder in the global seafood industry should pay attention to this development and consider to become a part of it – to make sure the rules are set fair, reasonable and responsible.**





# Summary

# Summary

- Must produce more healthy and safe food with less unsustainable environmental impacts
- Must identify the most efficient ways of doing this.
- LCA is a powerful tool to explore and compare the net environmental properties of different food production systems.
- The Norwegian seafood industry has explored aspects such as their Carbon footprint, marine primary production required, occupation of agricultural land, water footprint and several others.
- LCA will be a requirement for entering important markets all over the world
- Right now the rules are set for how our products should be assessed in the EU. Get involved to ensure fair, reasonable and responsible rules.



# Thank you !



## Questions?

**Erik Skontorp Hognes**

**Mail:**

[erik.hognes@sintef.no](mailto:erik.hognes@sintef.no)

**Tlf:**

**+47 40 22 55 77**

[www.sintef.no/miljoregnskap-sjomat](http://www.sintef.no/miljoregnskap-sjomat)