

# Environmental impacts of plant proteins

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### Finnish superwood

Riina Mäkelä-Mäkelä  
Tutkimuskeskus (research)  
19.9.2017

### Lukeen tilastopalvelut

Research Institute Statistics 27.1.2017

### Dronet luonnonvaratutkimuksen apuna

Joni Kivosaari

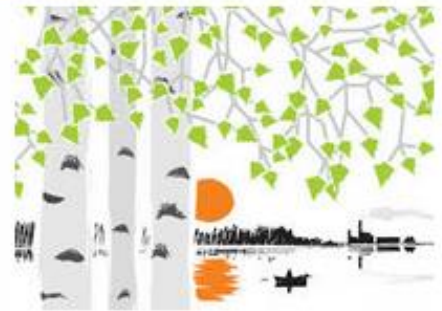


### Diversified use of forest ecosystem services

Anne Tolvanen  
Päivi Merilä & Olli Tarvainen  
Natural Resources Institute Finland



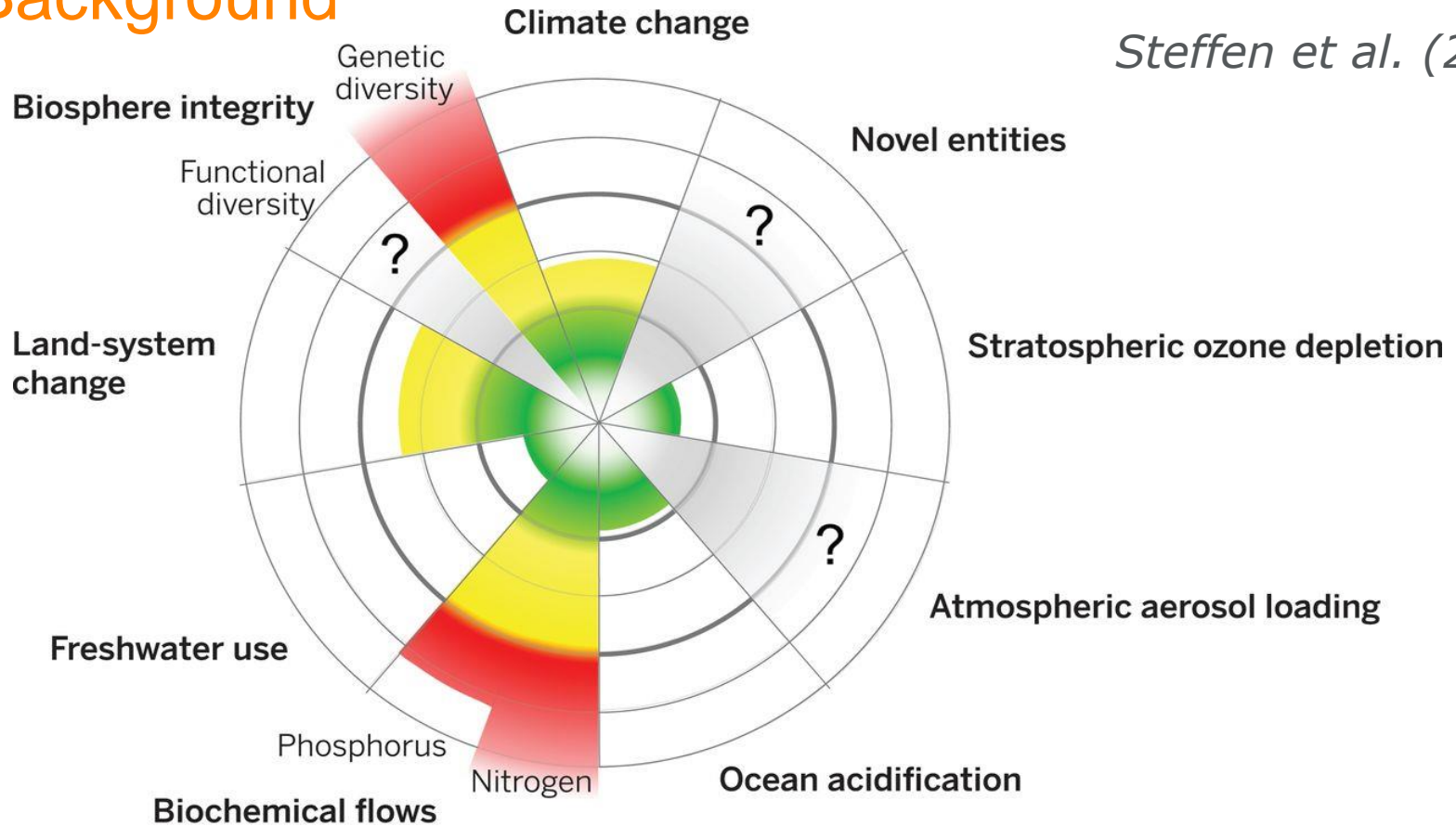
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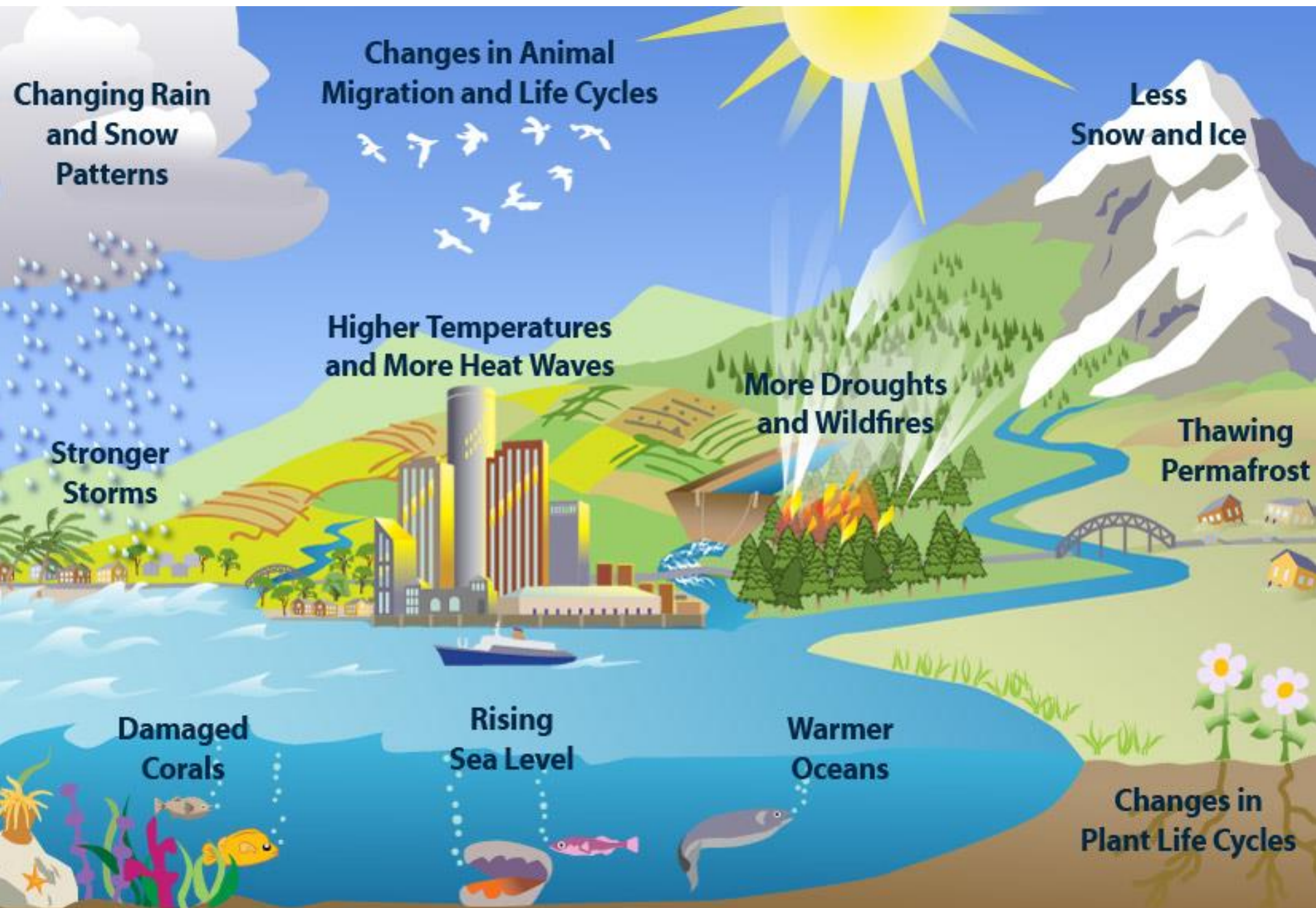
# Background

*Steffen et al. (2015)*



■ Beyond zone of uncertainty (high risk)  
■ In zone of uncertainty (increasing risk)

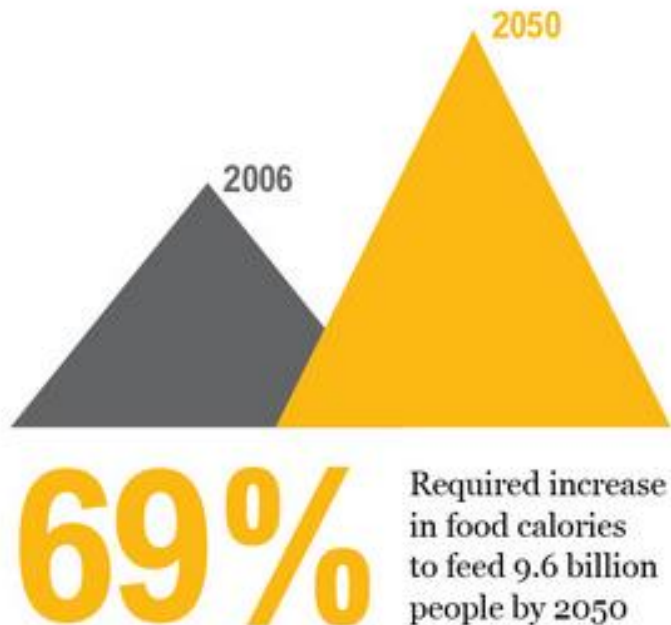
■ Below boundary (safe)  
■ Boundary not yet quantified



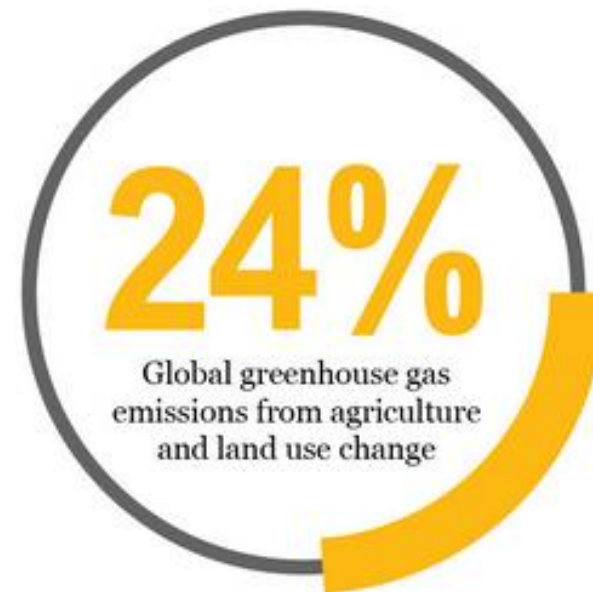
# THE GREAT BALANCING ACT


The world must achieve a “great balancing act” in order to sustainably feed 9.6 billion people by 2050.

## CLOSING THE FOOD GAP



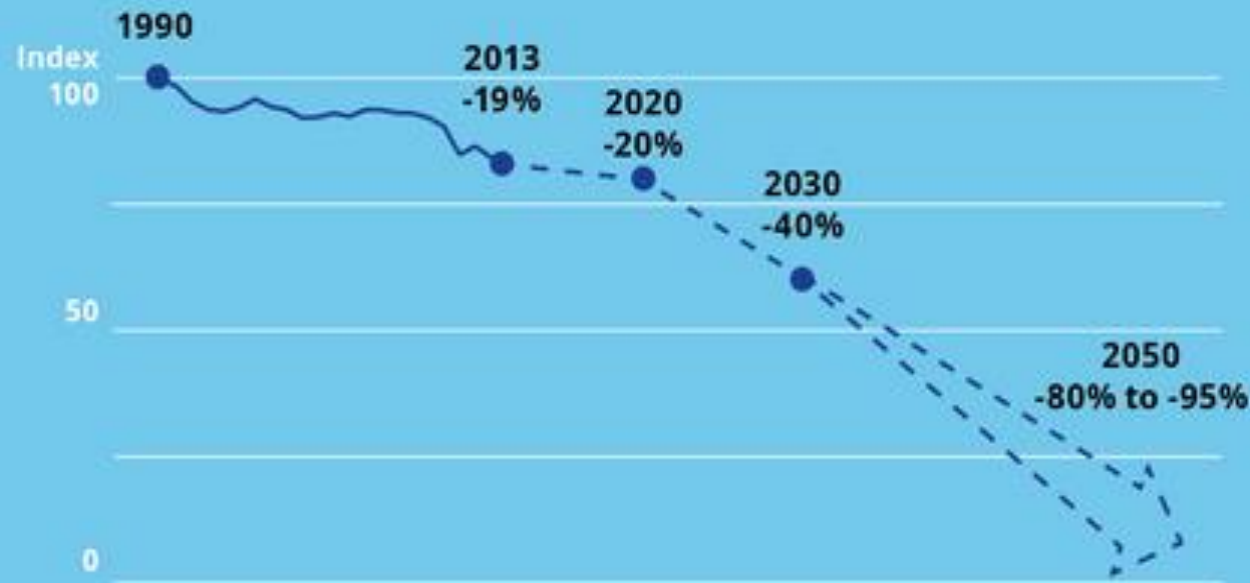
## REDUCING ENVIRONMENTAL IMPACT



 WORLD RESOURCES INSTITUTE

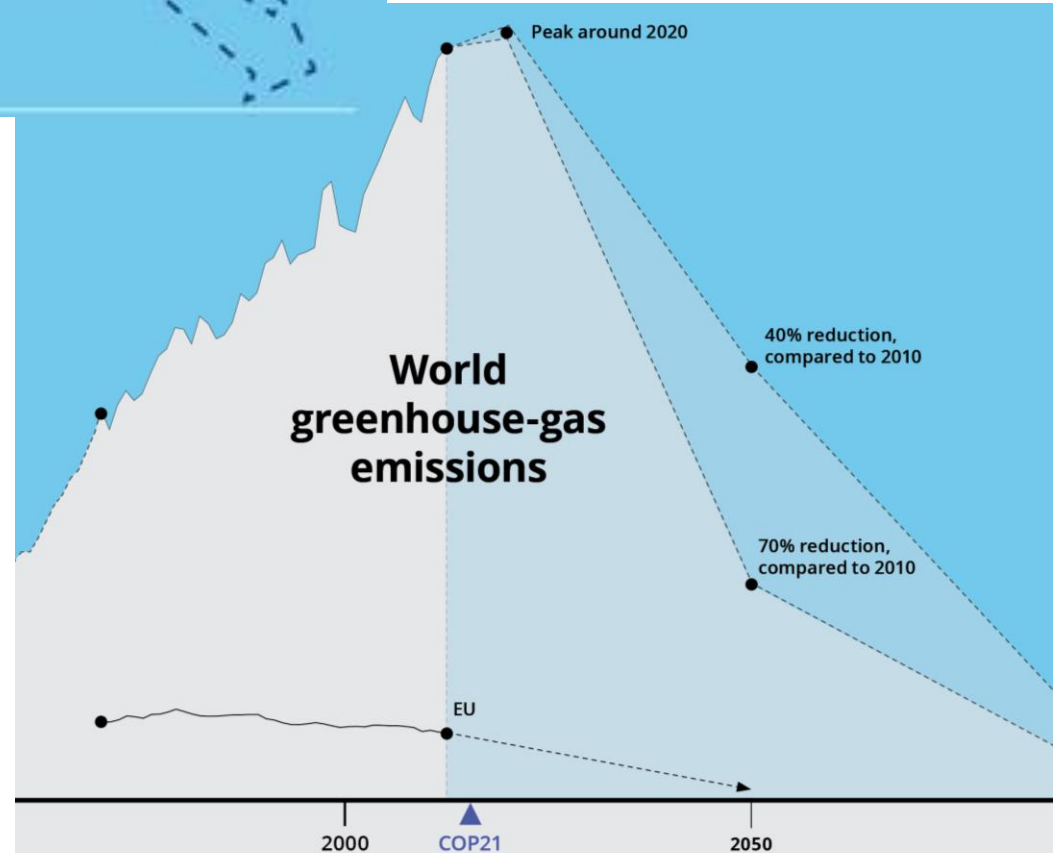


# EU greenhouse-gas emissions and reduction targets,

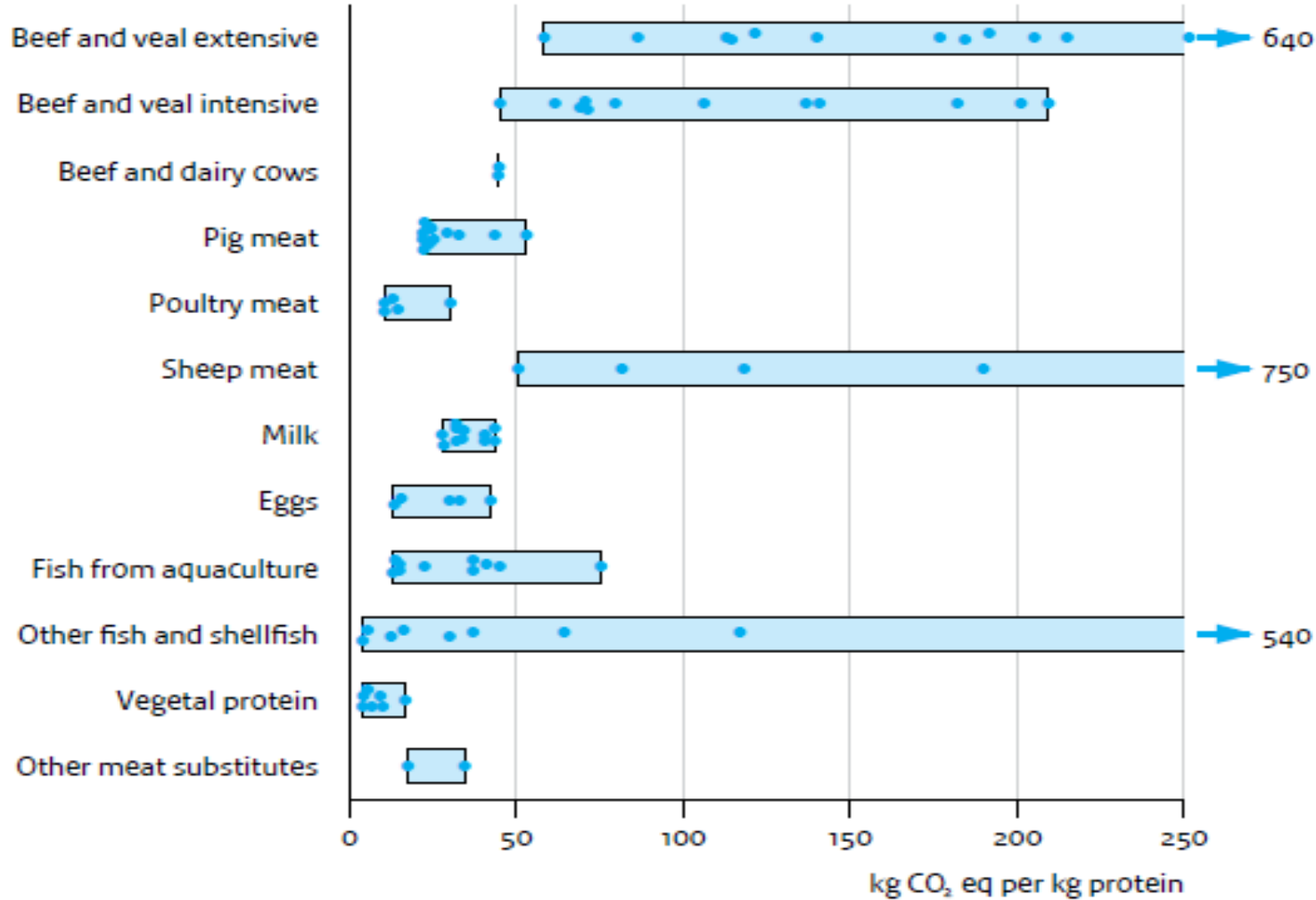


European Environment Agency 

## 2 degrees target



## Greenhouse gas emissions per protein source



Source: Westhoek 2011. Protein puzzle.





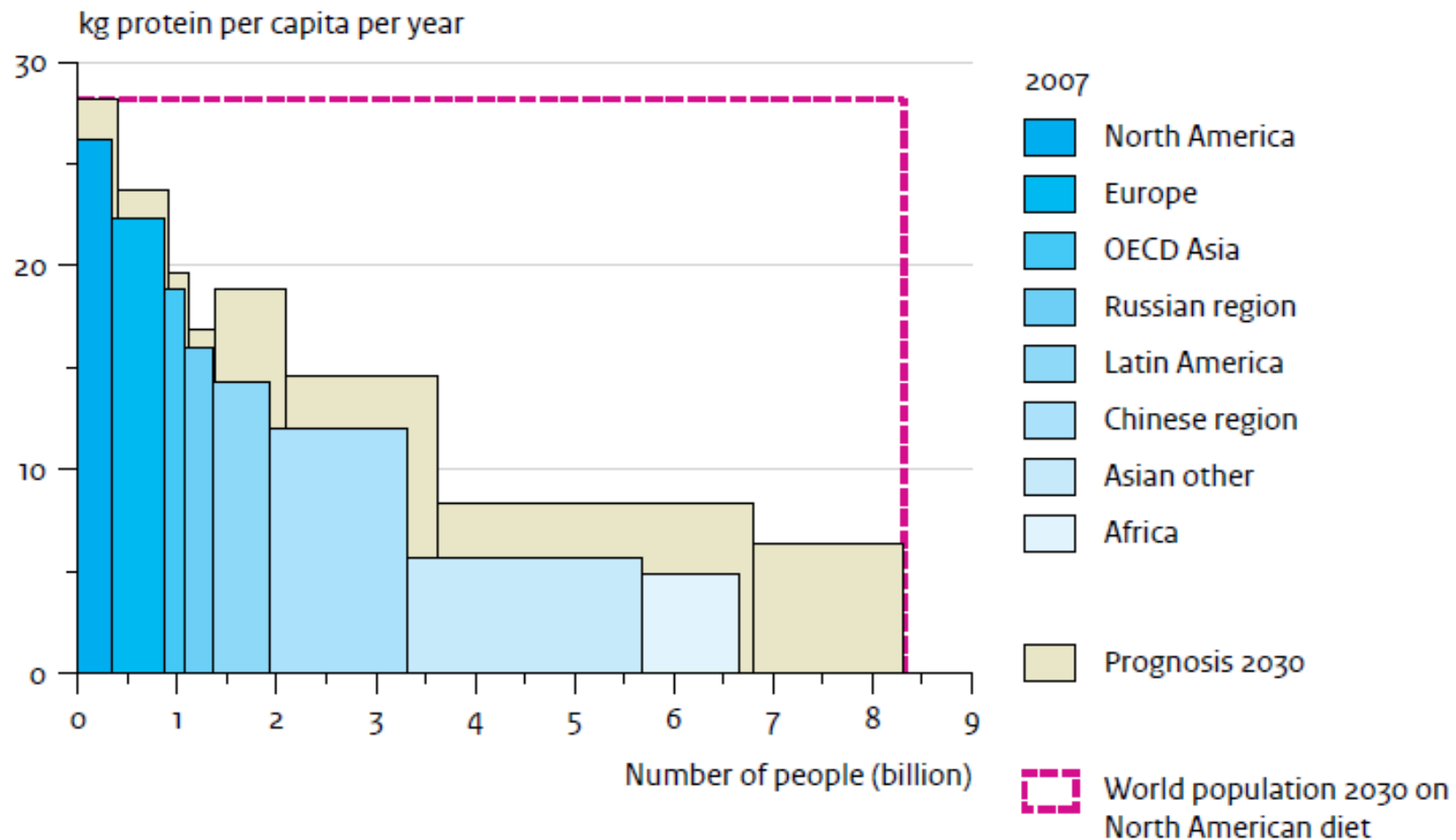
IFPRI Infographic  
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## INSIGHTS

MAGAZINE OF THE INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

Design: C. Hallowell/IFPRI. Source: IFPRI IMPACT projections.  
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## Global intake of animal protein per region



Source: Based on FAO (2006, 2010)

Source: Westhoek 2011. Protein puzzle.



- Oats are an important crop world-wide, but they are mainly used as feed for livestock
  - Side streams from cereal processing are under-exploited
  - Oat can be further processed, the production system improved to obtain valuable  $\beta$ -glucan, oat oil, and protein rich fraction
- 
- Oatpro: Valorizing oat protein from a side stream of  $\beta$ -glucan production system
  - Valuable protein, improved circular economy, side stream to direct human consumption

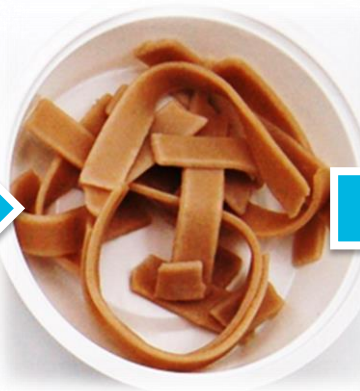


- There is of course a limit also to the amount of processing energy we can put to valorizing side stream
- Thus, the question from environmental perspective:

Are

- 1) oat protein concentrate,
  - 2) food products enriched with it and
  - 3) their use in diets
- surely more environmentally friendly  
compared to animal protein?

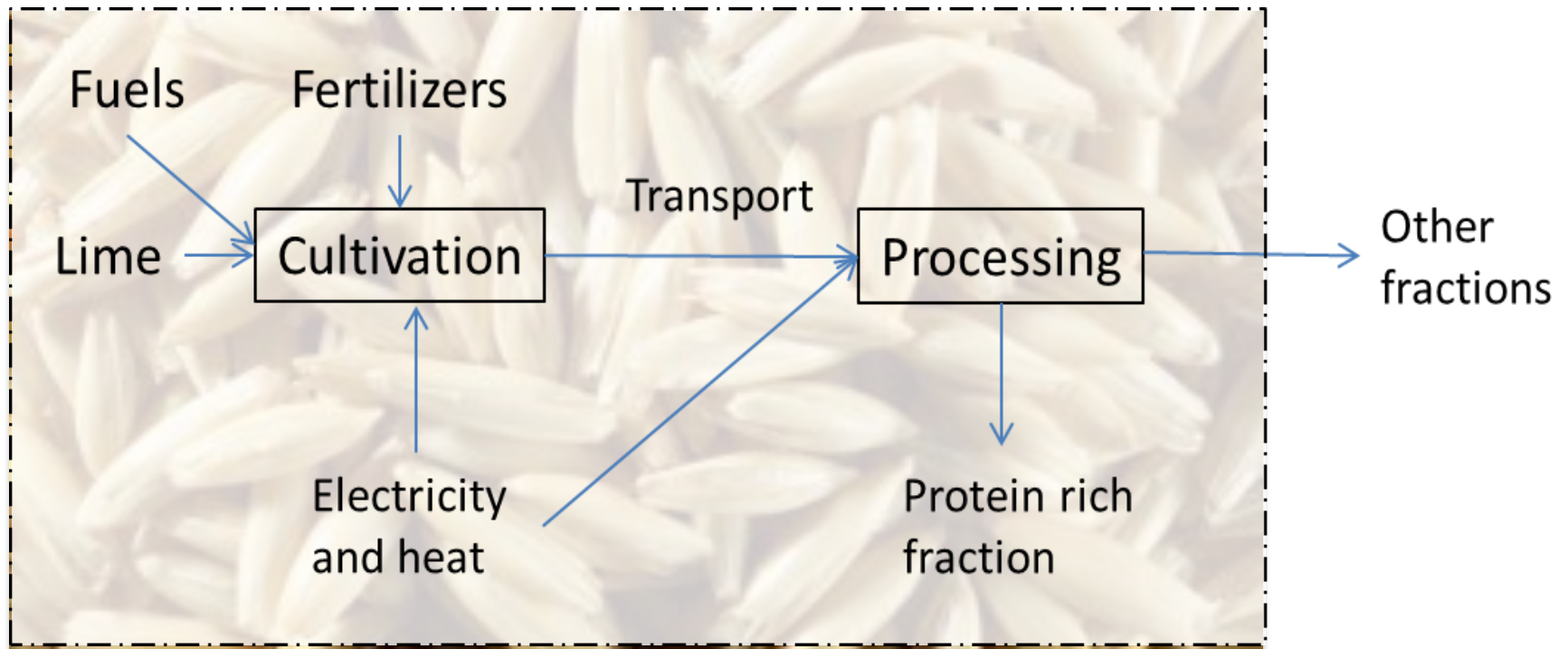




## How did we assessed the carbon footprint of oat protein and food products rich in oat protein?

- Life Cycle Assessment is internationally accepted method to estimate environmental impacts of products and services
  - ISO standards, EU guidelines etc.
  - Assessment of whole production system from raw material production to final consumption and waste management
  - Different environmental impacts: Climate, water, nutrients etc.
- Here we assessed carbon footprint, and land use
  - Greenhouse gases: CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>-emissions
  - Land use, m<sup>3</sup>

## System boundary of Life Cycle Assessment of oat protein

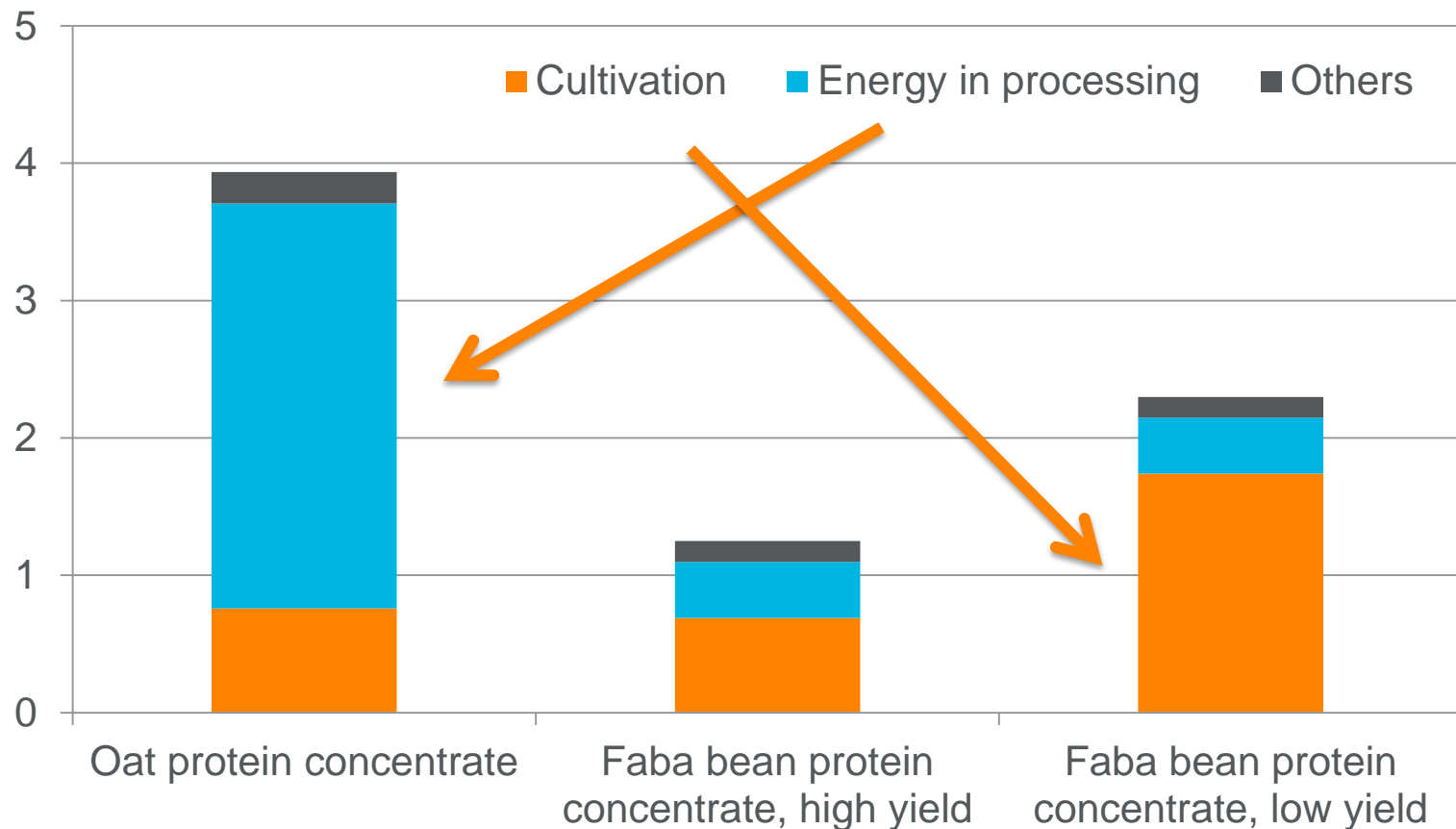


## Data collection

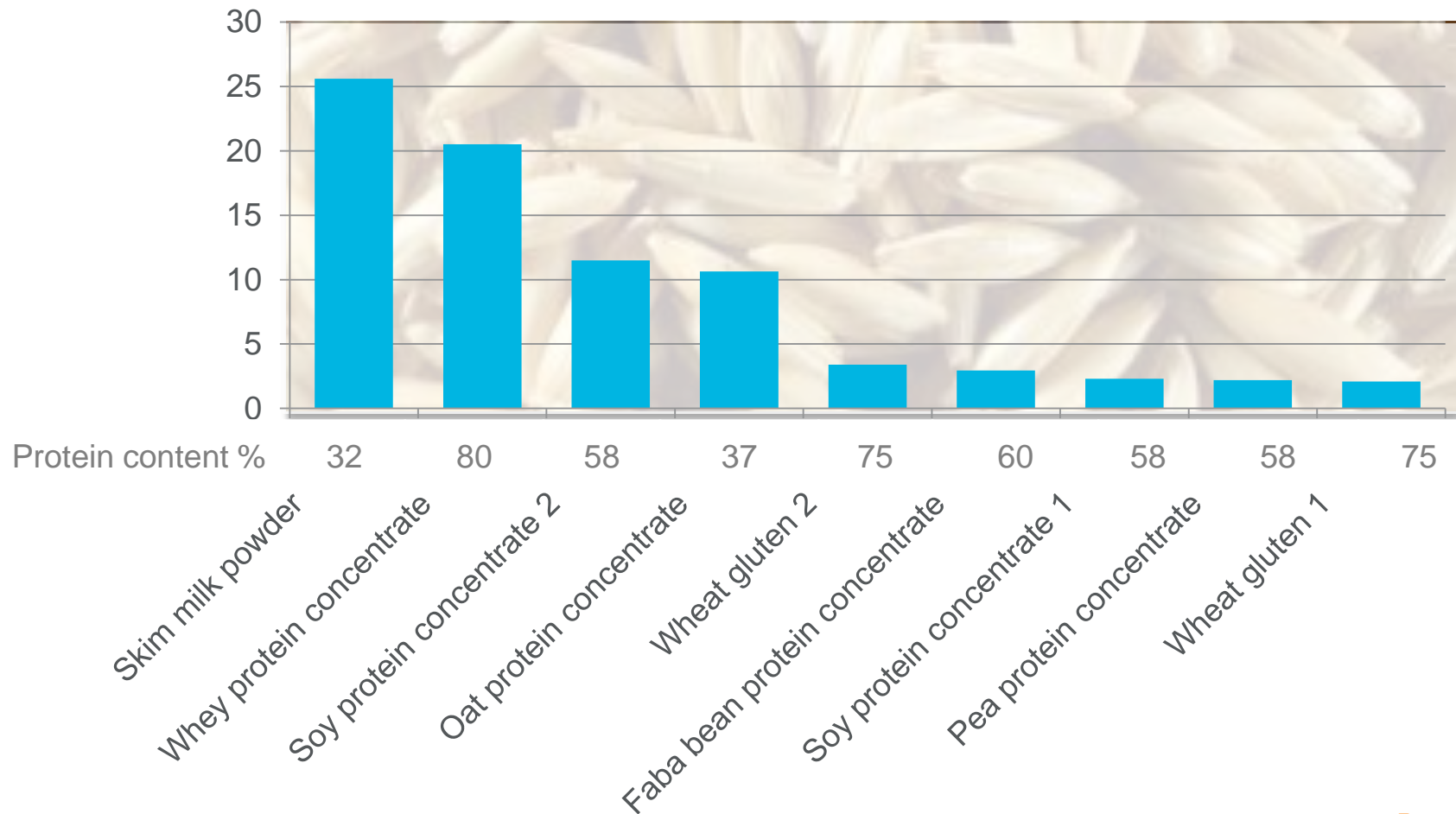
- Oat cultivation
  - Weighted average of Finnish, Danish German, Romanian oat
- Cultivation of wheat & durum wheat
  - Literature average of main European producer countries
- Oat protein production
  - Data from private companies conducting the processing for the project
- Production of final food products
  - Average literature data and previous studies form Luke



## Carbon footprint of oat and faba bean protein concentrates, kg CO<sub>2</sub>-eq / kg product



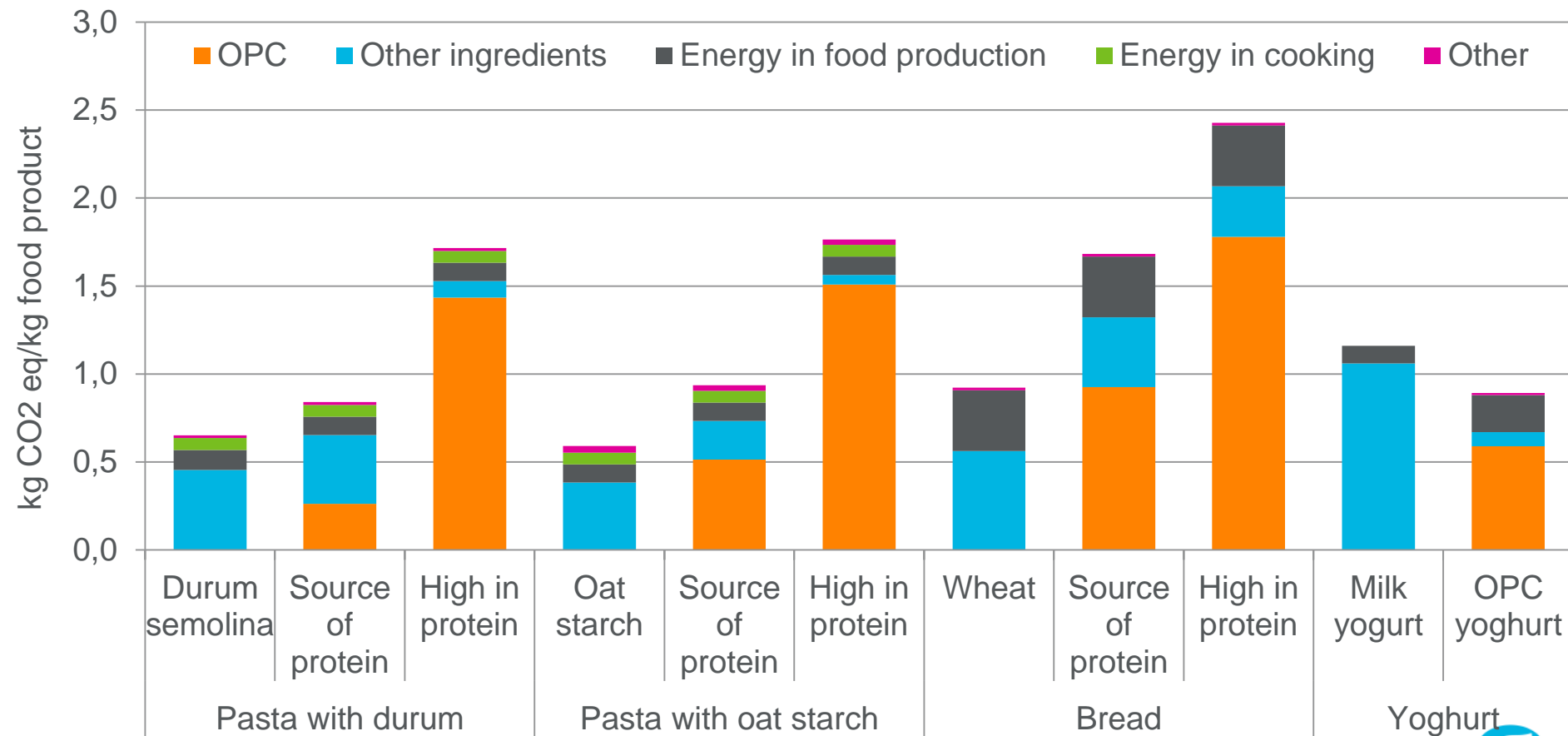
## Carbon footprint of protein concentrates, per kg of protein



## Food products rich in oat protein concentrate (OPC) – main ingredients, not water and other small ingredients

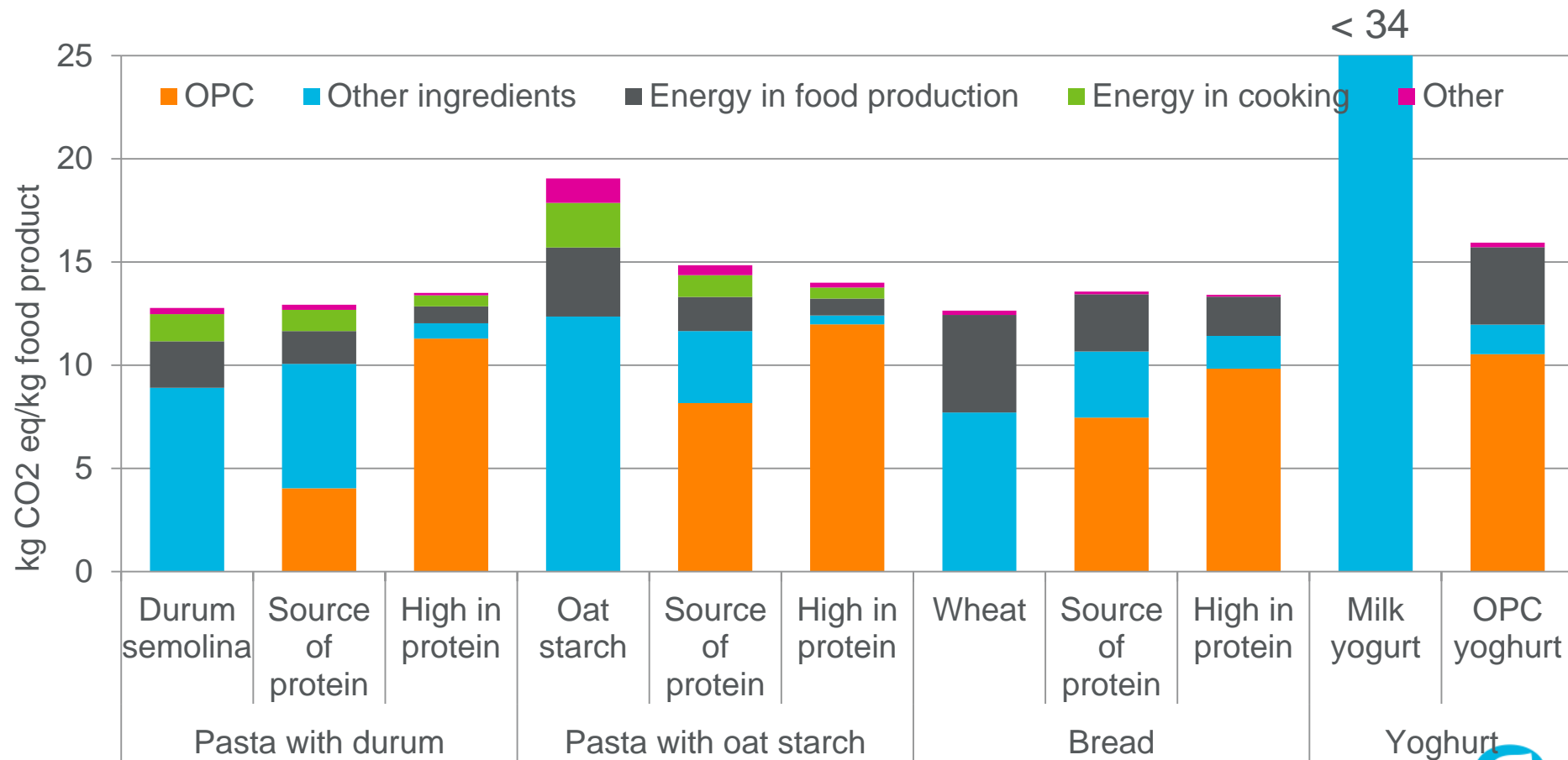
Food product	Recipe, grams per 1 kg product
Durum pasta	Durum wheat semolina 450
Durum + OPC pasta, source of protein	Durum wheat semolina 390 Oat Protein Concentrate 70
Durum + OPC pasta, high in protein	Durum wheat semolina 90 Oat Protein Concentrate 360
Oat starch pasta	Oat starch 600
Oat starch + OPC pasta, source of protein	Oat starch 410 Oat Protein Concentrate 160
Oat starch + OPC pasta, high in protein	Oat starch 110 Oat Protein Concentrate 480
Wheat bread	Wheat flour 610
Wheat + OPC bread, source of protein	Wheat flour 290 Oat Protein Concentrate 240
Wheat + OPC bread, high in protein	Wheat flour 80 Oat Protein Concentrate 450
OPC yoghurt, high in protein	Oat Protein Concentrate 150

## Carbon footprints of food products rich in oat protein (OPC) – per kg product

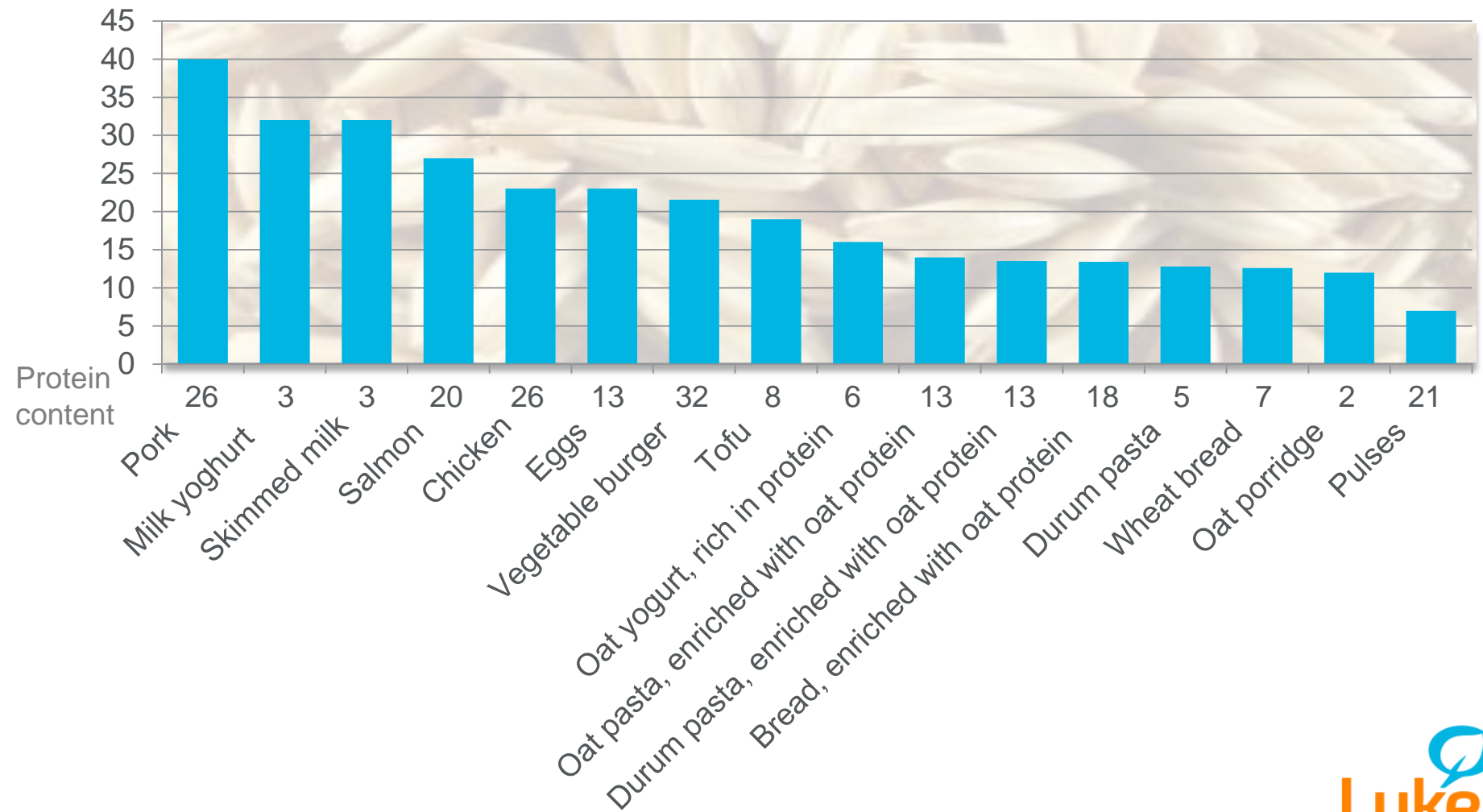




## Carbon footprints of food products rich in oat protein (OPC) – per kg protein



## Carbon footprint of products enriched with oat protein and conventional food products as ready-to-eat (cooked)





## Conclusions

- Oat protein good to replace animal proteins
- Food products rich in oat protein seem good to replace animal products
- Still, the carbon footprint is higher than of legume proteins
  - Fixing nitrogen in cultivation stage
  - Light processing stage
  - With the exception if there has been deforestation in case of soy, then OPC and soy on the same level
- Carbon footprint of oat protein is very dependent on the prices of the different side streams – creates uncertainties
- Environmental impacts are reduced only if animal protein and animal products are replaced

Thank you!