VEJEN TIL DET BÆREDYGTIGE ROBUSTE LANDBRUG

– FOKUS PÅ METODER

VED MARIE TRYDEMAN KNUDSEN

AARHUS
UNIVERSITY
DEPARTMENT OF AGROECOLOGY

MARIE TRYDEMAN KNUDSEN

- Seniorforsker ved Institut for Agroøkologi ved Århus Universitet og medlem af Klimarådet
- Agronom og ph.d. i livscyklusvurderinger af fødevarer
- Klima- og miljømæssig bæredygtighed af landbrugs- og fødevaresystemer, hvor jeg bruger livscyklusvurderinger - og underviser i jordbrug i globalt perspektiv.

FØDEVARESYSTEMER FRA JO TER, HUSDYR TIL KOSTSAMM

GRØNTSA

Hvad er klima- og miljøpåvirkningen?

Forbedringsmuligheder?

ÆTNING

SKOVLANDBRUG

BIORAFFINERI

Hvad fanger metoden?

Hvordan kan vi forbedre metoden (f.eks. kulstoflagring eller biodiversitet)?

HUSDYRPRODUKTION

ALTERNATIVE C

FØDEVARESYSTEMET FRA HELIKOPTERBLIK

MILJØPÅVIRKNING FRA FØDEVAREPRODUKTION

Klimapåvirkning

Næringsstofberigelse

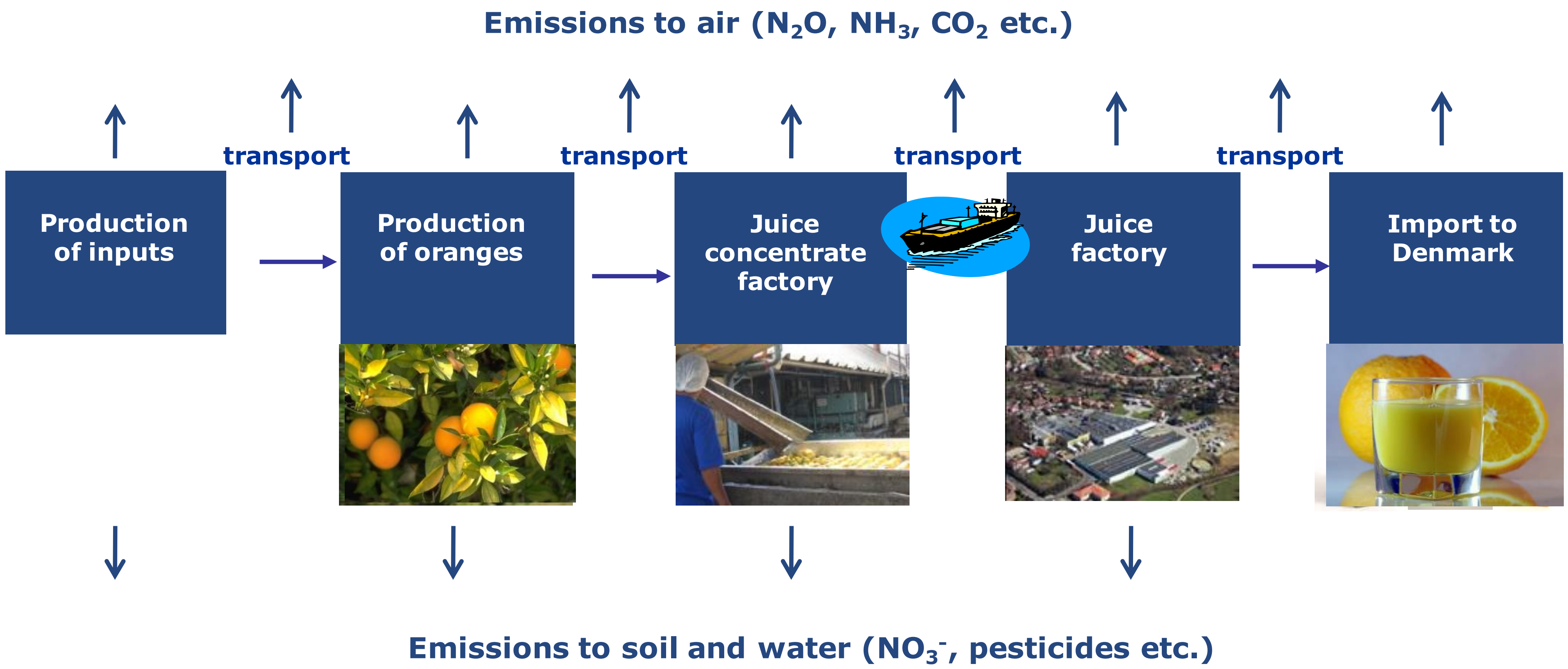
Økotoxicitet

Jord og kulstoflagring

Biodiversitet

Dyrevelfærd

BEREGNET VIA LIVSCYKLUSVURDERINGER

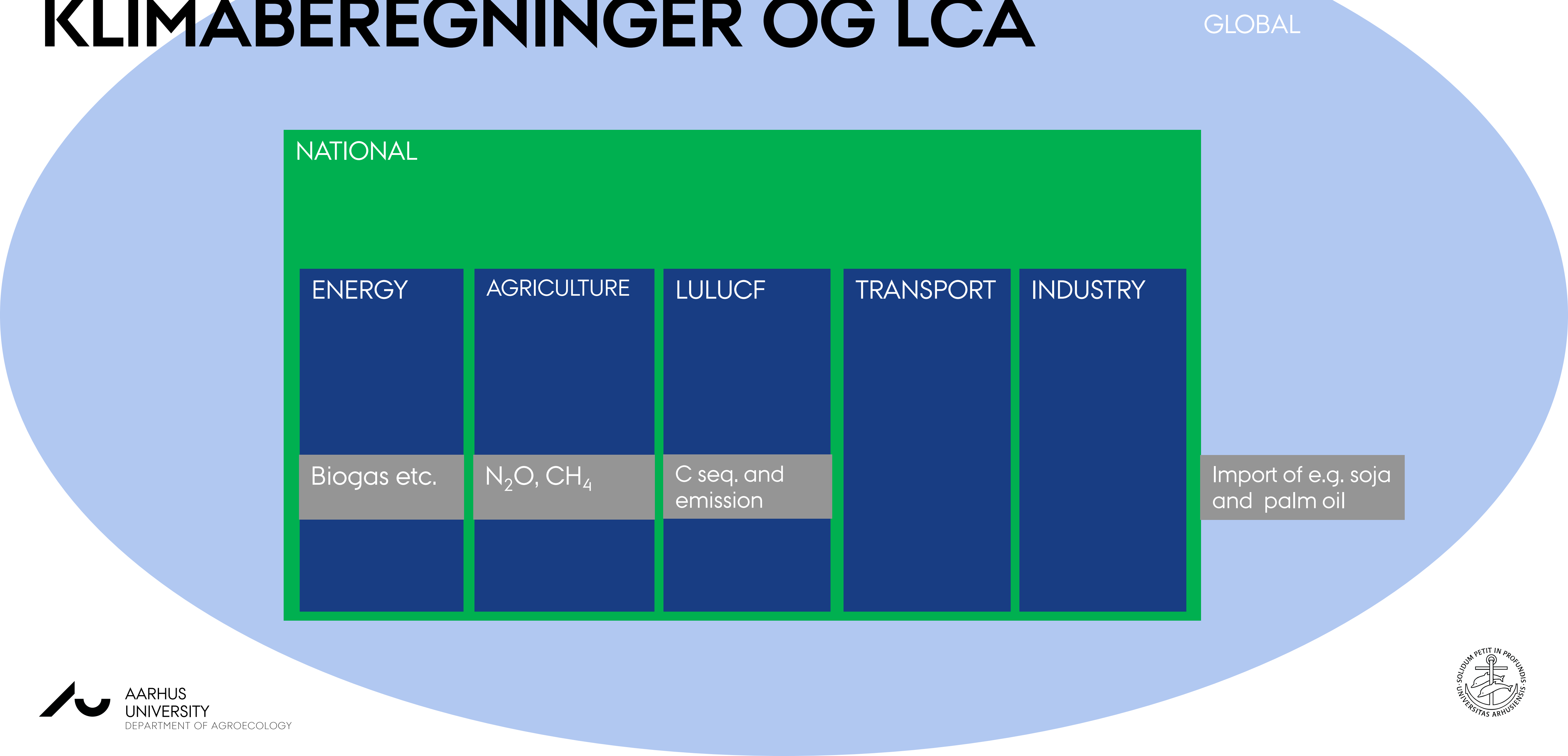


Emissions to air (N_2O, NH_3, CO_2 etc.)

Production of inputs → transport → **Production of oranges** → transport → **Juice concentrate factory** → transport → **Juice factory** → transport → **Import to Denmark**

Emissions to soil and water (NO_3^-, pesticides etc.)

KLIMABEREGNINGER OG LCA



GLOBAL

NATIONAL

ENERGY

Biogas etc.

AGRICULTURE

N_2O, CH_4

LULUCF

C seq. and emission

TRANSPORT

INDUSTRY

Import of e.g. soja and palm oil

PRODUCT ENVIRONMENTAL FOOTPRINT (PEF)

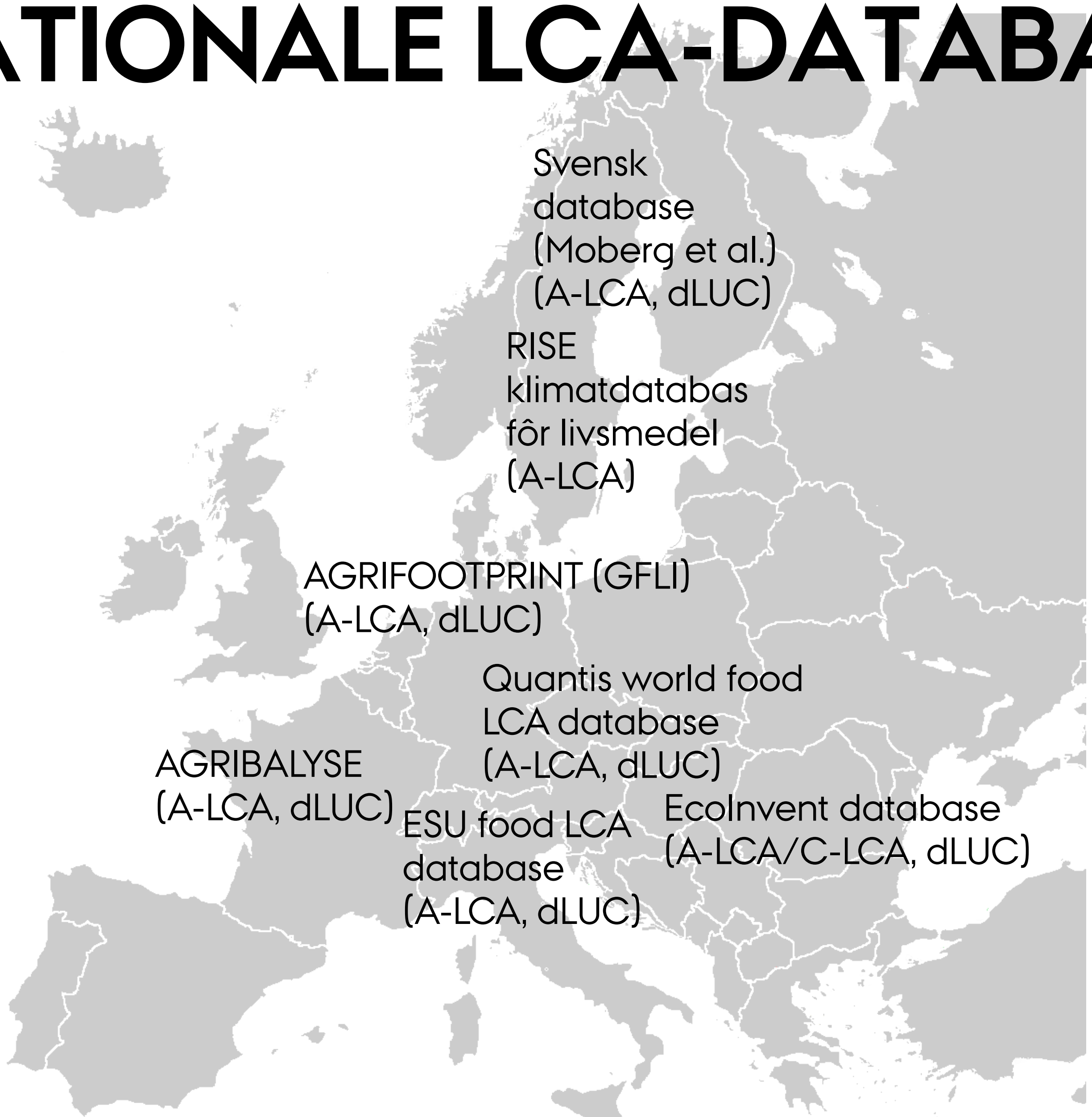
The development of the PEF and OEF methods

DG Environment has worked together with the European Commission's Joint Research Centre (JRC IES) and other European Commission services towards the development of a **harmonised methodology for the calculation of the environmental footprint of products and organisations** (including carbon).

Existing methods and initiatives were taken into account

- For the product angle, the International Reference Life Cycle Data System (ILCD) Handbook as well as other existing methodological standards and guidance documents (ISO 14040-44, PAS 2050, BP X30, WRI/WBCSD GHG protocol, Sustainability Consortium, ISO 14025, Ecological Footprint, etc).
- For the organisation angle, the Reference Life Cycle Data System Handbook (ILCD

INTERNATIONALE LCA-DATABASER



Svensk database (Moberg et al.) (A-LCA, dLUC)

RISE klimatdatabas fôr livsmedel (A-LCA)

AGRIFOOTPRINT (GFLI) (A-LCA, dLUC)

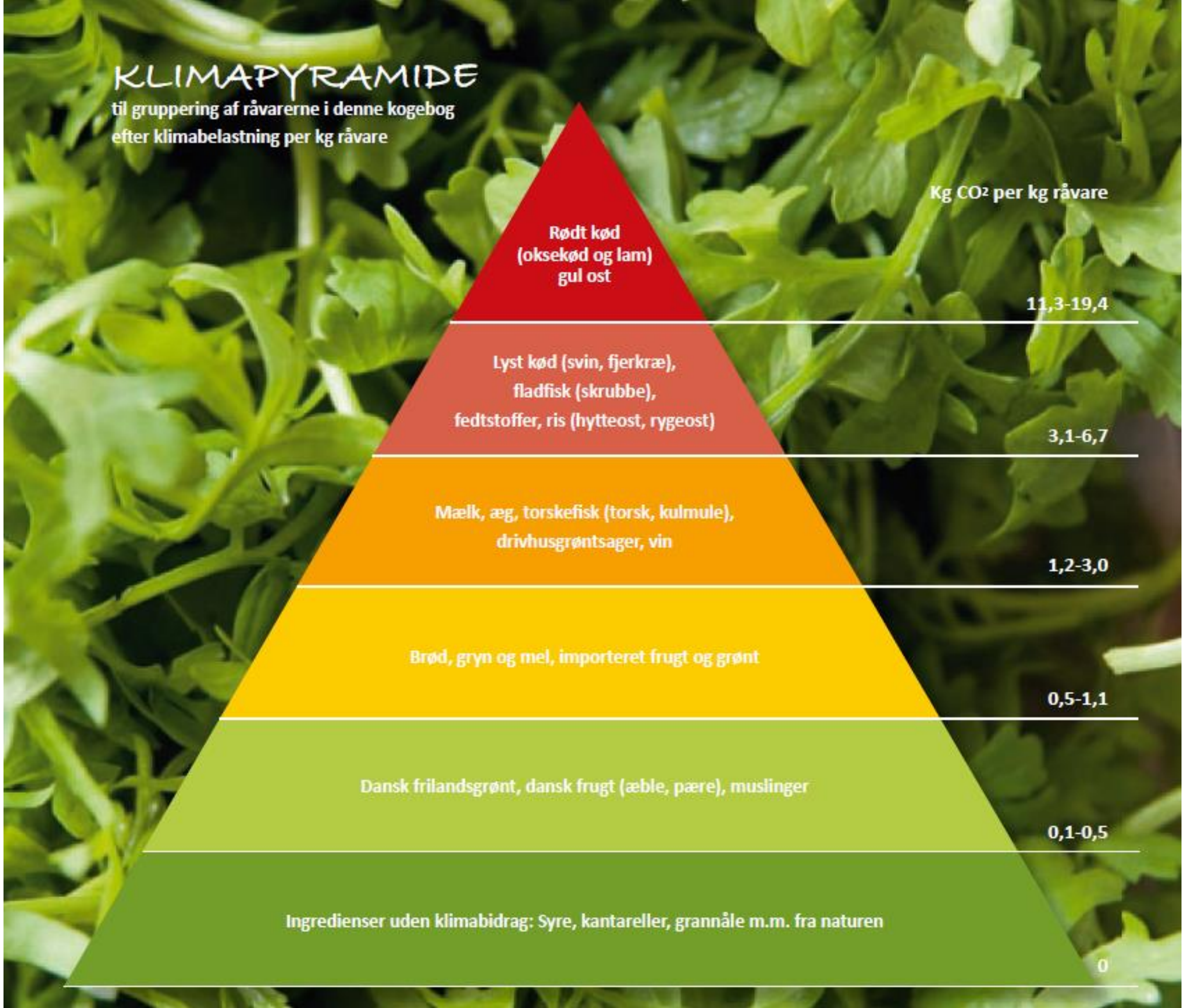
Quantis world food LCA database (A-LCA, dLUC)

AGRIBALYSE (A-LCA, dLUC)

ESU food LCA database (A-LCA, dLUC)

EcoInvent database (A-LCA/C-LCA, dLUC)

Mogensen et al. 2021

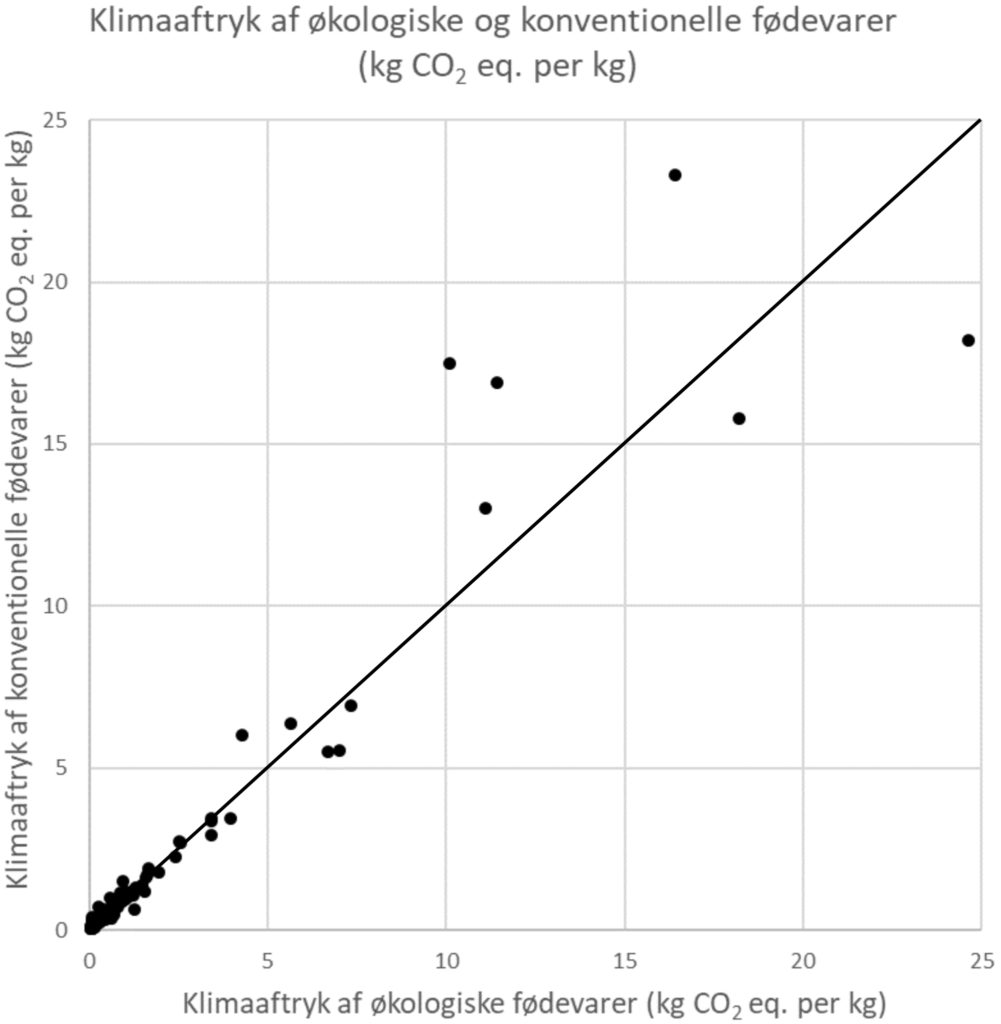


KLIMAPYRAMIDE

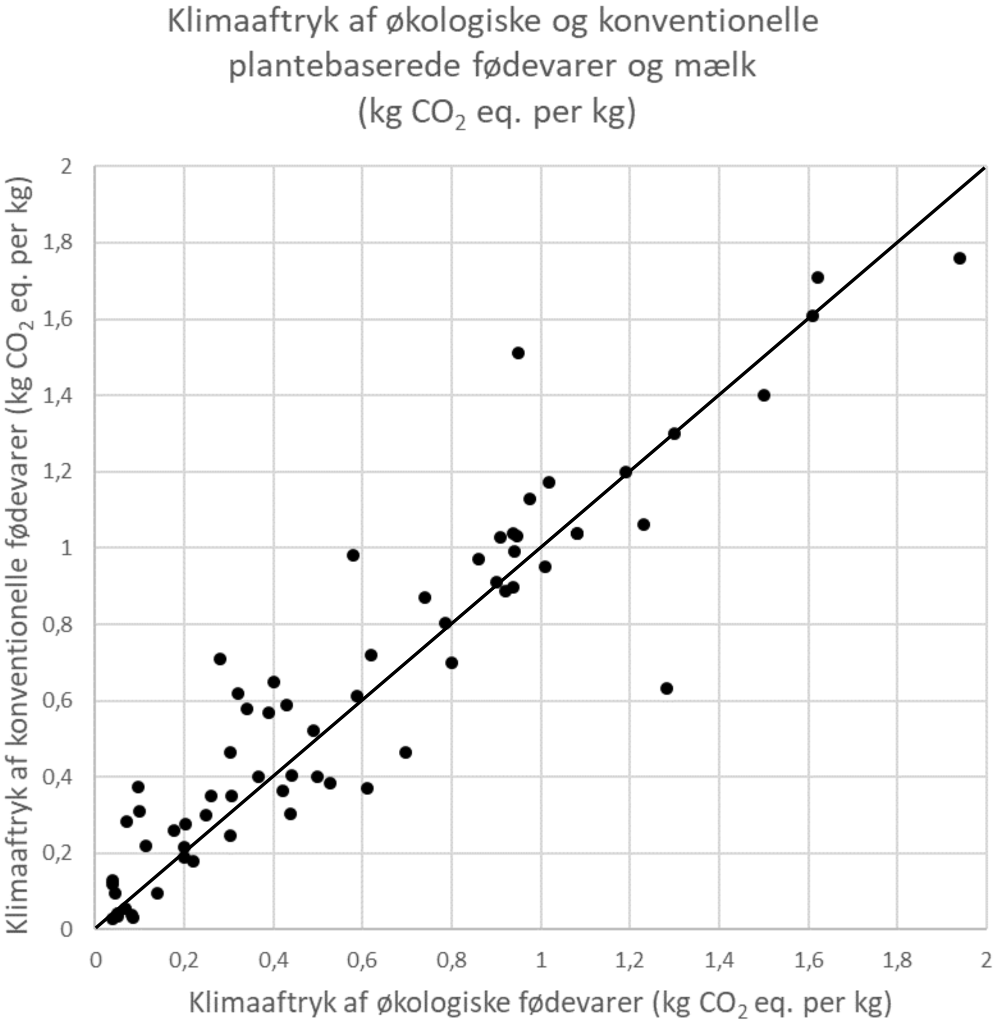
til gruppering af råvarerne i denne kogebog
efter klimabelastning per kg råvare

	Kg CO^2 per kg råvare
Rødt kød (oksekød og lam) gul ost	11,3-19,4
Lyst kød (svin, fjerkræ), fladfisk (skrubbe), fedtstoffer, ris (hytteost, rygeost)	3,1-6,7
Mælk, æg, torskefisk (torsk, kulmule), drivhusgrøntsager, vin	1,2-3,0
Brød, gryn og mel, importeret frugt og grønt	0,5-1,1
Dansk frilandsgrønt, dansk frugt (æble, pære), muslinger	0,1-0,5
Ingredienser uden klimabidrag: Syre, kantareller, grannåle m.m. fra naturen	0

KLIMAAFTRYK FRA FØDEVARER – PER KG
– BASERET PÅ REVIEW AF 50 VIDENSKABELIGE ARTIKLER



KLIMAAFTRYK FRA PLANTER OG MÆLK
– BASERET PÅ REVIEW AF 39 VIDENSKABELIGE ARTIKLER



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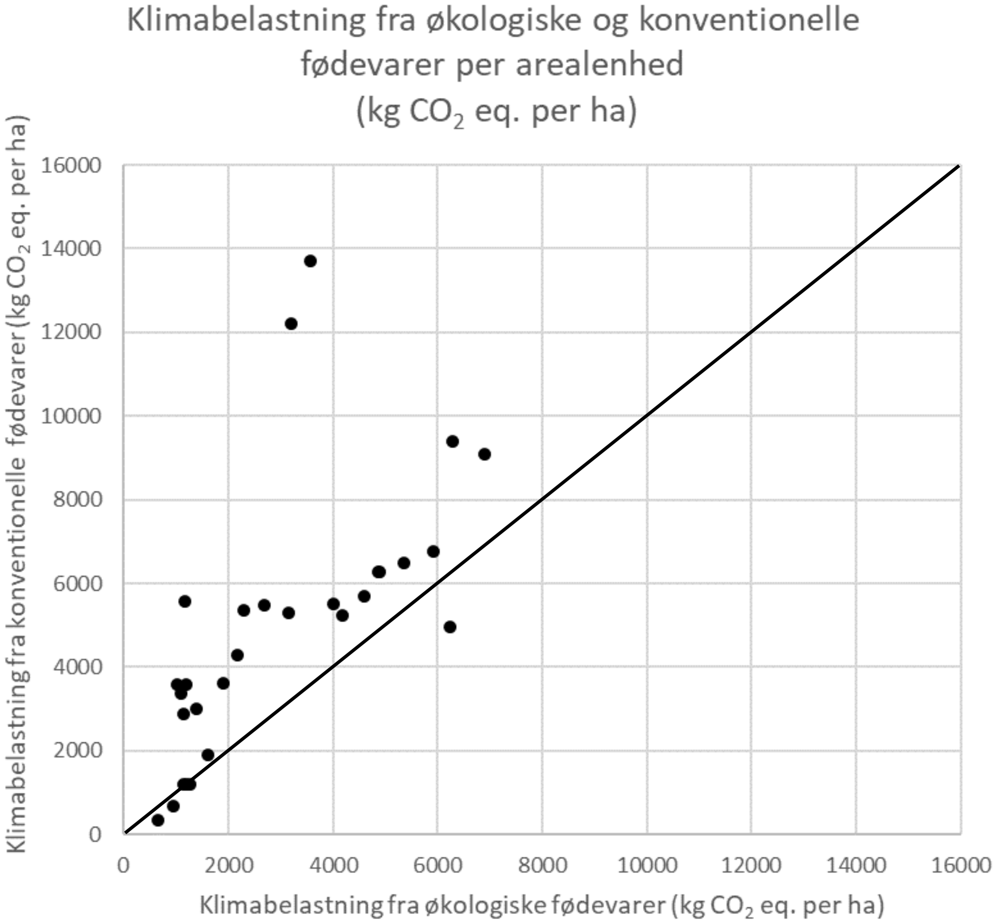
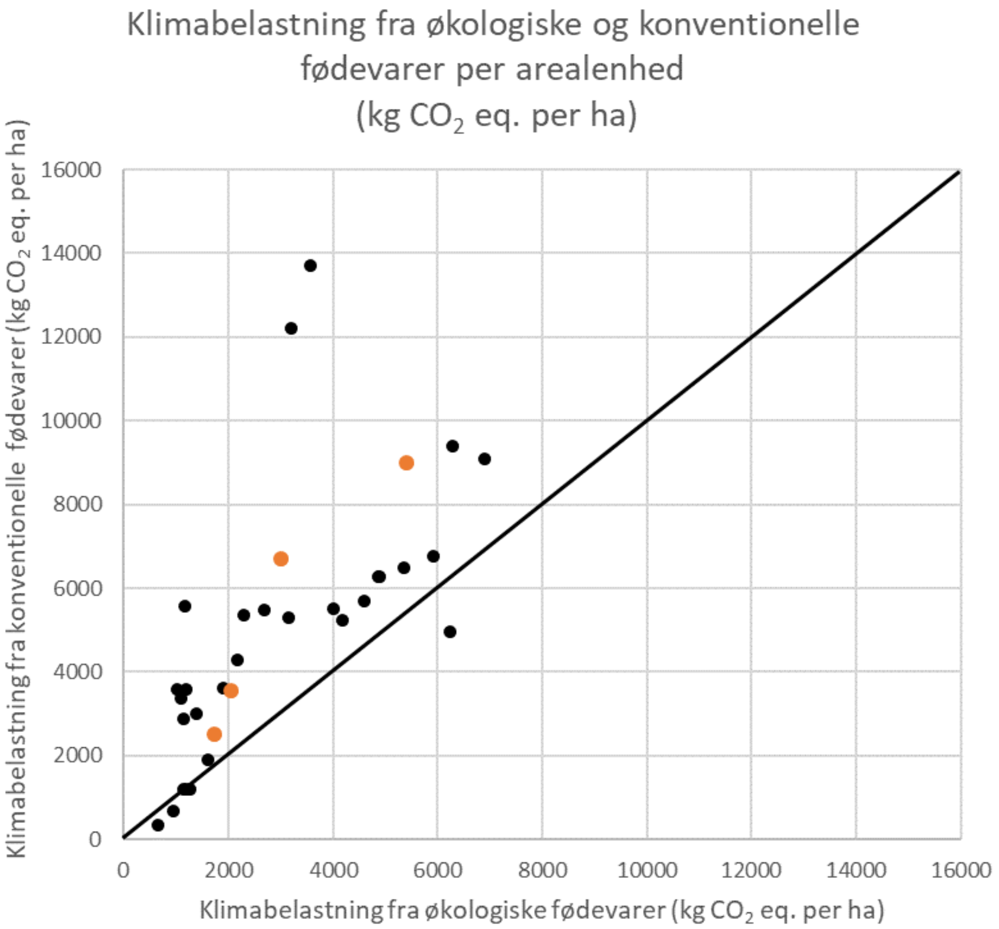
KLIMABELASTNING, FØDEVARER - PER HA
– BASERET PÅ REVIEW AF 23 VIDENSKABELIGE ARTIKLER



KLIMABELASTNING, FØDEVARER - PER HA

– BASERET PÅ REVIEW AF 23 VIDENSKABELIGE ARTIKLER



Kristensen et al. 2020

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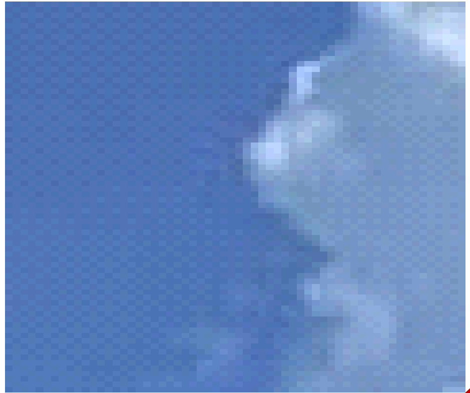
MILJØPÅVIRKNING FRA FØDEVAREPRODUKTION

Klimapåvirkning



Næringsstofberigelse

Økotoxicitet

Jord og kulstoflagring

Biodiversitet

Dyrevelfærd

MILJØPÅVIRKNING FRA FØDEVAREPRODUKTION

Klimapåvirkning

Næringsstofberigelse

Økotoxicitet

Jord og kulstoflagring

Biodiversitet

Dyrevelfærd

ØKOLOGISKE FØDEVARER

Klimapåvirkning

Næringsstofberigelse

Færre pesticidrester i urin (Hyland et al. 2019)

Økotoxicitet

Jord og kulstoflagring

Højere mikrobiel aktivitet i økologiske marker (Lori et al. 2017)

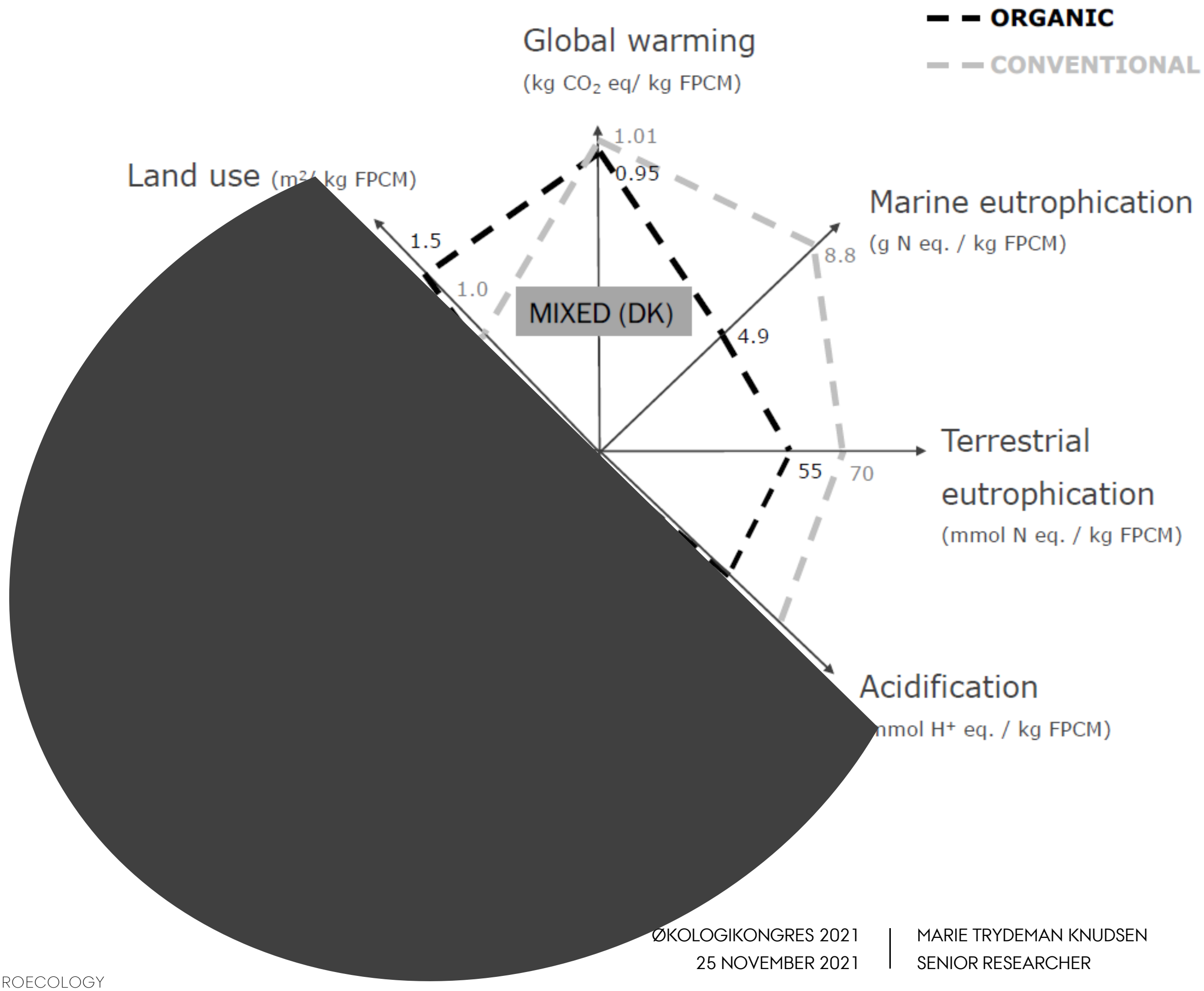
Bedre mulighed for at udfolde naturlig adfærd for husdyr og et lavere forbrug af antibiotika (Sørensen et al. 2015)

Dyrevelfærd

Biodiversitet

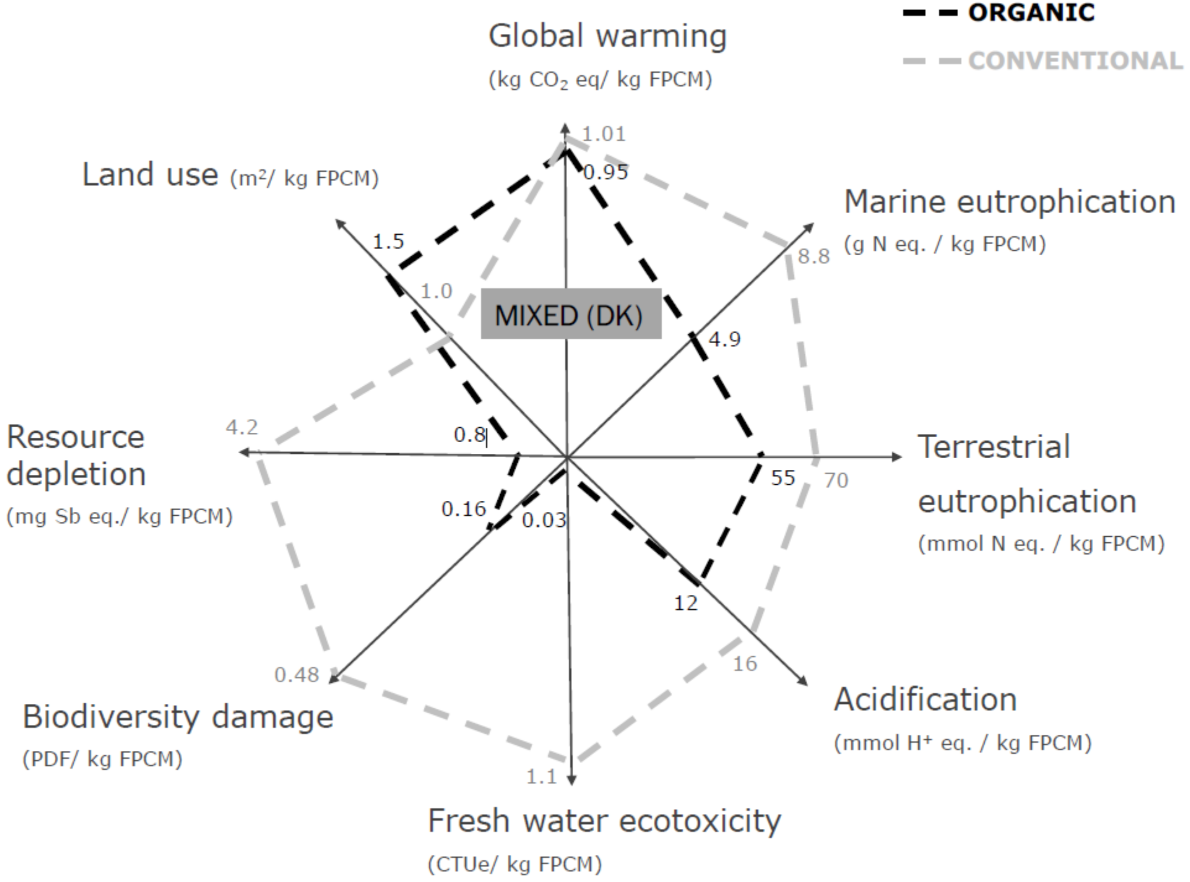
30% højere biodiversitet på de økologiske marker (Tuck et al. 2014)

MÆLKS MILJØPÅVIRKNING



Source: Knudsen et al. 2019

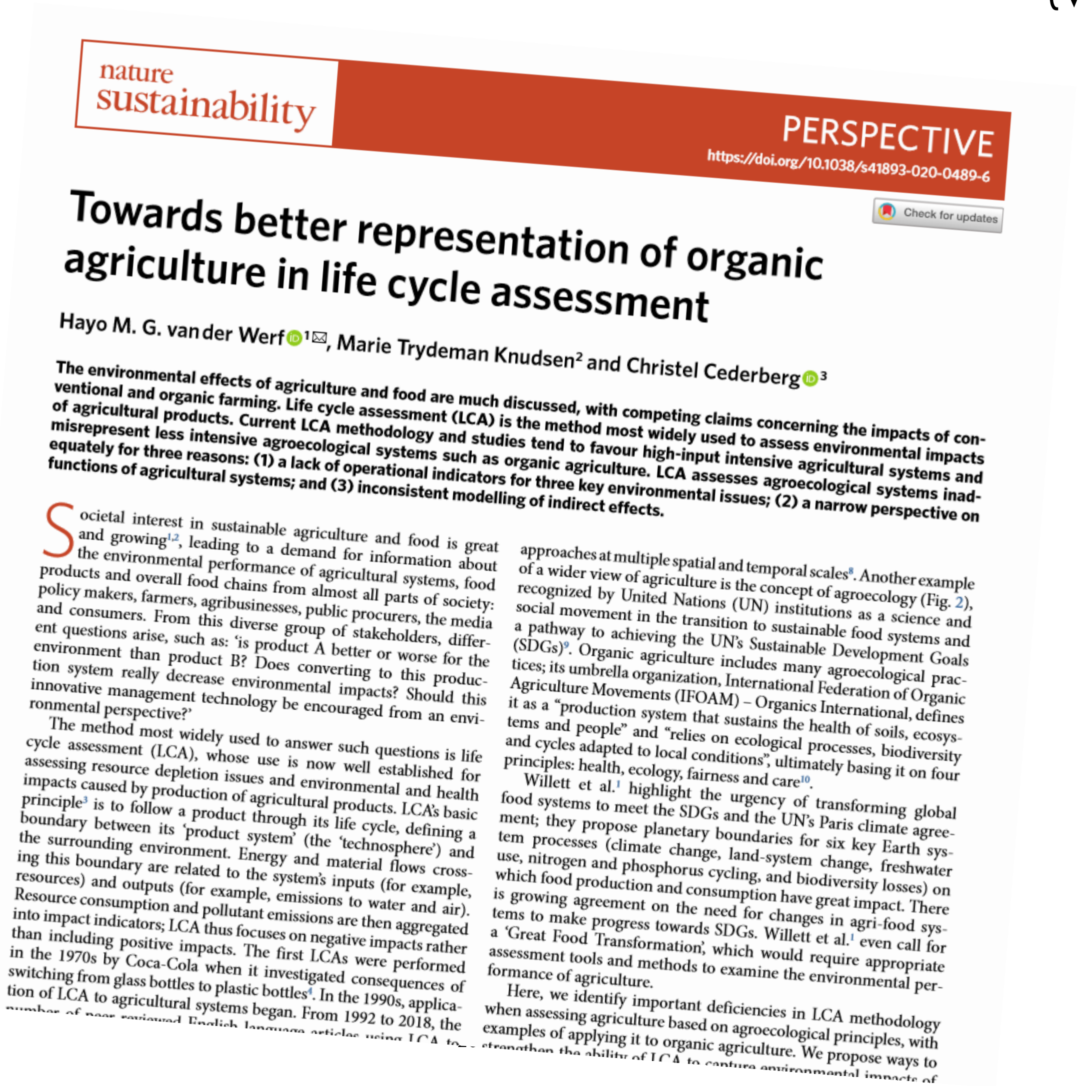
MÆLKS MILJØPÅVIRKNING



Source: Knudsen et al. 2019

ARTIKEL I “NATURE SUSTAINABILITY”

(Van der Werf, Knudsen & Cederberg, 2020)



nature sustainability

PERSPECTIVE

https://doi.org/10.1038/s41893-020-0489-6

Check for updates

Towards better representation of organic agriculture in life cycle assessment

Hayo M. G. van der Werf[1]✉, Marie Trydeman Knudsen[2] and Christel Cederberg[3]

The environmental effects of agriculture and food are much discussed, with competing claims concerning the impacts of conventional and organic farming. Life cycle assessment (LCA) is the method most widely used to assess environmental impacts of agricultural products. Current LCA methodology and studies tend to favour high-input intensive agricultural systems and misrepresent less intensive agroecological systems such as organic agriculture. LCA assesses agroecological systems inadequately for three reasons: (1) a lack of operational indicators for three key environmental issues; (2) a narrow perspective on functions of agricultural systems; and (3) inconsistent modelling of indirect effects.

Societal interest in sustainable agriculture and food is great and growing[1,2], leading to a demand for information about the environmental performance of agricultural systems, food products and overall food chains from almost all parts of society: policy makers, farmers, agribusinesses, public procurers, the media and consumers. From this diverse group of stakeholders, different questions arise, such as: ‘is product A better or worse for the environment than product B? Does converting to this production system really decrease environmental impacts? Should this innovative management technology be encouraged from an environmental perspective?’

The method most widely used to answer such questions is life cycle assessment (LCA), whose use is now well established for assessing resource depletion issues and environmental and health impacts caused by production of agricultural products. LCA’s basic principle[3] is to follow a product through its life cycle, defining a boundary between its ‘product system’ (the ‘technosphere’) and the surrounding environment. Energy and material flows crossing this boundary are related to the system’s inputs (for example, resources) and outputs (for example, emissions to water and air). Resource consumption and pollutant emissions are then aggregated into impact indicators; LCA thus focuses on negative impacts rather than including positive impacts. The first LCAs were performed in the 1970s by Coca-Cola when it investigated consequences of switching from glass bottles to plastic bottles[4]. In the 1990s, application of LCA to agricultural systems began. From 1992 to 2018, the number of peer reviewed English language articles using LCA to

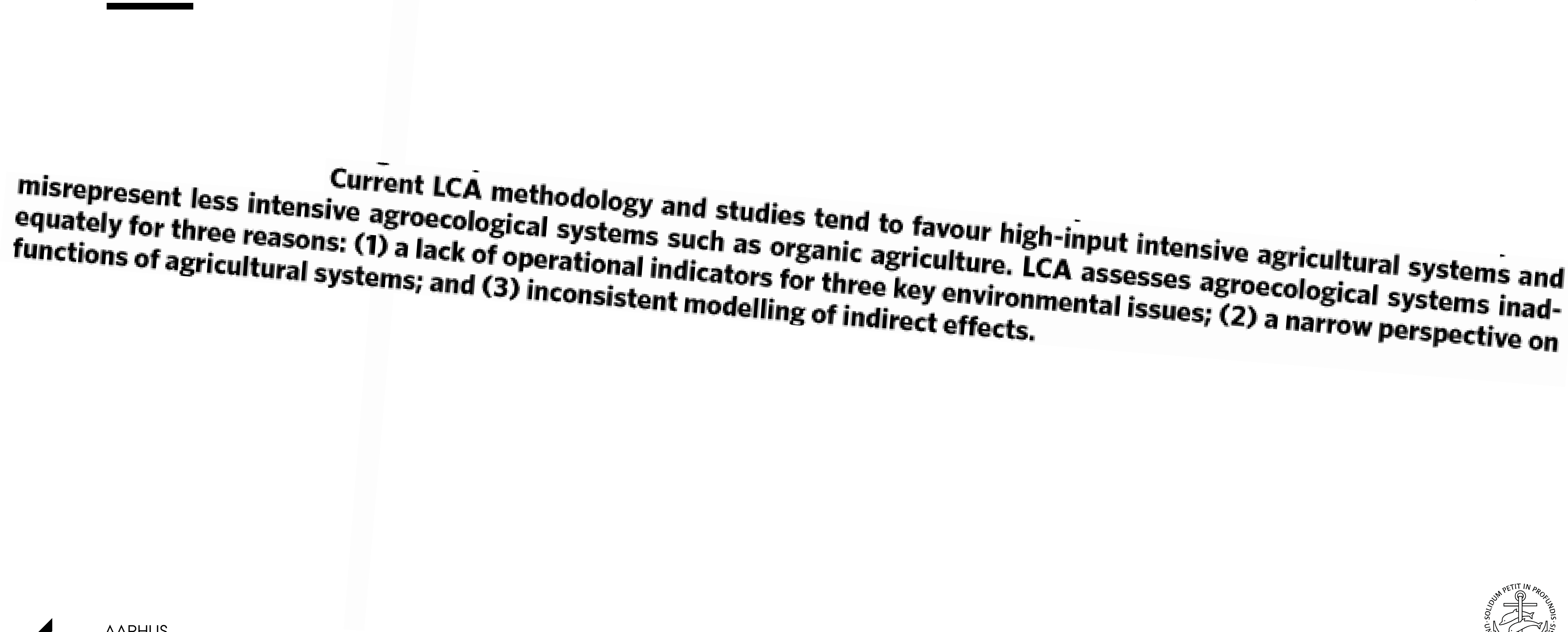
approaches at multiple spatial and temporal scales[8]. Another example of a wider view of agriculture is the concept of agroecology (Fig. 2), recognized by United Nations (UN) institutions as a science and social movement in the transition to sustainable food systems and a pathway to achieving the UN’s Sustainable Development Goals (SDGs)[9]. Organic agriculture includes many agroecological practices; its umbrella organization, International Federation of Organic Agriculture Movements (IFOAM) – Organics International, defines it as a “production system that sustains the health of soils, ecosystems and people” and “relies on ecological processes, biodiversity and cycles adapted to local conditions”, ultimately basing it on four principles: health, ecology, fairness and care[10].

Willett et al.[1] highlight the urgency of transforming global food systems to meet the SDGs and the UN’s Paris climate agreement; they propose planetary boundaries for six key Earth system processes (climate change, land-system change, freshwater use, nitrogen and phosphorus cycling, and biodiversity losses) on which food production and consumption have great impact. There is growing agreement on the need for changes in agri-food systems to make progress towards SDGs. Willett et al.[1] even call for a ‘Great Food Transformation’, which would require appropriate assessment tools and methods to examine the environmental performance of agriculture.

Here, we identify important deficiencies in LCA methodology when assessing agriculture based on agroecological principles, with examples of applying it to organic agriculture. We propose ways to strengthen the ability of LCA to capture environmental impacts of

ARTIKEL I "NATURE SUSTAINABILITY"

(Van der Werf, Knudsen & Cederberg, 2020)



Current LCA methodology and studies tend to favour high-input intensive agricultural systems and misrepresent less intensive agroecological systems such as organic agriculture. LCA assesses agroecological systems inadequately for three reasons: (1) a lack of operational indicators for three key environmental issues; (2) a narrow perspective on functions of agricultural systems; and (3) inconsistent modelling of indirect effects.

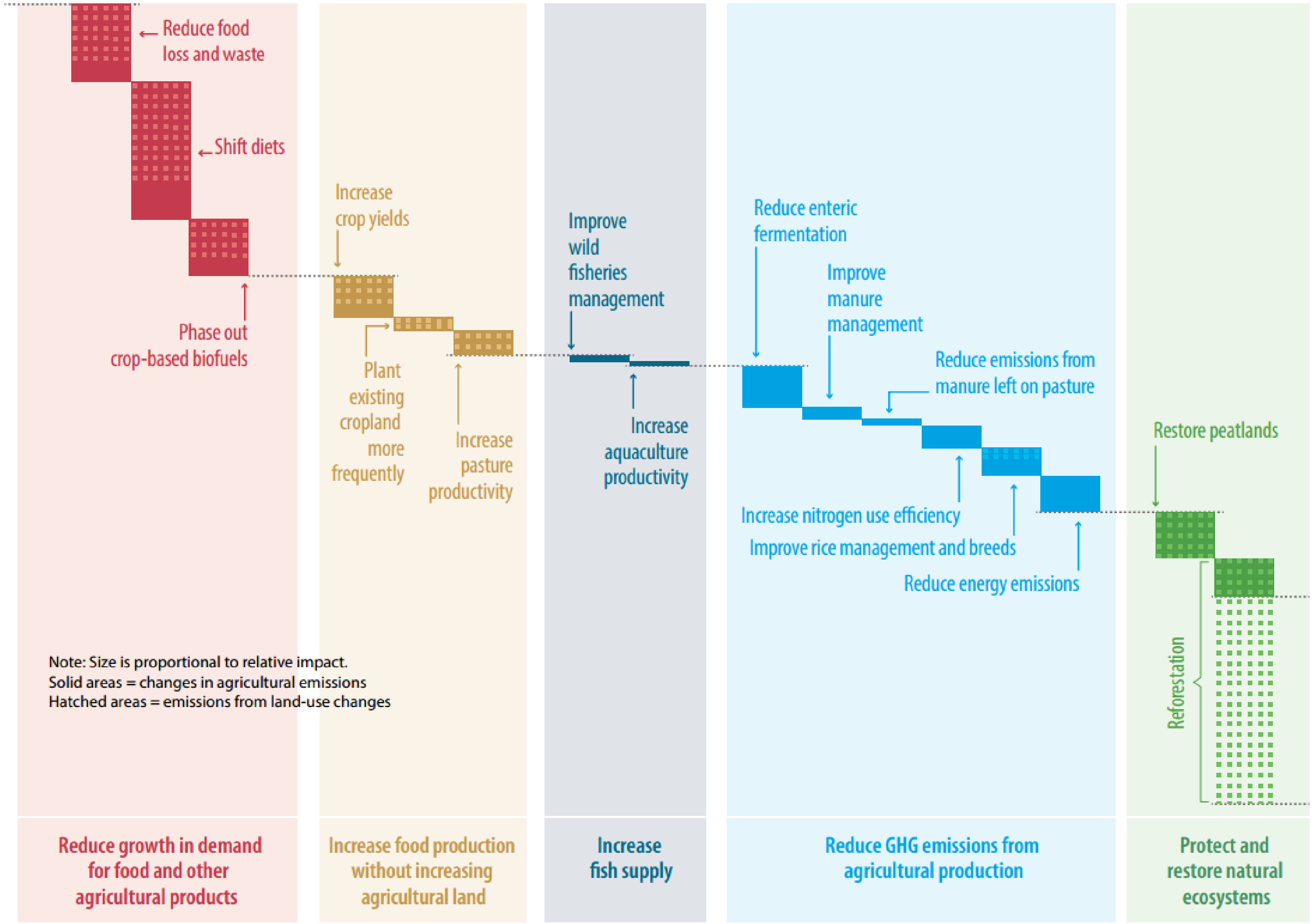
KONKLUSION

- Klimaaftryk per kg af økologiske og konventionelle fødevarer er det samme.
- Klimabelastning per ha er lavere for økologisk sammenlignet med konventionel.

- EU's harmonisering af LCA guidelines (PEF) bruger ALCA og dLUC (ikke iLUC), hvilket også gælder for de fleste internationale LCA-databaser.

- Evaluering af fremtidens bæredygtige robuste systemer; vigtigt at inkludere alle relevante miljøpåvirkningskategorier – og evaluere både per kg og per ha.

MULIGHEDER FOR REDUKTION I FØDEVARE- OG LANDBRUGSSYSTEMET



Note: Size is proportional to relative impact.
Solid areas = changes in agricultural emissions
Hatched areas = emissions from land-use changes

UN (2019)

MULIGHEDER FOR REDUKTION I LANDBRUGET

- Øge N-udnyttelsen og mindske tab og emissioner – højere udbytter
- Reducere energiforbruget og producere energi (biogas)
- Binde CO_2 via træer og i jord – og udgå emissioner fra tørvejorde

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PRODUCT ENVIRONMENTAL FOOTPRINT (PEF)

The development of the PEF and OEF methods

DG Environment has worked together with the European Commission's Joint Research Centre (JRC IES) and other European Commission services towards the development of a **harmonised methodology for the calculation of the environmental footprint of products and organisations** (including carbon).

Existing methods and initiatives were taken into account

ISO 14025, Ecological Footprint, etc).

- For the organisation angle, the Reference Life Cycle Data System Handbook (ILCD

requirements for calculating these emissions are not fully developed. Therefore, the assessment of emissions arising from indirect land use change is not included.

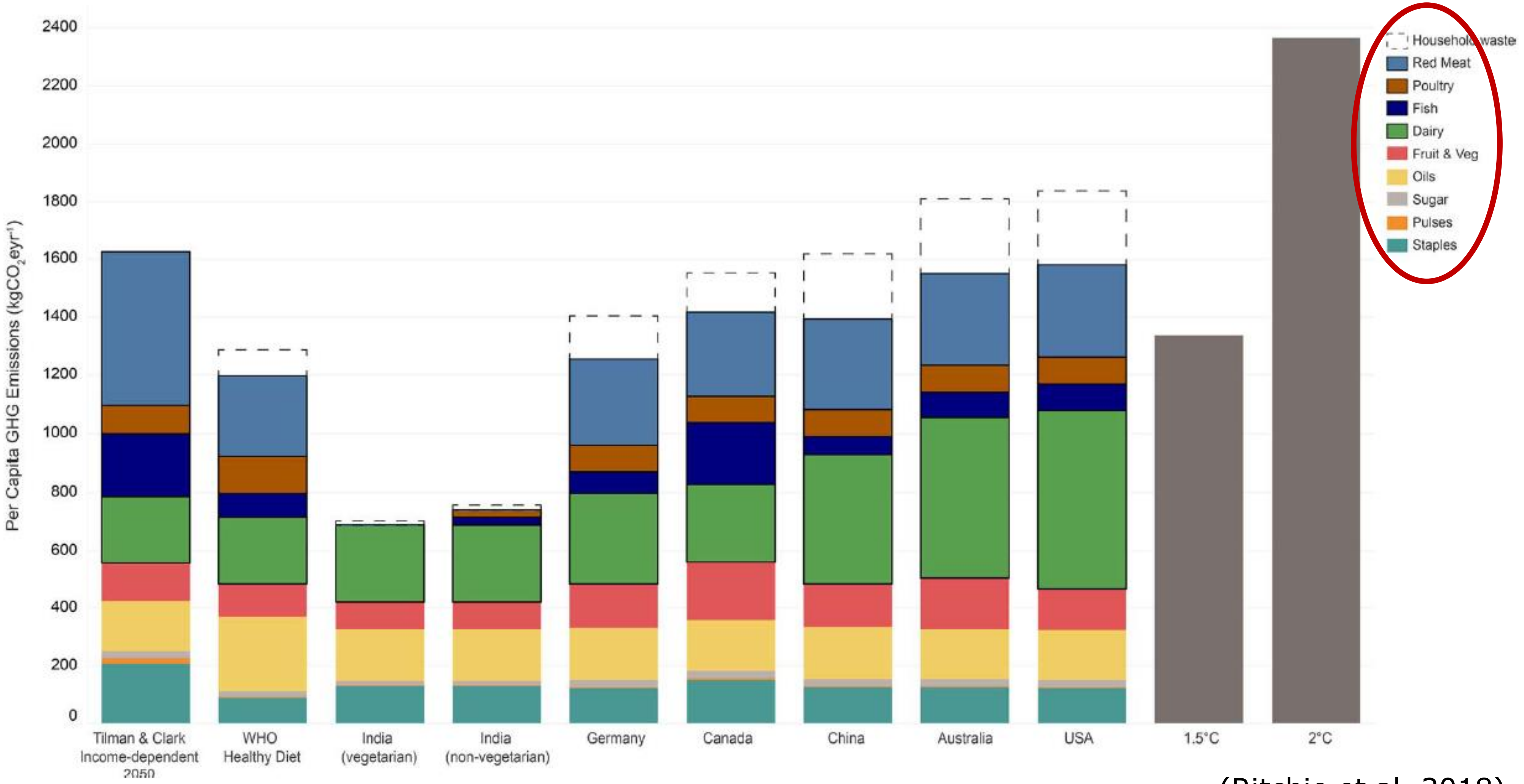
INDIREKTE EFFEKTER

- Indirekte arealændringer (iLUC) pga. lavere udbytter?

  Men samtidig:

- Mindre kødforbrug hos økologiske forbrugere (Baudry et al. 2017)
- Rebound effekt: højere priser giver færre penge på budgettet til rejser mv.

CARBON FOOTPRINT FROM DIETS



(Ritchie et al. 2018)