HVORDAN SIKRES "BÆREDYGTIGHED" OG HVOR BEVÆGER BEGREBET SIG HEN?

FØDEVAREPRODUKTION I CIRKULÆR ØKONOMI

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with illustration from research performed in collaboration with PhD students: Xuequian Zhang, Dominika Teigiserova, Elisavet Angouria-Tsorochidou and Michele Marini

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BÆREDYGTIG FORVALTNING AF RESSOURCER

Cirkulær ressourceforvaltning som bevarer og styrker naturlige økosystemers sundhed

I.

Efterligne naturens systemiske principper for resourceforvaltning

II.

Kemi i kredsløb skal holdes på et niveau, så vi undgår effekter på miljø og sundhed

III.

Sunde økosystemer vil levere services til fremtidige generationer

ØKOSYSTEM BEVARENDE RESSOURCE STRØMME

Cirkulær økonomi = industriel økologi

Et netværk af aktører som tilsammen skaber cirkulære ressourcestrømme i en cirkulær økonomi uden affald.

Cirkulære ressourcestrømme som bidrager til at bevare og genoprette økosystem services.

Ecosystem health improving resource flows, infrastructure and technology systems **mimicking nature –** being **restorative** and **regenerative by design**

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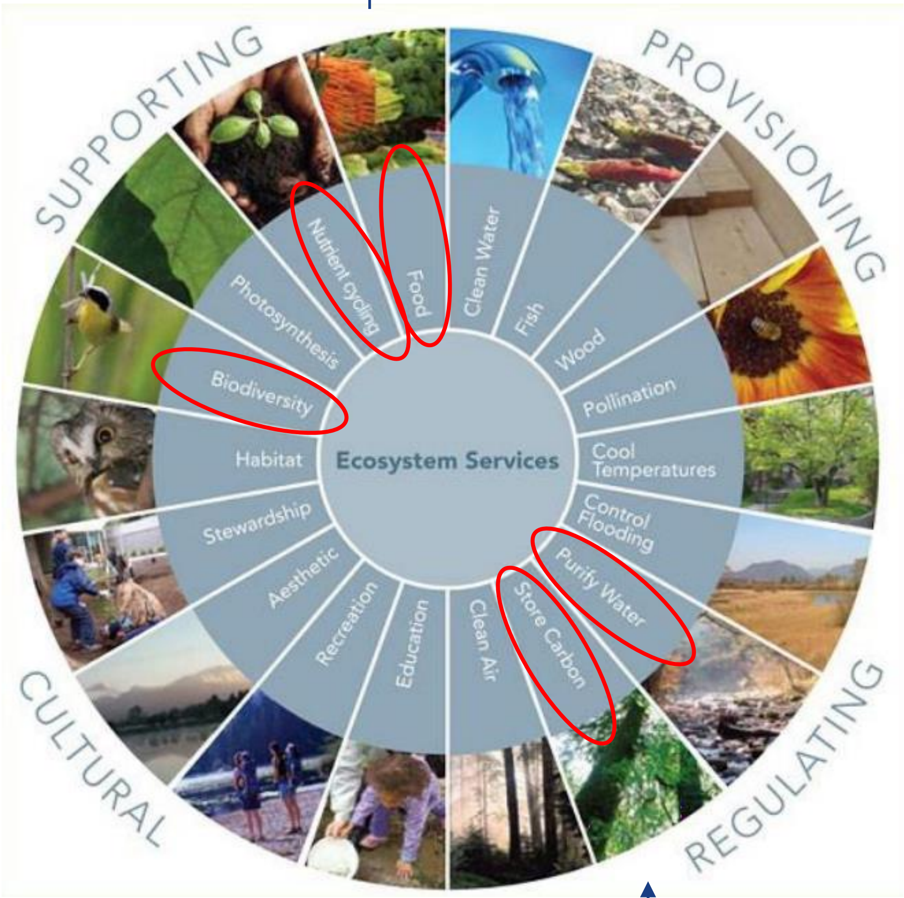
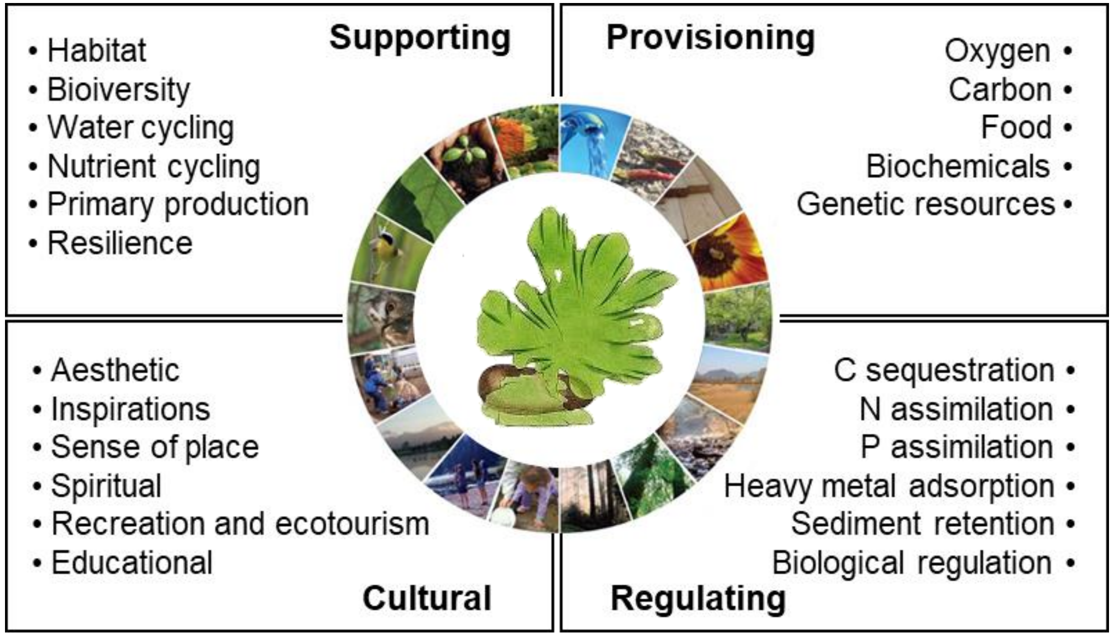
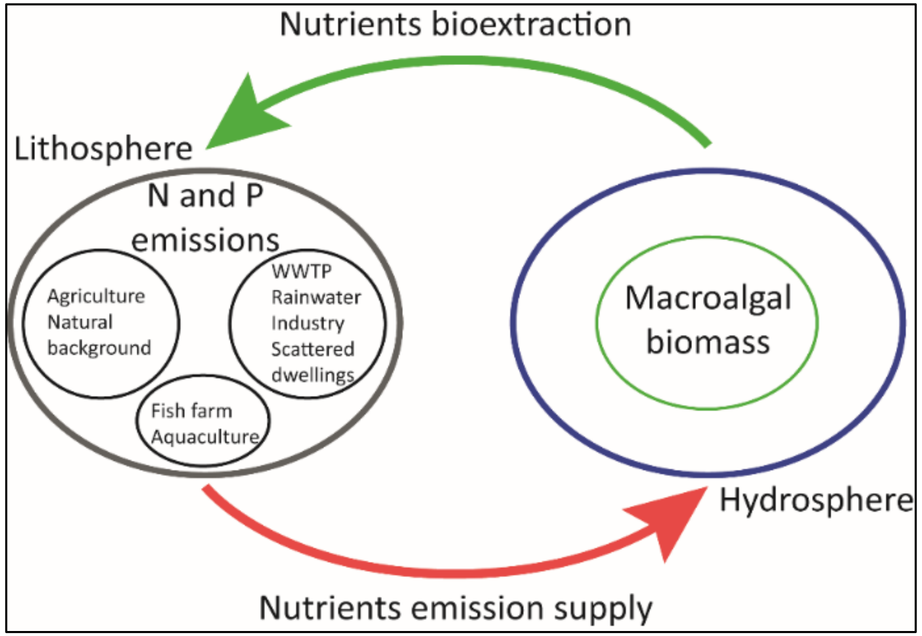


http://www.algecenterdanmark.dk/media/14359/marianne_thomsen.pdf

biogøding

CIRCULAR BIORESOURCE ECONOMIES - LOCAL BY NATURE





Seghetta, M., Tørring, D., Bruhn, A., Thomsen, M., 2016. Bioextraction potential of macroalgae in Denmark - an instrument for circular nutrient management. Science of The Total Environment 563–564, 513-529, https://doi.org/10.1016/j.scitotenv.2016.04.010

Engineered ecosystem services from mussel and seaweed cultivation and biorefinery systems

LOKALE FØDEVARE SYSTEMER INDENFOR DE PLANETÆRE GRÆNSER

- Lokale partnerskaber og aktører som forudsætning for bæredygtig forvaltning af bioressourcer
- Kortkædede lokale symbioser som skaber
  - selvforsyning fra lokale cirkulære resource økonomier
  - bidrager til lokale miljøforbedringer og modvirker globale klimaforandringer
  - klimaneutrale fødevare produktionssysmer
  - adskilte tekniske og biologiske circler/kredsløb
  - økosystembevarende udveksling af biologiske næringsstoffer med naturlige systemer
- Verdensmålene handler om at genskabe balance ved lokal resourceforvaltning

Illustration: Azote for Stockholm Resilience Centre, Stockholm University

ÆNDRET FOKUS - ØGET BEVIDSTHED

Health se

Healthy d

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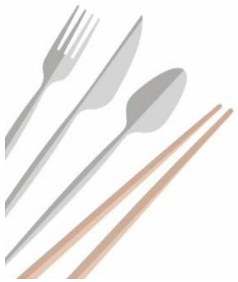
Target 1 – **Healthy Diets**
2500 kcal/day



Whole grains
Rice, wheat, co

Tubers or starch
Potatoes and c

Vegetables
All vegetables

Fruits
All fruits

Dairy foods
Whole milk or e

Protein sources
Beef, lamb and
Chicken and ot
Eggs
Fish
Legumes
Nuts

Added fats
Unsaturated oi
Saturated oils

Added sugars
All sugars

Introduction

The EAT-Lancet Commission

Our Food in the Anthropocene: Healthy Diets From Sustainable Food Systems

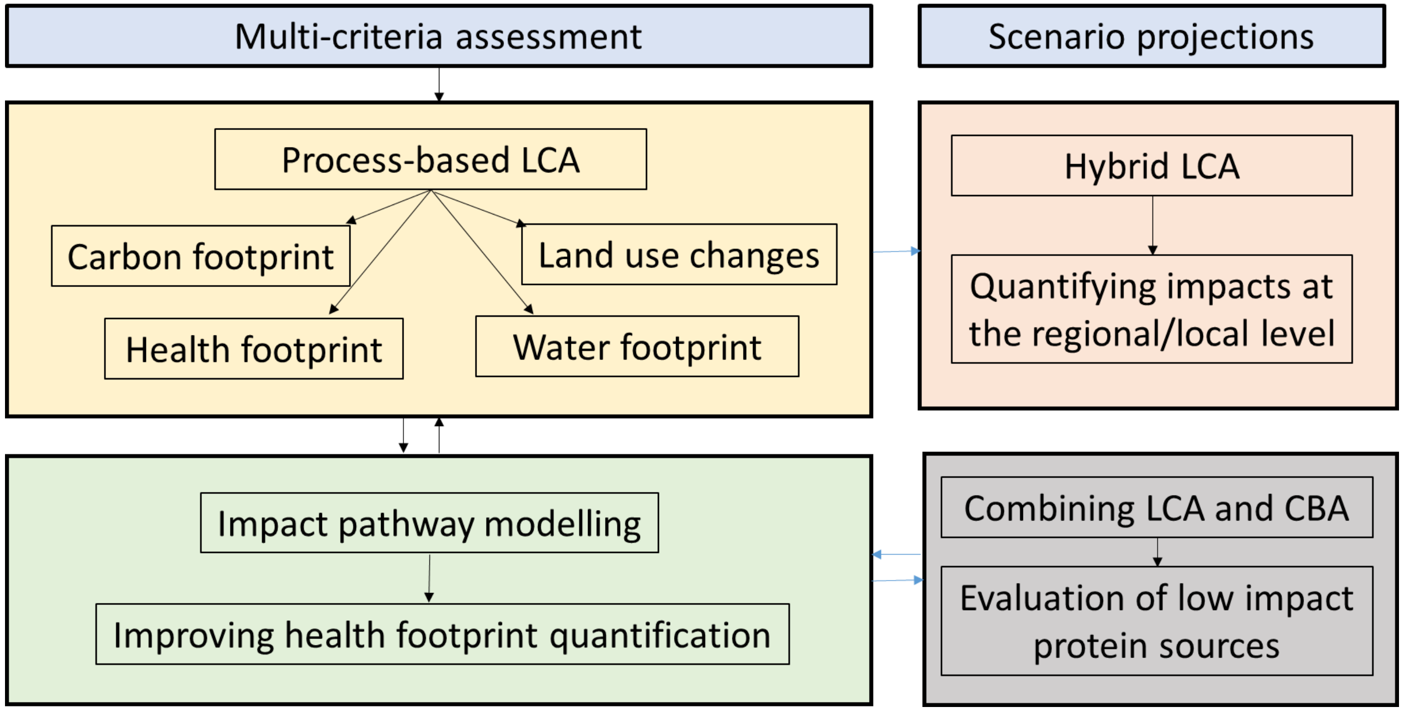
Without action, the world risks failing to meet the UN Sustainable Development Goals (SDGs) and the Paris Agreement, and today's children will inherit a planet that has been severely degraded and where much of the population will increasingly suffer from malnutrition and preventable disease.

able Food Production

Control variable	Boundary (Uncertainty range)
GHG emissions	5 Gt CO_2-eq yr^{-1} (4.7 – 5.4 Gt CO_2-eq yr^{-1})
Cropland use	13 M km^2 (11–15 M km^2)
Water use	2,500 km^3 yr^{-1} (1000–4000 km^3 yr^{-1})
N application	90 Tg N yr^{-1} (65–90 Tg N yr^{-1}) * (90–130 Tg N yr^{-1})**
P application	8 Tg P yr^{-1} (6–12 Tg P yr^{-1}) * (8–16 Tg P yr^{-1})**
Extinction rate	10 E/MSY (1–80 E/MSY)

Multiple Sustainability Criteria

- GHG emissions - Whole value chain CO_2 footprint
  - Energy and process-based emissions
- Ressource use/depletion
  - Water footprint
  - Energy
  - Fertilizers...
- Water and soil quality
  - Health footprint
- Productivity
  - Protein per ha
  - Land use changes



PROCESS-BASED LCA – FOOD CONSUMPTION

Case study on Danish food intake

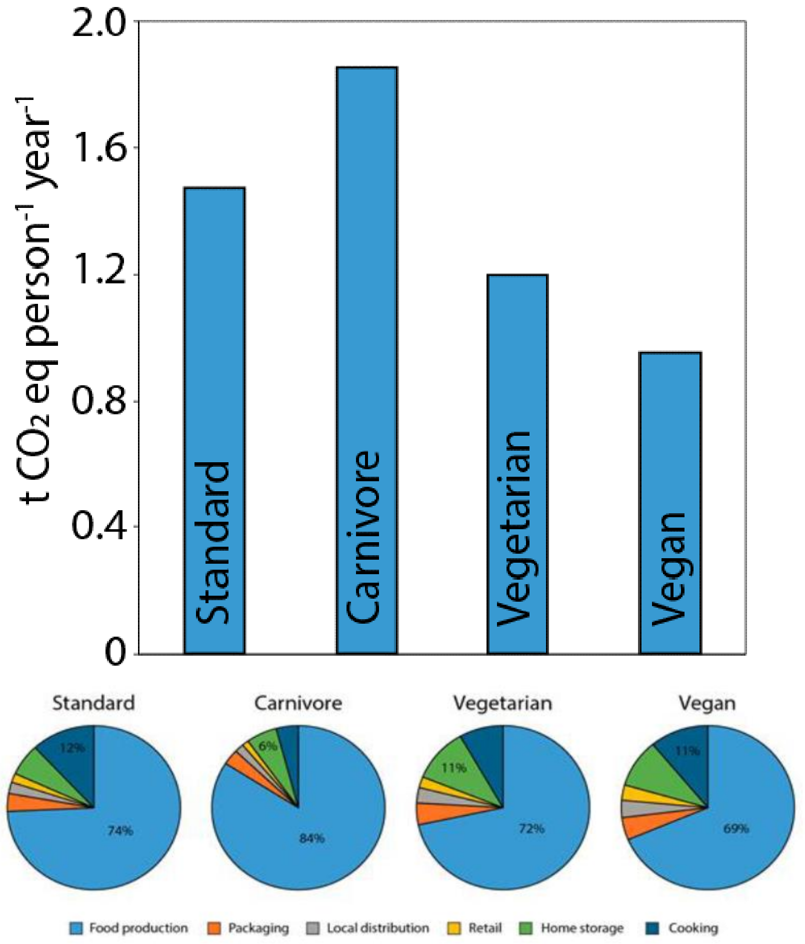
System boundary covers all activities and use of materials and energy, from the food production phase to final consumption (“from-cradle-to-fork”)

Carbon footprint (CF) of four different diet scenarios in Denmark: standard, carnivore, vegetarian and vegan

The food production phase is the most significant in terms of CF (69-84%)

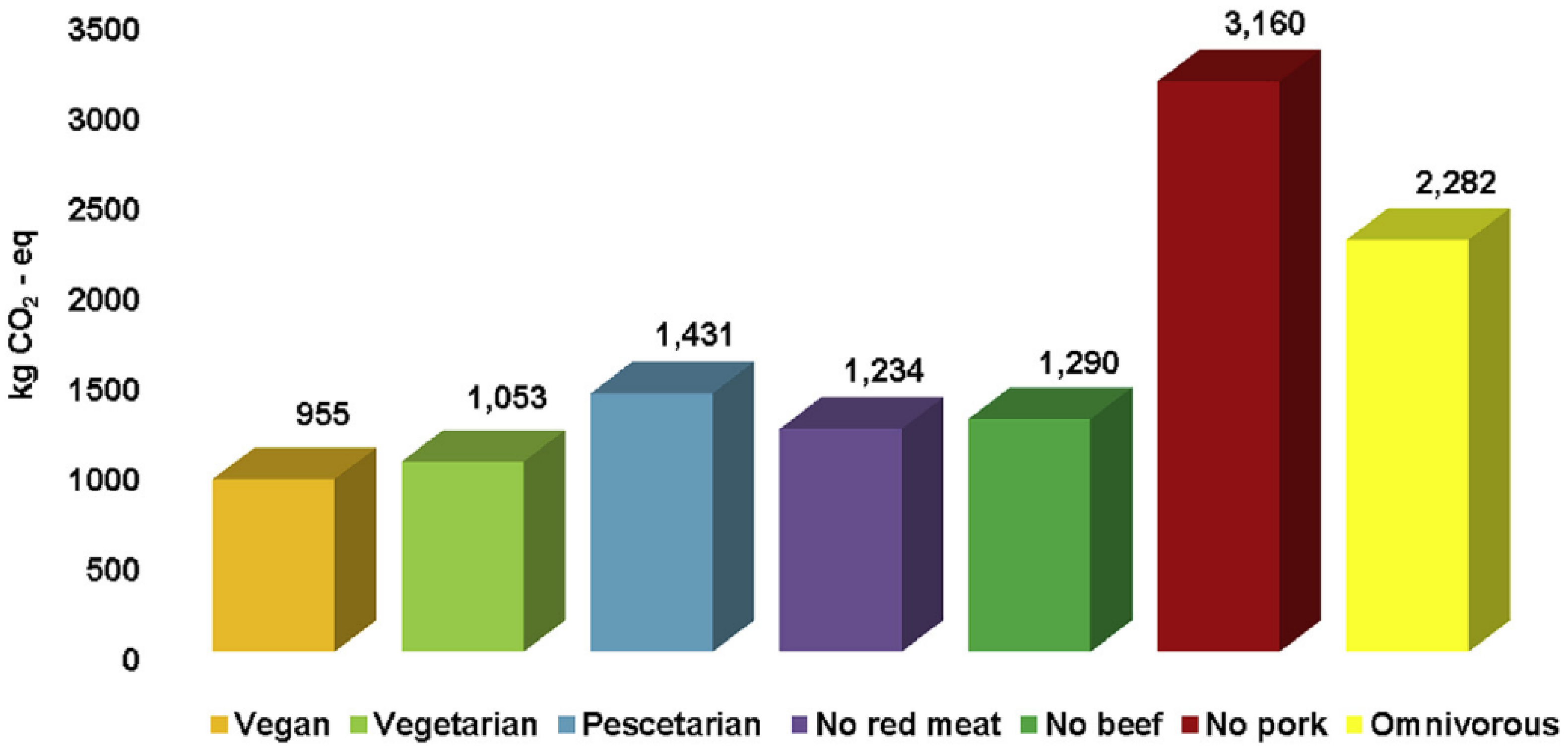
The CO_2e footprint of a meat rich diet is twice as intensive as the vegan plate

Bruno, M., Thomsen, M., Pulselli, F.M. et al. Climatic Change (2019). https://doi.org/10.1007/s10584-019-02508-4



BÆREDYGTIGE KOSTVANER

A. Veeramani et al. / Journal of Cleaner Production 162 (2017) 1398–1406

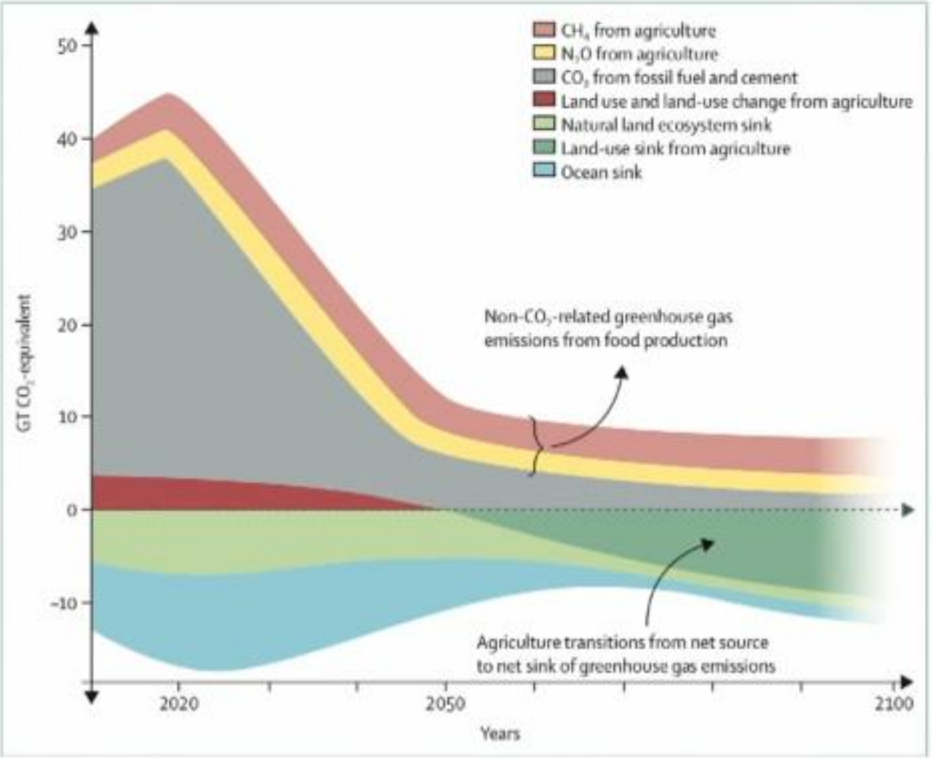


SUNDE FØDEVARER FOR JORDENKLODEN & MENNESKER

The EAT-Lancet Commission

DECARBONISATION OF THE FOOD SYSTEM

Food Production with Safe Operating Space for Climate

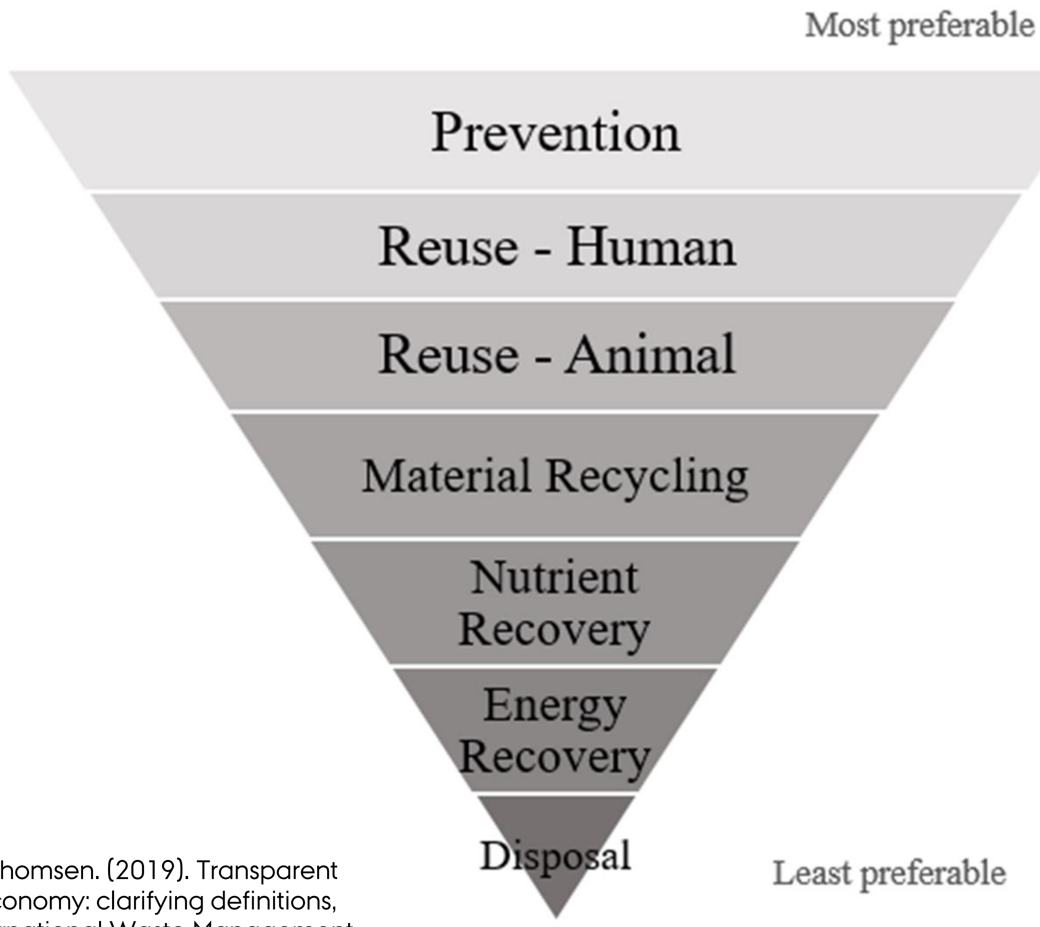


DECARBONISATION OF THE FOOD SYSTEM

Scenarios

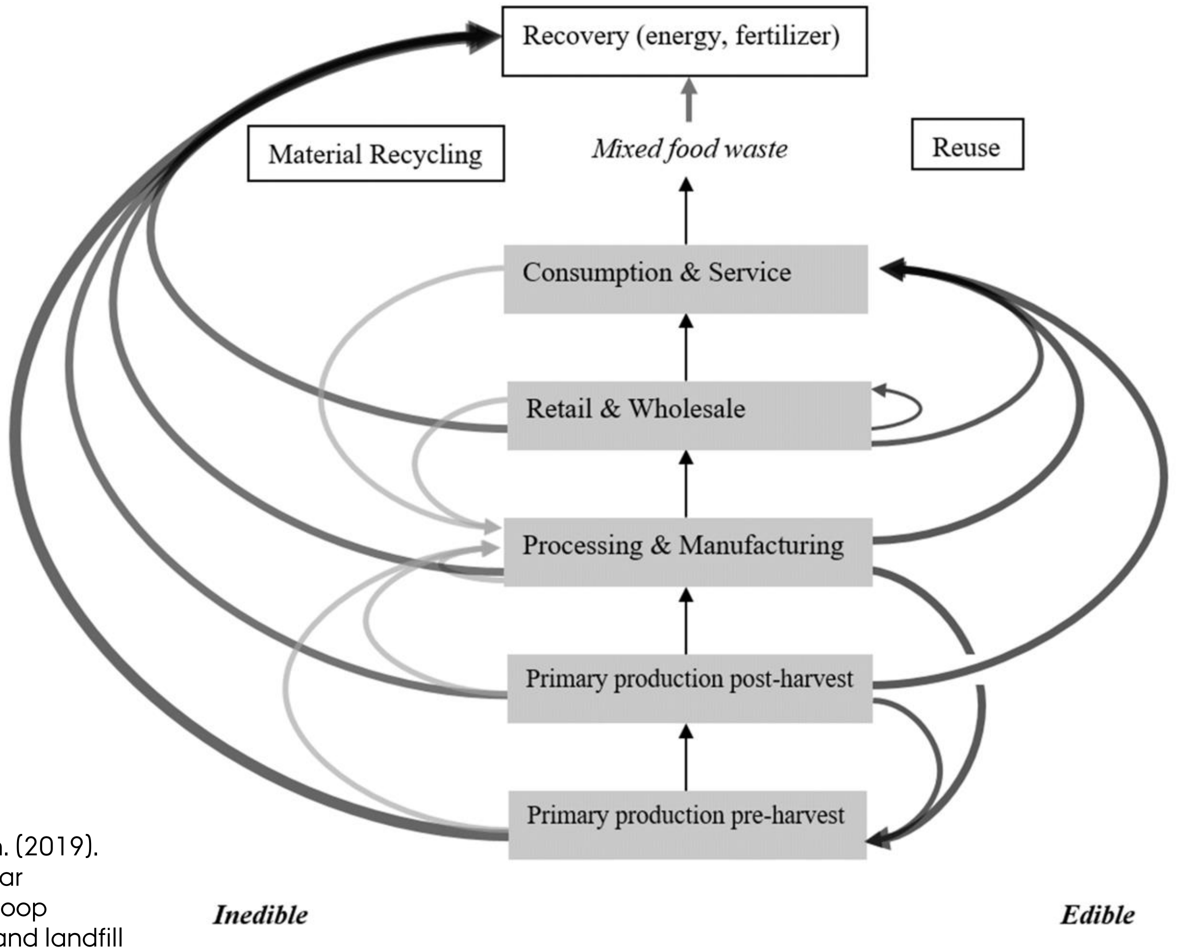
Production (2050)	Waste (2050)	Diet (2050)	GHG emissions	Cropland use	Water use	Nitrogen application	Phosphorus application	Biodiversity loss
Food production boundary			5.0 (4.7-5.4)	13 (11.0-15.0)	2.5 (1.0-4.0)	90 (65.0-140.0)	8 (6.0-16.0)	10 (1-80)
Baseline in 2010			5.2	12.6	1.8	131.8	17.9	100-1000
BAU	Full waste	BAU	9.8	21.1	3.0	199.5	27.5	1,043
BAU	Full waste	Dietary shift	5.0	21.1	3.0	191.4	25.5	1,270
BAU	Halve waste	BAU	9.2	18.2	2.6	171.0	23.2	684
BAU	Halve waste	Dietary shift	4.5	18.1	2.6	162.6	21.2	885
PROD	Full waste	BAU	8.9	14.8	2.2	187.3	25.5	206
PROD	Full waste	Dietary shift	4.5	14.8	2.2	179.5	24.1	351
PROD	Halve waste	BAU	8.3	12.7	1.9	160.1	21.5	50
PROD	Halve waste	Dietary shift	4.1	12.7	1.9	151.7	20.0	102
PROD+	Full waste	BAU	8.7	13.1	2.2	147.6	16.5	37
PROD+	Full waste	Dietary shift	4.4	12.8	2.1	140.8	15.4	34
PROD+	Halve waste	BAU	8.1	11.3	1.9	128.2	14.2	21
PROD+	Halve waste	Dietary shift	4.0	11.0	1.9	121.3	13.1	19

MADAFFALDSHIERAKIET



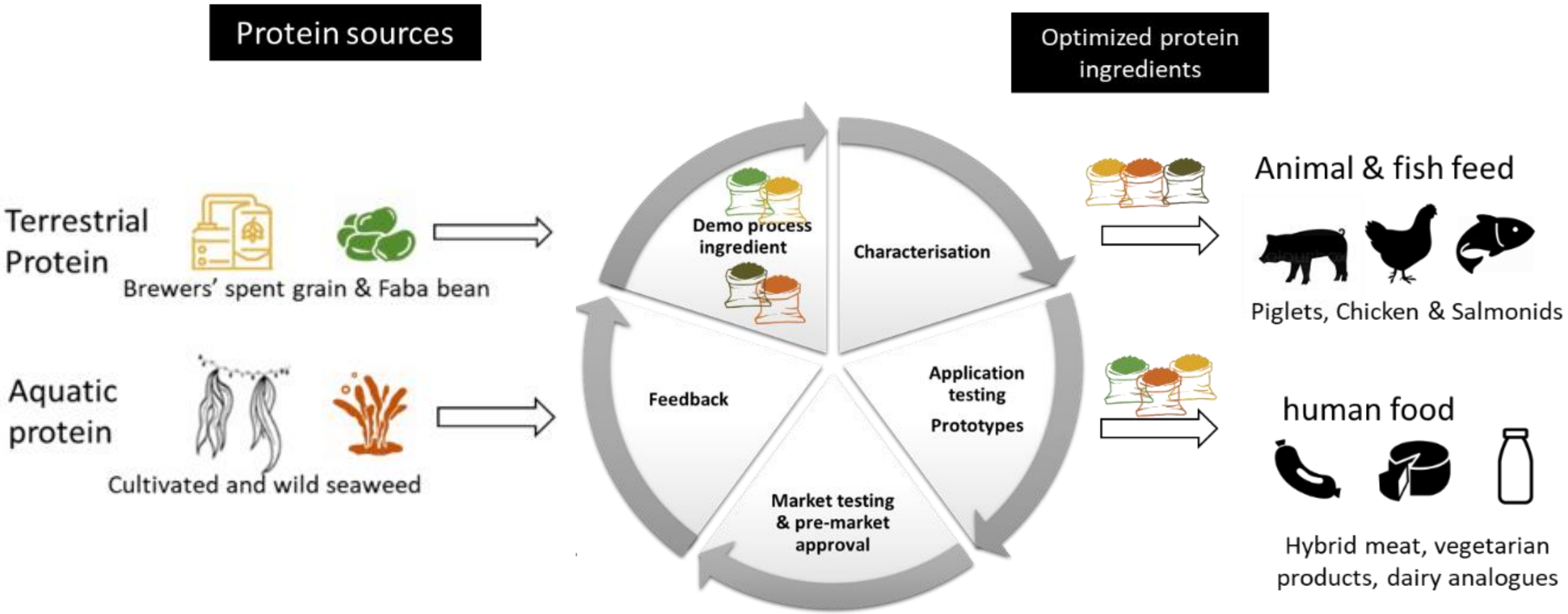
D. A. Teigiserova, M. Marini, L. Hamelin, M. Thomsen. (2019). Transparent valorization of food waste in the circular economy: clarifying definitions, policy and closed-loop pathways. 17th International Waste Management and landfill symposium, Italy.

SUSTAINABLE FOOD WASTE BIOREFINERY

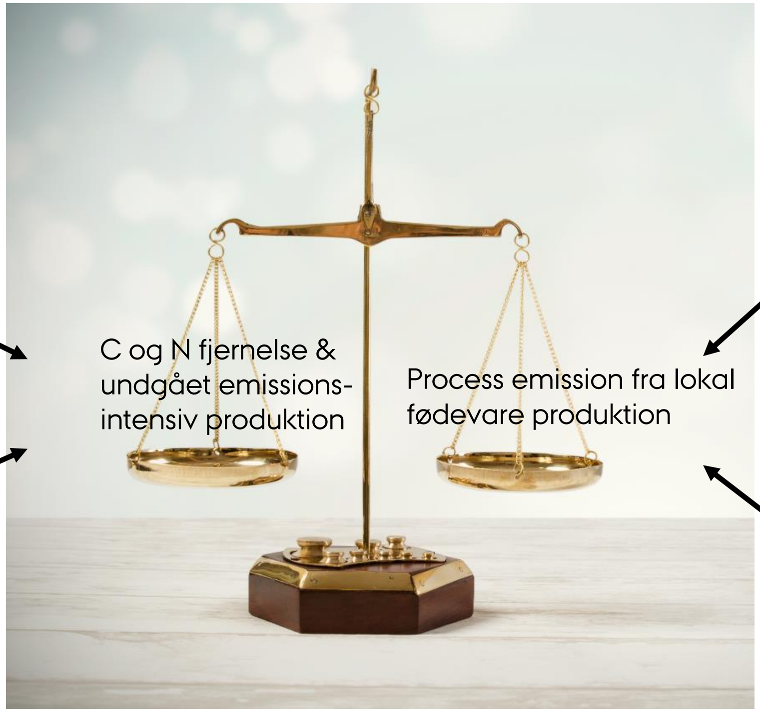


D. A. Teigiserova, M. Marini, L. Hamelin, M. Thomsen. (2019). Transparent valorization of food waste in the circular economy: clarifying definitions, policy and closed-loop pathways. 17th International Waste Management and landfill symposium, Italy.

KLIMANEUTRALE ALTERNATIVE PROTEINER



KLIMANEUTRAL FØDEVAREPRODUKTION



Emission Capture & Utilization (CCU)

Thomsen, M., 2019. Algae aquaculture -Can protein from ocean save land, freshwater and carbon emissions?. 14th EUSEW (EU Sustainable Energy Week) Polikcy Conference, Brussels 18-20 June, 2019. https://www.eusew.eu/clean-planet-all-role-oceans

THE ROLE OF SEAWEED IN PLANETARY RESILIENCE

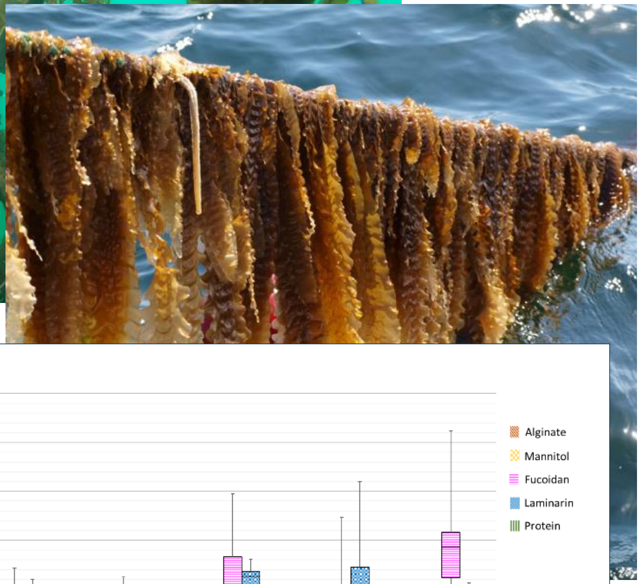
The raw material is grown at sea:

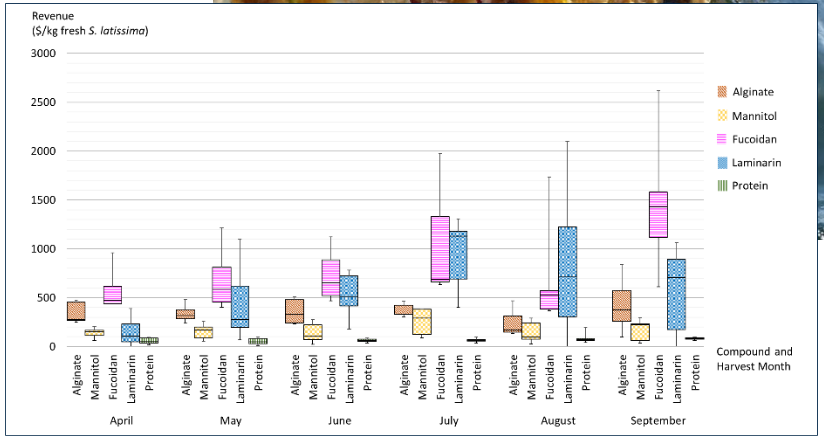
- Does not occupy land
- Does not require fertilization
- Requires no artificial light
- Does not require the addition of water

Seaweed absorbs 1.3-1.9 kg CO_2e per kg of dry matter harvested

- Seaweed is bioassimilates excess nutrient losses from land based activities (recirculation of nutrients)

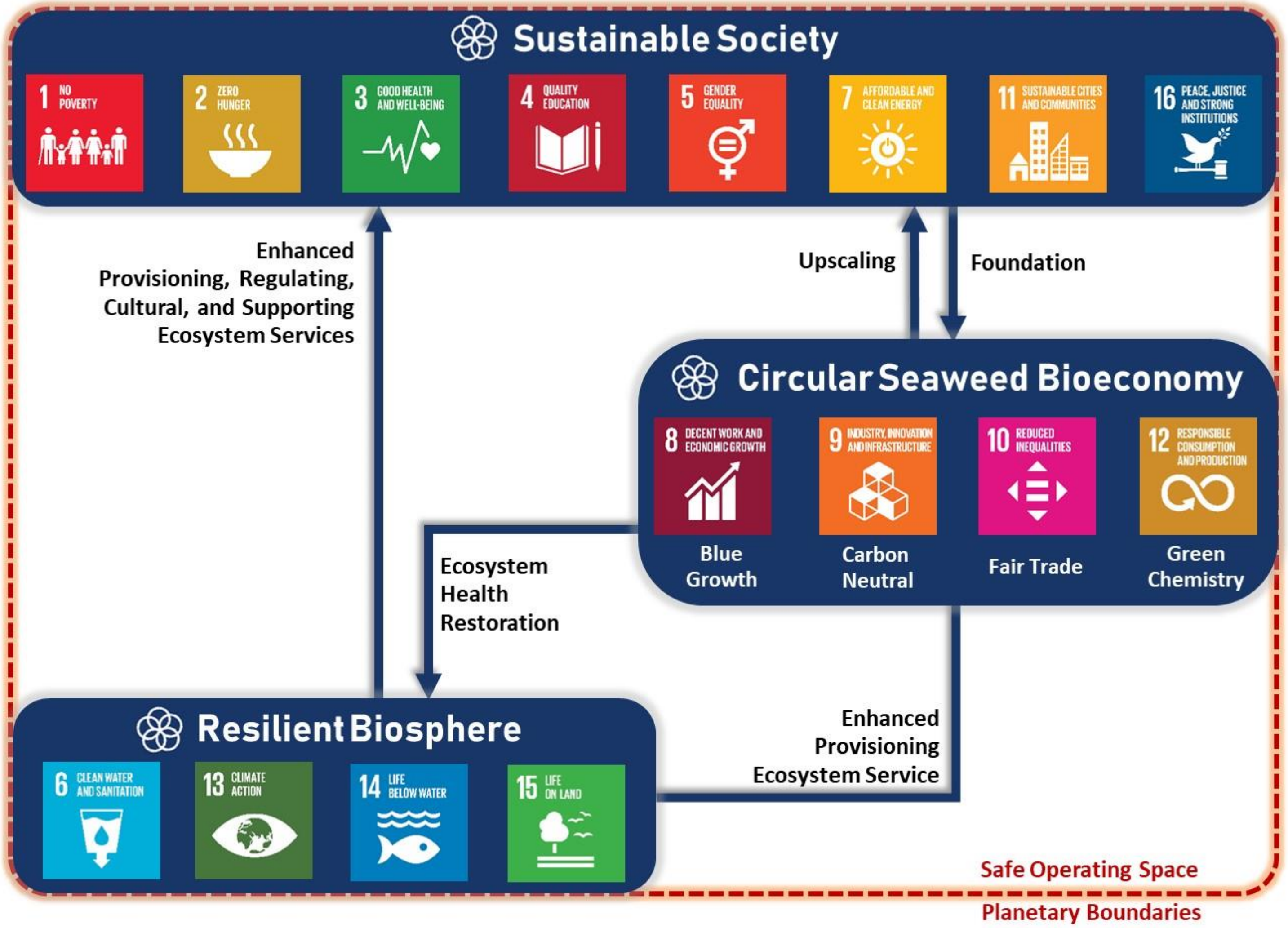
- Seaweed transforms emissions into high value bioactive molecules
- Seaweed areas attract fish fry
- Seaweed based feed supplements may reduce the enteric fermentation of ruminants thereby potentially reducing the CO_2e footprint of beef production





Zhang, X., & Thomsen, M. (2019). Biomolecular composition and revenue explained by interactions between extrinsic factors and endogenous rhythms of Saccharina latissima. Marine drugs, 17(2), 107. doi:10.3390/md17020107

REGENERATIVE CIRCULAR BLUE ECONOMY



Thomsen. M. and Zhang, X., 2020, 'Life Cycle Assessment of Macroalgal Eco-industrial Systems', in H. Dominguez, S. Krann (eds.), Sustainable Seaweed Technologies, Elsevier, Cambridge, Pending Publication

GULDBORGSUND DEMONSTRATIONSPLATFORM FOR BÆREDYGTIG LOKAL FØDEVARE PRODUKTION

Med partnerskabet Agri-Aqua Innovation Denmark ønsker vi skabe bæredygtig vækst med afsæt i symbioser mellem landbrug og akvakultur. Det vil vi bl.a. gøre ved at samle interessenter om at udvikle lokale løsninger, der bidrager til lokale sunde økosystemer til modvirkning af globale klimafordringer, jobskabelse og har potentiale til at kunne skaleres.

Quinella
Lolland-Falster udgaven af Paella

Mylius
A SDG tool
powered by ORBICON

BIDRAG TIL FN´S 17 VERDENSMÅL

Quinellaen er udviklet som et partnerskab mellem private virksomheder og offentlige organisationer, og er således et godt eksempel på, at bæredygtig udvikling kan skabes som effektive og målrettede partnerskaber

Quinellaen er baseret på lokale ingredienser, hvoraf nogle af ingredienserne udgør ressourcer, der ikke tidligere er brugt i dansk madlavning. Der er ikke tradition for at bruge quinoa og tang i dansk madlavning, og sortmundet kutling er en invasiv art, der med stor fordel kan udnyttes.

Quinellaen er en sund og proteinrig ret, der kræver få og lokale ressourcer. Quinoaen er proteinrig og de marine råvarer indeholder vigtige proteiner og olier, der er gode for vores sundhed.

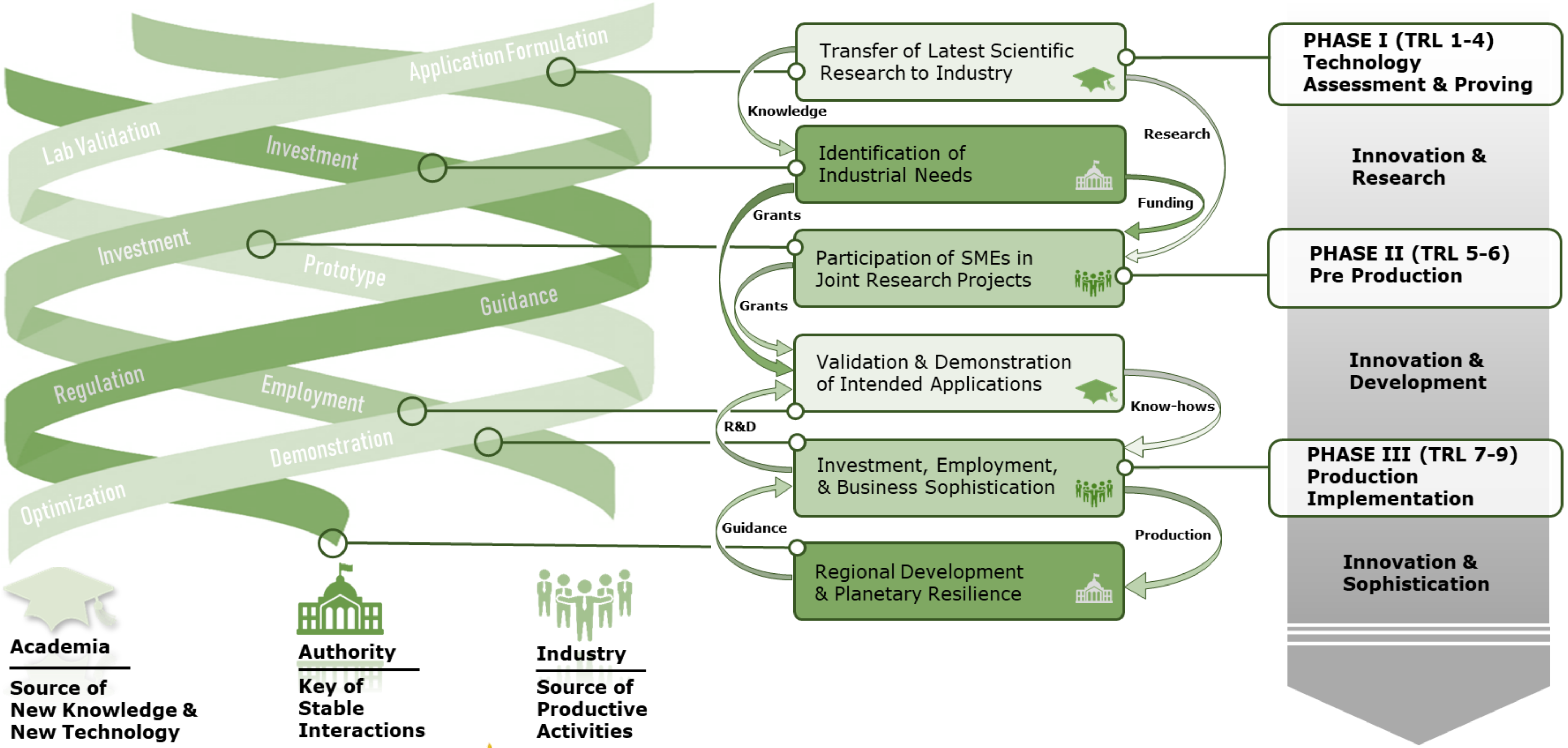
Quinellaen bruger nye råvarer. Produktionen af disse råvarer skaber nye jobs inden for landbrug, fiskeri og akvakultur i udkantsområder.

Udviklingen af retten omfatter målrettet formidling og undervisning, og bidrager således til en nytænkning i forhold til vores måde at lave fødevarer på.

Quinella

Lolland-Falster udgaven af Paella

Mylius
A SDG tool
powered by ORBICON


Application Formulation
Lab Validation
Investment
Investment
Prototype
Guidance
Regulation
Employment
Demonstration
Optimization
Transfer of Latest Scientific Research to Industry
Knowledge
Identification of Industrial Needs
Research
Funding
Grants
Participation of SMEs in Joint Research Projects
Grants
Validation & Demonstration of Intended Applications
Know-hows
R&D
Investment, Employment, & Business Sophistication
Guidance
Production
Regional Development & Planetary Resilience
PHASE I (TRL 1-4) Technology Assessment & Proving
Innovation & Research
PHASE II (TRL 5-6) Pre Production
Innovation & Development
PHASE III (TRL 7-9) Production Implementation
Innovation & Sophistication
Academia
Source of New Knowledge & New Technology
Authority
Key of Stable Interactions
Industry
Source of Productive Activities

Bon Appétit

Agri-
Aqua Innovation Denmark

AARHUS
UNIVERSITY