EU MISSIONS
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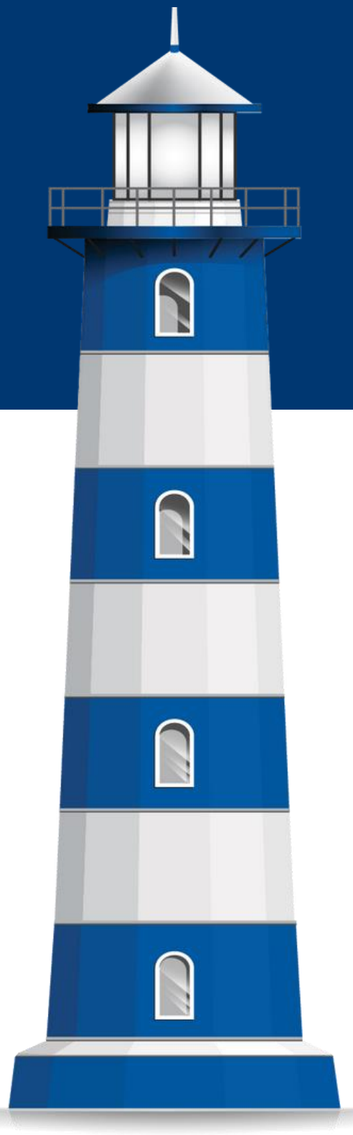
BLUE MISSION BANOS

Supporting the Mission Ocean Lighthouse in the Baltic and North Sea Basins



3rd MISSION ARENA

26-27 November 2024

Amsterdam

REGIONAL FOCUS ARENA 3

The Netherlands
BELGIUM
DENMARK I West
GERMANY I West
FRANCE I North

EU MISSIONS
RESTORE OUR OCEAN & WATERS

BLUE MISSION BANOS

3rd MISSION ARENA
26-27 November 2024 | Amsterdam

Environmental LCA in the blue bioeconomy: ecosystem services and carrying capacity”

Efthalia Arvaniti – s.Pro// SUBMARINER Network

26. November, 11:15-13:00 am
Hall 3 Suite

#MissionArena3

Funded by the European Union

Why this – why now?

- LCAs a requirement in EU research projects - especially for algae systems
- Environmental LCAs in Green Claims
- Methodological harmonization for more comparable and useful LCAs
- The importance of stakeholders
- From LCAs to ecosystem service and carrying capacity modelling

Outcomes & followup

2025+

Outcomes for today

- Promote, and align bottom-up LCA community efforts
- Provide validated recommendations to DG MARE/ENV on needs/opportunities supporting LCA standardisation work

Followup with EU4Algae 2.0

- SUB-TASK 1.2.1: EU4Algae EU Project Cluster Meetings >>> plan an LCA?
- SUB-TASK 1.2.2: Thematic Workshops, Webinars Or Surveys >>> plan on standardisation?
- SUB-TASK 2.4.2: Support for developing carbon and nutrient credit schemes in the EU >>> you join us ?

Agenda

Time	Title	Speaker
11:15 – 11:25	Welcome, plan and intro	Jean-Baptiste Thomas, KTH & Efthalia Arvaniti, s.Pro// SUBMARINER
11:25 - 11:30	DG MARE on CEN standards on algae LCA methodology	Maris Stulgis, DG MARE
11:30 - 11:40	Environmental Footprint (EF) methods and PEFCR/OEFSR processes: state of play and outlook	Mauro Cordella, DG ENV (online)
11:40 – 11:50	EU4Algae Preliminary recommendations on LCA standardisation needs	Efthalia Arvaniti
11:50 - 11:55	Towards harmonization of Life Cycle Assessment in Algal biotechnology: A cross-EU-project initiative	Margarida Costa, NIVA
11:55 - 12:00	A global Algae LCA Community of Practice group dealing for the challenges to doing LCAs in blue bioeconomy	Jean-Baptiste Thomas
12:00 - 12.10	Sustainability in the Blue Bioeconomy: LCA, Ecosystem Services and Carrying Capacity	Sophie Koch, Sjokovin (online)
12:10 - 12:20	Q&A	Jean-Baptiste Thomas // Efthalia Arvaniti
10:20 - 12:55	Moderated discussion	Jean-Baptiste Thomas
12:55 - 13:00	Closing & next steps	Jean-Baptiste Thomas // Efthalia Arvaniti

Slido poll

3985545

LCAs to assess the environmental footprint of algae products & services

Efthalia Arvaniti, s.Pro - sustainable projects GmbH

26/11/2024

EU Algae Initiative

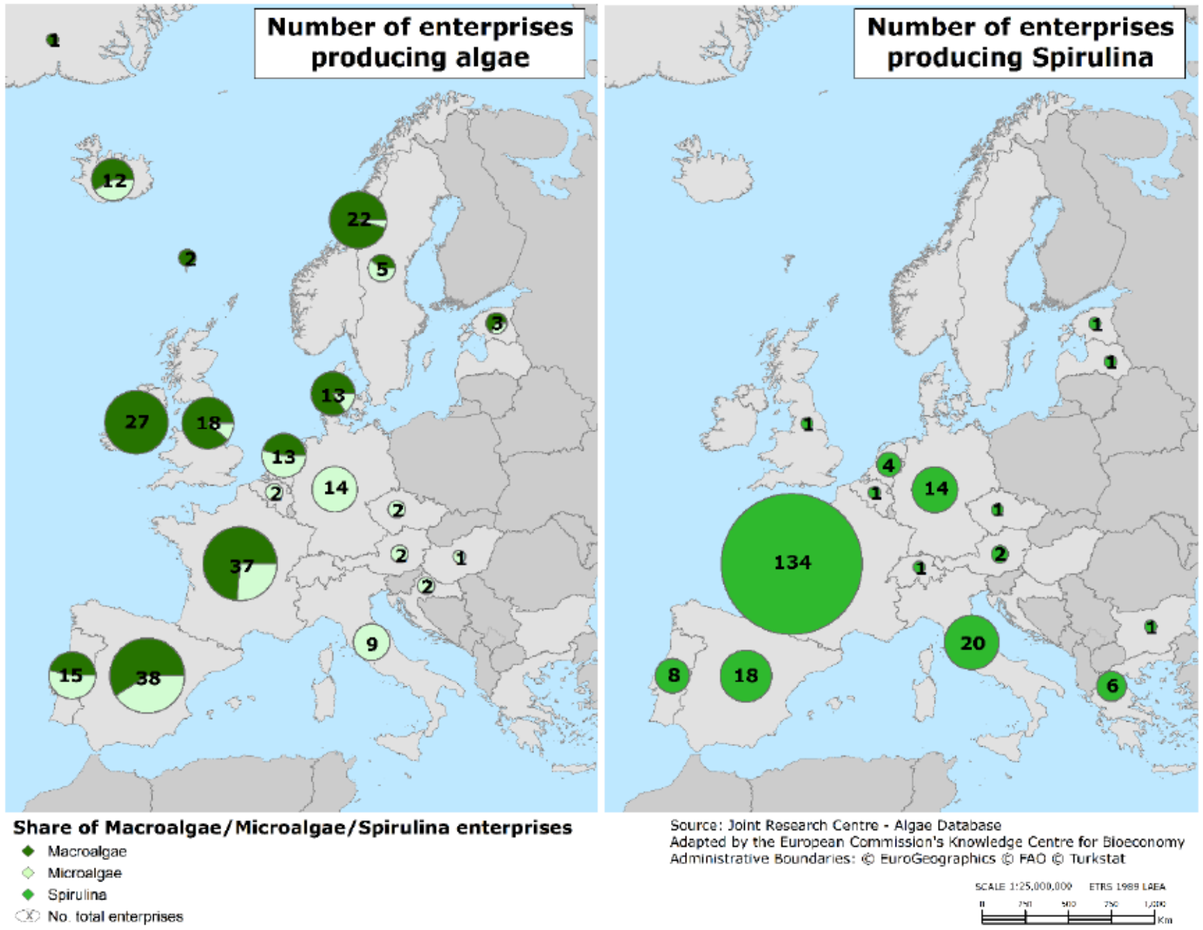
#EU4Algae

Relevant EU Algae Initiative actions	This work
Action 3 - by the end of 2026, together with the European Committee for Standardization (CEN), develop standard testing, quantification and extraction methods for algae ingredients and contaminants;	The work will provide recommendations on blue carbon, and also consolidate knowledge on environmental LCA and other assessment tools needed in algae biofuel standards.
8) work with the algae industry and Member States to: C. support the life cycle assessment of the environmental and climate impact of algae cultivation and production by considering the development of monitoring methodologies and indicators to measure the environmental impact and sustainability of seaweed cultivation;	This work will contribute to: C) by consolidating knowledge on LCA tools and methods to measure environmental impacts and sustainability of seaweed cultivation.
Action 12 - by the end of 2023, integrate algae sector knowledge into the EU aquaculture assistance mechanism;	This work is well aligned with the parallel Aquaculture Assistance Mechanism that updates guidelines, especially the Environmental Performance chapter. For this, findings and recommendations are informed and integrated.

European algae production and companies

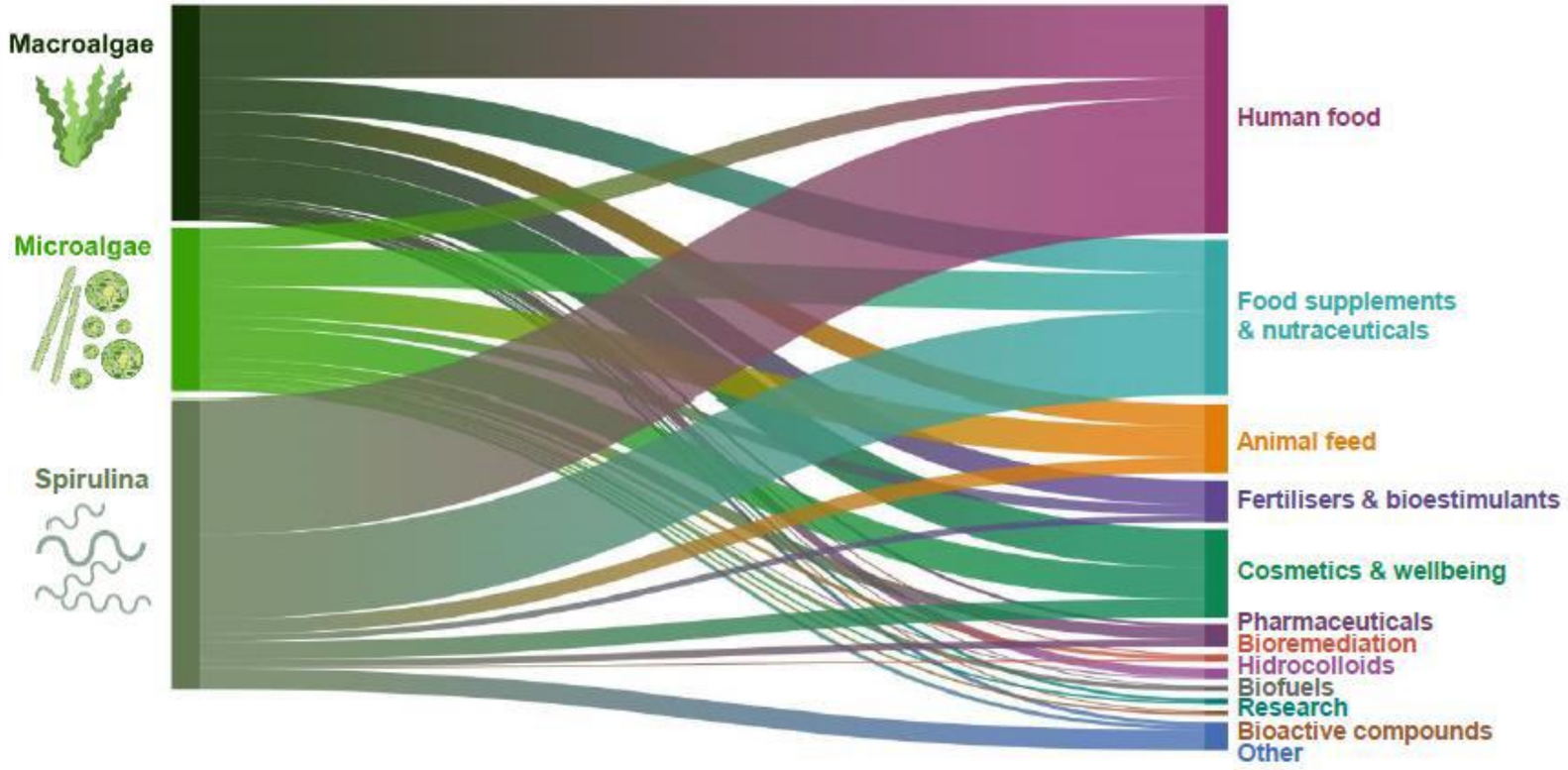
- European seaweed production is currently around 300 k tonnes, which represents only 1,4% of the global seaweed production (Hidden Champion 2022)

- European microalgae production is estimated to be less than 650 tons, which corresponds to only 0.5 % of global production, (incl. cyanobacteria and Labyrinthulomycetes) (EUMOFA 2023)



#EU4Algae

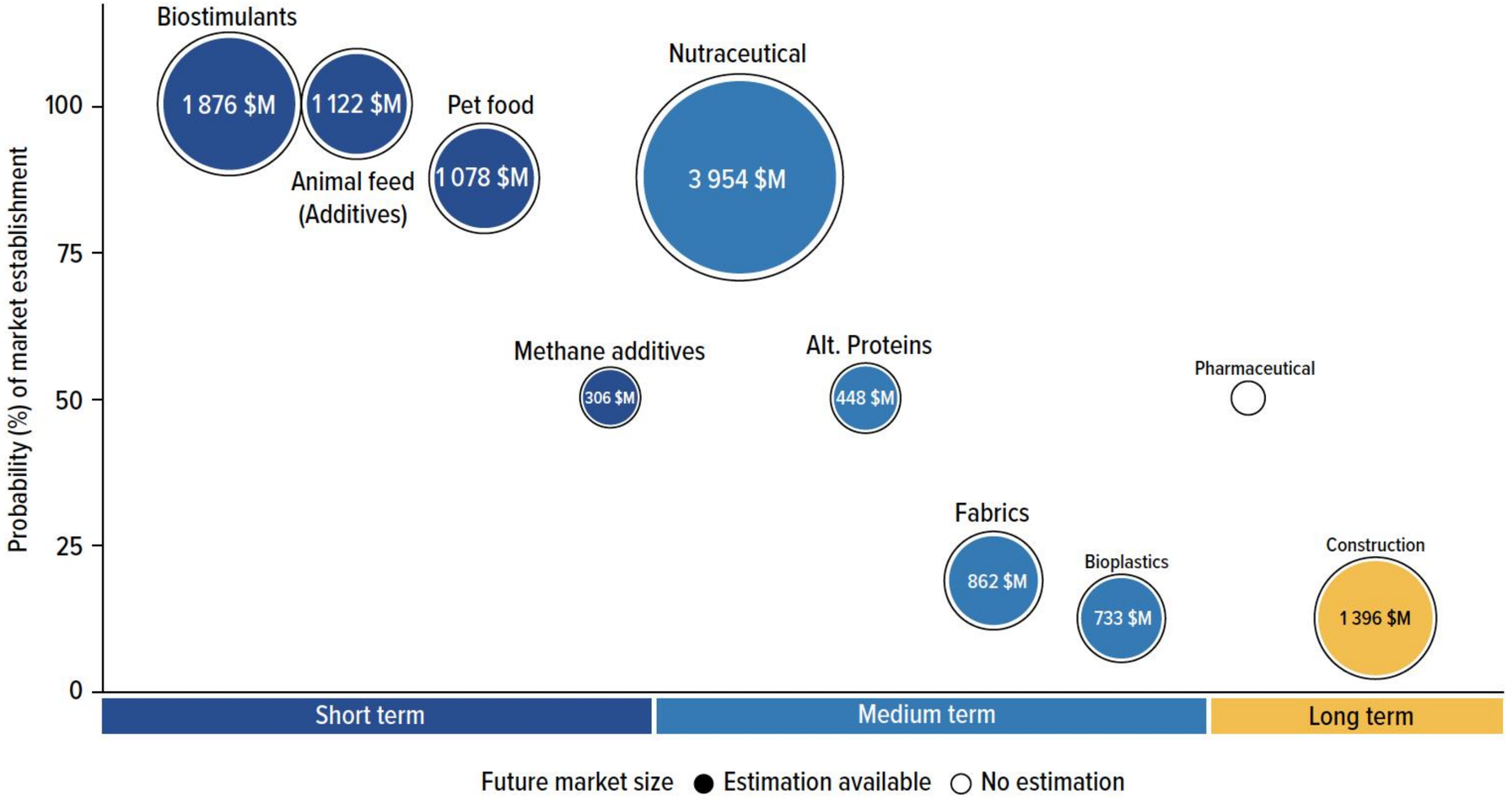
Algae biomass uses in Europe



based on the number of companies supplying biomass for these uses (Vazquez Calderon and Sanchez Lopez 2022)

#EU4Algae

Global Seaweed Market Projections to 2030+

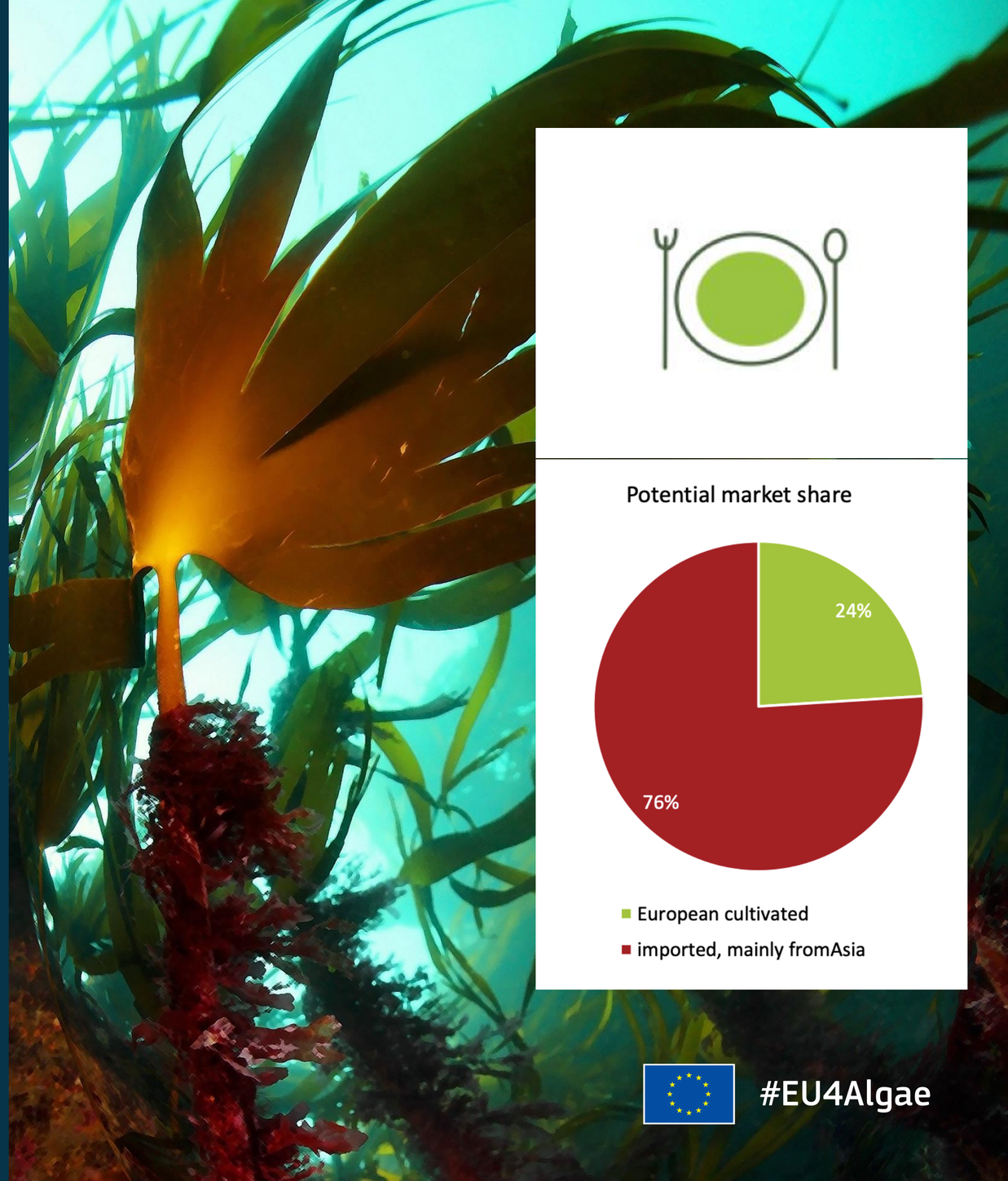


#EU4Algae

EU imports of seaweed food products were almost double of exports (178 ktons vs. 102 ktons)

>>> 24% of the seaweed demand could come from locally produced seaweeds by 2030

Source: Valgorise 2018



Environmental performance dictates consumer and European strategies

No scale up unsustainable practices that do significant harm

Algae will save the climate

Consumers demand sustainable products

Financial Taxonomy does not support unsustainable aquaculture practices

Polluters shame, blame and pay

Consuers trust that algae are vegan, nutritious, green alternative product ingredients

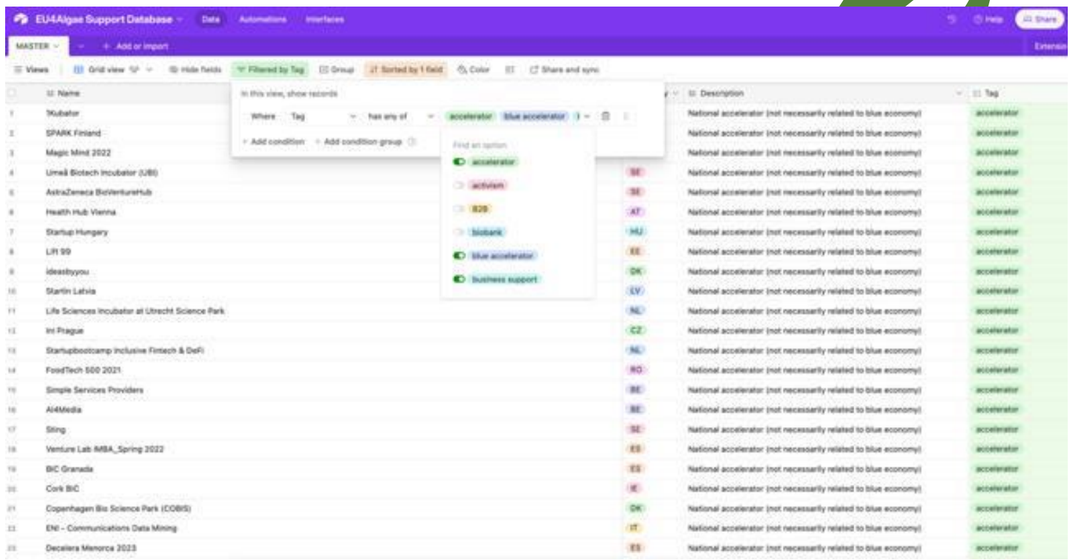
Mission Ocean ~Initiative supports zero carbon low trophic aquaculture

Corporate Sustainability Reporting goes public

#EU4Algae

How to Measure the Environmental Performance of Products and Processes: Many algae LCA studies!!

- Found 68 algae European projects with LCAs in the EU4Algae AirTable, since the EnAlgae project in 2013.
- Ca. 50 studies of macroalgae systems and 100 studies of microalgae systems.
- EN Industry Standards associated with environmental management and sustainability, only a few contain impact categories relevant to land-based LCAs and algae



EN-1SO 14040	**Environmental management — Life cycle assessment — Principles and framework**
EN-1SO 14044	Environmental management — Life cycle assessment — Requirements and guidelines

#EU4Algae

Knoledge gaps in algae LCAs

- No clear guidelines on how to conduct LCAs of biobased products including algae systems, nor of marine-based product systems
- Subjective decision-making by practitioners
- Lack of openly available, high-quality, specific data on algae production systems to improve the accuracy and reliability of LCAs
- Most algae LCAs do not refer to PCRs at all
- LCAs for zero-waste algae value chains are even more complex
- Lack of impact categories that adequately cover marine production systems
- Impact categories like marine biodiversity loss, ocean acidification, and effects on marine ecosystem services are either underrepresented or not specifically addressed.

How can algae companies comply to GCD without a standard LCA methodology to use?

Recommendations – R/I/G/(S)

1) Verify the environmental performance of algae value chains

- New PEFCR/PCR relevant to algae and algae products (R/I)
- Develop a LCA practitioner's guide (R/I/G)
- Setup studies looking at environmental carrying capacities of European sease and spatial differentiation

2) Promote circular solutions

- Update and simplify circularity parameters of PEF, e.g, use of residual streams, zero waste and biorefining (G/R/I)

3) Integrate Ecosystem Services with PEF

- Enhance knowledge using carbon forensic science for seaweed systems and climate impacts at sea (G/R)
- Setup studies looking at carrying capacities and spatial differentiation (G/R)

4) Protect and enhance algae legitimacy

- Environmental Impact Research on Algae Production (R)

#EU4Algae

For mor info on EU4Algae outcomes and new activities:

Stay in touch

DG MARE

@EU_MARE

@ourocean_eu

EU Maritime & Fish

EU4Algae

CINEA

@cinea_eu

CINEA - European Climate, Infrastructure and Environment Executive Agency

#EU4Algae

Thank you

#EU4Algae

Environmental Footprint (EF) methods and PEFCR/OEFSR processes: state of play and outlook

Arena 3 workshop on LCA in the blue bioeconomy: ecosystem services and carrying capacity

26-27 November 2024
Amsterdam

Mauro CORDELLA

European Commission, DG Environment

LCA and the harmonization need

Same product

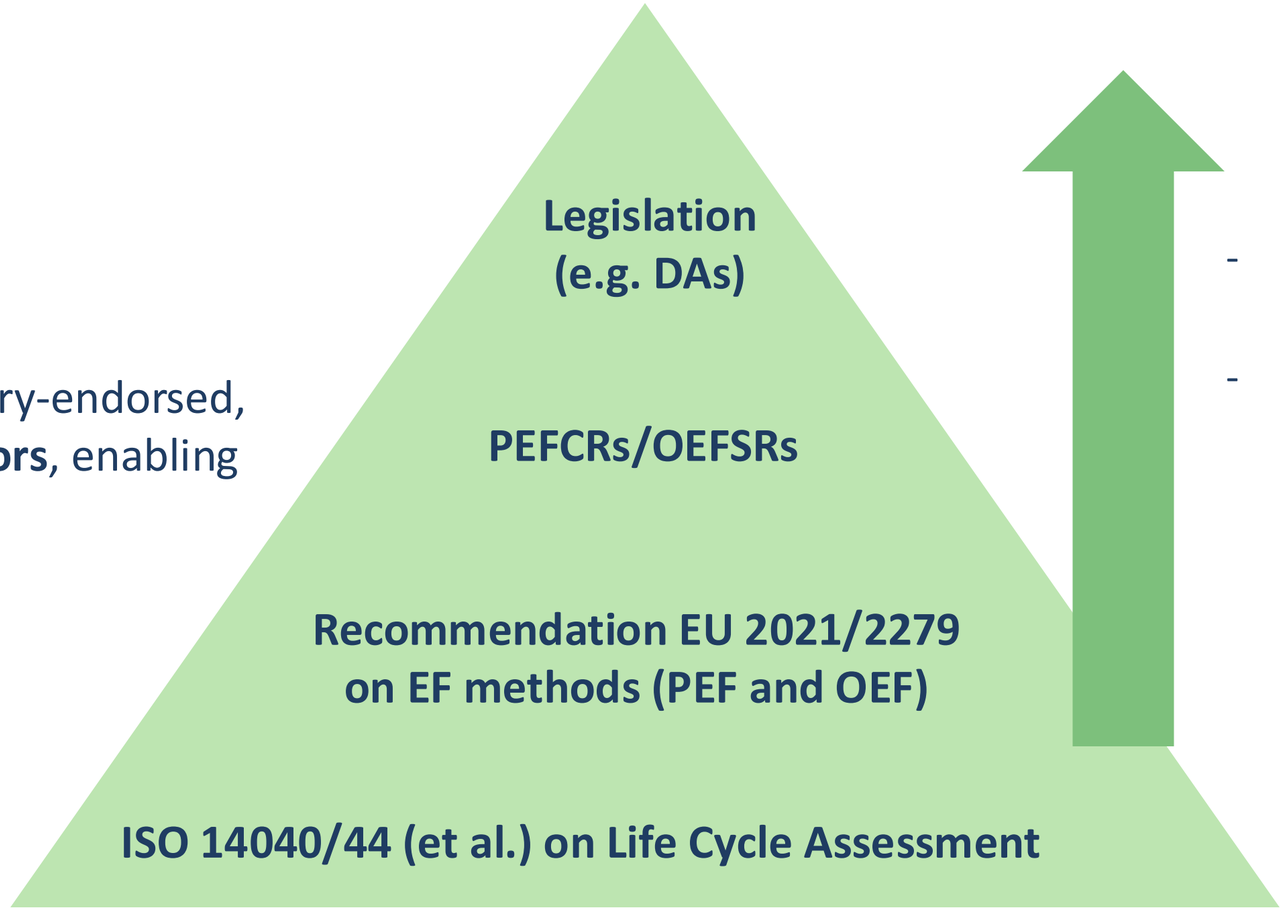
Different results

- impact assessment methods
- modelling (e.g. system boundaries, allocation, end of life)
- data
- interpretation

LCA, as standardised by ISO, as powerful tool but not directly suitable for some applications

EF methods in the LCA & EU policy context

PEFCR/OEFSRs: Industry-endorsed, **specific rules per sectors**, enabling reliable comparisons

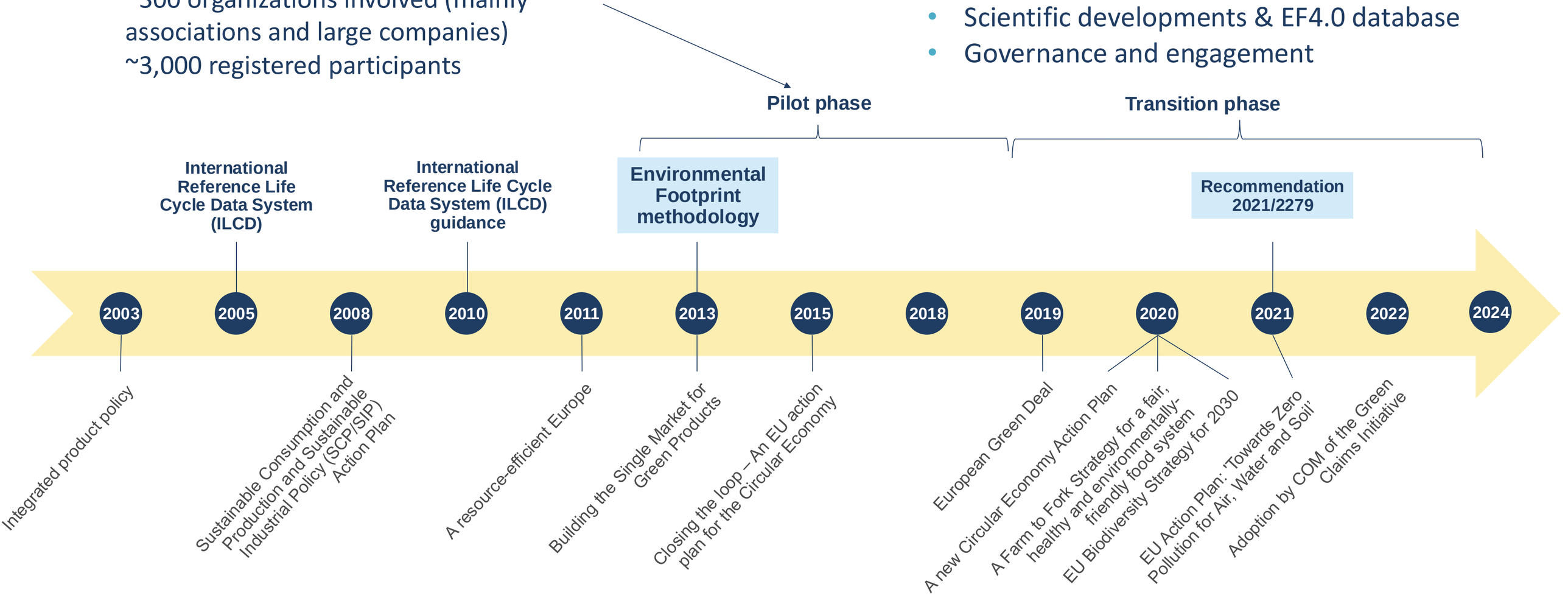


- *Each layer aims to build on the one below*
- *Going up, further methodological and data specifications leave less space for own assumptions and enhance reliability, comparability and verifiability*

The EF journey

21 PEFCR/OEFSRs
~300 organizations involved (mainly associations and large companies)
~3,000 registered participants

Developments:
- Progress / finalisation of PEFCR/OEFSRs
- Monitor and mainstream implementation
- Scientific developments & EF4.0 database
- Governance and engagement



New PEFCRs expected for 2024-2025

1. Aquaculture and marine fish
2. Apparel& Footwear (linked to ESPR)
3. **Cut Flowers and potted plants**
4. **Synthetic turf**

Updates expected for 2024-2025

5. Batteries and accumulators
6. Beer
7. **Copper (OEFSR)**
8. Dairy products
9. Feed for food-producing animals
10. Pasta
11. Pet food

Other PEFCRs:

12. Aircrafts, drones and VTOL (EASA), 2024-2025
13. Space (DEFIS), 2026
14. Tourism (GROW), 2025

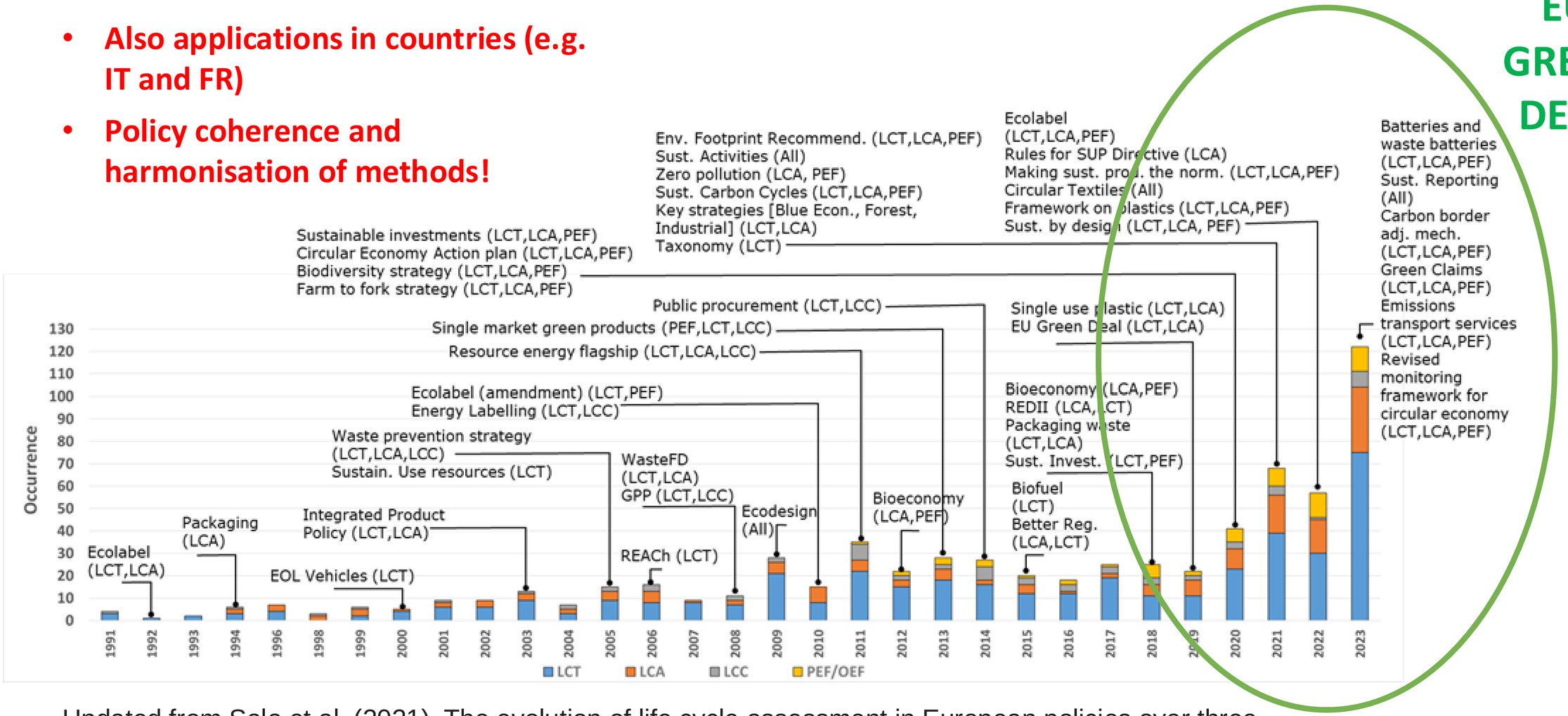
“Shadow” PEFCRs:

- Developed by industry independently from EC
- Not to formally follow all EF procedures/rules (adaptations possile)
- Could be reference for further developments, incl. EF processes and policy uses

Increasing use of LCA / EF in EU policies

- **Also applications in countries (e.g. IT and FR)**
- **Policy coherence and harmonisation of methods!**

EU GREEN DEAL



Updated from Sala et al. (2021). The evolution of life cycle assessment in European policies over three decades. *The International Journal of Life Cycle Assessment*, 26, 2295-2314.

Outlook for EF methods

- Planned review of EF Recommendation in 2025 (text, PEFCR/OEFSR-related procedures, methods)
- New EF4.0 database (2026-2027)
- Review of governance (e.g. update of EF TAB via Register of Commission expert groups)
- Training and communication
- Finalisation of PEFCRs and WP for future years
- Support to application of EF methods across EU polices (e.g. GCD/ESPR)

THANK YOU!

ENV website: Environmental Footprint methods

JRC website: European Platform on LCA (EPLCA)

EF TAB: Register of Commission expert groups

Circular economy: Circular economy

Green claims: Green claims

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BLUE MISSION BANOS

Sustainability in the Blue Bioeconomy: LCA, ES and CC

Sophie Koch - Sjókovin

26 November, 11:15-13:00am
Hall 4

#MissionArena3

Funded by the European Union

Agenda

With the example of seaweed aquaculture

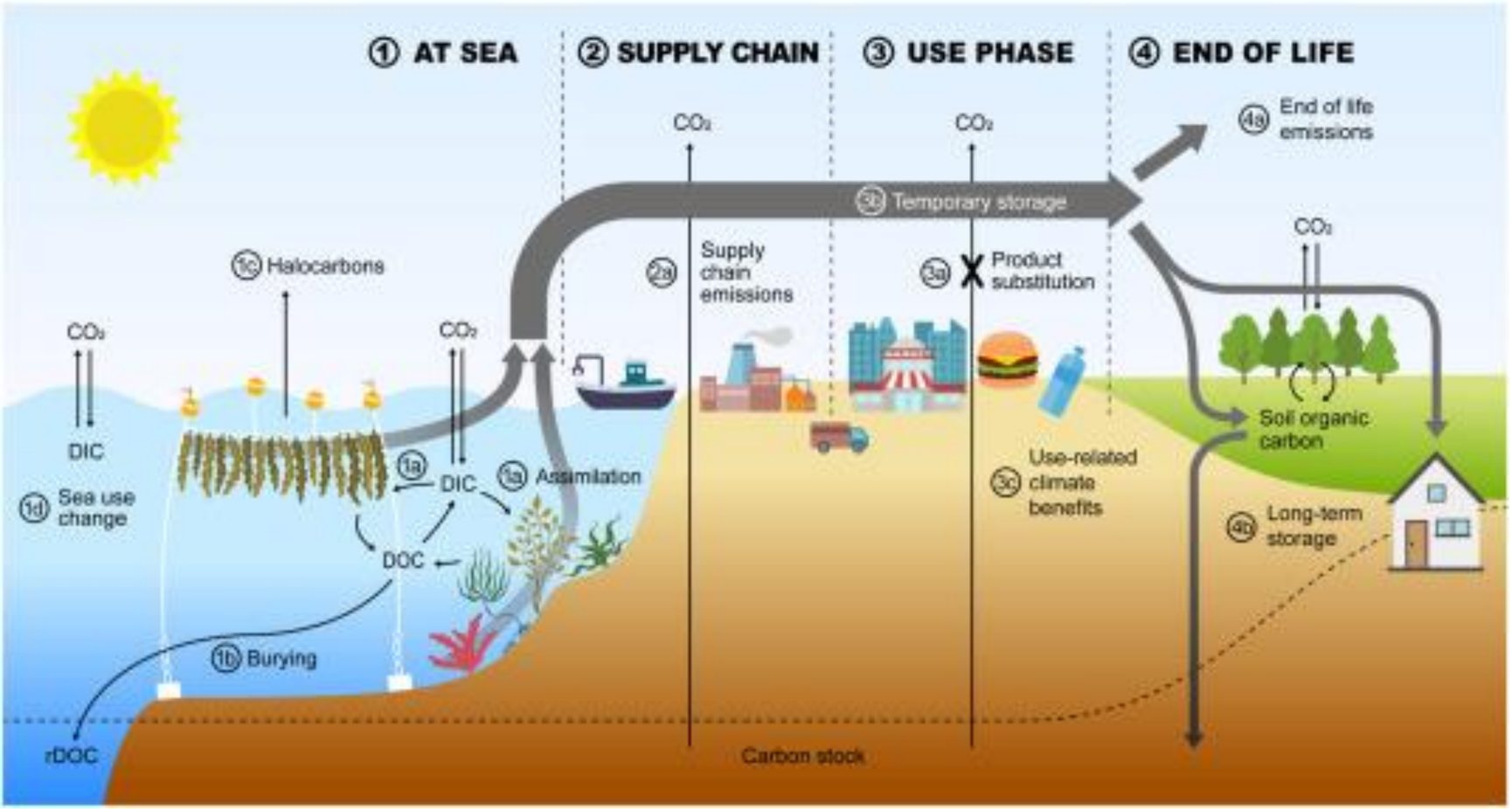
- What tools are out there
  - LCA
  - Ecosystem services
  - Carrying capacity
  - Barriers
  - Optimal window for operation
- Different scopes, objectives, advantages and what they’re missing
- Is there a tool that can do it all?

Sustainability tools

- **For when** : status quo or including projected bigger production?
  => Expansion
- **Of what** : current 'product' or including value chain?
  => Value Chain
- **Where** : Impacts in the water or on land?
  => Ecosystem
- **Which dimension** : Society? Environment? Government? Economy?
  => Dimensions

⇒ What is taken into consideration ?

LCA

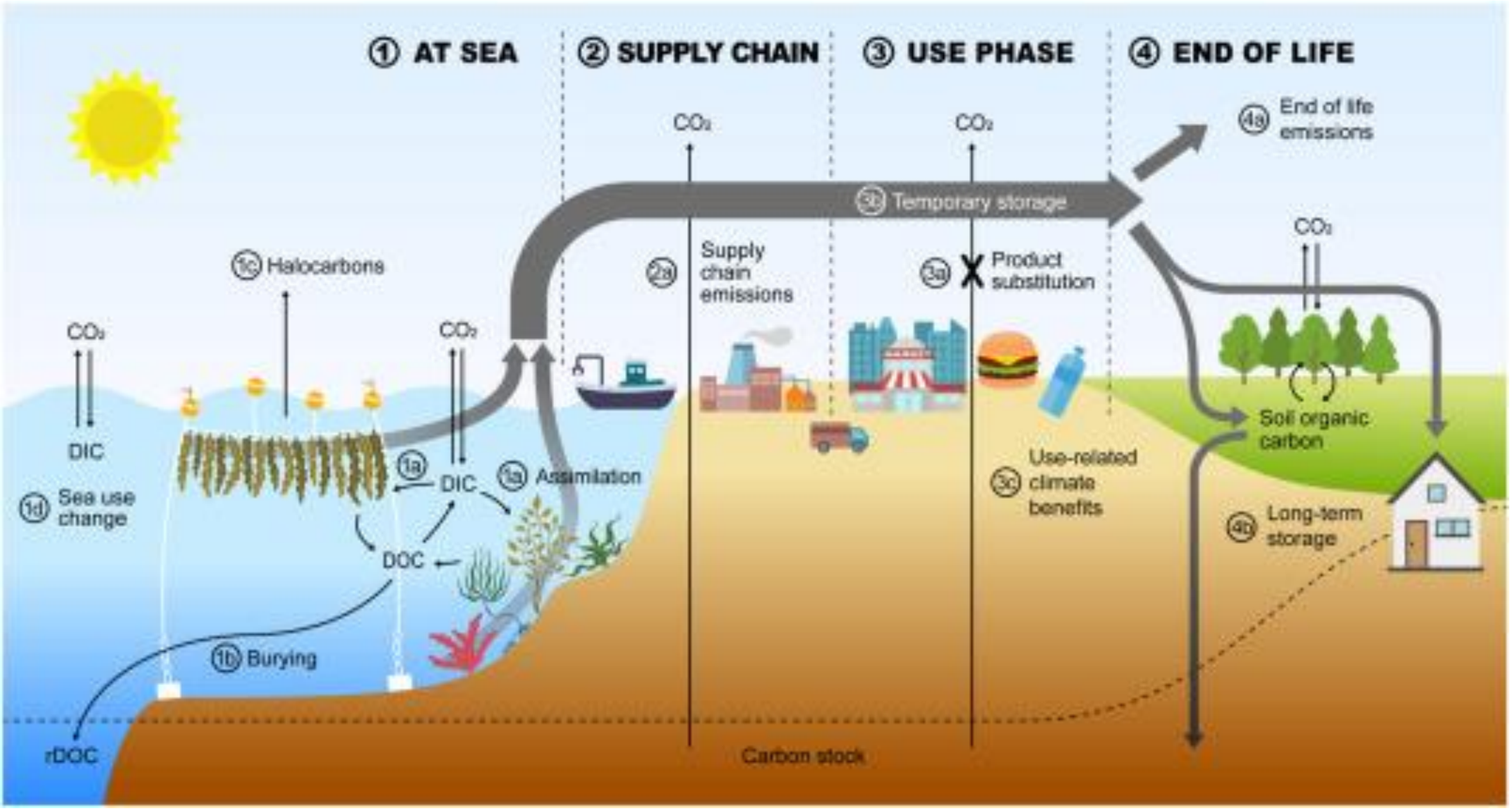


Expanded to also encompass

- Social LCA
  - Human health
  - Labour considerations
  - Community well being
  - Equity
- Economic LCA
  - Cost
  - Benefit
  - Financial implications

FIgure credits: Hasselström and Thomas 2022: https://doi.org/10.1016/j.cesys.2022.100093

LCA



Environmental LCA

Mainly terrestrial:

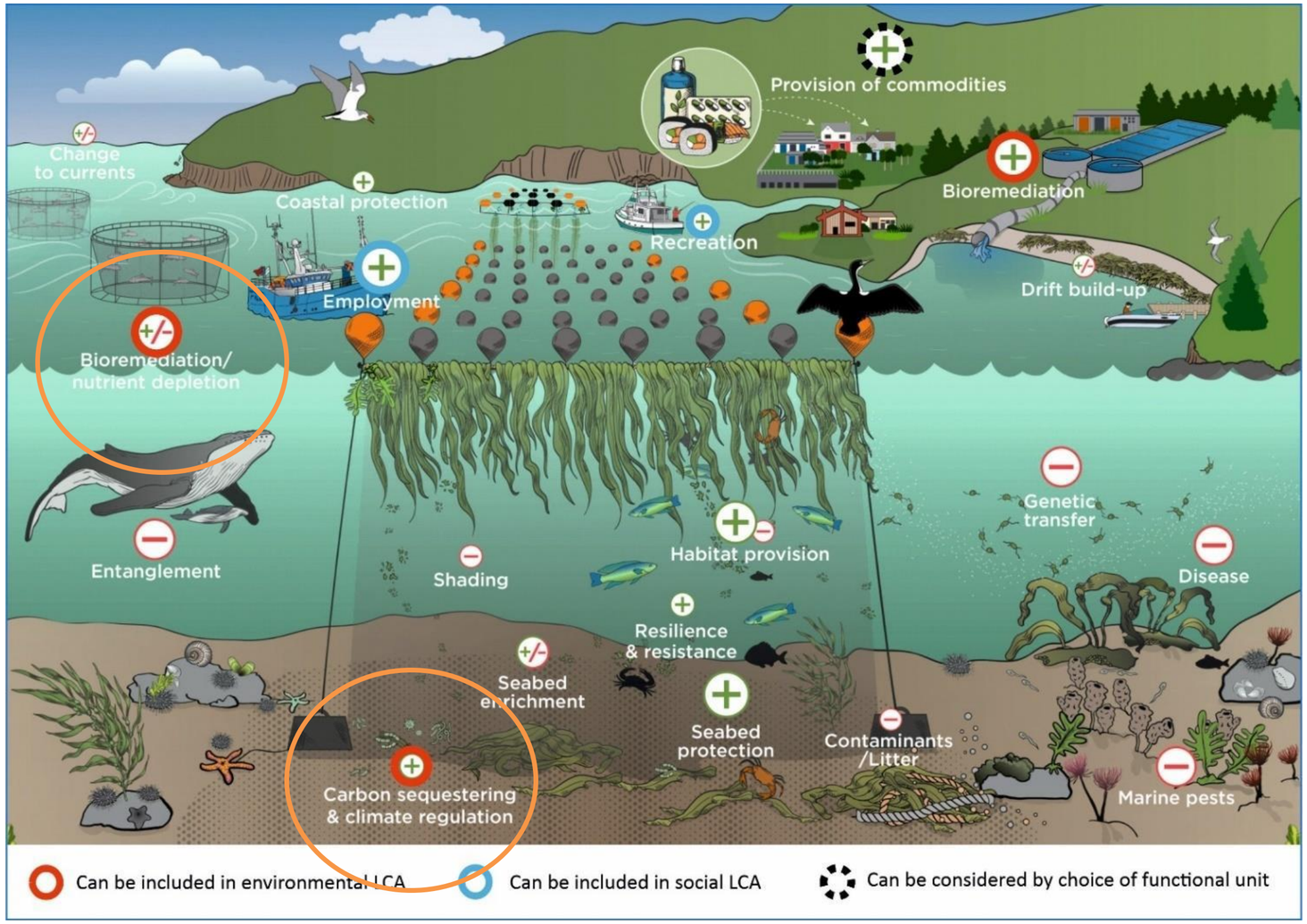
- Supply chain
- Use phase
- End of life

Narrow focus on marine ecosystem:

- Focus on CO2 emitted and sequestered
- Bioremediation

Figure credits: Hasselström and Thomas 2022: https://doi.org/10.1016/j.cesys.2022.100093

Environmental LCA



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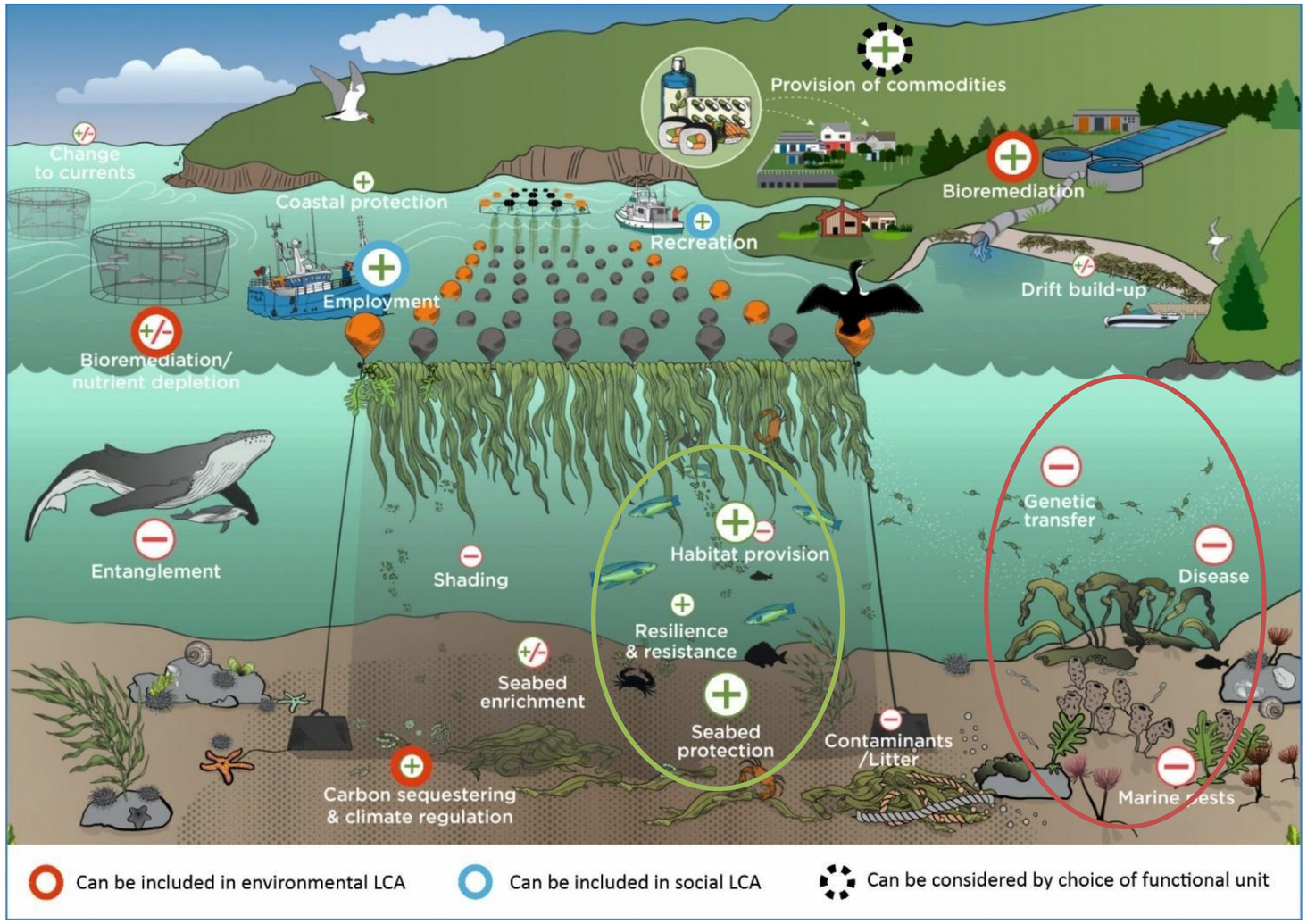
⇒ But there are many other environmental impacts not taken into account in LCAs

Figure credits: Algae Pro Banos D1.1 , *Adapted from Clark et al. (2021).*

LCA

- ✓ Whole value chain
- ✓ Many dimensions
- ✗ Not all impacts in marine environment
- ✗ expansion



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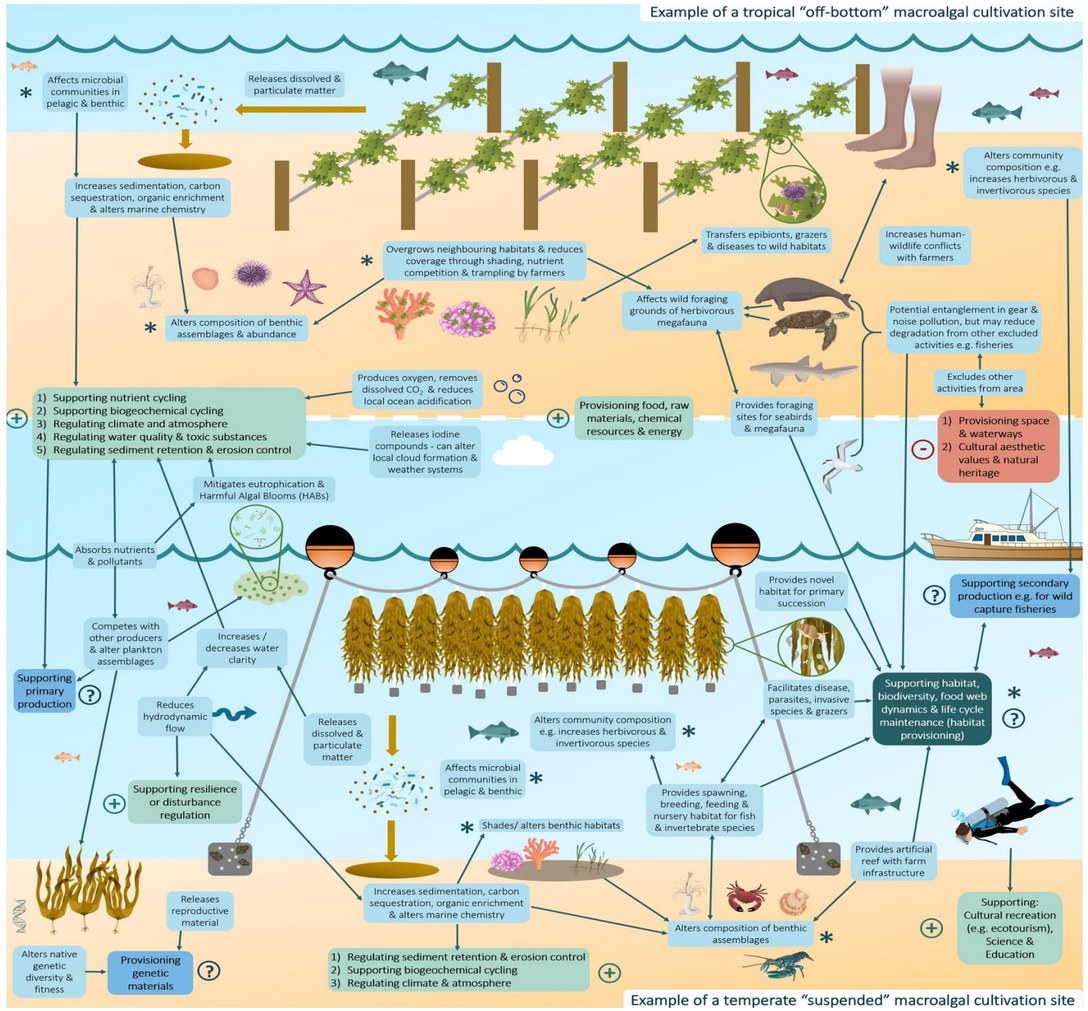
⇒ Complementary tools

Figure credits: Algae Pro Banos D1.1 , *Adapted from Clark et al. (2021).*

Impacts from seaweed aquaculture



Positive impacts: Ecosystem service assessment

- Biodiversity (habitat, shelter)
- Carbon sequestration
- Bioremediation

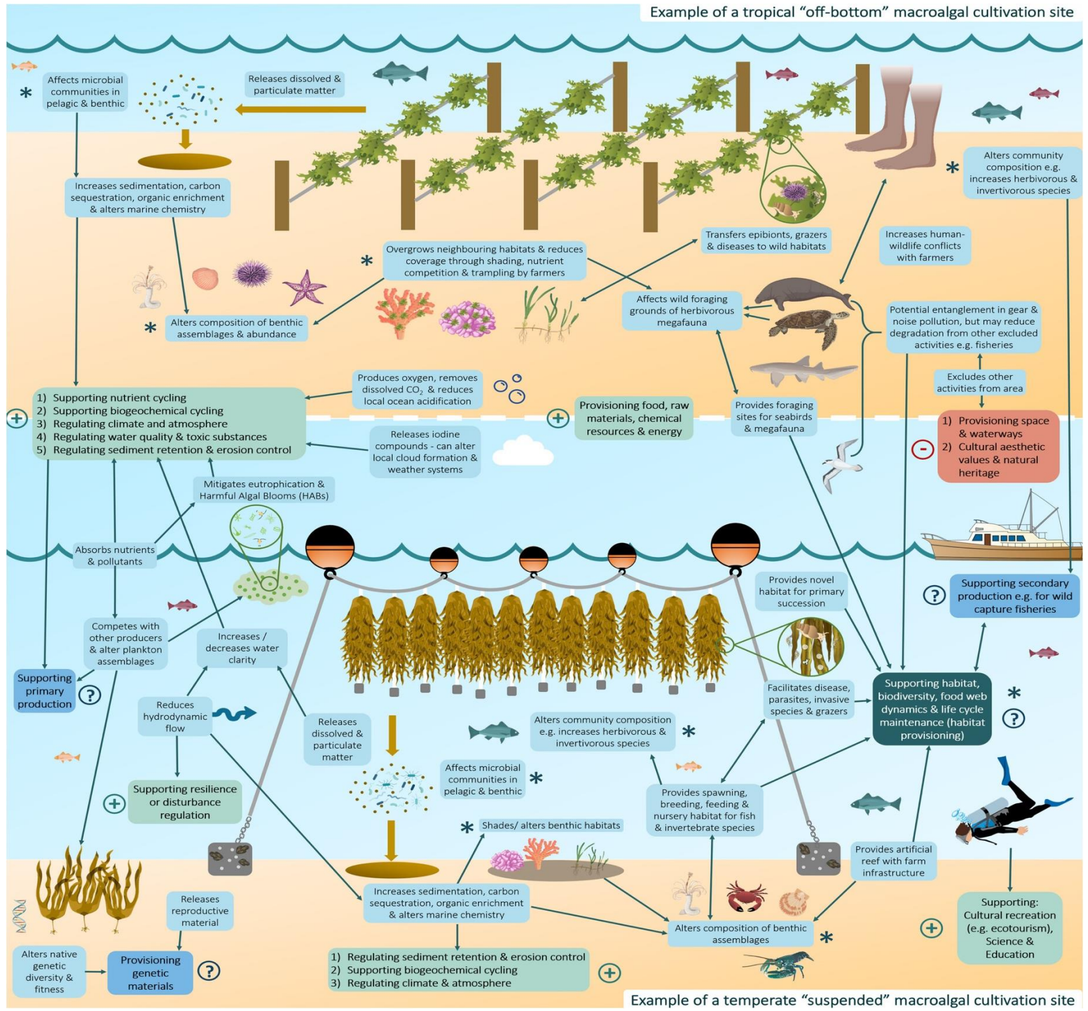
☑ Marine ecosystem
✗ Many dimensions
✗ Expansion
✗ Value Chain

Negative impacts: Environmental impact assessment (EIA)

- Disease
- Invasive species
- Too much shading

Figure credits: left: Corrigan et al 2022: https://doi.org/10.1111/raq.12669, up: Alleway et al 2018

Impacts from seaweed aquaculture



Positive impacts: Ecosystem service assessment

- Biodiversity (habitat, shelter)
- Carbon sequestration
- Bioremediation

⇒ The more the merrier

- ☑ Marine ecosystem
- ☒ Many dimensions
- ☑ Expansion
- ☒ Value Chain

Negative impacts: Environmental impact assessment (EIA)

- Disease
- Invasive species
- Too much shading

⇒ There will be a limit of unacceptable change

⇒ **Carrying capacity assessment**

Image credits: Corrigan et al 2022: https://doi.org/10.1111/raq.12669

Carrying capacity (CC)

- Production
- Physical
- Ecological
- Socio-economic

⇒ What are the limits to expansion (intensification, upscaling)

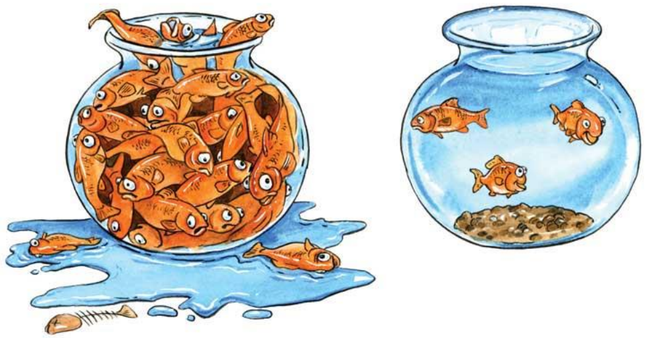


Image credits: https://ecosystemsunited.com/2015/12/16/question-is-there-such-thing-as-a-human-carrying-capacity/

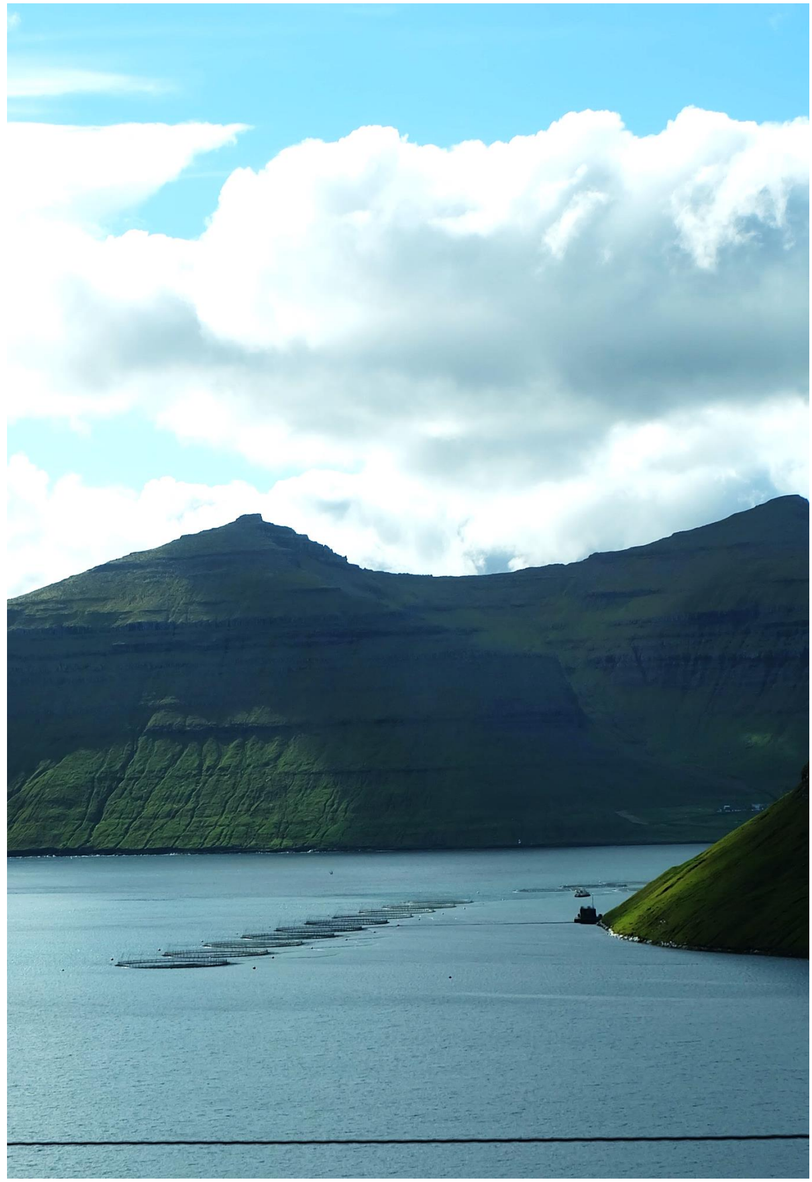


Image credits: Sophie Koch

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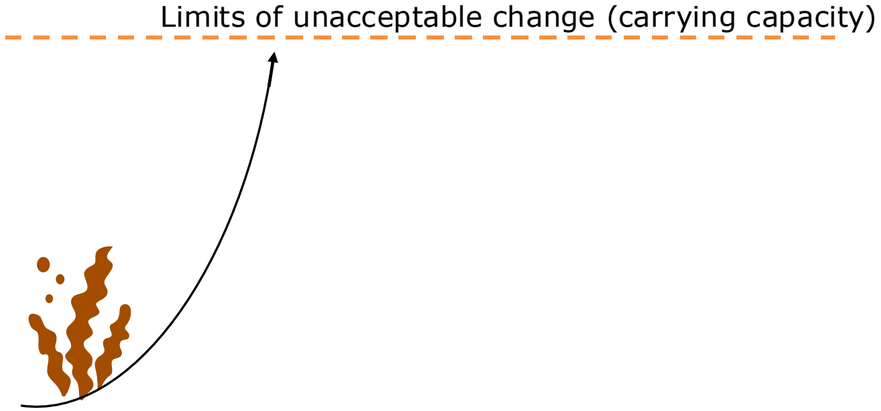

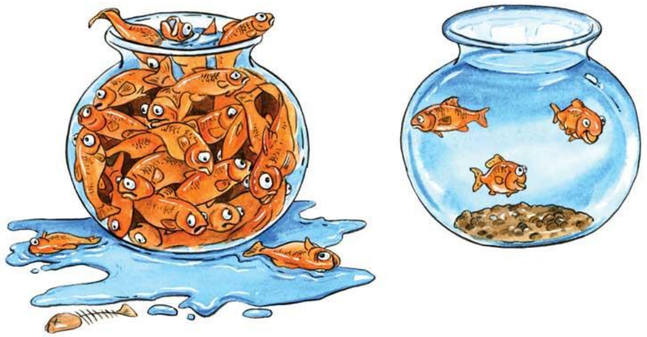

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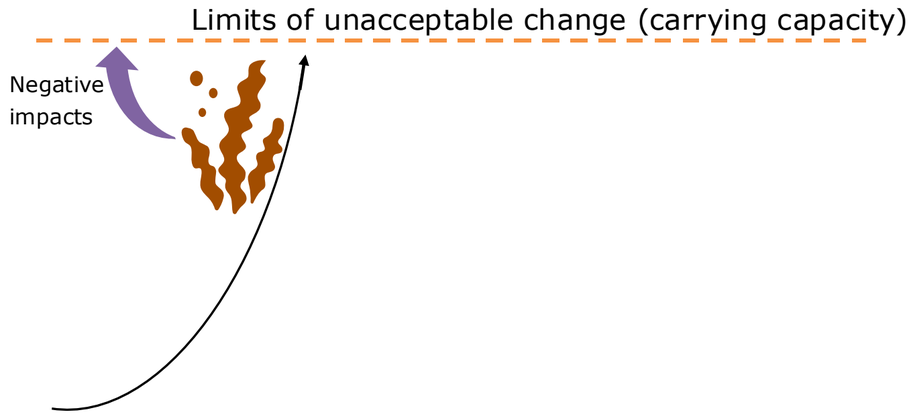

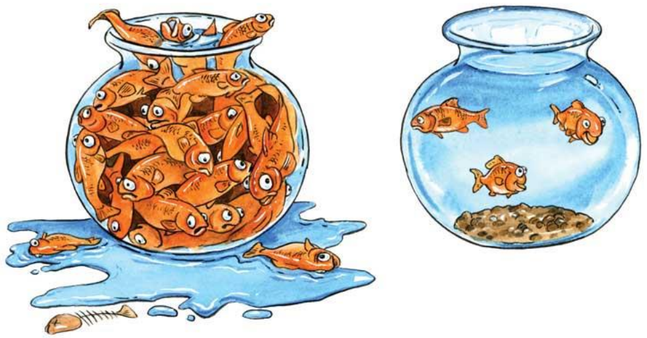

ex: Negative environmental impacts from seaweed: too much shading, invasive species…

Image credits: https://ecosystemsunited.com/2015/12/16/question-is-there-such-thing-as-a-human-carrying-capacity/

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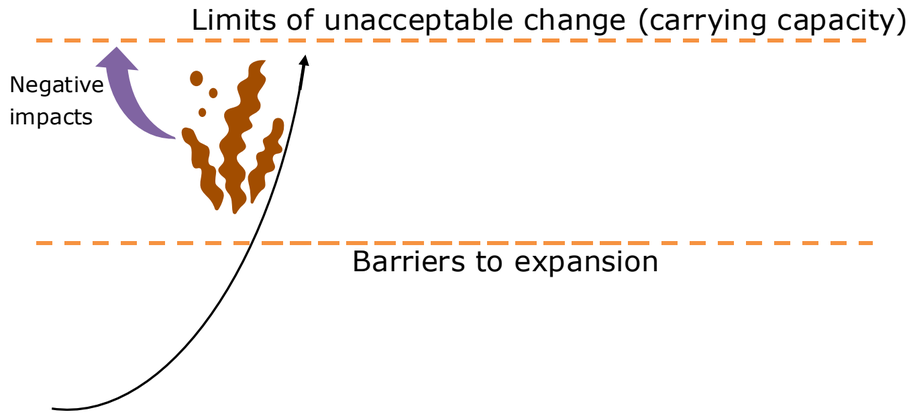

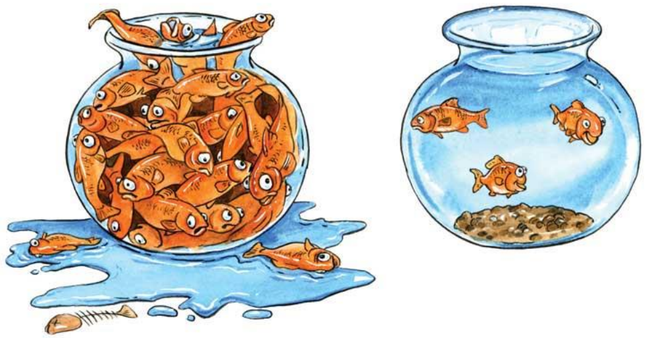

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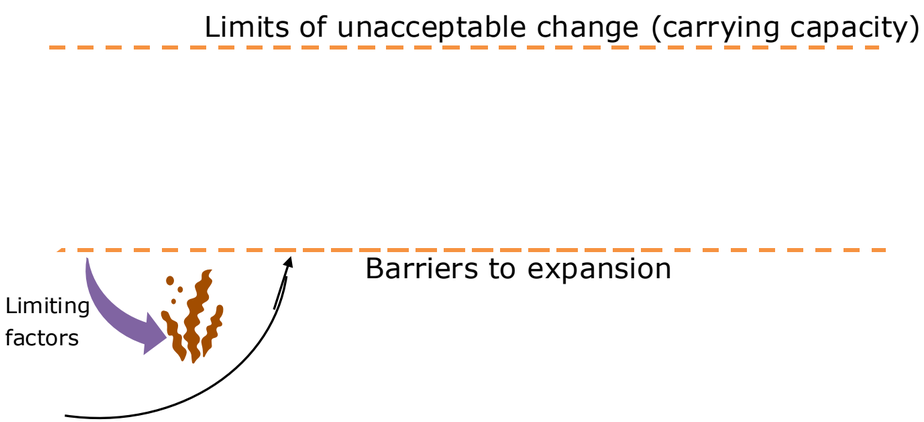

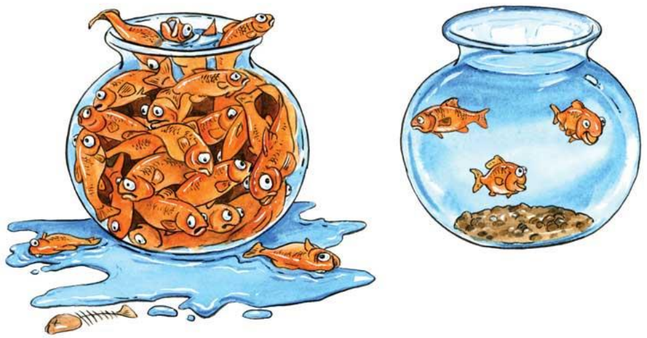

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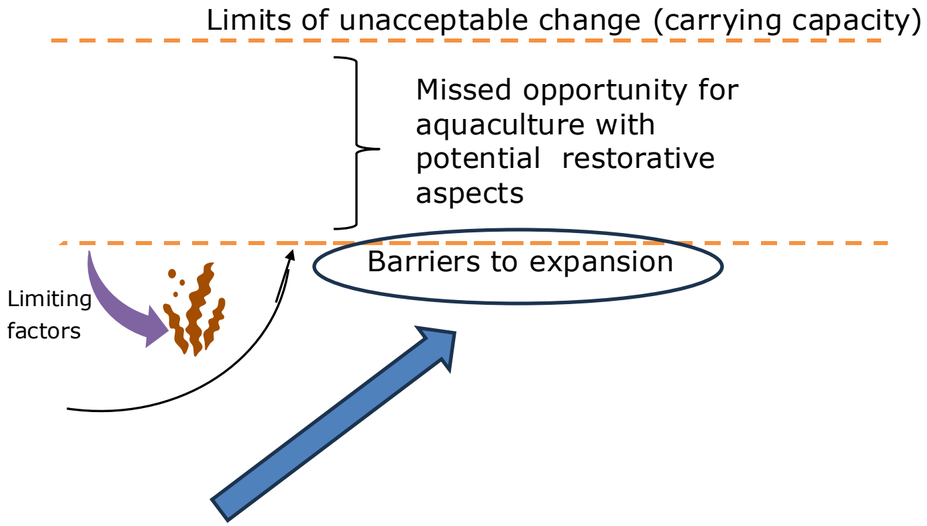
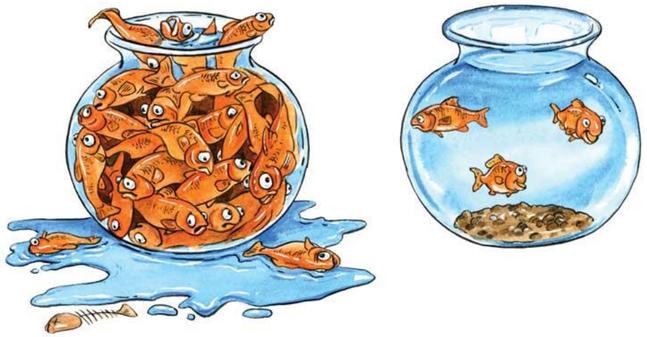




ex: socio-economic:

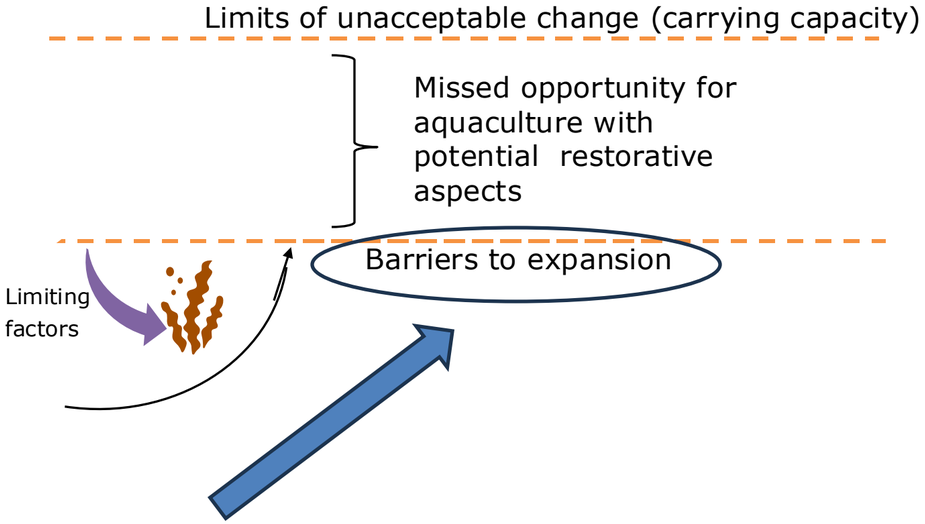
Profitability, market, conflicts with other coastal users…

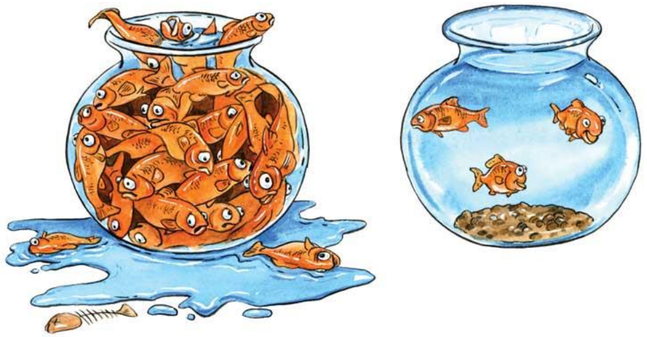
Image credits: https://ecosystemsunited.com/2015/12/16/question-is-there-such-thing-as-a-human-carrying-capacity/

Carrying capacity (CC) + Expansion barriers

- Production
- Physical
- Ecological
- Socio-economic

⇒ What are the limits to expansion (intensification, upscaling)



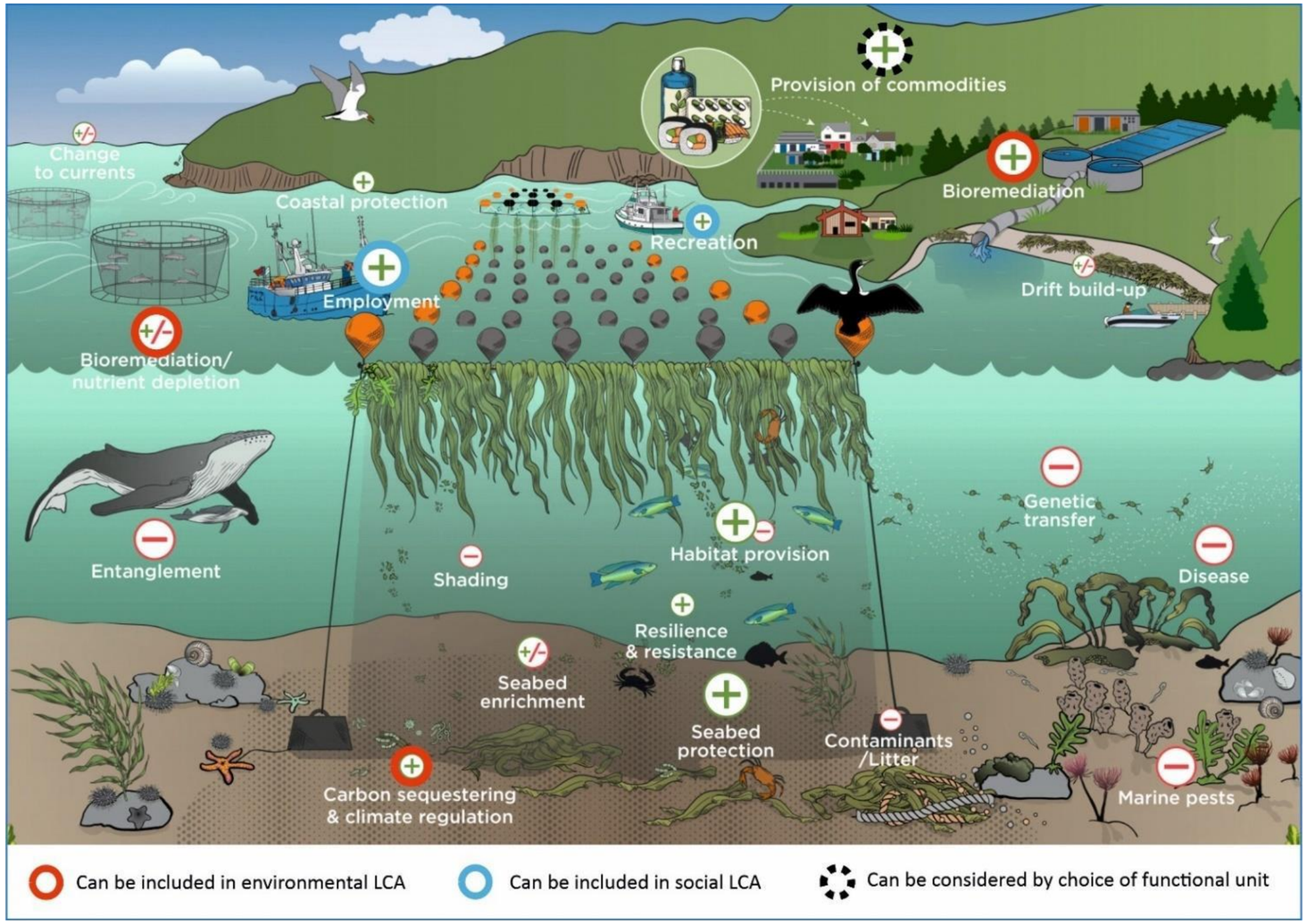


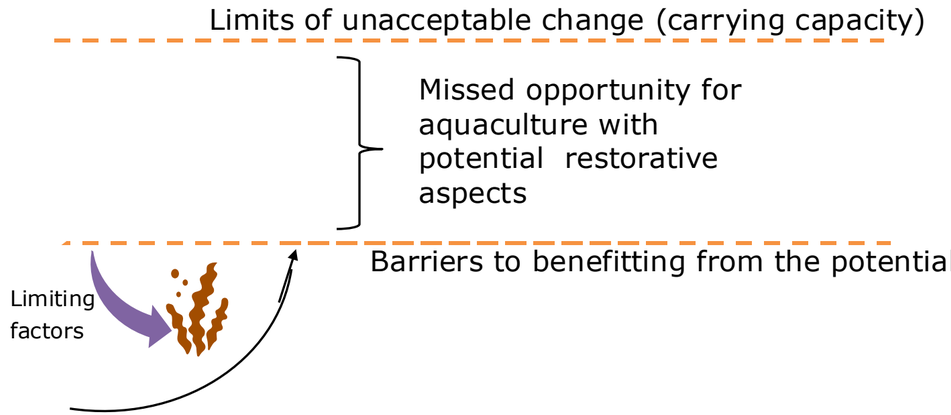
ex: socio-economic:

Profitability, market, conflicts with other coastal users…

Image credits: https://ecosystemsunited.com/2015/12/16/question-is-there-such-thing-as-a-human-carrying-capacity/

Carrying capacity (CC) + Expansion barriers





⇒ Negative impacts (pressures)
⇒ Limiting factors (barriers)
⇒ But also positive impacts (ecosystem services) can be assessed and integrated for tradeoff discussions

Image credits: Algae Pro Banos D1.1 , *Adapted from Clark et al. (2021).*

Limits of unacceptable change (carrying capacity)

Barriers to benefitting from the potential

Image credits: Algae Pro Banos D1.1 , *Adapted from Clark et al. (2021).*

Optimal window for operation

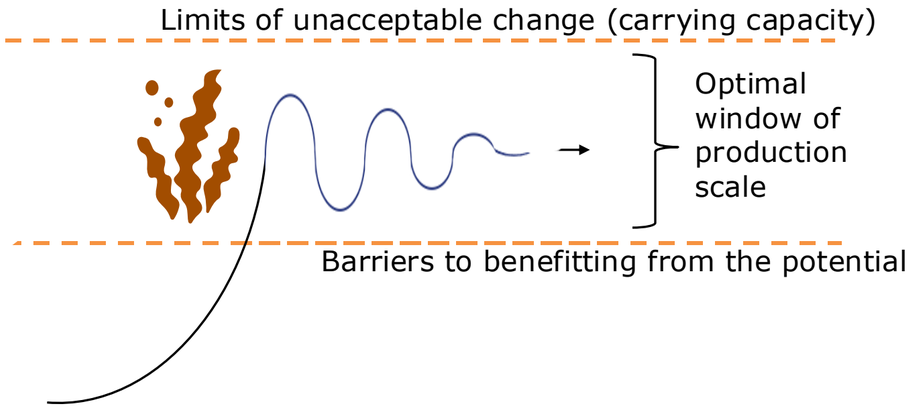
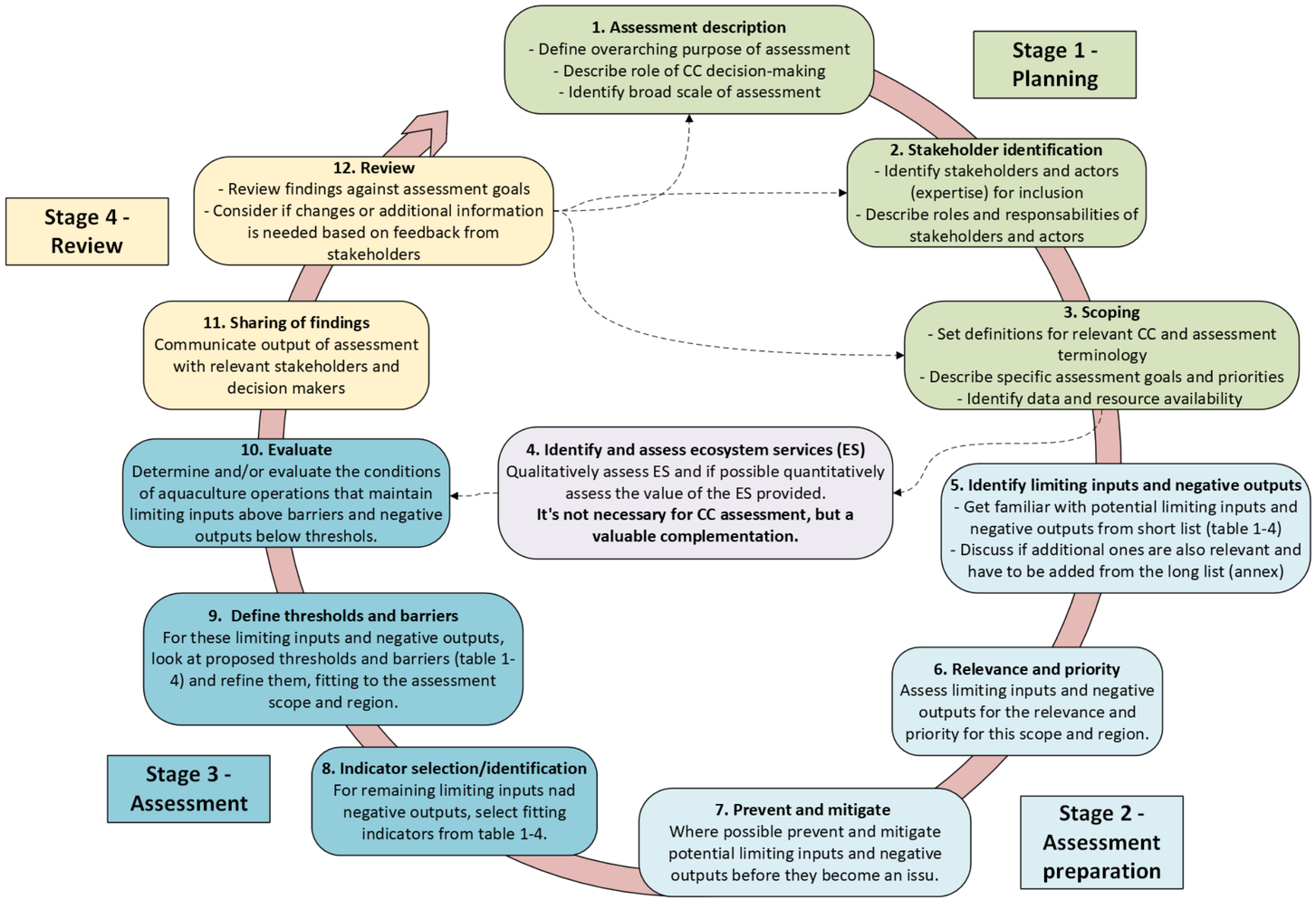
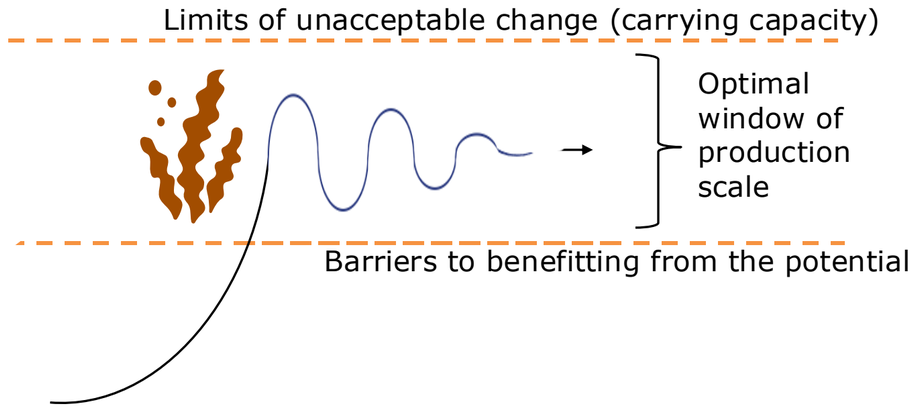


Figure credits: Koch et al 2024 preprint: DOI: 10.2139/ssrn.5003456

Optimal window for operation





- ✓ Marine and Terrestrial ecosystem
- ✓ Expansion
- ✓ Many dimensions
- ✗ Value Chain

Figure credits: Koch et al 2024 preprint: DOI: 10.2139/ssrn.5003456

Sustainability assessment

Tool		Expansion	Value Chain	Ecosystem	Dimension
LCA		✗	✓	Mostly terrestrial	Almost all
Optimal operating window	ES	✗	✗	Marine	Environmental
	CC	✓	✗	Both	All
	Barriers	✗	✗	NA	All

4 Pillars of the assessment from The AlgaeProBANOS Project:

- Environmental Tolerance Indicators => CC
- Performance indicators => balancing 4 dimensions
- Integrated assessment tools e.g. LCA => holistic evaluations
- Sustainability Calculation Algorithm => sustainability score

=> Combination out of indicators and tools on all dimensions

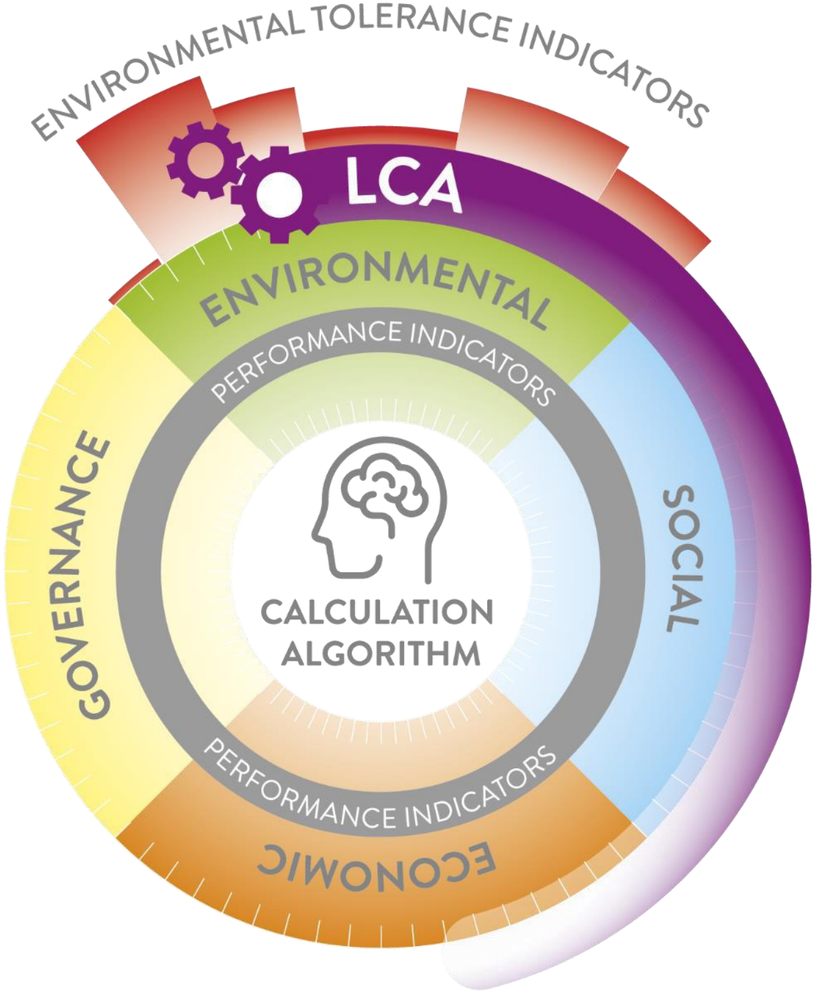
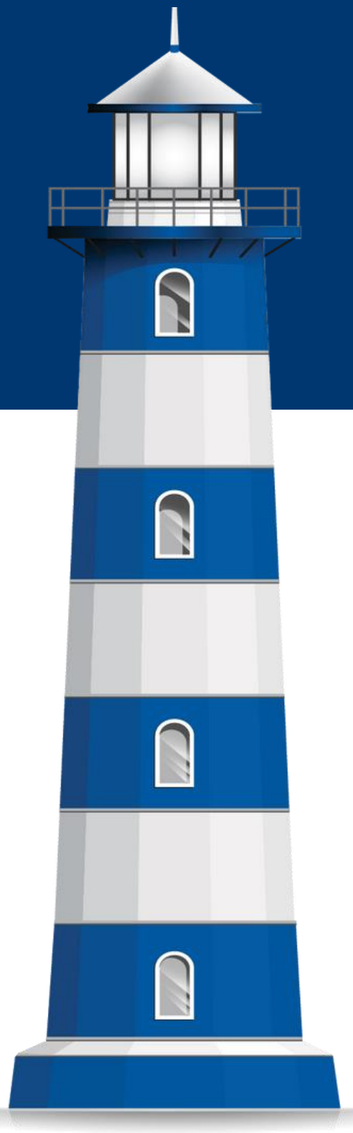


Figure credits: AlgaeProBANOS project D1.1

BLUE MISSION BANOS

Supporting the Mission Ocean Lighthouse in the Baltic and North Sea Basins

EU MISSIONS
RESTORE OUR OCEAN & WATERS



Thank you !

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