Blue Opportunities in the North Atlantic: Marine Biomass Cultivation

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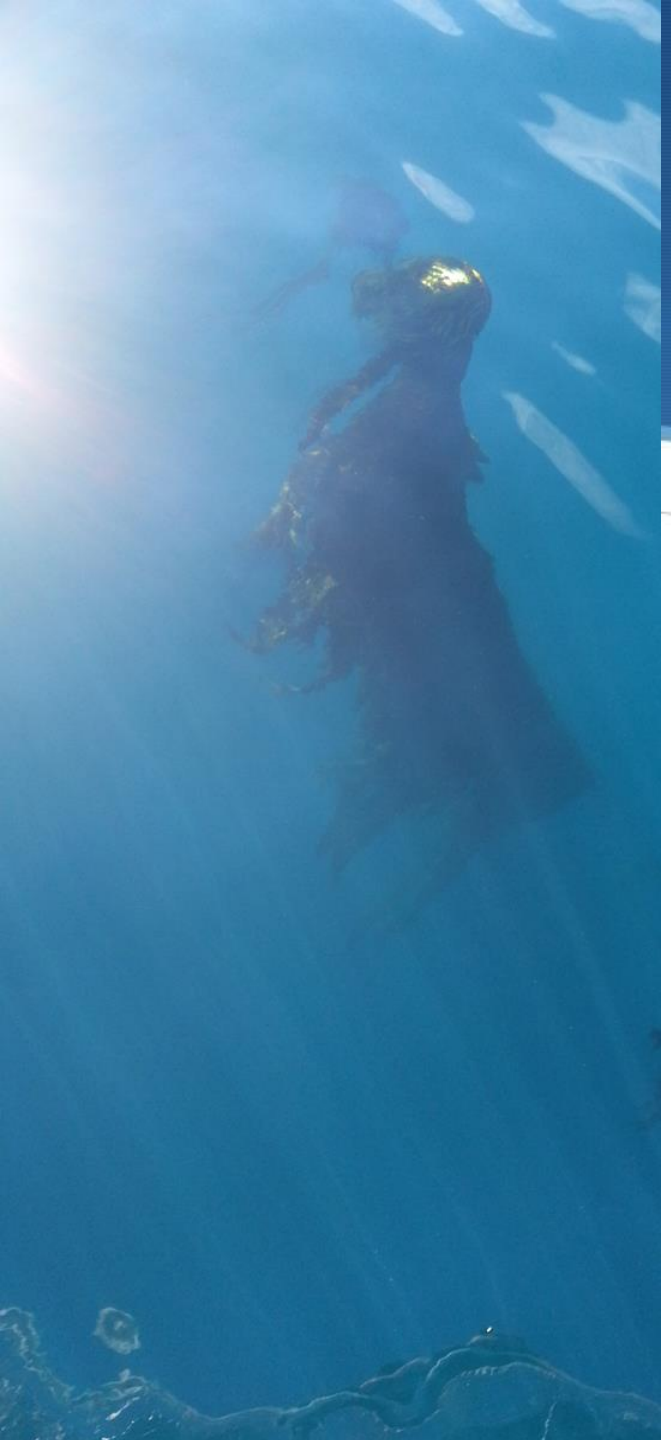

Blue Bioeconomy & Seaweed as marine biomass

- Oceans **70%** of the Earth's surface
- Food & feed production **+70%** by 2050
- **90%** of global fish stocks over- or fully exploited
- Aquaculture will provide **60%** of global seafood consumption by 2030
- Significantly higher growth rates than land based plants (**10x**)
- No need for fertilizers & not competing with human food source
- Untapped marine resource to be utilized for food, feed, pharma and energy production
- Fits Blue Bioeconomy as sustainable and knowledge based use of marine resources

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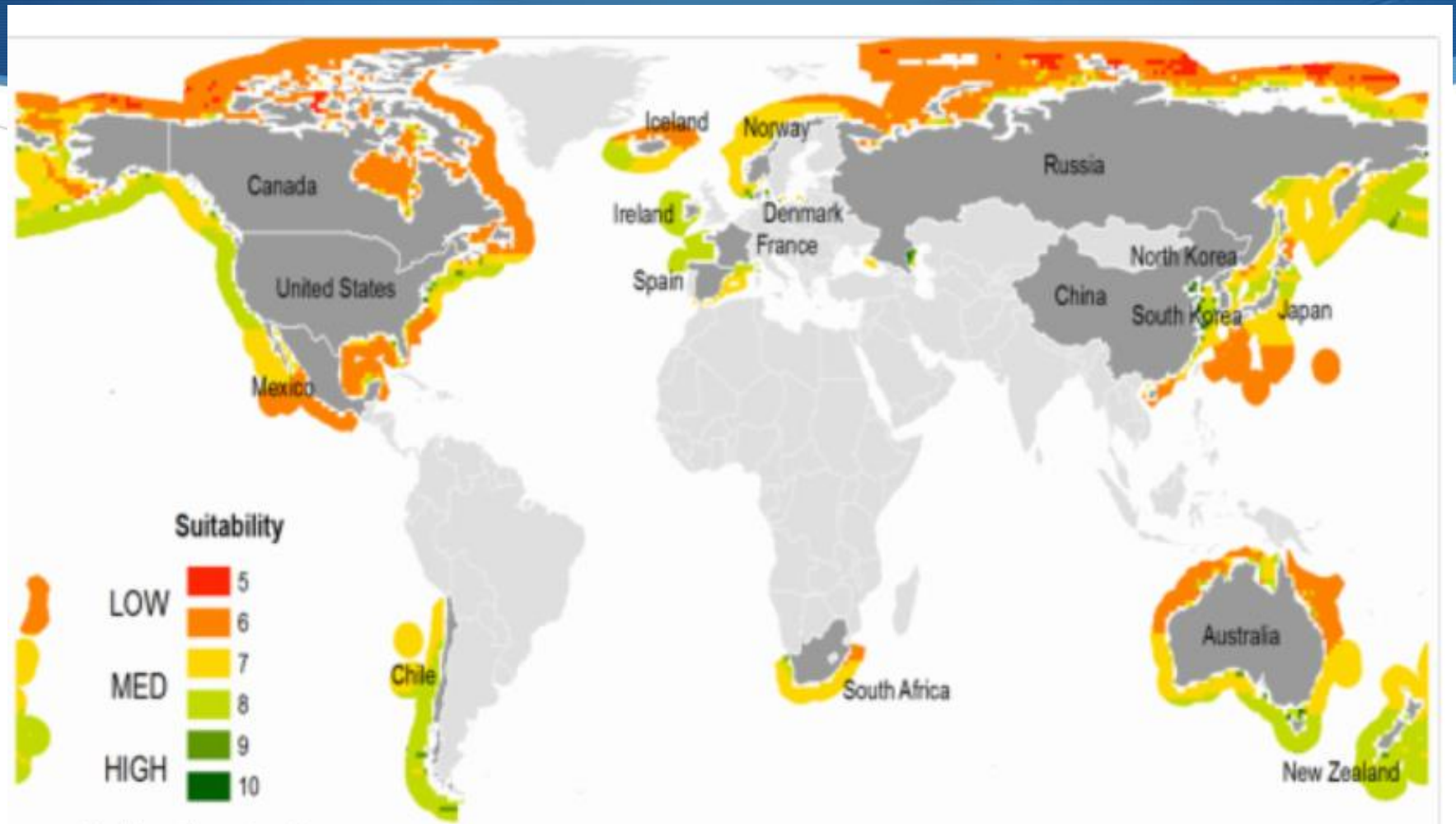
Brown macroalgae suitability map



Yield estimates by score:

10: 147 wet MT/ ha-yr , **9:** 141 wet MT/ ha-yr , **8:** 135 wet MT/ ha-yr , **7:** 129 wet MT/ ha-yr

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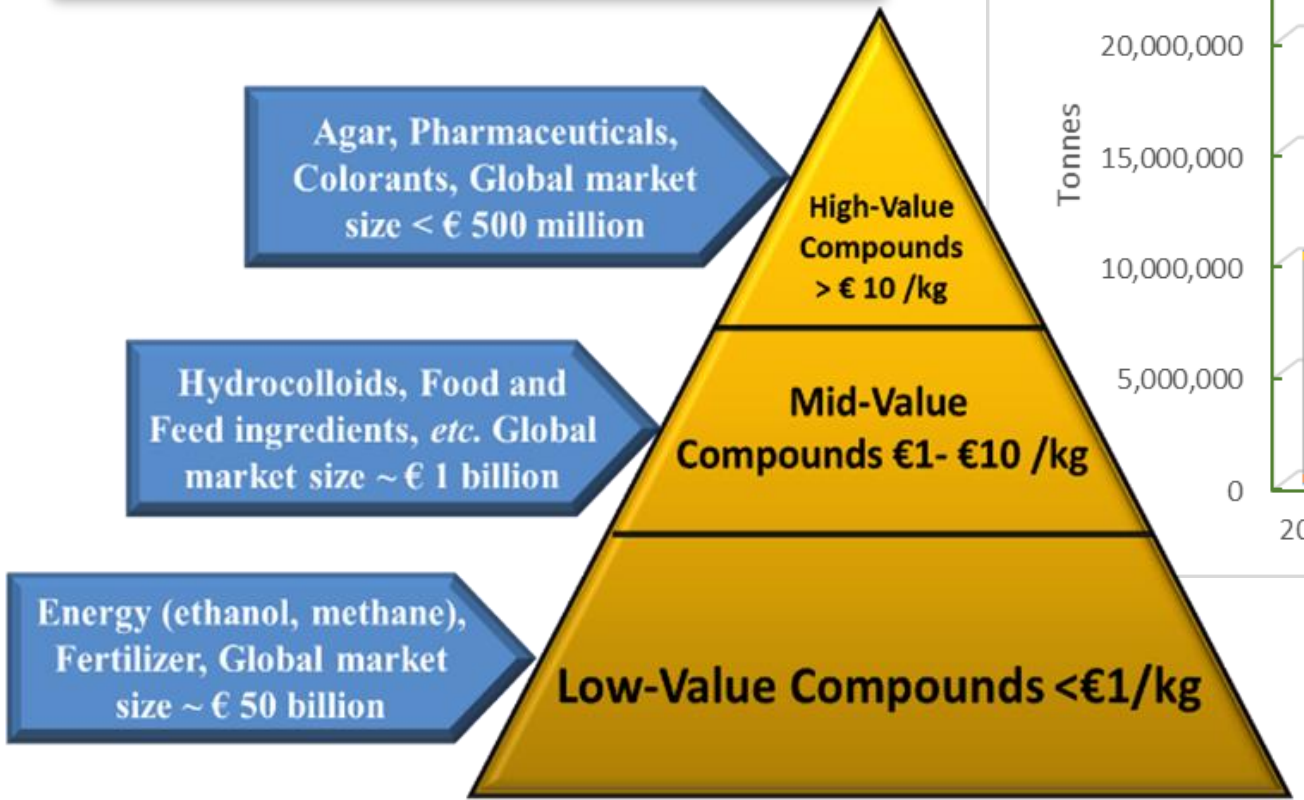
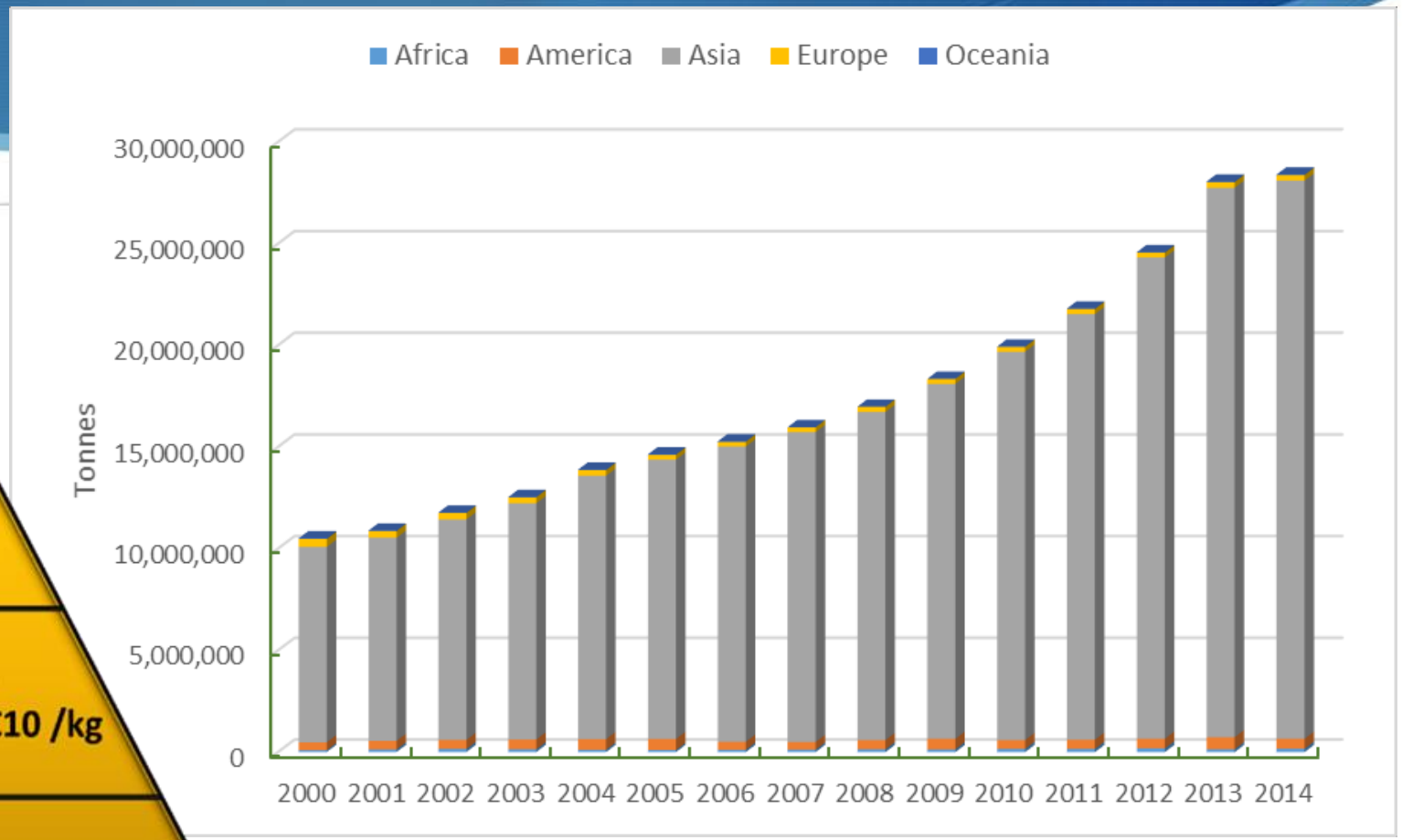
Global production of macroalgae & market assements

The global commercial seaweeds market:
2015: >€10 billion
2024: >€20 billion





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Why seaweed for food and feed products?

- Natural food additives (alginate, E407-E418)
- Flavour (Umami taste)
- Natural pigments (in feed for fish & animals)
- Sodium reduction (major public health issue in US and EU)
- Improve digestion (pre/pro biotic effects)
- Essential amino acids and minerals (jod, B12 vitaminir, OMEGA 3 etc.)

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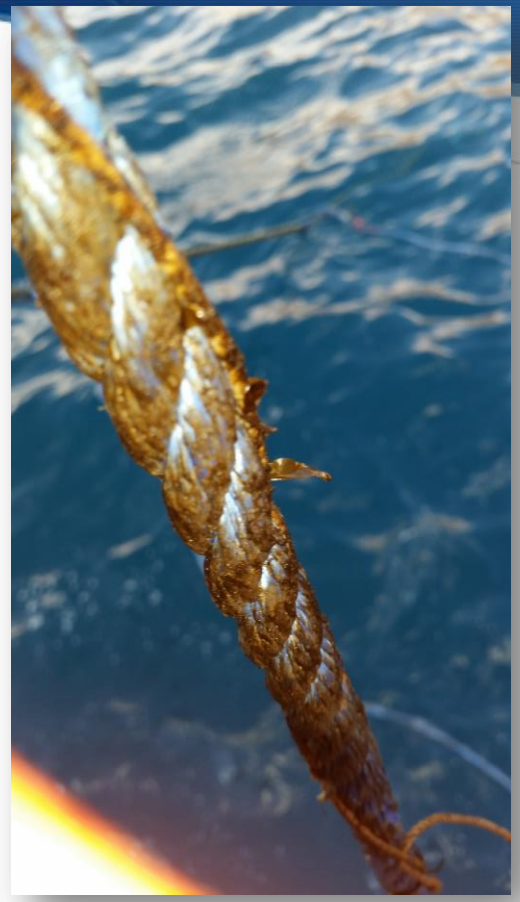
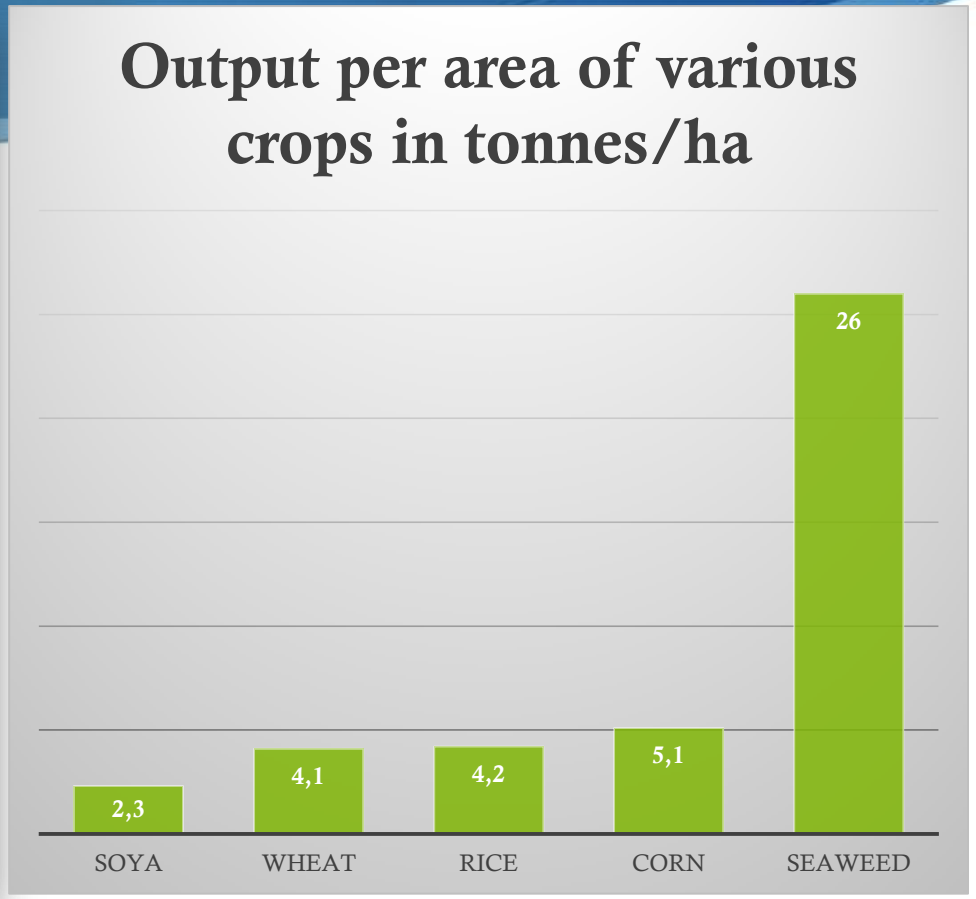
High yield in comparison



February 2015

20 May 2015



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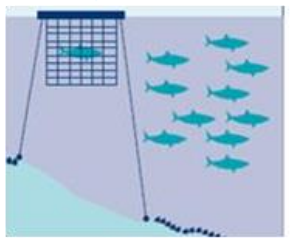
The bio refinery approach



CO_2

H_2O

N

P

K

Feed

Food

1. Cascade Microbial refining Prebiotic/ Probiotic (pilot)

Alginate

Mannitol

Proteins

Fucoidan

2. Cascade Extraction/ seperation Pysico/chemical – enzyme aided (lab)

Harvesting & Pre-conditioning (pilot)

Cosmetics focoidan

Prebiotics fucoidan

Bio-Plastics

3. Cascade Enzymatic refining for high value products (lab)

Uronic acids

Probiotics Lminarin

Health alginate

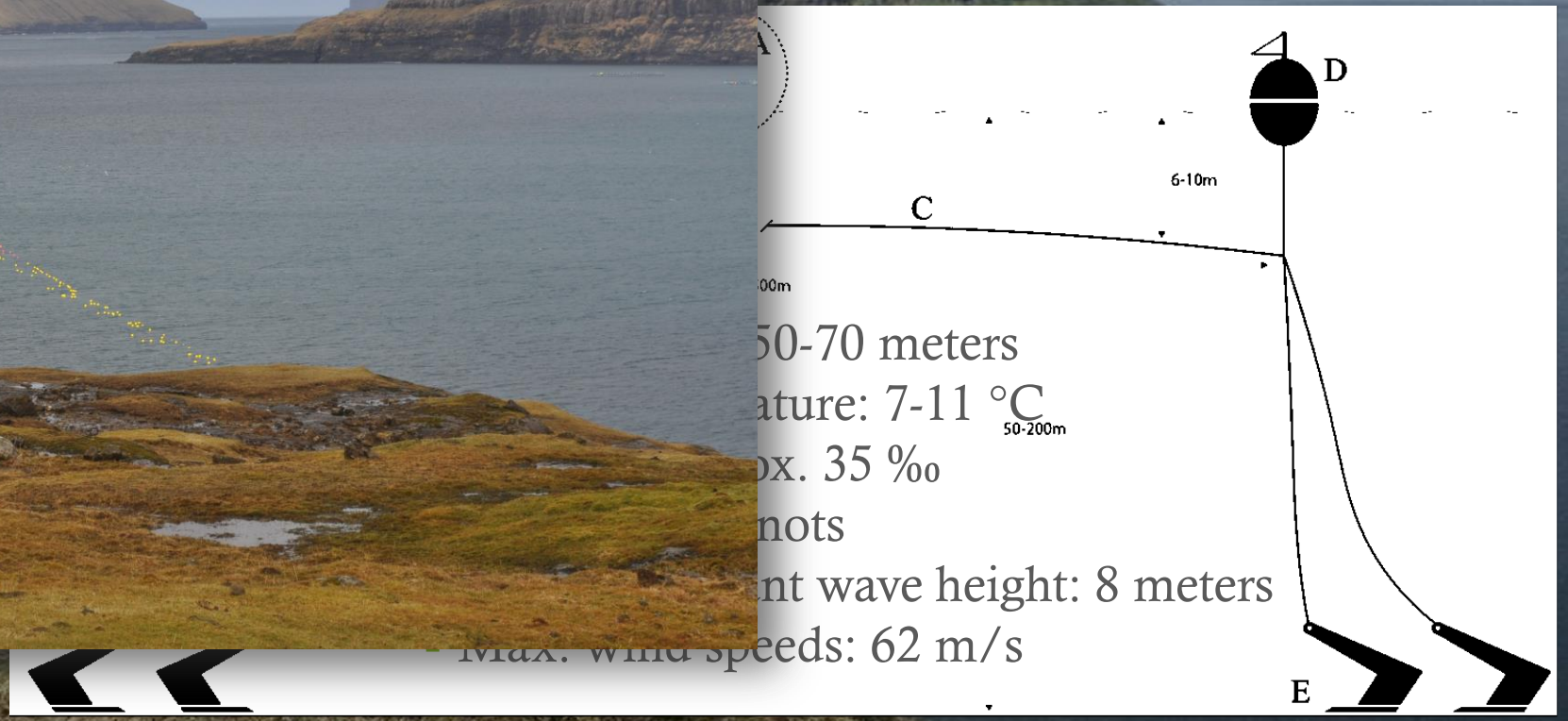
Cosmetics aminarin

Energy

Fertilizers

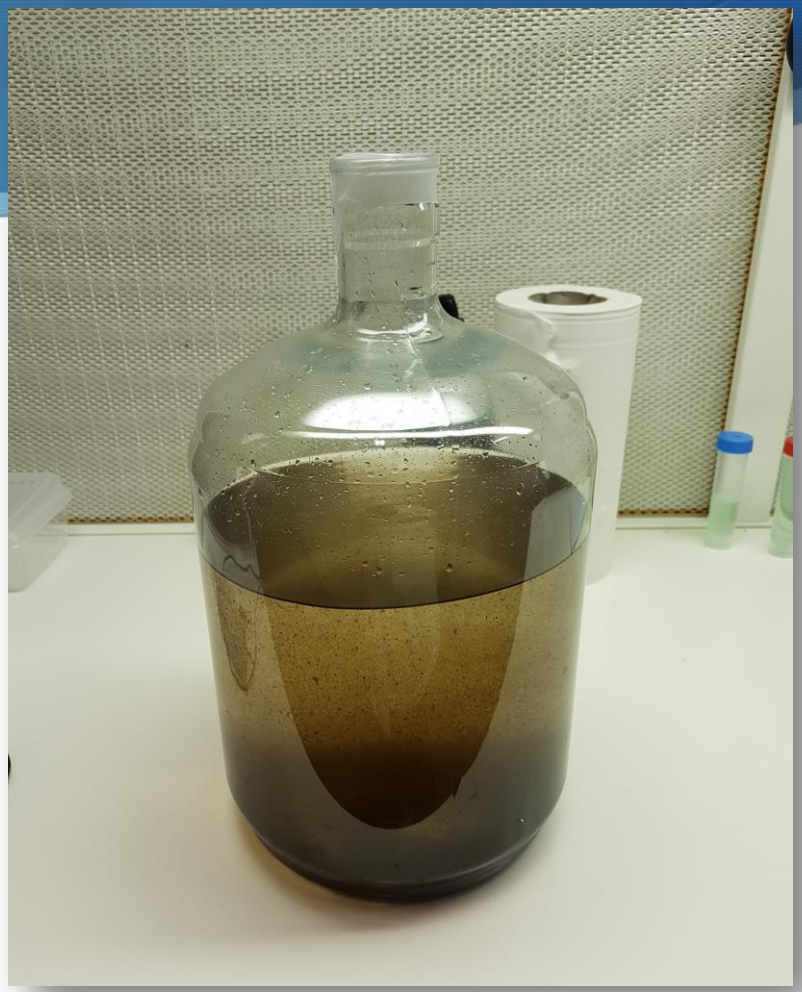
4. Cascade Left-over residuals (concept)

Macro Algae Cultivation Rig (MACR)



50-70 meters
ature: 7-11 °C
ox. 35 ‰
nots
nt wave height: 8 meters
eeds: 62 m/s

Seeding



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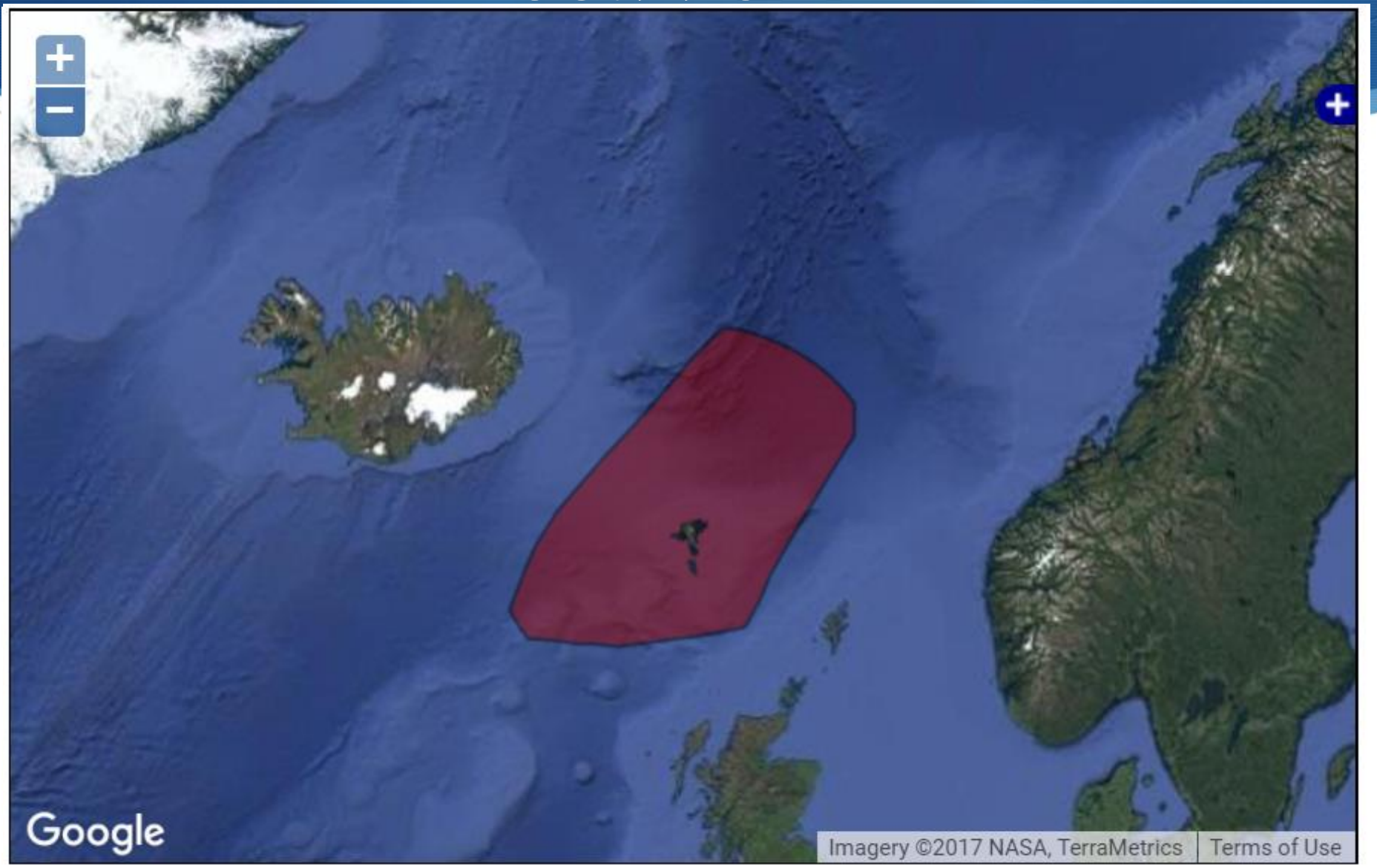
Deploying seedlines

Exclusive Economic Zone Faroe Islands
260.996 km²



EEC per capita:

- 36.0 km²
- 5.2 km²
- 2.5 km²
- 0.5 km²
- 0.15 km²
- 0.10 km²
- 0.05 km²
- 0.04 km²
- 0.01 km²

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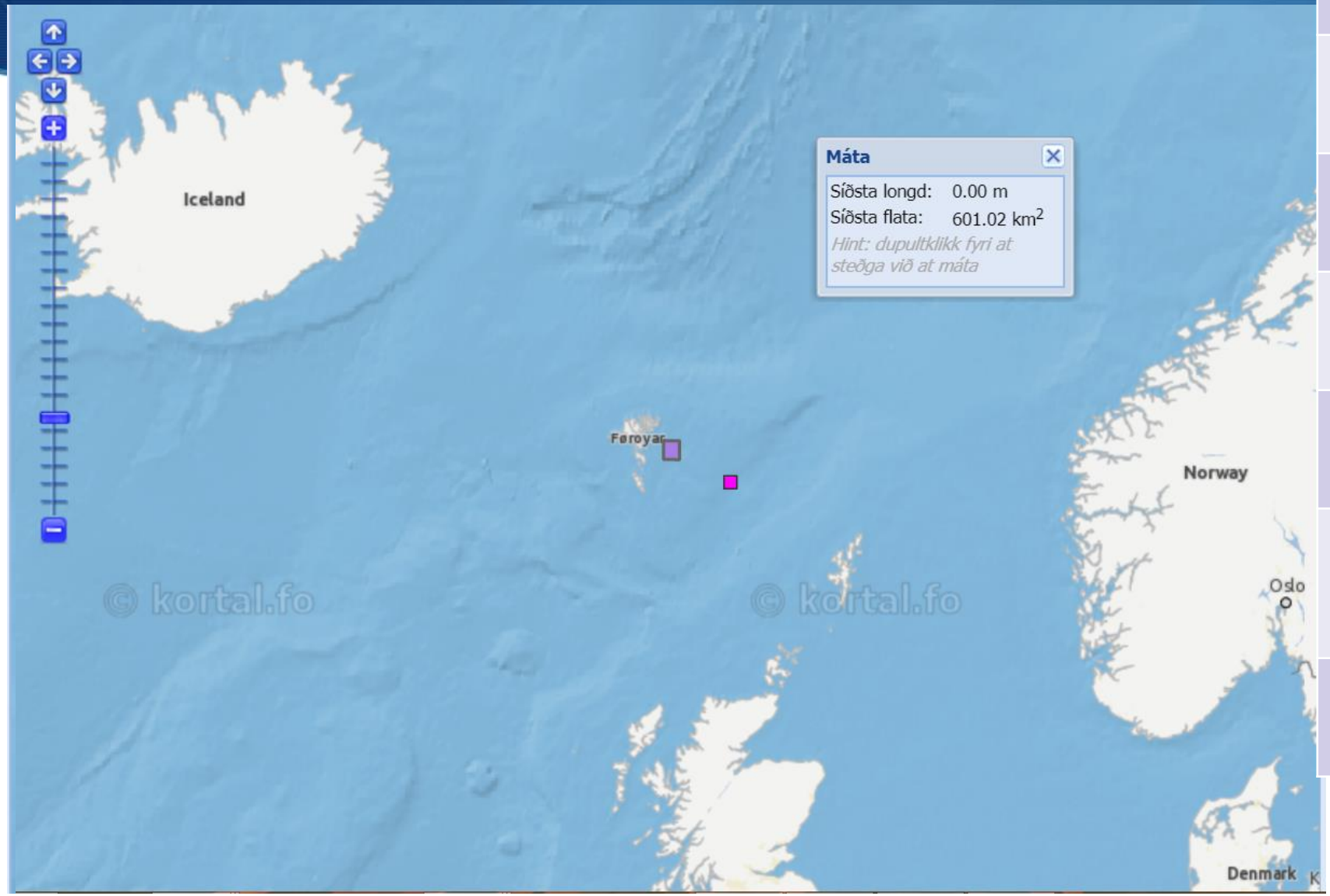
Large scale, offshore cultivation Business Case in the Faroe Islands



Salmon production	70.000 tonnes
Nitrogen Phosphor	3500 tonnes 700 tonnes
4 kg N pr 1000 kg, wet seaweed	1 mio. Tonnes wet weight
Emission of CO^2 in 2016	870.000 tonnes
3 kg ww seaweed/1 kg CO^2	3 Mio. Tonnes ww seaweed
5000 tonnes/km^2	600 km^2 or 0.002 of EEZ
CAPEX €800M Depreciation & fin. cost €100/year	60.000 tonnes & 200 tonnes bioethanol
Average price €1/kg = €300M	40% OPEX €80M profit

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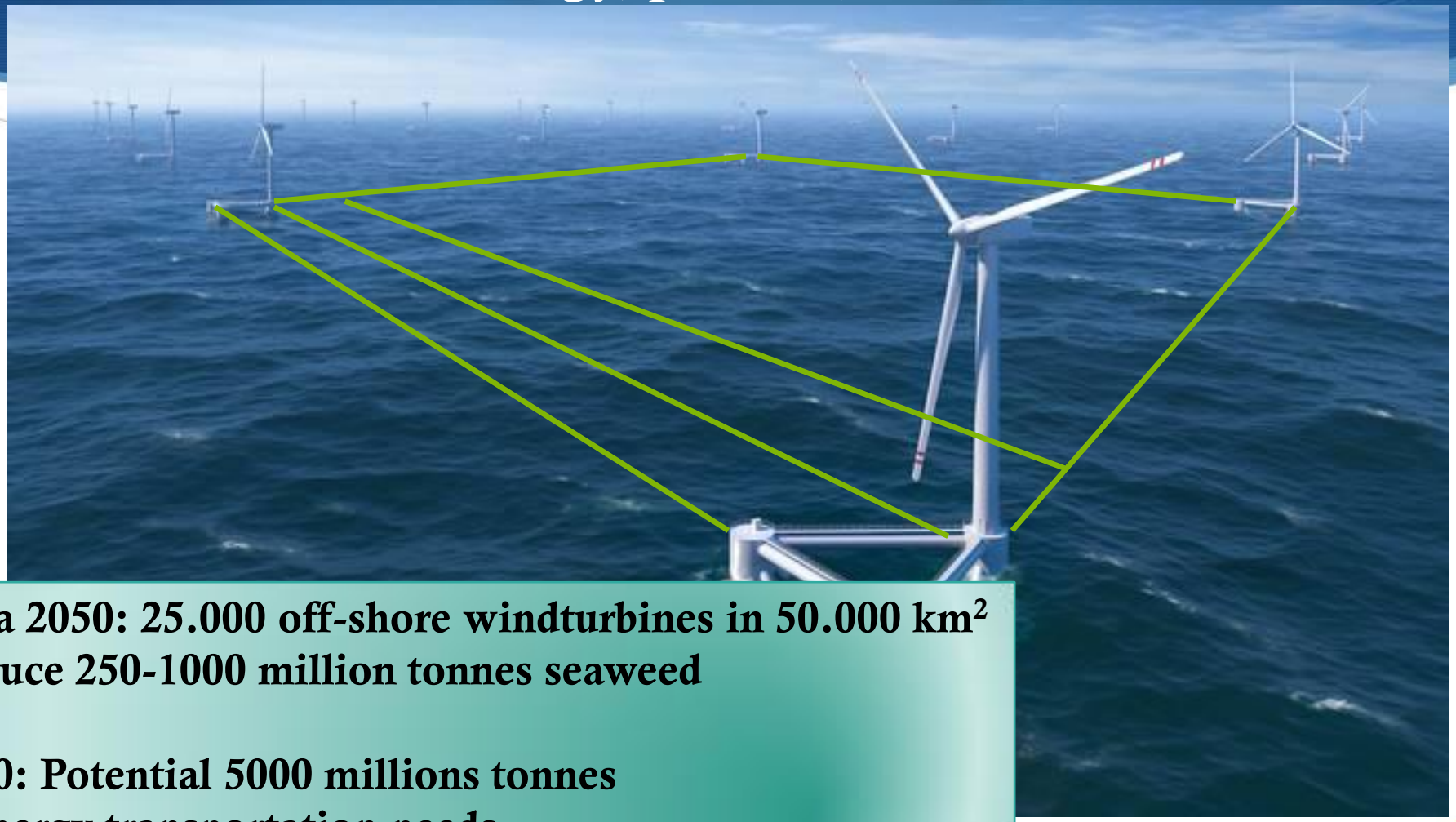
Replacing fossil fuels

for energy, plastics, textile etc.



North Sea 2050: 25.000 off-shore windturbines in 50.000 km^2
Can produce 250-1000 million tonnes seaweed

USA 2050: Potential 5000 millions tonnes
10% of energy transportation needs

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Key issues for commercial seaweed cultivation

- Scalability → Proven
- Survivability → Proven
- Sustainability → Proven
- Predictability → Proven
- Profitability → Needs investment

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Thank you

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