Cultivated seaweed for bioplastics and other materials

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The many problems of plastics

- 400 million tons of plastic produced every year, using >900 million tons petroleum (as raw materials and for energy)
- 10-12 million tons of this plastic end up in the oceans every year
- Only 1% of all plastics in Europe are bioplastics (bio-based/biodegradable)
- **Many currently available bioplastics have issues related to costs, production efficiency, sustainability, degradability/recyclability and/or technical properties**

Image: Romolo Tavani/Shutterstock

The PlastiSea project

The objective of PlastiSea is to develop competitive bioplastic materials and production technology based on cultivated brown algae

SINTEF

Project coordinator, biomass processing

B'ZEOS GREEN TECH

Bioplastics formulation and prototyping

SEAWEED ENERGY SOLUTIONS AS

Seaweed cultivation and pre-processing

aitiip centro tecnológico

Pilot production and material validation

AD NYE VEJE AALBORG UNIVERSITET

Sustainability and environmental assessment

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Biopolymer/material characterization and high-end applications

Why seaweed for bioplastics?

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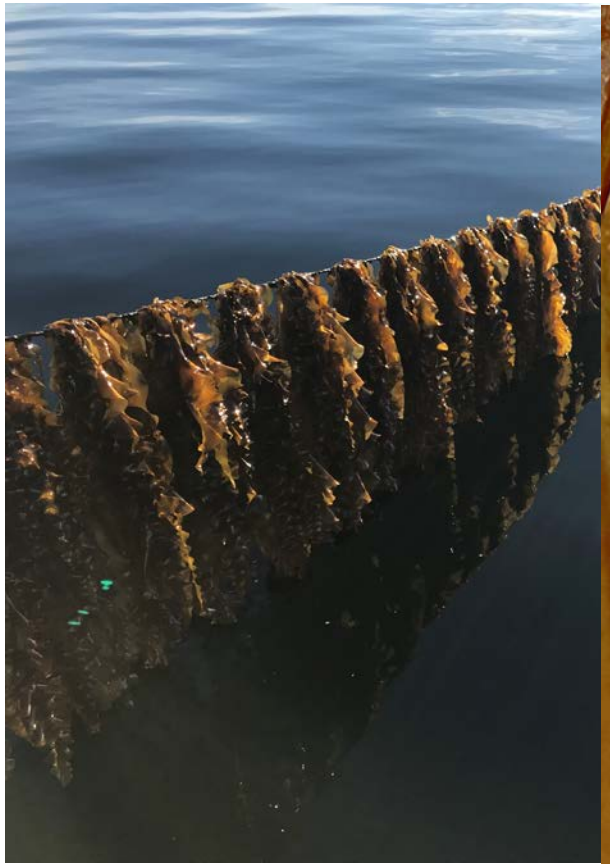
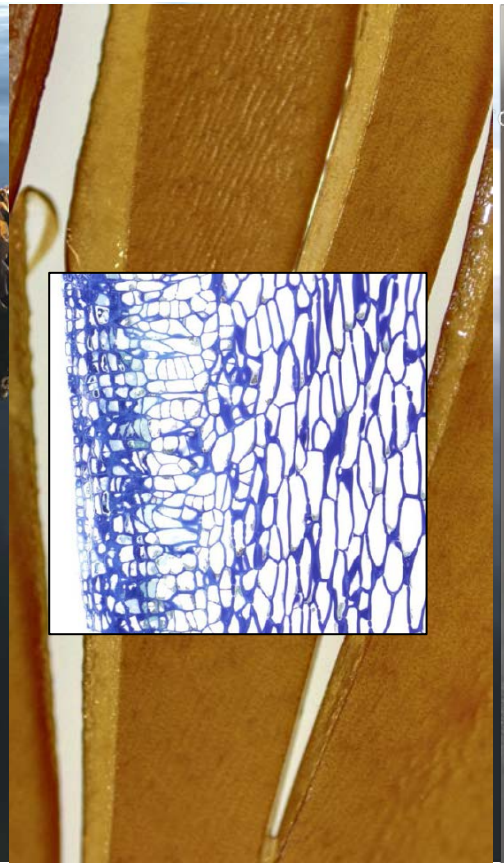
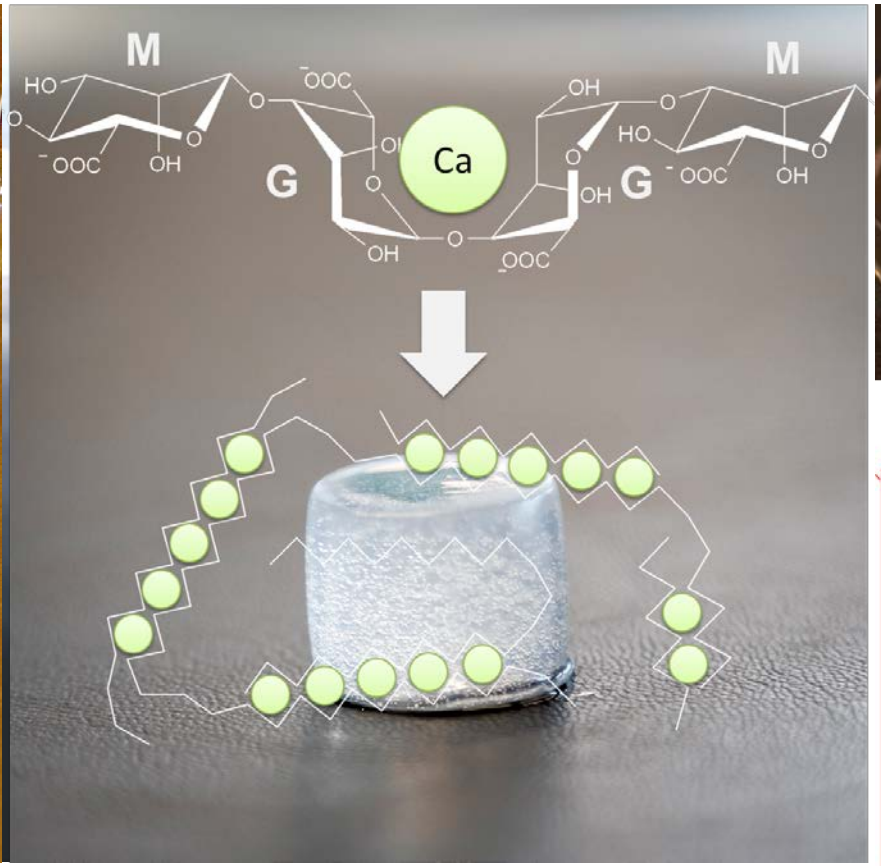
Renewable and resilient marine biomass, large potential for non-competing production

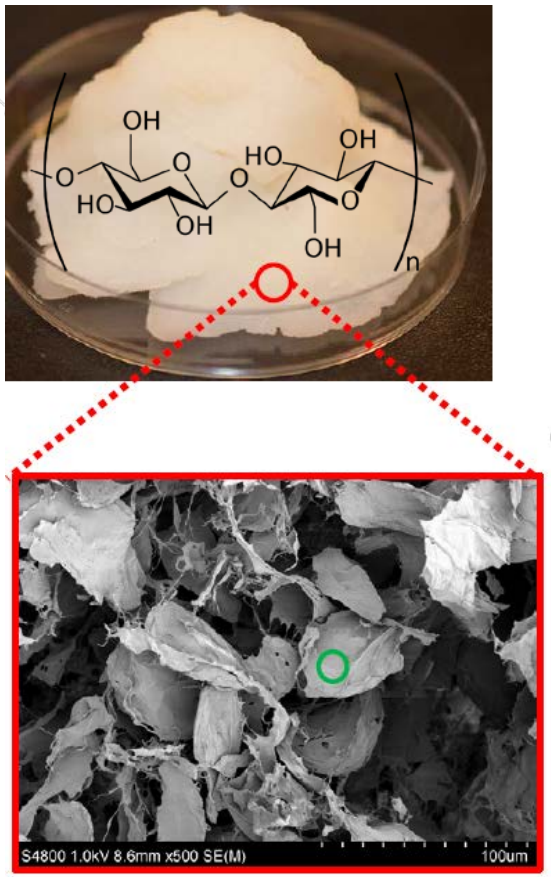
Structural biopolymers that can be extracted and utilized in bioplastics

- Alginate: Polysaccharide cross-linked by divalent ions and extensively used in the food industry as well as other technical and pharmaceutical applications.
- Cellulose: Can be obtained from residues after alginate extraction.

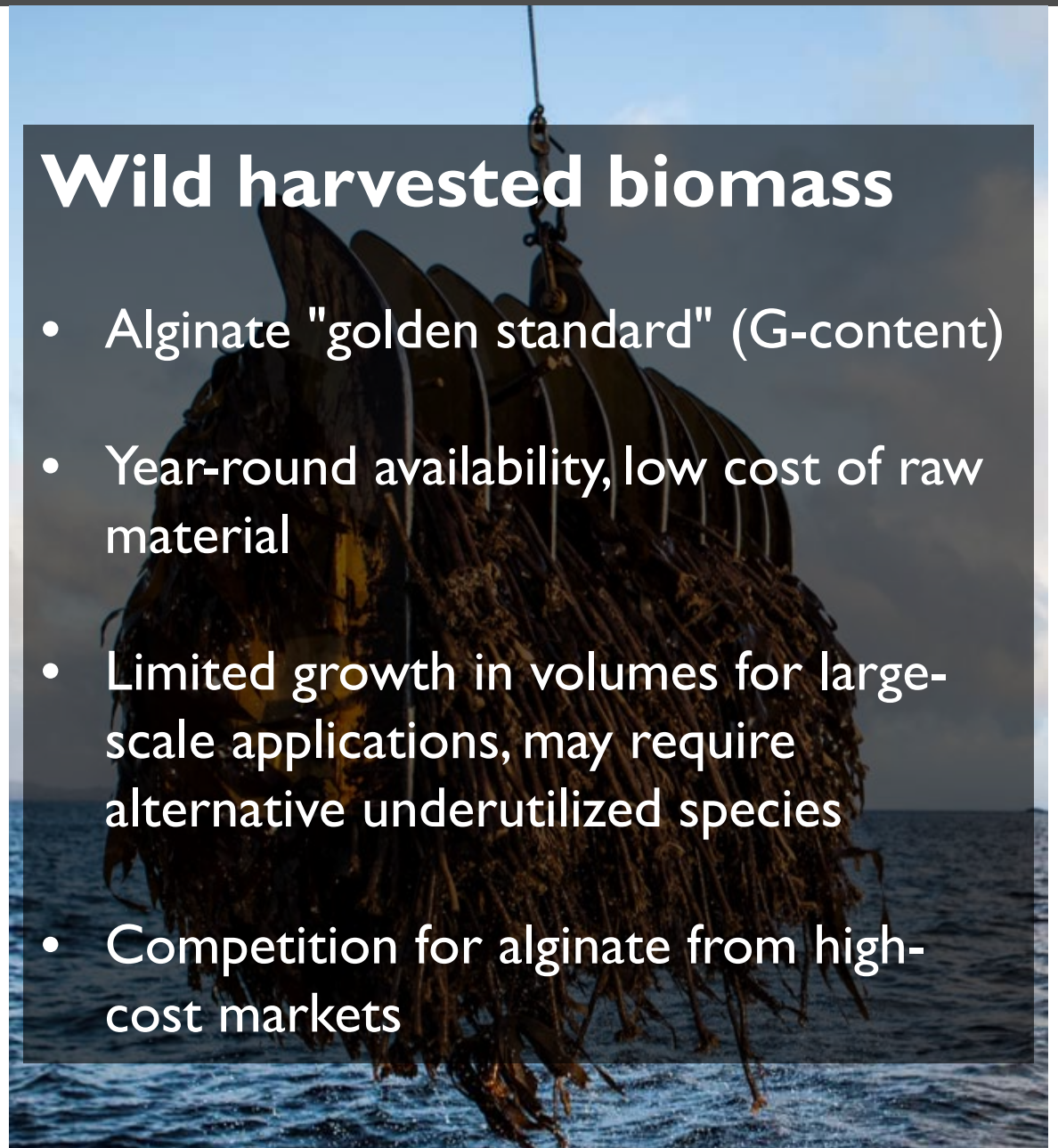






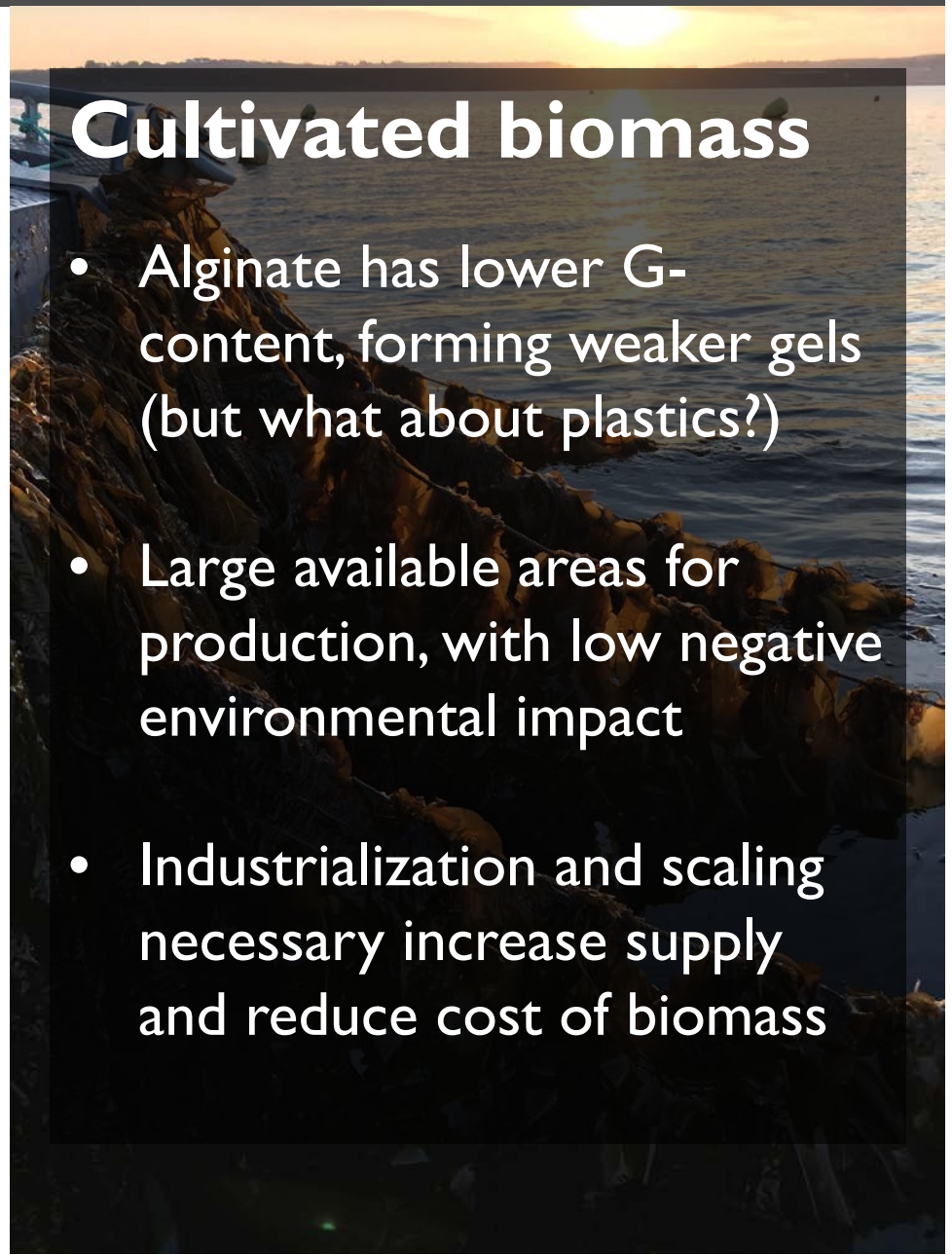


Biomass supply



Wild harvested biomass

- Alginate "golden standard" (G-content)
- Year-round availability, low cost of raw material
- Limited growth in volumes for large-scale applications, may require alternative underutilized species
- Competition for alginate from high-cost markets



Cultivated biomass

- Alginate has lower G-content, forming weaker gels (but what about plastics?)
- Large available areas for production, with low negative environmental impact
- Industrialization and scaling necessary increase supply and reduce cost of biomass

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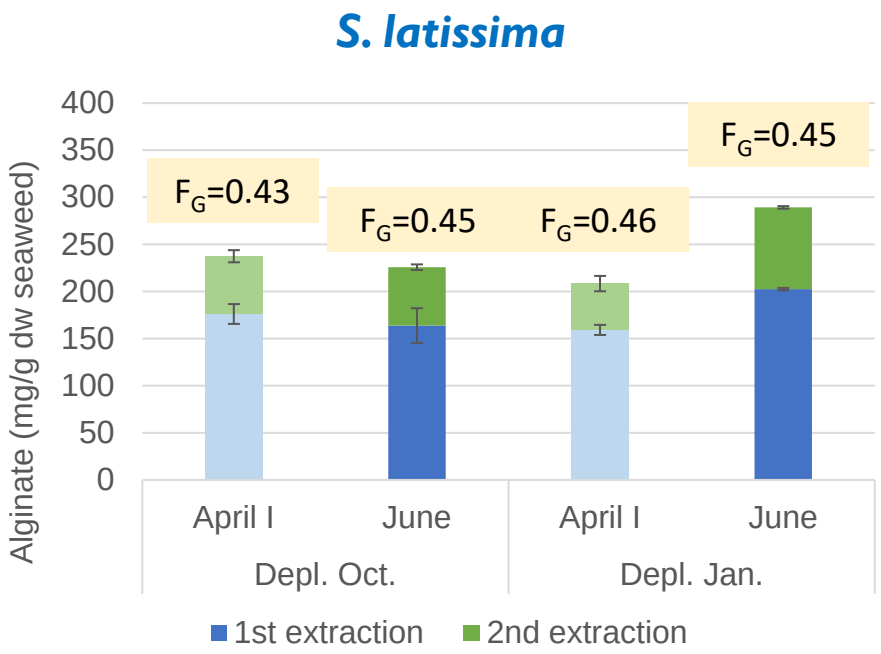
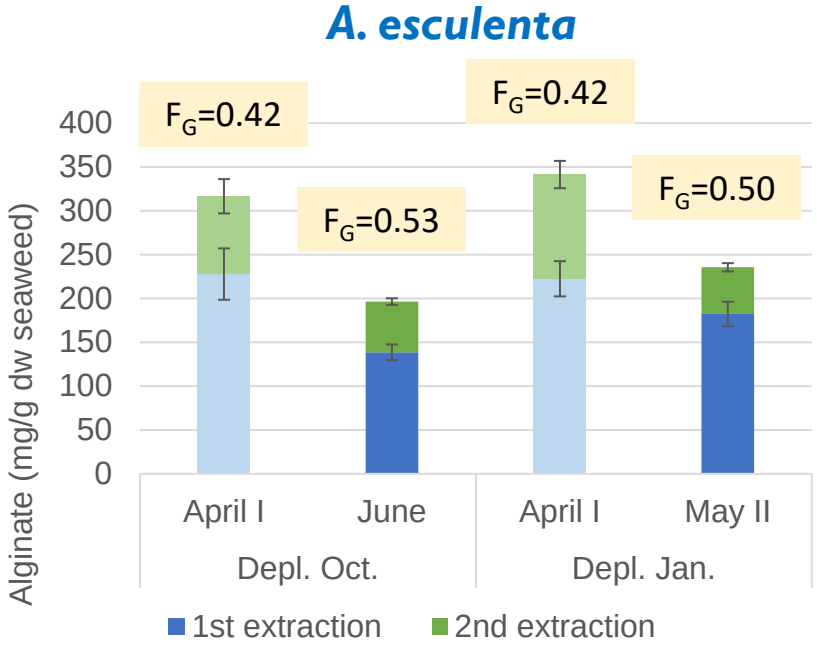
Understanding the biomass

Assessment of seasonal variation in biomass and eligibility for bioplastics

- Sampling of cultivated biomass from two deployment times and throughout harvesting season
- Compositional analysis to be published late 2022/early 2023

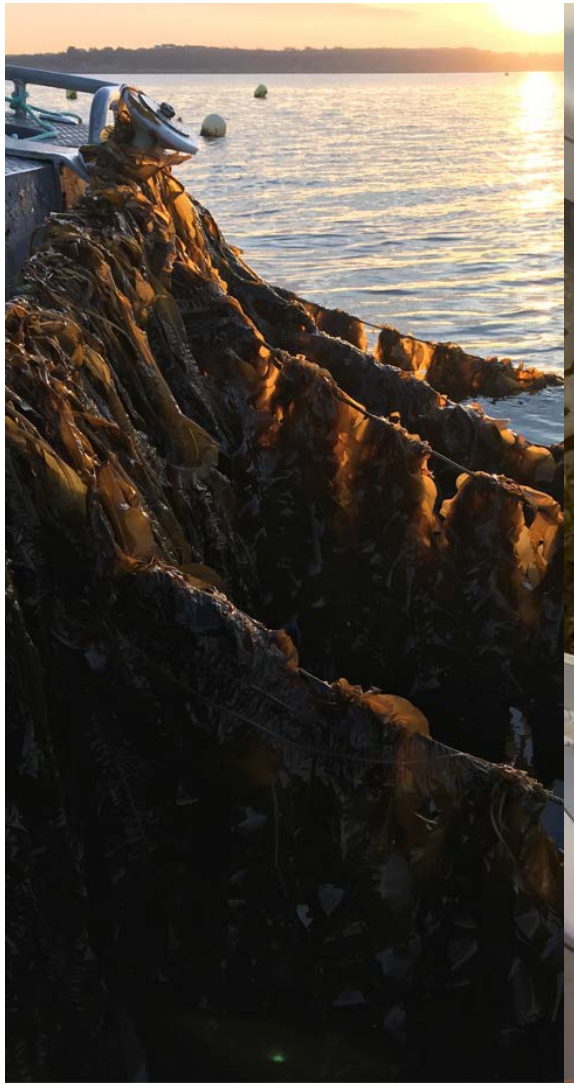
- **Work in progress: What are the effects of alginate MW and G content on bioplastic properties?**





From biomass to bioplastics

Cellulose can also be extracted from residues for high-value specialty products



- Transparent flexible films
- Thermoplastic formulations
- Coatings

- Reinforced composites with improved biodegradability

Low-cost processing of biomass for bioplastic substrates

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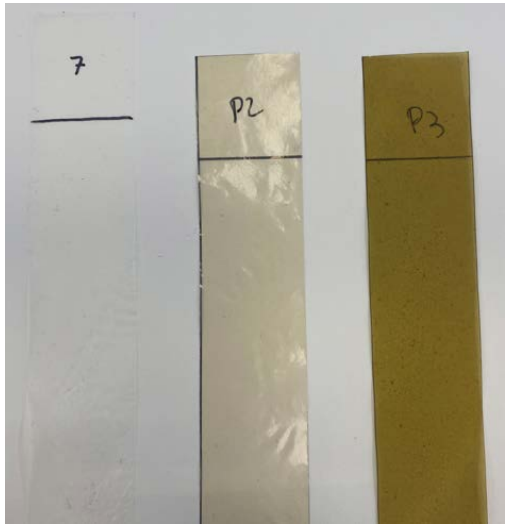
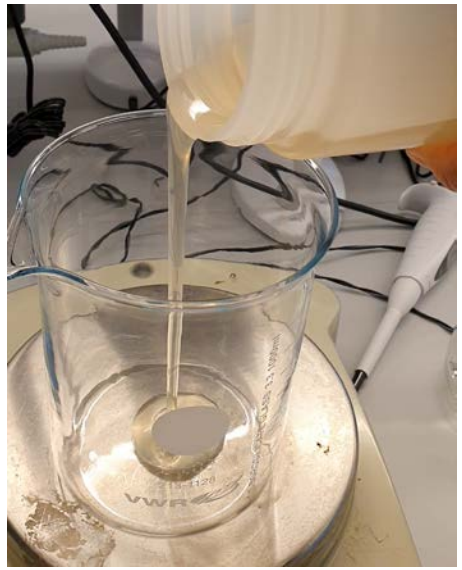
Minimal processing of seaweed to "crude" substrates

- Reduce steps in alginate refinery to lower costs without compromising technical properties of materials.
- Important to consider sensory aspects, consumer perspectives



Utilization of residual material from food process line



High-viscosity and low-color alginate extracts

Product development and characterization

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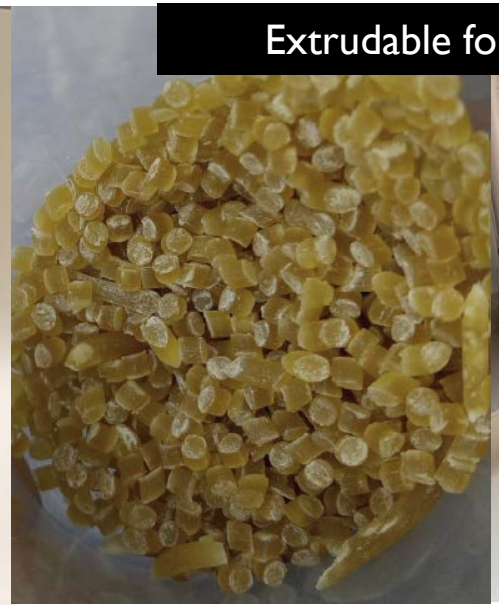
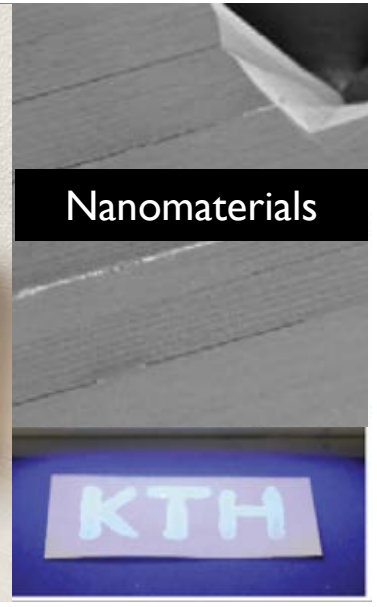
Transparent films, solution casting

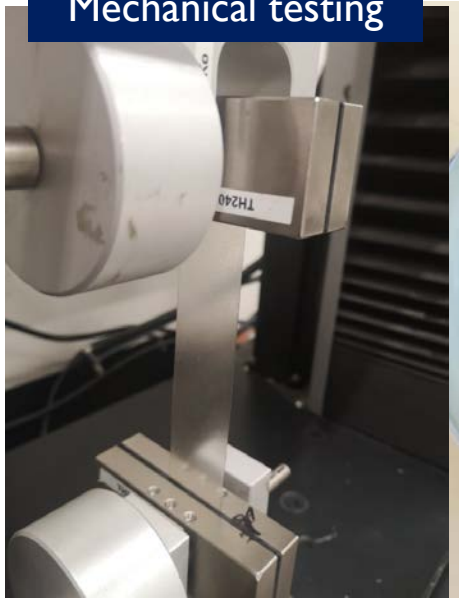
Extrudable formulations



Nanomaterials

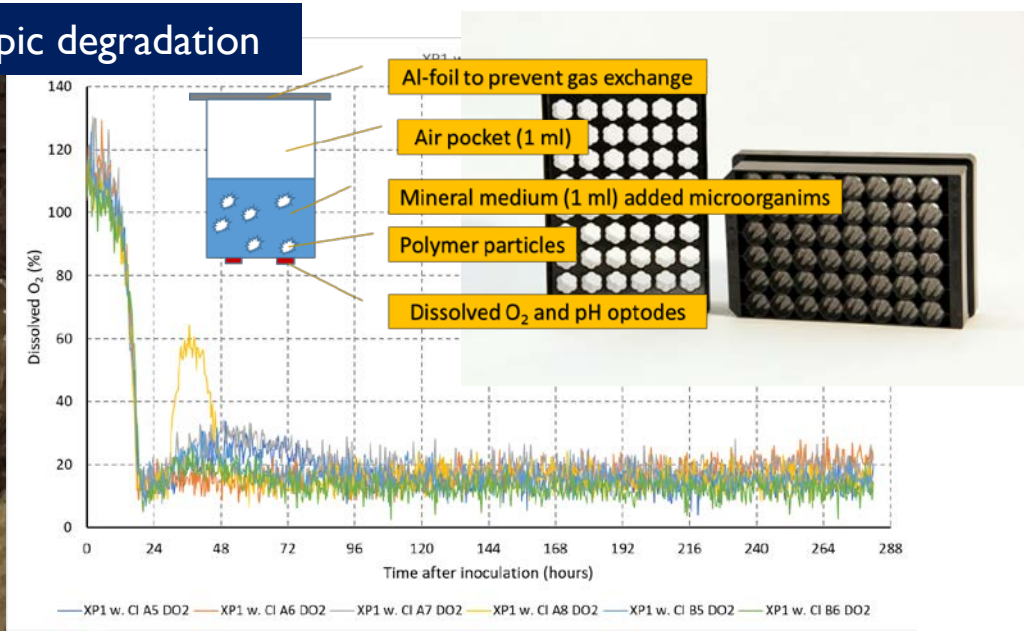


Mechanical testing



Barrier properties

Macro- and microscopic degradation



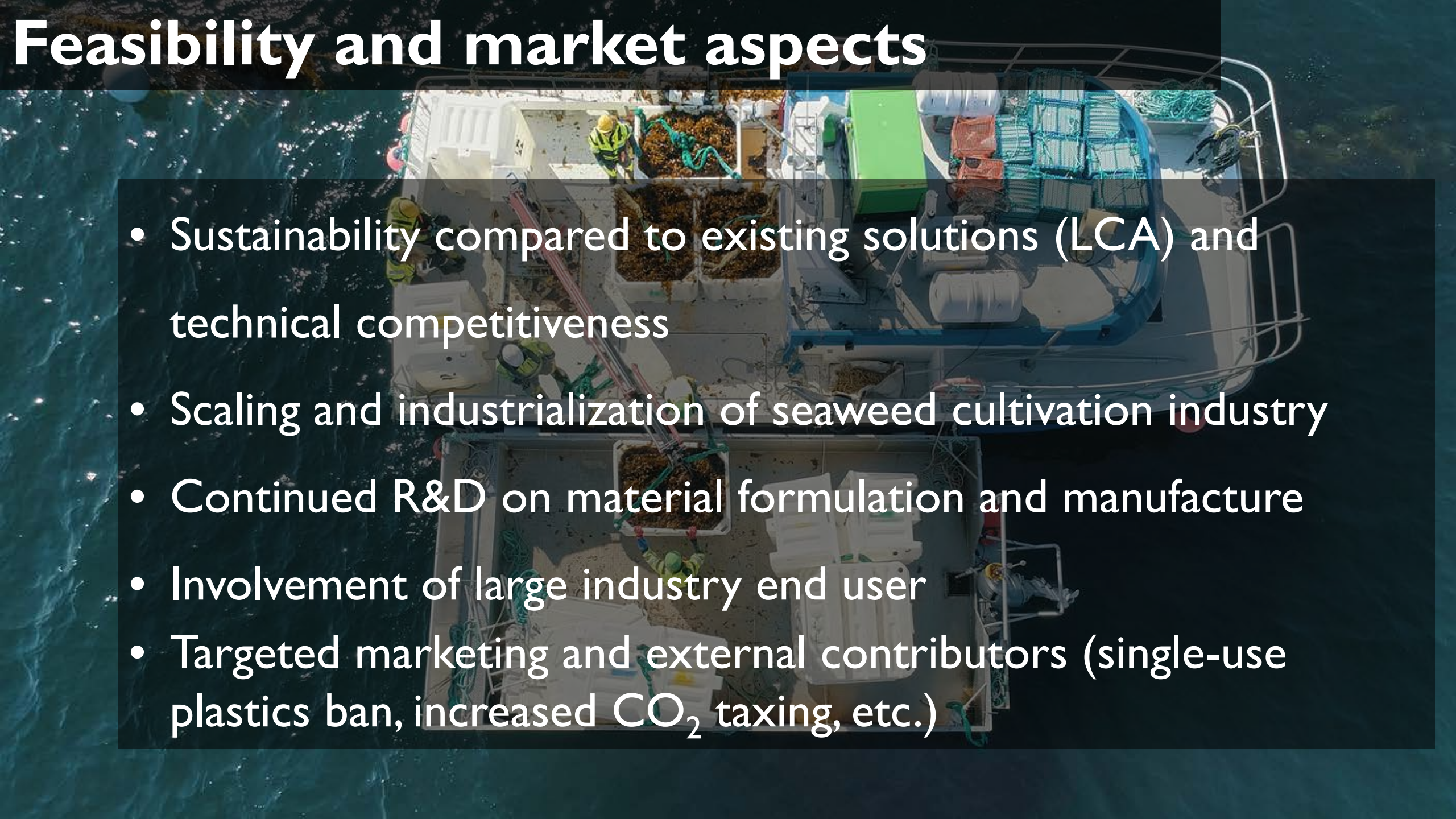
Ongoing work and key challenges

Scaling of manufacturing and adaptability to existing technology

Making processing more efficient by reducing time and cost and retrieving multiple products

Improving of barrier functions (for transparent films)
Development of coating formulations

Feasibility and market aspects



- Sustainability compared to existing solutions (LCA) and technical competitiveness
- Scaling and industrialization of seaweed cultivation industry
- Continued R&D on material formulation and manufacture
- Involvement of large industry end user
- Targeted marketing and external contributors (single-use plastics ban, increased CO_2 taxing, etc.)

Welcome to the 2nd Seaweed Applications conference!

At Inderøy, Norway, the 22nd – 24th March 2023

The conference will target existing and novel application areas for seaweed, including:

Polysaccharides and bioactives

Biomaterials and personal care products

Food and feed

Biomedical applications

Full program to be published within the coming weeks

Early bird registration by Dec 31st

Thank you for your attention!

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