Bio-inspired seaweed dryer
Growing European seaweed market

As the global population is projected to reach over 9 billion people in the next 40 years, seaweeds are a promising sustainable and regenerative resource that has the potential to meet the growing market demand for sources of food, feed, nutraceuticals or biopolymers.

Supported by a positive political context, such as the EU Blue Growth Strategy, the European seaweed market is expected to rapidly grow over the next decade.

- 7% to 10% yearly growth rate
- Newly registered algae producing companies increased by 150% in the last decade
- € 2.8bn worth by 2030
The lack of efficient raw seaweed stabilization methods (i.e. conservation) flanges the development of the seaweed market\(^2\). However, drying stands out as the most promising tradeoff between shelf life and bio-active compound preservation\(^2\).

Current dehydration protocols are still not adapted for seaweed handling and often associated with high capital investment, heavy environmental impact and bulky structure. Hence, overcoming this hurdle could unlock the full potential of this growing industry.
Our alternative: DRYLGAE

- **Solar** dryer, treats freshly harvested algae with a **minimal amount of energy** input
- Relies on **bio-inspired structures** to effectively **dehumidify** and **warm** the air
- **Light and resilient** structure, easy to **deploy near the harvest site**
Efficiency based on bio-inspired features

- **Moth eye-like nano-structured anti-reflective solar harvester**
- **Hercules beetle-derived microporous membrane**
- **Camel nose-inspired circumvoluted condensator**

Solar radiation harvesting

Airstream dehumidification

Airstream condensation

Visual prototype

Airflow
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Drying performance</th>
<th>Seaweed capacity</th>
<th>Handling</th>
<th>Energy consumption</th>
<th>Space cost</th>
<th>Investment costs</th>
<th>Primary field of application</th>
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</thead>
<tbody>
<tr>
<td>Belt dryer</td>
<td>Short drying time</td>
<td>High</td>
<td>Continuous feed</td>
<td>High energy</td>
<td>Requires a lot of room</td>
<td>$$$</td>
<td>Sweetened cereals Fruits and vegetables</td>
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<td></td>
<td>Good air flux</td>
<td></td>
<td></td>
<td>consumption</td>
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<tr>
<td>Drum dryer</td>
<td>Nutrient preservation</td>
<td>High</td>
<td>High tonnage capability</td>
<td>High energy</td>
<td>Requires a lot of room</td>
<td>$$</td>
<td>Wood chips Limestone</td>
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<td></td>
<td>Seaweed agglomeration</td>
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<td></td>
<td>consumption</td>
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<tr>
<td>Line drying</td>
<td>Long drying time</td>
<td>Intermediate</td>
<td>Labour intensive</td>
<td>No energy required</td>
<td>Large drying area</td>
<td>$</td>
<td>Any material that can be hung on a line</td>
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<td>High contamination</td>
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<tr>
<td>Convective air dryer</td>
<td>Short drying time</td>
<td>Intermediate</td>
<td>Difficult to feed</td>
<td>High energy</td>
<td>Requires a minimum amount of room</td>
<td>$$</td>
<td>Dehydrated vegetables</td>
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<td>Low product contamination</td>
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<td>consumption</td>
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<td></td>
<td>High T° damages the nutrients</td>
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<tr>
<td>Spray dryer</td>
<td>Nutrients preservation</td>
<td>Intermediate</td>
<td>Not adapted for seaweed</td>
<td>High energy</td>
<td>Requires a lot of room</td>
<td>$$$</td>
<td>Starches Fine chemicals</td>
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<td>Short drying time</td>
<td></td>
<td>Complex handling</td>
<td>consumption</td>
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<tr>
<td>Freeze dryer</td>
<td>Nutrient preservation</td>
<td>Intermediate</td>
<td>Vacuum conditions</td>
<td>High energy</td>
<td>Relatively compact</td>
<td>$$$</td>
<td>Fruits and vegetables Pharmaceuticals</td>
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<td>High product quality</td>
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<td>consumption</td>
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<td>Long drying time</td>
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<tr>
<td>Superheated steam dryer</td>
<td>Low oxidation levels</td>
<td>High</td>
<td>Complex system</td>
<td>Low energy</td>
<td>Requires a lot of room</td>
<td>$$</td>
<td>Wood waste Animal feed</td>
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<td>Potential leakage problems</td>
<td>consumption</td>
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<tr>
<td>Drylgae dryer</td>
<td>Intermediate drying time</td>
<td>Intermediate</td>
<td>Light structure</td>
<td>Low energy</td>
<td>Compact and modular</td>
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<td>Seaweed</td>
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<td>Nutrient preservation</td>
<td></td>
<td>Deployable near harvest site</td>
<td>consumption</td>
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</table>

Comparison with popular drying equipments
Expanding market opportunity

Seaweed drying demands about **7270 kWh per dry ton**, which corresponds to an average of **400€ per dry ton**. We aim to stay below this cost threshold. More accurate pricing estimation will be possible once we have a MVP.

We want to propose our equipment to **European seaweed producers** through a **rental revenue model** combined with a fee for service.

Our **addressable market**: Over 200 established seaweed producers in Europe and growing (c.f. Annex 1).

Raw seaweed: **13€/kg**

Dried seaweed: **383€/kg**
Offering unique added value

**Customer pains**
- Energy and operating costs
  - Equipment storage
- Drying facility availability
  - Wet biomass transportation
  - Insufficient drying

**Drylgae added value**
- Drying with solar energy
  - Low energy consumption
  - Low operating costs
- Bio-inspired heating and dehumidifying structures
  - Reduced environmental impact
  - Improved drying conditions
- Light and resilient structure
  - Reliable and enduring equipment
  - Deployment at remote areas
DRYLGAE is developed by SeaStem: A Swiss-based startup in the algae industry that aims to sustainably optimize the logistics of seaweed production by designing innovative harvesting and post-harvesting equipment.

Our team is composed of engineers, biologists, biomimicry professionals and marketing experts, sharing the same drive and ambition of having an impact on tomorrow’s European seaweed industry.
Future plans: Prototyping, Funding and Networking

**January/April 2022**
- First prototyping round
  - Validate technical assumptions
  - Generate a MVP

**May/August 2022**
- Get funded
  - Enter an incubator/accelerator program
  - Apply for relevant funding channels

**2022 perspectives**
Annex 1: Established seaweed companies and start-ups
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References