

R2GAS

Biomethane workshop April 2023

GOA VENTURES

# Seaweed as novel biomass to Biomethane R2Gas Workshop

25 – April 2023

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## Seaweed a.k.a MACRO Algae

## seaweed intro

- Saltwater crops; 70% of the globe is saltwater space and 95% of the water on earth is salt water.
- Wild harvest (since man are on earth) and farmed already for 75+ years. Re-invented.
- Growth rate of up to 6% per DAY. (big in CO<sub>2</sub> capture - reduction of ocean acidity)
- Main countries – Korea, China, Taiwan, Thailand, Indonesia, Philippines. 70 mio ton ww/yr. Start of upscaling in France, Scotland, Norway and Ireland 100kTon WW /yr. Nuisance 30mio ton ww/yr in Caribbean.
- Emerging new business in all other coastal countries. US/NA make lot of pace.
- Due to local fertilizer load in oceans, problems such as sargassum in Caribbean. (mineral capture)
- 50 - 80 mio ton (wet weights) used globally representing 11-12 Bio €. Europe is < 1 %.
- >10.000 species split in 3 main groups (green – brown – red). Seasonal crop in most geographies.

USES: Direct consumption as is. (Asia)

- Fresh, dried and ground in food & feed products.
- Processed into thickening agent (western foods)

Future biomass source for:

- More food (direct & indirect)
- Renewable Energy
- Renewable Chemistry
- Bioplastics
- Fertilizer ... (and more)

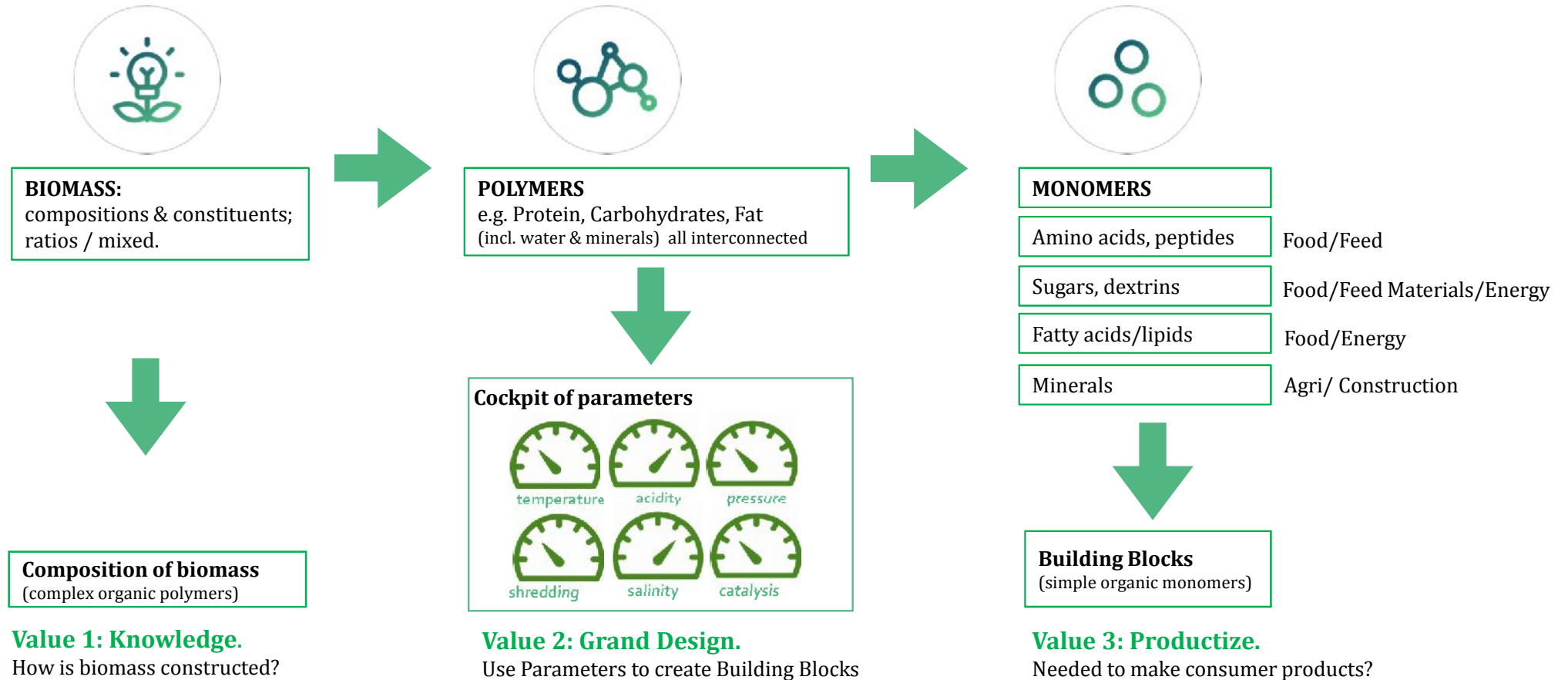


**RED SEaweeds**

**BROWN  
SEaweeds**

**GREEN  
SEaweeds**

# Core competencies GOA: mastering seaweed-refinery along 3 values



## Challenge: seaweed business profitability → GOA: create breakthrough for upscaling seaweed

### GOA consortium analyzed all seaweed projects globally:

- 99% of projects work with *Dried* seaweed (thus more difficult to extract high values), and a mix of:
  - Focus on 1 product and/or not cascaded (lower revenues, less sustainable)
  - No integrated processing (higher OPEX)
  - Science oriented (lacking entrepreneurship) and/or poor customer involvement (unclear specs/outlet)
  - Customer lock-ins (e.g. for FEED purposes ) to upscale
  - Thin vision for upscaling and/or cost reduction farming (and if fresh seaweed stuck in niche models)
  - In Asia mainly bulk product with relatively low OPEX (yet low-quality products & processing)

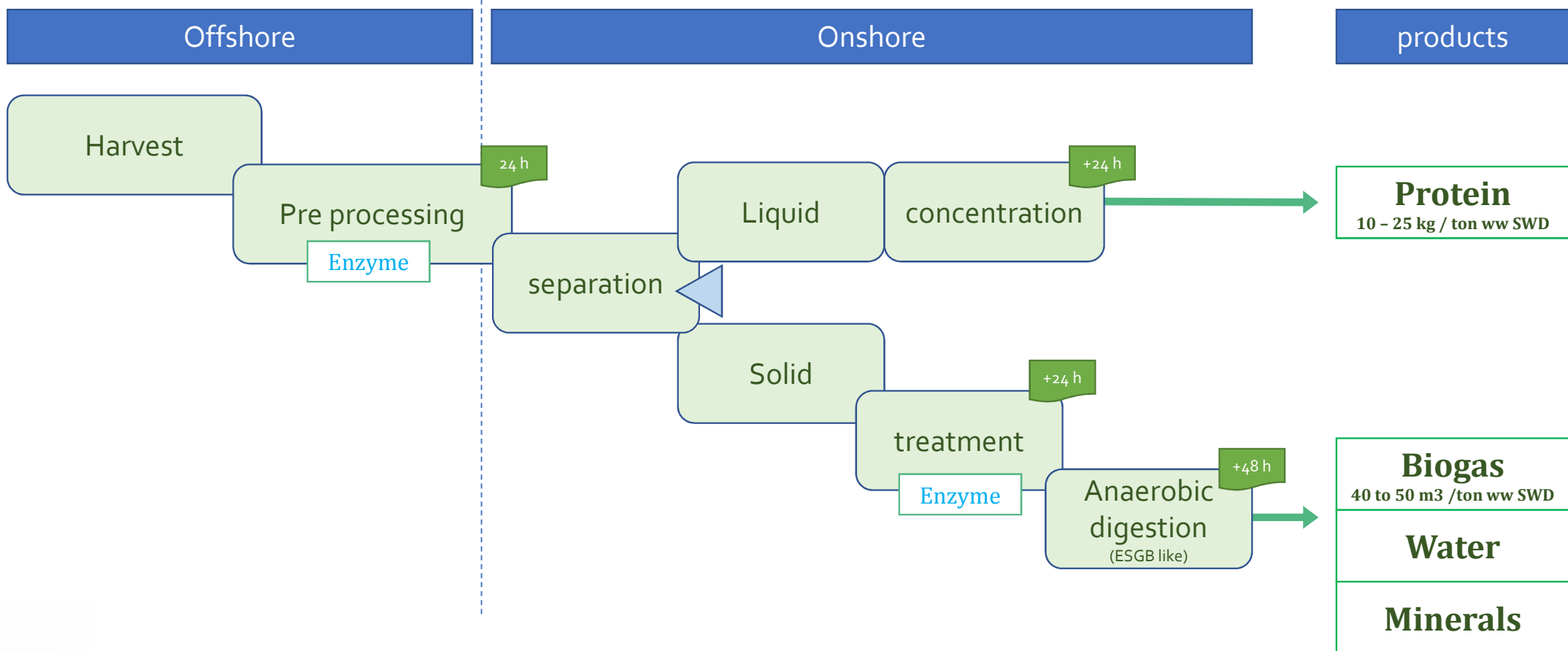
all  
relevant  
to  
learn

### GOA's new approach:

- Use *Fresh* seaweed: extract higher values
  - Maximize carbon reduction through cascaded approach
  - Maximize economic value (higher quality protein for human food market)
  - Split salt and/or salt water
  - Customer centric project development (customers are part of specs and hedge offtake)
  - Integrate farming & refinery in 1 model (cost- and process control)



# Schematic GOA process



## Samples to lead the way

Over 50 experts were asked to feedback the first batches of seaweed (Ulva) protein:

- **Visual: slightly 'cream-green' fine powder**
  - This product holds still some "green seaweed" particles (improvements identified for next production)
  - However, product can be filtered to less green powder ( e.g. lighter batch for dairy applications )
- **Taste: pleasant - intense concentrated soup**
- **Smell: Soup / Tomato / Nice**
  - No - fish / No - seaweed / No - bad smell
  - Chicken / pleasant / Intense
- **Functionalities:**
  - Meat-(soya)and egg replacement
  - Foaming, gelling, emulsifying and dough compatibility
- **Protein profile:**
  - Attractive / complete profile
  - Substantial amounts of proline and hydroxyproline
  - Attractive quantity of glutamic acid (hence the umami smell & taste experience)
  - Initial digestibility > 0,8 PDCAAS

*"this GOA protein is even better than the Ferrari of Protein."*

**Market leader Egg protein**



## Latest Development: hot pipeline to start demo projects across the world

### GOA starting to **productize process** into flexible refinery technology

- **Bring the refinery to the seaweed** instead of seaweed to refinery.
- Translated IP in *scalable & modular & flexible* refinery solutions: **tech in a box**
- Improved business case compared to insights 2016 (less capex intensive): substantially **improved ROI**
- Expanded **processing bandwidth** to work with *fresh* seaweed (from 3 to 48 hrs.) within the specs of quality
- Boost of enzyme mix usage. **Protein & Biogas yield improvements**
- Ready for latest energy techniques for **producing green molecules**



Pictures taken at foodgrade testing site.

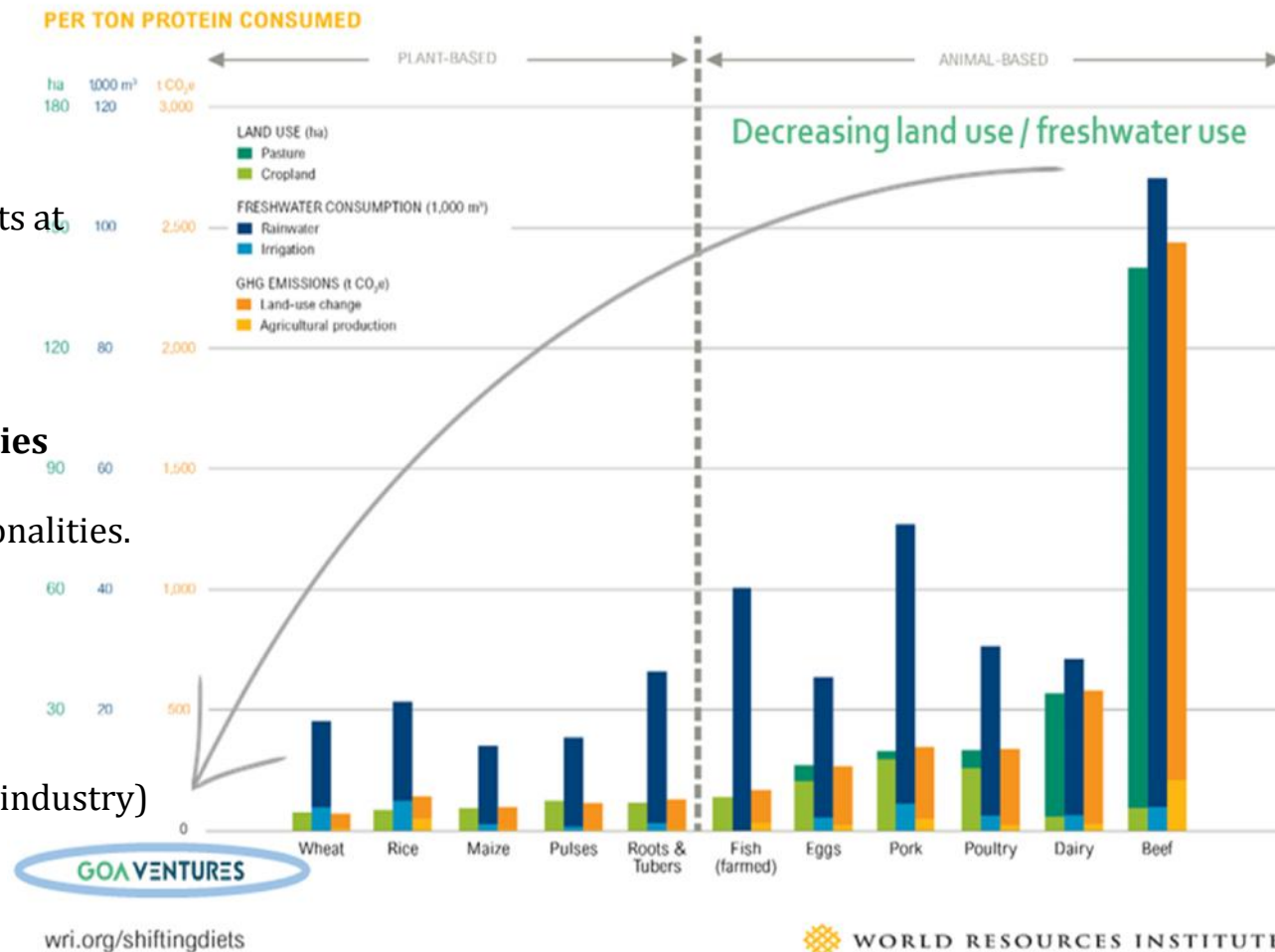
### GOA improved **flexible growth**

- Tested various SWD species and ecosystems. Aim **service all types, global**. Process works on red, brown & green SWD.
- Most work done on protein rich ULVA (green seaweed). In '21/'22 gained experience with various brown SWDs
- Improved range of protein functionalities into platform allowing to service multiple food markets.
- **Focus on controlled production (farming)**. Yet approached to focus on floating quantities, help to keep beaches clean.

# GOA improves PxQ for seaweed development

## Key-elements & value of IP (granted)

- GOA mastered a new seaweed refinery approach
- Process FRESH seaweed to retrieve more products at higher quality & yield (Price x Quantity)
  - **Food grade functional protein** → €
  - **Biogas / Biomethane** → €
- new **platform of functional (protein ) properties**
- out-performs known proteins in high-end functionalities.
- Cascaded: more products in 1 process flow
- 0-waste operation. No digestate but mineral mix.
- Sustainable value fast-growing (if CO<sub>2</sub> tax enters industry)

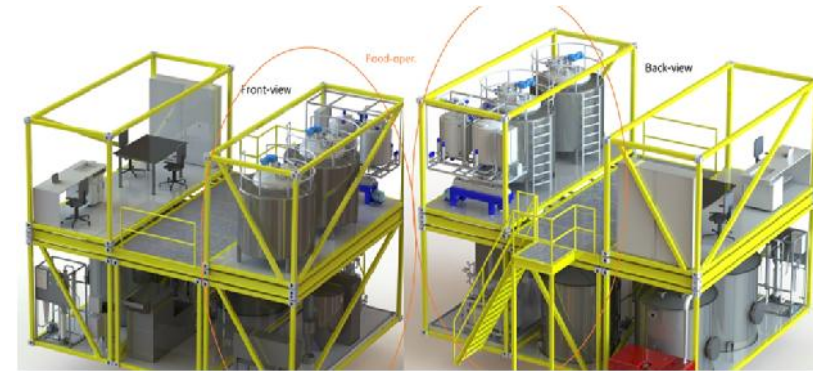




## GOA business model & way of cooperation

### The business model of GOA-ventures;

1. Turn-key operation & License of SWD refinery technology
2. First year: operate/transfer knowledge to licensee team
3. Extra if needed: support the sale of the derived products



Impression of DEMO facility ( front& back view)

### Customer relations into projects leading to commercial activities?

- Stage 1 – Get to know each other (matching vision, values), design first business case (Paper)
- Stage 2 - Testing & Feasibility study (swd; species, availability, local conditions, etc.) (Lab data)
- Stage 3 – Confirm the technology delivers on local seaweeds (Demo-plant)
- Stage 4 - Create SPV's to build, own and operate (harvesting and) processing operation. (Go commercial)

Looking forward to further cooperation  
In renewable energy field.

*Doing good for mother earth*  
And speeding up seaweed valorization.

GOA Ventures | Theo Verleun | General Manager | [theo@goa-ventures.com](mailto:theo@goa-ventures.com) | +31 – 653 230 244 | April 2023

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# Seaweed is part of firm growth market(s)

## Seaweed

**Climate Agreement Netherlands: 14,000 km<sup>2</sup> MMIP12: urge Hybrid windpark development**

**Global Seaweed Market 2018-2024**  
 \$4,097.93 million in 2017;  
 Projected \$9,075.65 million by 2024,  
 CAGR of 12.0% from 2018 to 2024



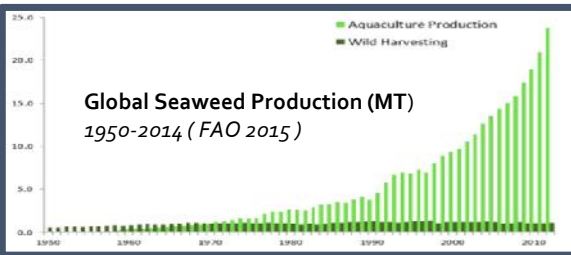
**The Bezos Earth Fund has awarded the World Wildlife Fund (WWF) \$100 million towards scaling up seaweed farming**



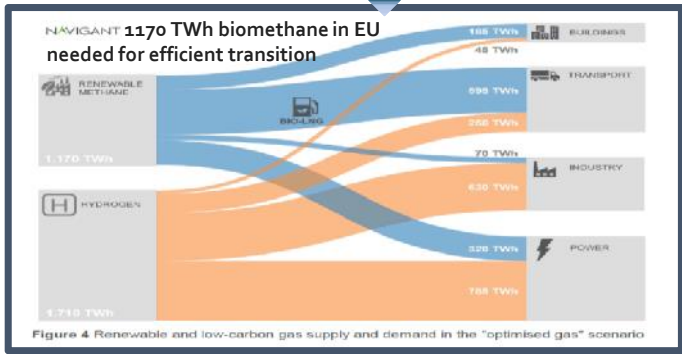
**Science reporting**  
 ~48 million km<sup>2</sup> is suitable for seaweed aqua culturing



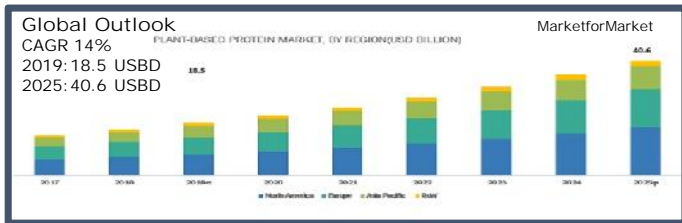
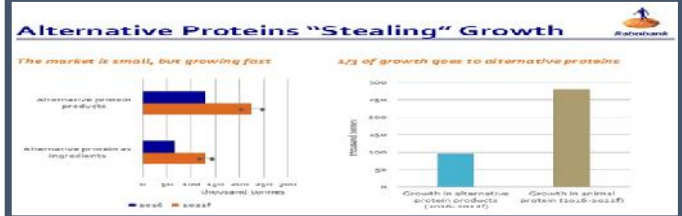
**Science reporting**  
 ~500,000 km<sup>2</sup> seaweed culturing would offset 10% of current food



## Food & Fuel



**30% Millennials eat meat alternatives every day**  
**50% Millennials eat meat alternatives few times a week**



## Growth Capital

"For every company that's looking for money for renewable alternatives, there are two or three investors. Beyond California, the early innovators are in the Netherlands, the birthplace of alternatives for meat and other renewable products and processes"

*Olivia Fox Cabane, chair Int.Alliance Alternative Protein*

