PILOT PLANT FACILITY FOR SUSTAINABLE MICROALGAE CULTIVATION

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GoToS3 ALPO
LID VAN ASSOCIATIE KU LEUVEN

RESEARCH @RADIUS

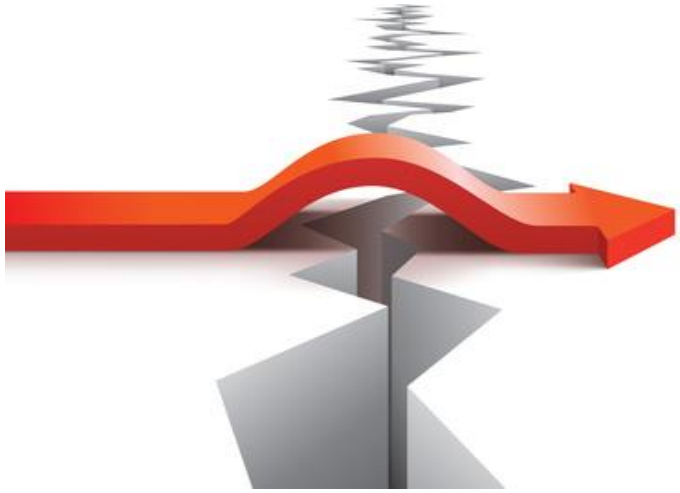
@THOMAS MORE

THOMAS MORE University of Applied Sciences

Side streams	Cultivation	Downstream processing	Biobased chemicals	Applications
				
				

WHY RESEARCH ON MICROALGAE PRODUCTION?

- Algae production is a promising alternative for the conventional production of food, feed and high-value biochemicals.
- It remains a challenge to cultivate microalgae efficiently on a large scale.

Lab  Industry

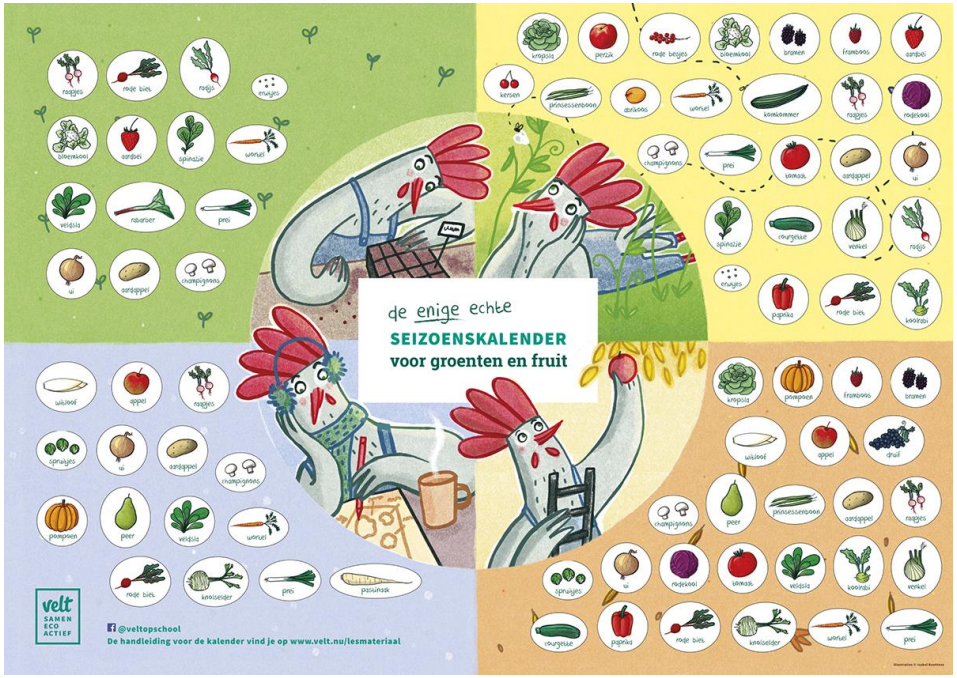
PILOT PLANT

RESEARCH FOCUS

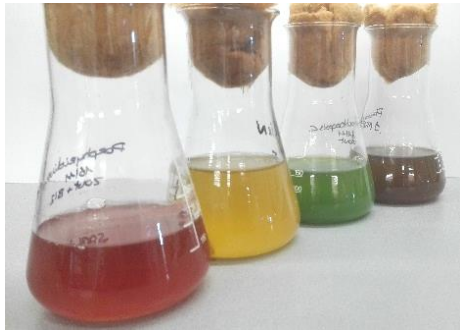
- Creating sustainable and economically feasible production processes
  - Recycling of water and nutrients
  - CO_2 capture
- In greenhouses in the NW-European climate

Interreg North-West Europe IDEA
European Regional Development Fund

www.nweurope.eu.idea



FROM LAB TO PILOT SCALE



250-2000 mL

10-20 L

300 – 1800 L

1.2M€ INVESTMENT PROJECT

2014: **Pilot scale** photobioreactors were built in a **greenhouse** for research on the cultivation of microalgae with applications in:

- **Horticulture**: alternative and innovative crop
- **Chemical industry**: sustainable biochemicals
- **Food/feed industry**: nutraceuticals, colorants…
- Processing of **side streams** (CO_2, agricultural and industrial waste waters)

WHICH CULTIVATION SYSTEM?

Seambiotic, Ashkelon (IL)

Open

Closed

AlgaEnergy (IT)

NOVAGreen (EE)

Wageningen, NL

CLOSED TUBULAR PHOTOBIOREACTORS @TM

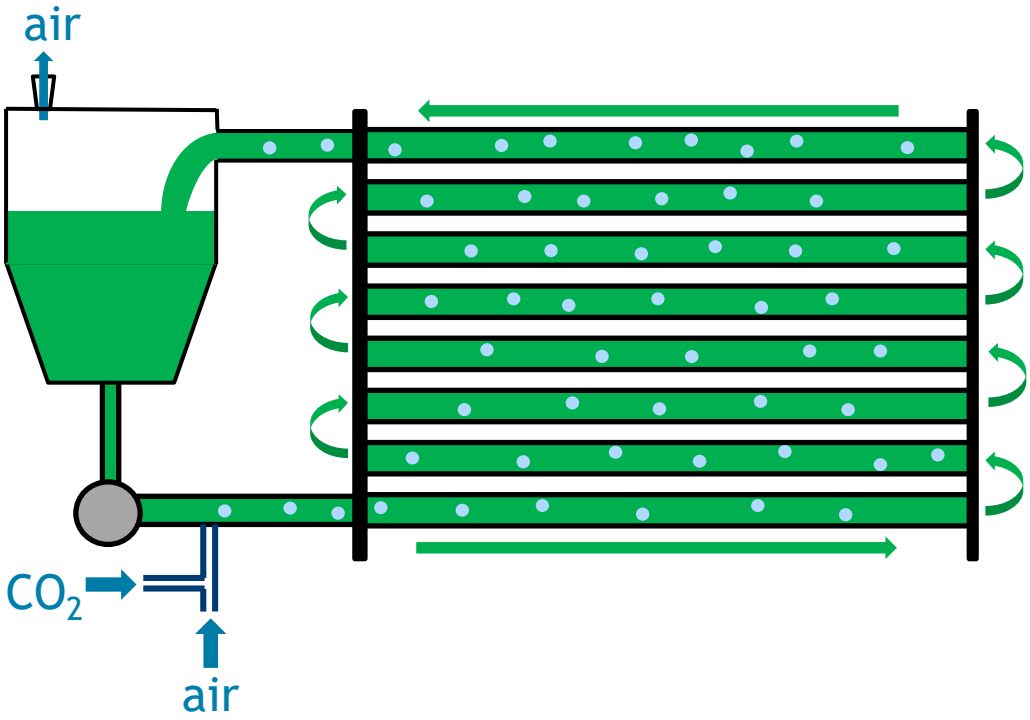
Pro's

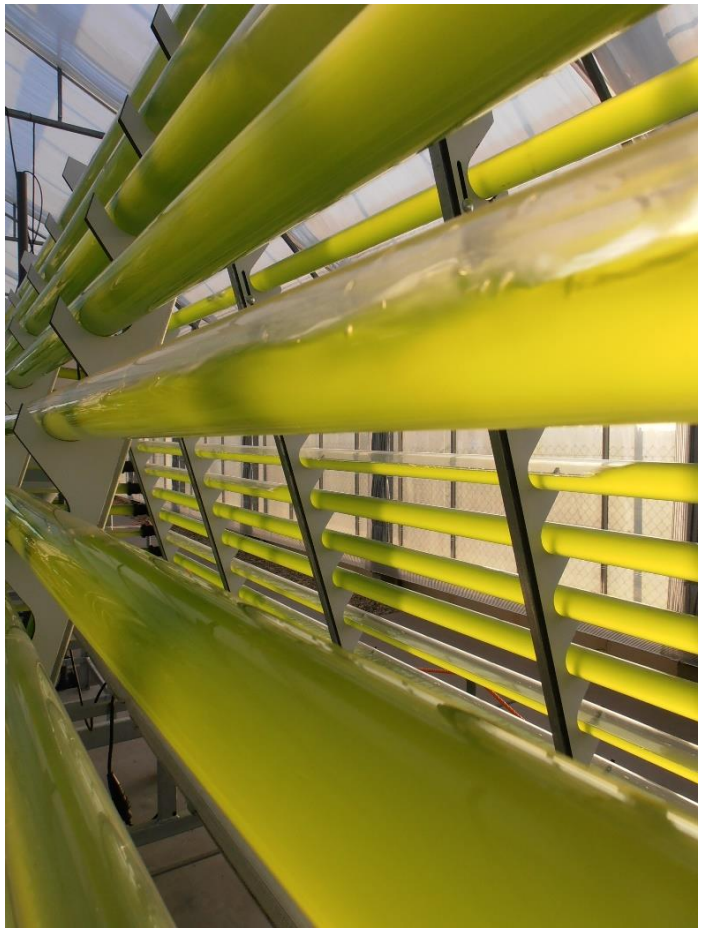
- High control
- High yield
- High quality

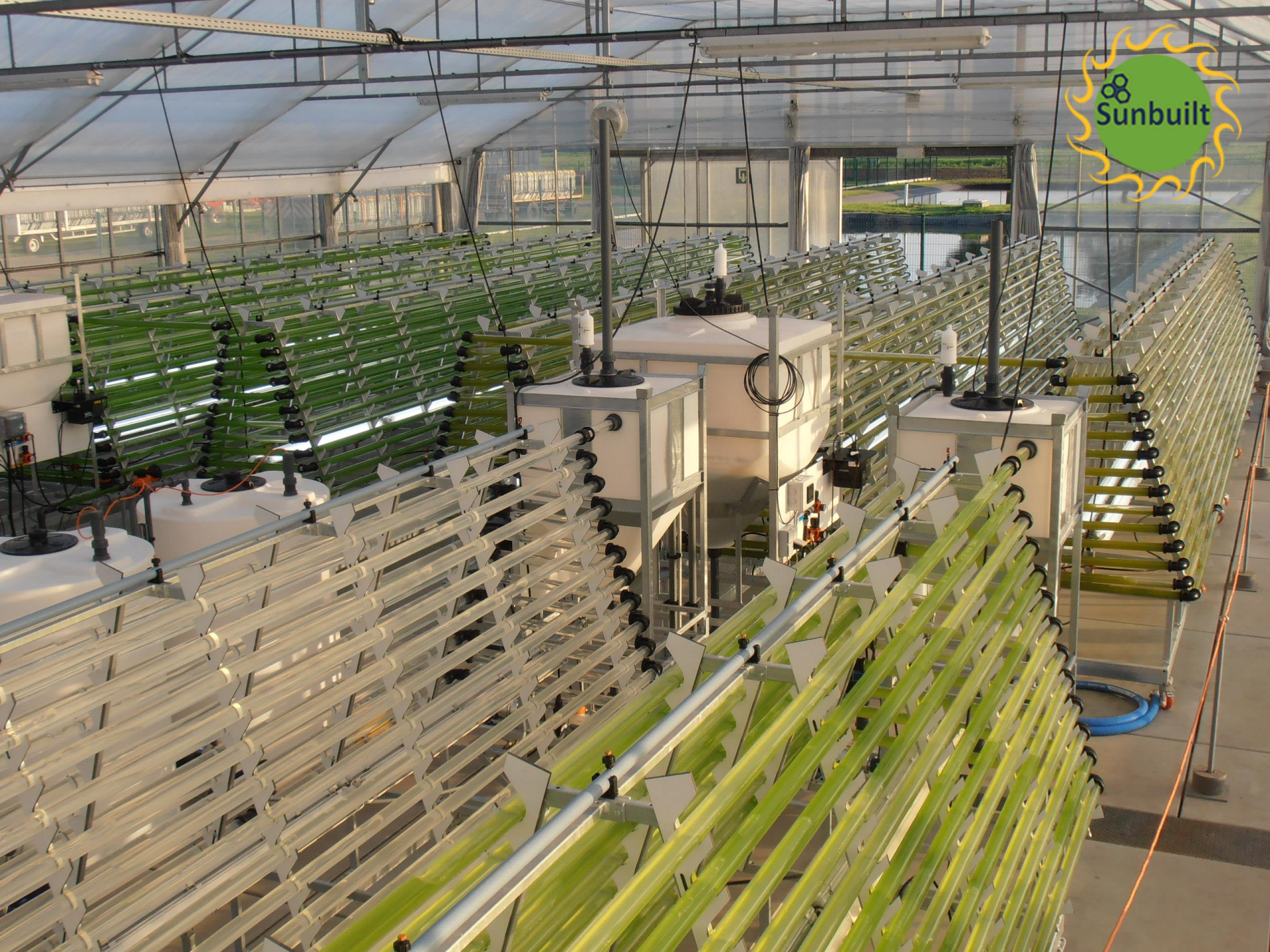
Con's

- High investment cost
- High engineering skills

CLOSED TUBULAR PHOTOBIOREACTORS @TM





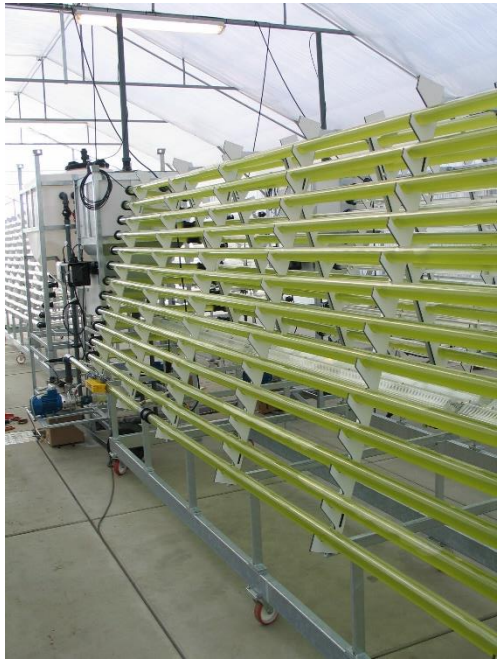

Sunbuilt

PBRs were designed as ‘christmas trees’ and installed in a greenhouse with as much as possible standard horticultural equipment

- Modular reactors: 2x 300L + 2x 1500L
- Automated climate control and continuous logging climate and growth parameters
- Harvesting unit comprizing centrifuge, storage tanks and freeze drying installation

CLIMATE CONTROL & AUTOMATISATION

NUTRIENTS



0.2 µm filtration

NUTRIENTS & CLIMATE: LAB RESEARCH

- Optimization of growth conditions
- > ten different microalgae strains

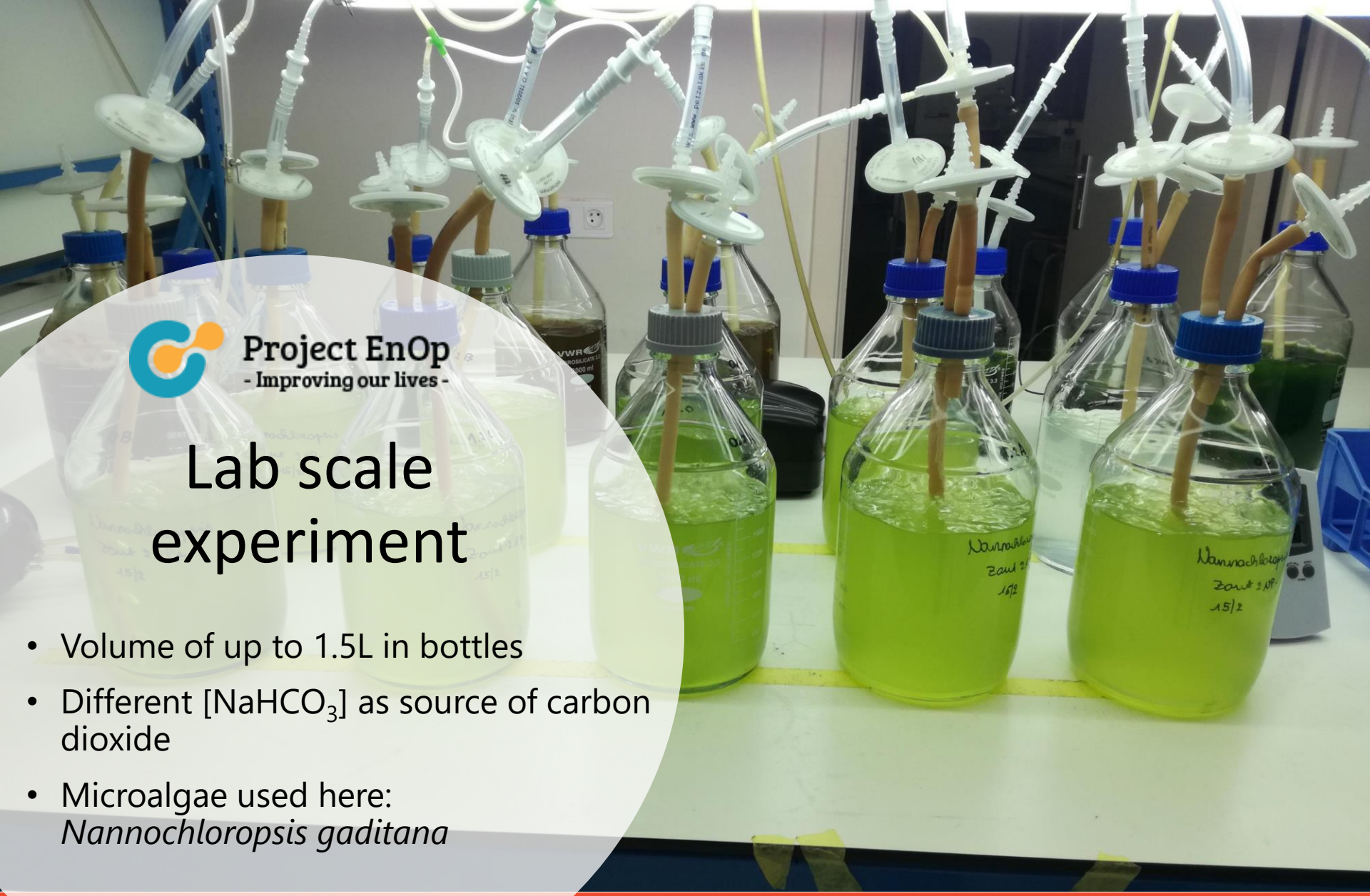
NUTRIENTS & CLIMATE: LAB RESEARCH

- Optimization of growth conditions
- > ten different microalgae strains
  - Fertilizers
  - Light
  - Temperature
  - pH
  - CO_2

Project EnOp
- Improving our lives -

Interreg
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling
EUROPESE UNIE

www.projectenop.eu

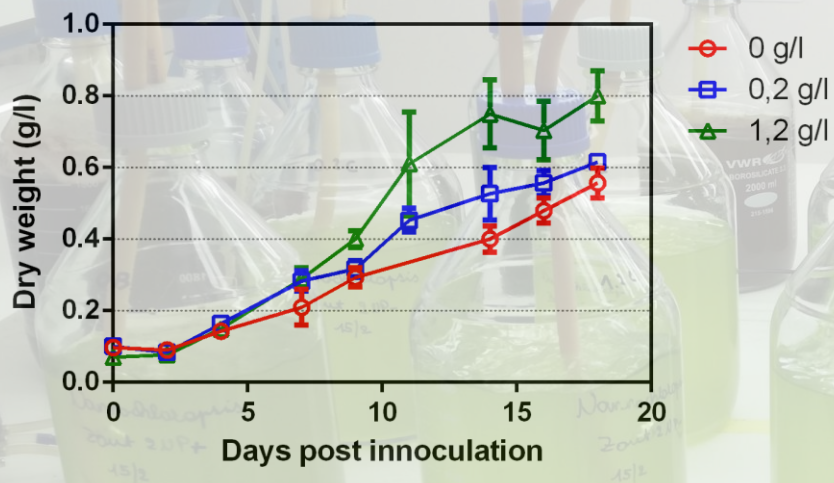


Project EnOp
- Improving our lives -

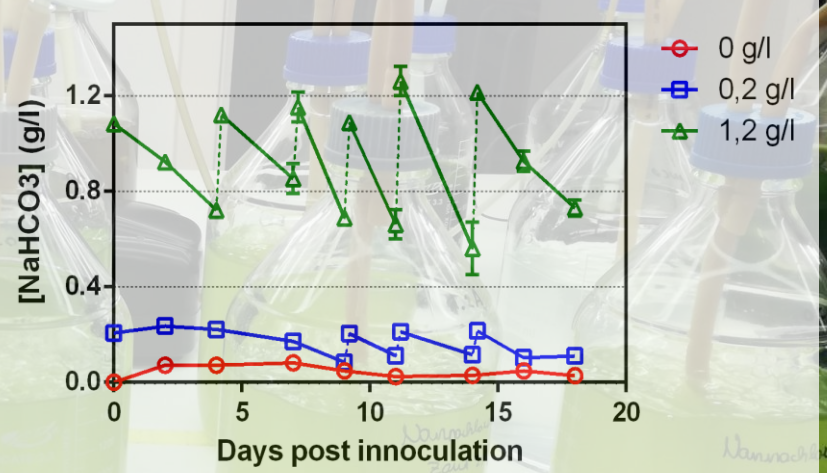
Lab scale experiment

- Volume of up to 1.5L in bottles
- Different [$NaHCO_3$] as source of carbon dioxide
- Microalgae used here: *Nannochloropsis gaditana*

Growth



Removal of bicarbonate

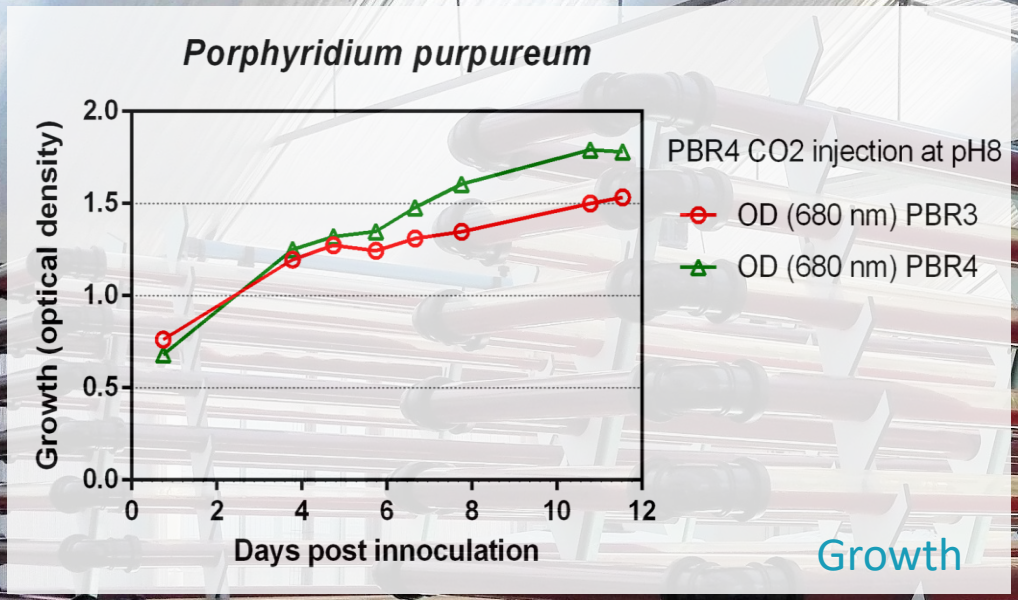


- Productivity from 0.02 to 0.15g/L/day
- Maximum rate of carbonate removal is 0.13g/L/day in equivalents CO_2
- Total $NaHCO_3$ removed from the medium was 3.8g for 1.1g of biomass = 1.8g CO_2 per gram biomass of *Nannochloropsis*

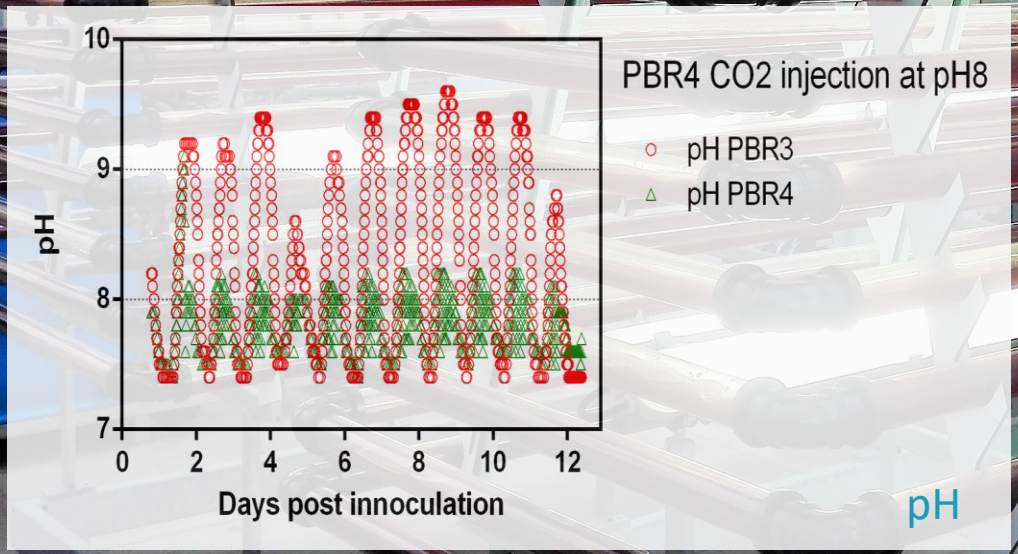
Project EnOp
- Improving our lives -

Pilot scale experiment

- Volume of 300L
- CO_2 injection coupled to pH control
- Microalgae used here: *Porphyridium purpureum*



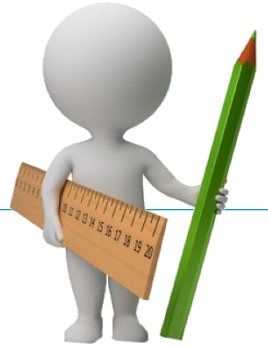
Growth



pH

- Growth rate accelerates when CO_2 is injected in the system
- Total injection of 2.1kg of CO_2 in PBR4 over 12 days
- An average of 0.6 g/L/day was injected

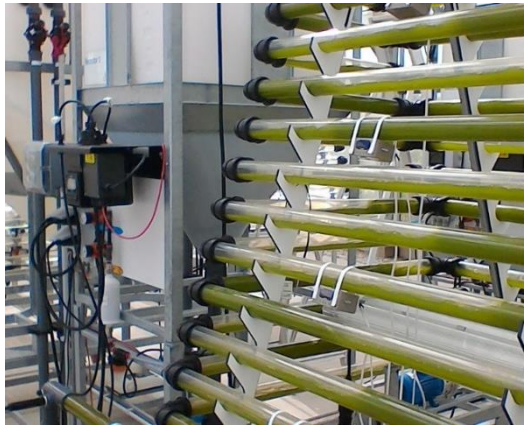
MONITORING



Logging

- Temperature
- Light
- pH
- CO_2
- DO
- Turbiditity
- Flow
- Color

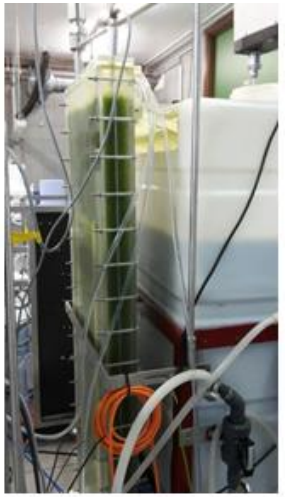
Sample taking



HARVEST

- Semi-batch
  - Centrifugation
  - Membrane based
  - Flocculation

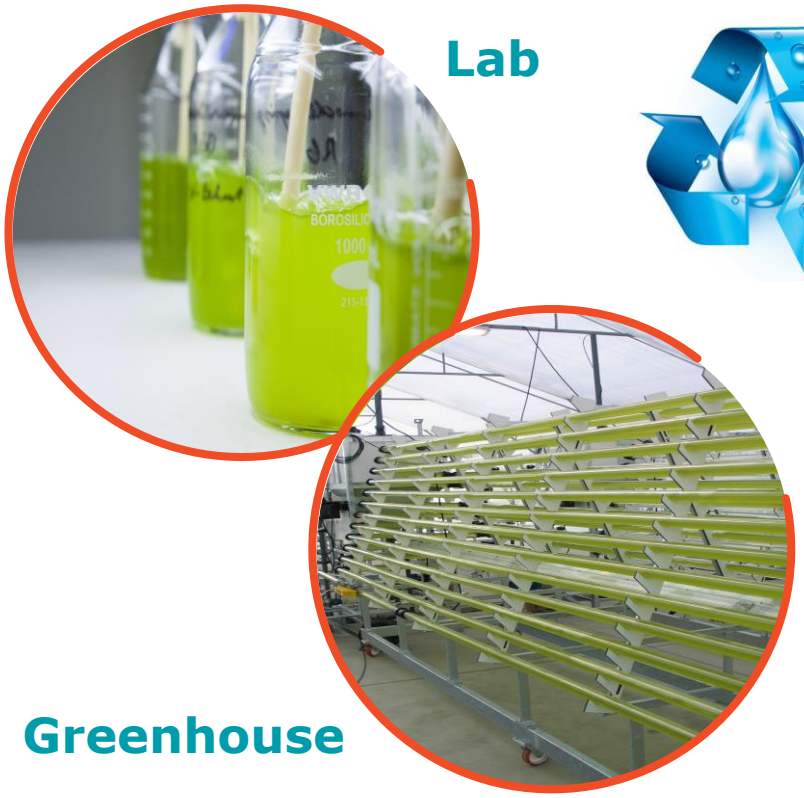
- Turbidostate
  - Automated based on turbidity measure

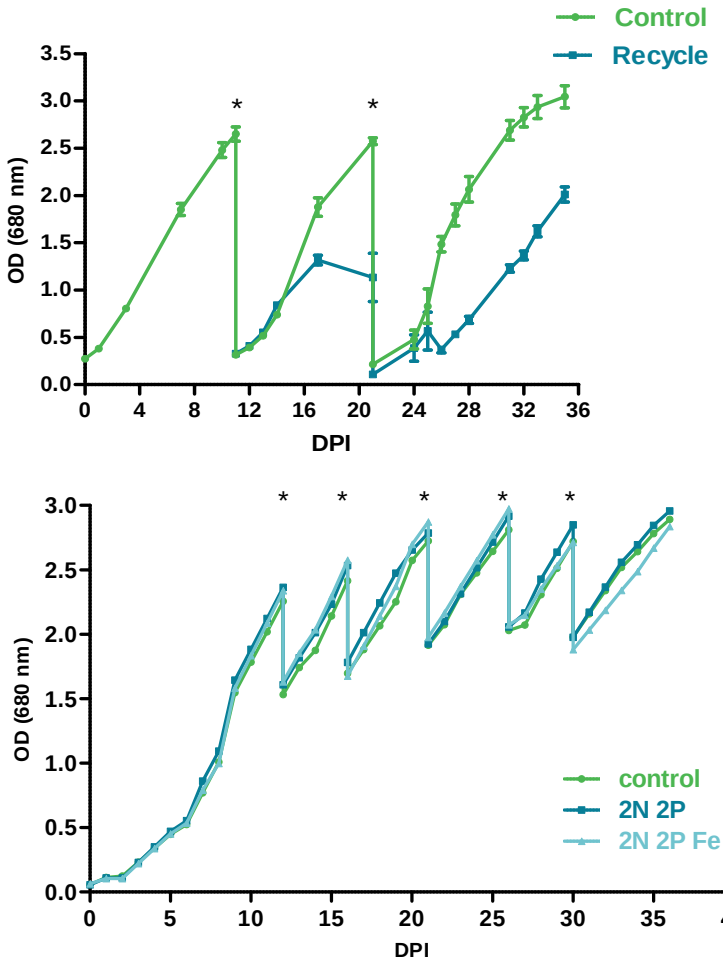


- Water and nutrient recycling

MEDIUM RECYCLING

- Finding optimal recycle regime





MODELING

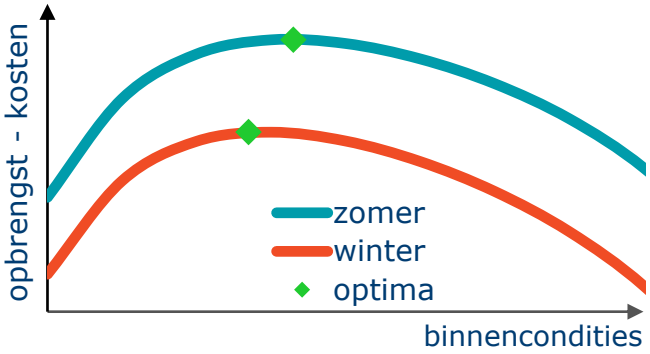
KENNISCENTRUM ENERGIE @THOMAS MORE

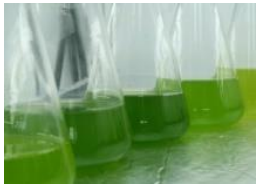
- Energetic optimalisation of algae production in greenhouse

Monitoring and simulation of energy use

Measuring algae growth i.f.o. environmental conditions

Optimal greenhouse conditions



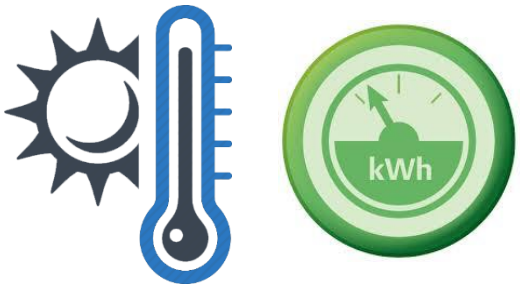


MODELING

KENNISCENTRUM ENERGIE @THOMAS MORE

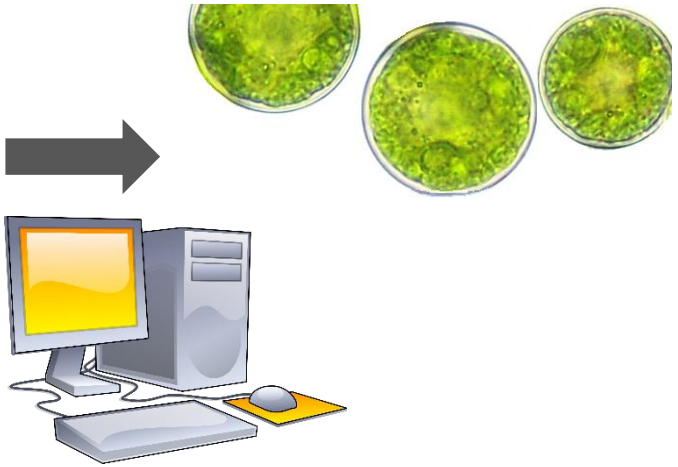
- Make prediction on algae growth and profit in function of input parameters and energy use

Weather conditions + energy use

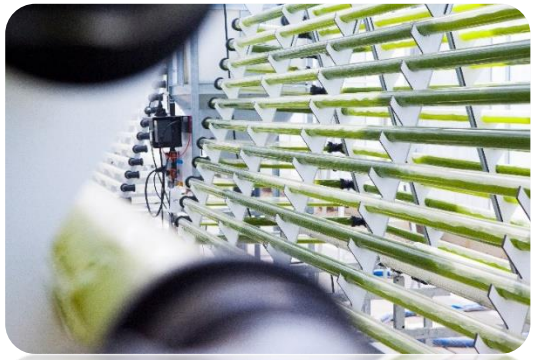


Greenhouse conditions

Algae growth predictions



THANK YOU FOR YOUR ATTENTION



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