
# MIKROALGER I STORSKALA

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# MIKROALGE-PRODUKTION I STOR SKALA

## Skalerbar sund forretning—hvordan?

**Hvad skal der til for at få en kommerciel succes?**

**Hvad skal der til for succesfuld opskalering?**

**Hvilken viden mangler?**

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# HVORFOR MIKROALGER?

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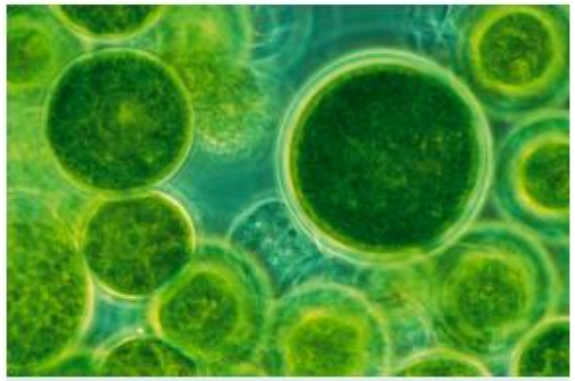
# Microalgae cultivation

## Fast growing biomass source




Light



**Microalgae**

- *Can directly utilize carbon dioxide as carbon source*
- *1 kg Biomass binds about 1.8 kg carbon dioxide*
- *Do not require fertile land*

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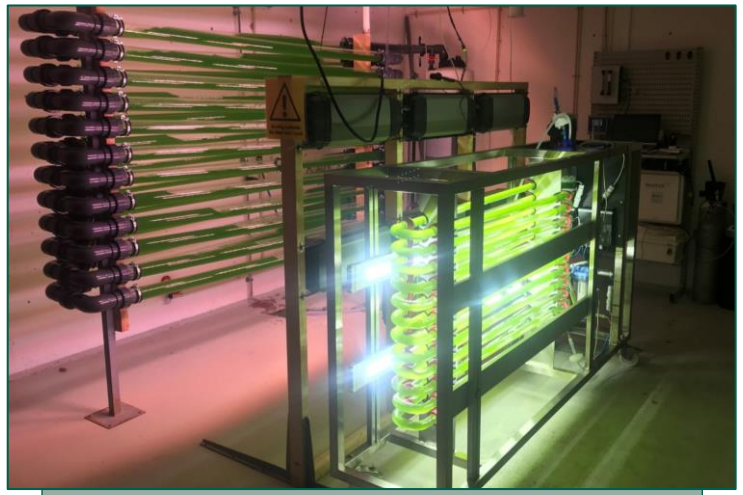
# Microalgae cultivation facilities

From single cell to laboratory cultures of up to 5 L working volume



Upscaling with 25 to 200 L indoor photobioreactors

Pilot demonstration with 150 $m^2$ outdoor photobioreactors

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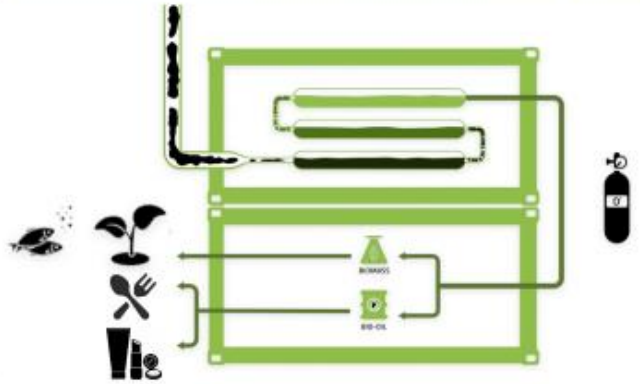
# CONCEPT – CARBON UTILIZATION AS-A-SERVICE (CCU)

**Carbon Capture** in modular, scalable and plug & play **Photo-Bio-Reactors (PBR)**

**Utilizing** $CO_2$ to produce **high-value** microalgae **biomass** and **bio-oil** using natures own process (photosynthesis)

**PhotoBioReactor**

**Process requires CO2, medium and light**



ALGIECEL

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# Microalgae – production systems

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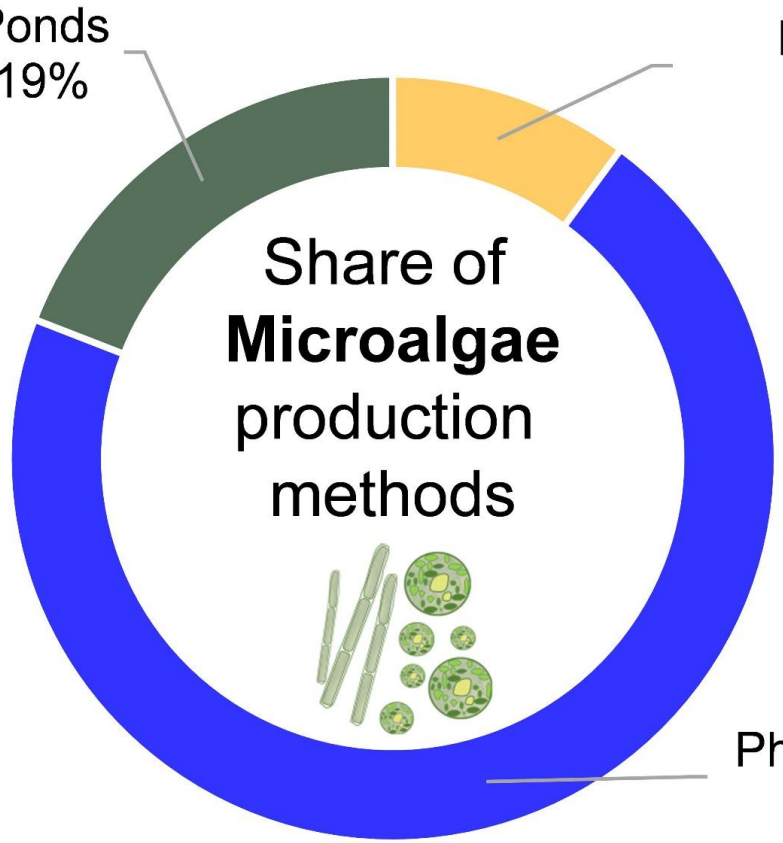
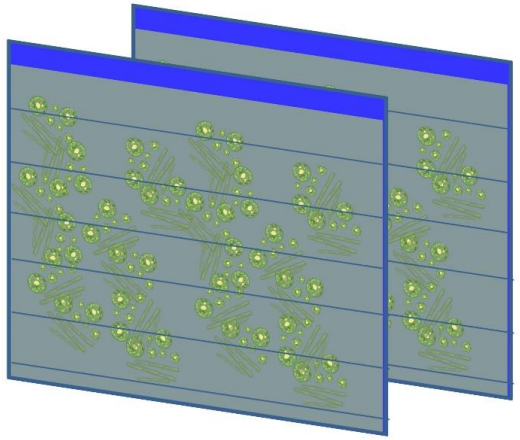
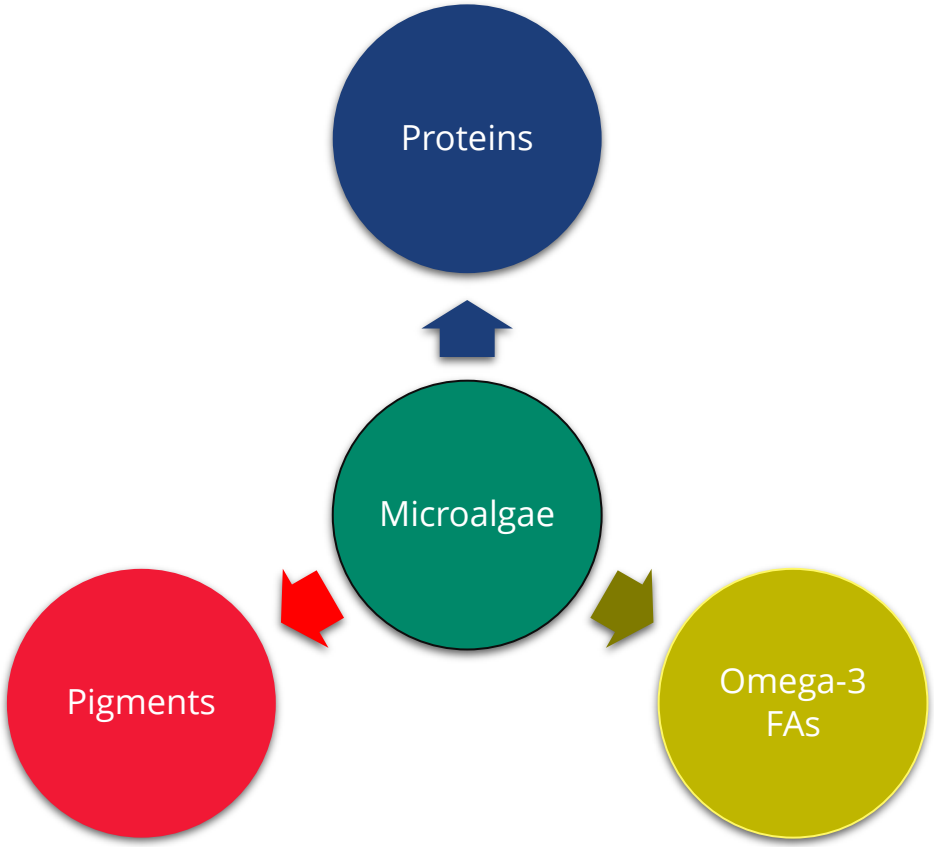



Fermenters
10%



Source: Araújo et al., 2021

# Focus on high-value products




- Food/feed
- Pharma/Nutraceuticals
- Cosmetics/Biomaterials

# ReMAPP

## Resource Efficient Microalgae Protein Production

Partly funded by the Innovation Fund Denmark (IFD)
Oct 2018-dec 2023

SUNLIGHT

$CO_2$ + BIOGAS DIGESTATE

BIOGAS PLANT

$O_2$ $O_2$ $O_2$

$N,P,CO_2$ $N,P,CO_2$ $N,P,CO_2$

HARVEST

SEDIMENTATION

CENTRIFUGATION

Water returned to production system

COFORMULATION, SILAGING
PROTEIN HYDROLYSIS

FEEDING TRIALS

PRODUCT SAFETY/ANALYSIS

ReMAPP ©

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# Pilot plant 2 at Nature Energy Månsson, Brande 2022

- Degassed manure as nutrient source
- $CO_2$ from upgraded biogas
- Ca. 90 m reactor tubes

Mikroalgeproduktion i stor skala

Udlagt 90 m lange poser hos Månssons i Brande

Koblet til biogasanlæg –både CO2 og digestat

Høst efter ca. 15 - 20 dage

~ 3 g/l høstes ca. 3-400 kg på en sæson

Svarer til 5-10 ton biomasse/ ha

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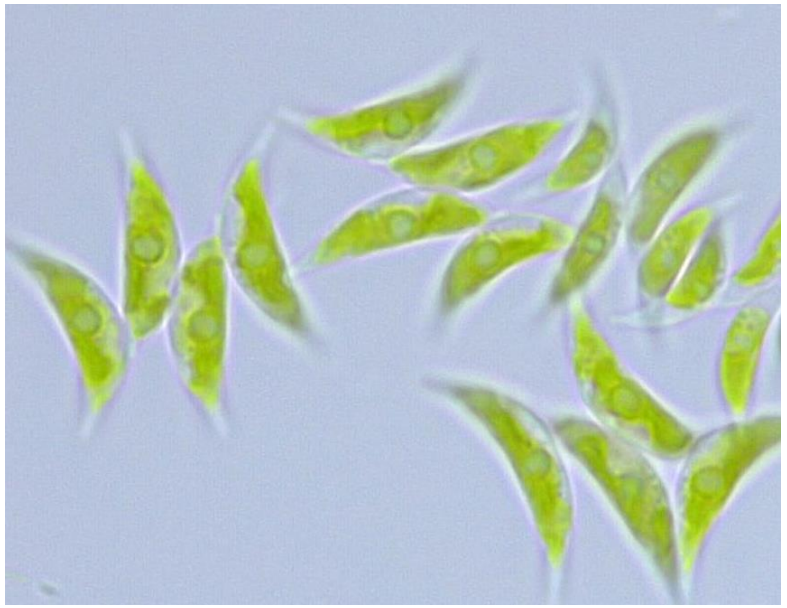
# Mikroalger *(Scenedesmus sp.)* vs. soybean protein productivity



~5-15 ton protein/ha/yr
(estimate based on outdoor algae cultivation in 2.000 liter scale in DK)

0.6 -1.2 ton protein/ha/yr

Import of Soy: 1,6-1,7 mio. tons to Denmark

# The benefits of microalgal oil

**1 ha of rapeseed culture**

- *1.4 t/a rapeseed oil*
- *4.6 t/a $CO_2$ emission*
- *125 $m^3$ $H_2O$*

**0.004 ha of microalgae can produce 1.4 t algae oil**

**No dependence on fertile land for the generation of renewable energy**

**$CO_2$ neutral or even negative production is possible**

**Other environmental impacts need to be considered**

Kilde: Fraunhofer "Circular Bioeconomy", 2023

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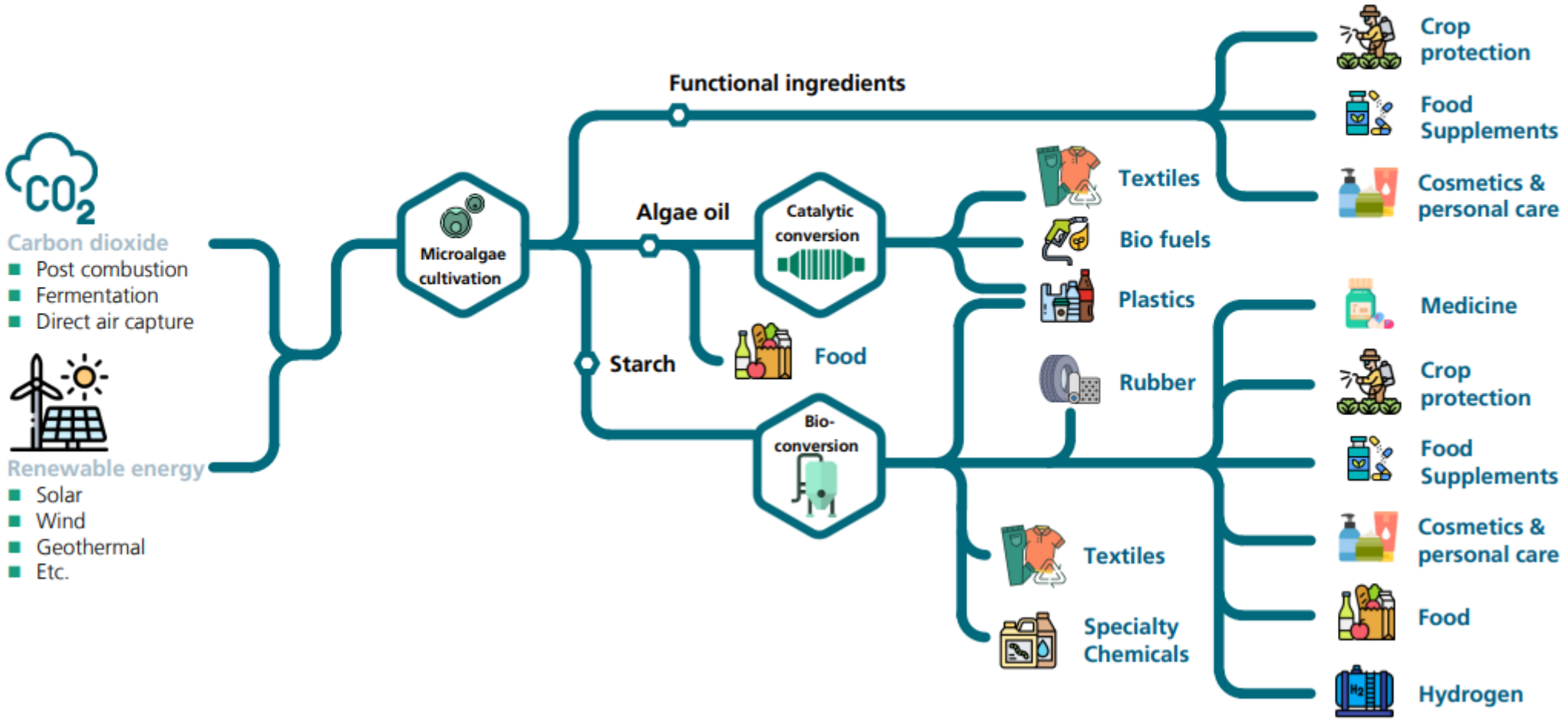
# The carbon dioxide refinery approach

## Combining biology and chemistry

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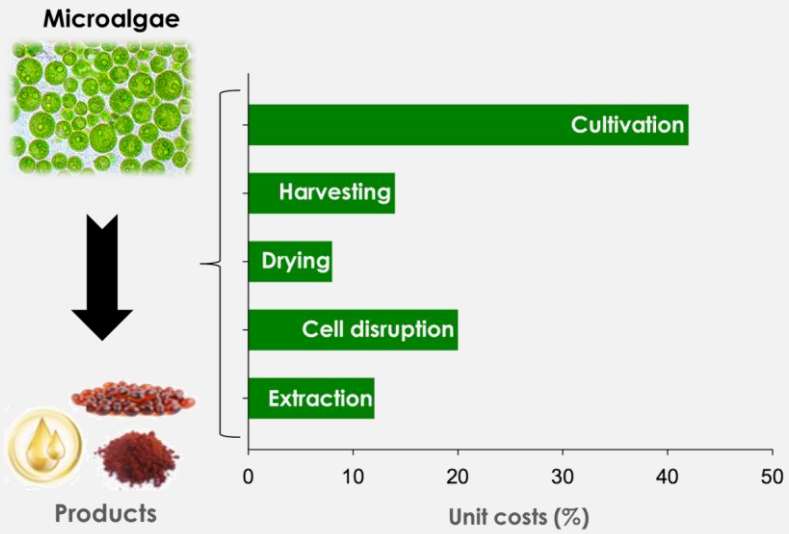
# HVAD SKAL DER TIL FOR SUCCESFULD OPSKALERING?

# HVILKEN VIDEN MANGLER?

# Microalgae bioprocess




# Alle led skal optimeres...

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# HVAD SKAL DER TIL FOR AT FÅ EN KOMMERCIEL SUCCES?

## Marked for mikroalger

- Støt voksende på grund af de mange potentielle anvendelser
- Stigende antal kommercielle producenter af mikroalger
- Der er videnskabelig/ samfundsmæssig interesse for mikroalger som grøn teknologi

Succes vil afhænger også af faktorer som

- Forbrugernes efterspørgsel/ accept
- Regulatoriske overvejelser
- Konkurrencedygtige priser.


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# TAK FOR OPMÆRKSOMHEDEN

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