

Bio360 - Nantes 2024

Conference presentation - Towards Net-Zero in the Maritime Sector

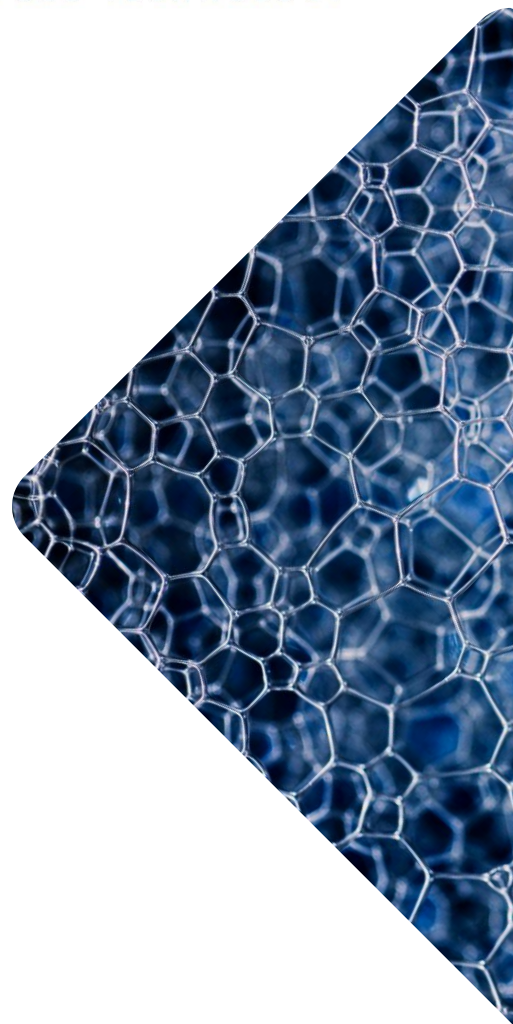
ORGANIC
FUEL TECHNOLOGY

Microwave cracking for biofuels

Organic Fuel Technology's unique microwave solutions
for circular biofuels

CEO JENS HENRIK HAAHR

JANUARY 2024



Organic Fuel Technology is on a mission

... to make organic waste valuable and create circular biofuels that will limit global warming and solve major waste challenges across the planet.

Applying unique microwave solutions, our technology turns waste materials into circular bio-oil and biochar with carbon storage.

The idea

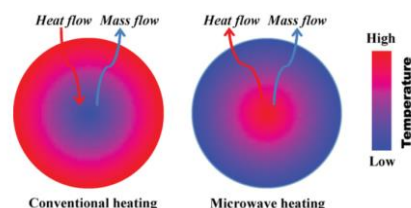
- USE MICROWAVES TO GENERATE BIOOIL AND BIOCHAR FROM BIOMATERIALS



- Organic Fuel Technology's main invention is the microwave reactor system for depolymerization and cracking of polar organic materials.
- Biomaterials are converted into bio-oil, biogas, and bio-char.
- The bio-oil can be upgraded, refined and utilized as circular biofuels – thereby displacing fossil fuels.
- The biochar can be utilized as carbon-storage and for soil improvement. Its energy can also be used in combustion as a climate-neutral fuel.

OFT's technology differs fundamentally from normal "kitchen" microwaves

Conventional vs. microwave heating

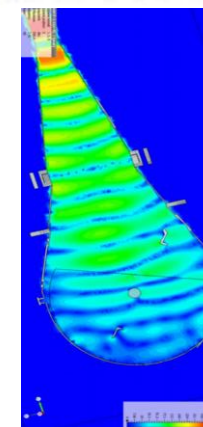
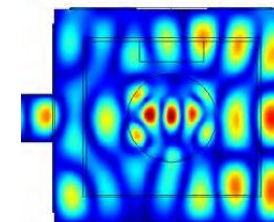


Microwaves operate **in the depth of the material** as opposed to conventional heat. This optimizes heat transfer.

In addition, OFT's technology uses microwaves in a new way:

1. OFT's reactor applies monomode heating, where the MW field is uniform, there are no reflections and thus **entirely uniform heating**. This offers high energy effectiveness and uniform process parameters.
2. OFT's optics and reactor design enables the microwaves to be emitted as a **strong electro-magnetic field** (100 V/m) which alternates rapidly (5 billion times per second). This catalyzes bond breaking.

Multimode (kitchen) vs. monomode (OFT) microwaves



Simulation of OFTs microwave field strength in single mode (to the left) compared to field strengths with multimode microwaves (above).

- ❑ A new way to generate fuels with electrical power: a wavelength used to convert biomass to biofuels and carbon storage.
- ❑ Efficient carbon utilization – the process is driven by renewable electricity
- ❑ Produces a high share of oil – up to more than 40% (mass).
- ❑ Low process temperatures (325 – 350 °C) and microwave radiation results in good end products
 - PFAS destroyed – no PFAS in biochar, very little PAH produced in the process
 - Oil has relatively high stability and relatively low viscosity.
- ❑ Bio-char with high capacity for carbon storage
 - Biochar contains +88 per cent geologically inert carbon – well suited for carbon storage
- ❑ Process carried out at atmospheric pressure.



OFT8 – A commercial plant being finalized for construction

Capacity:

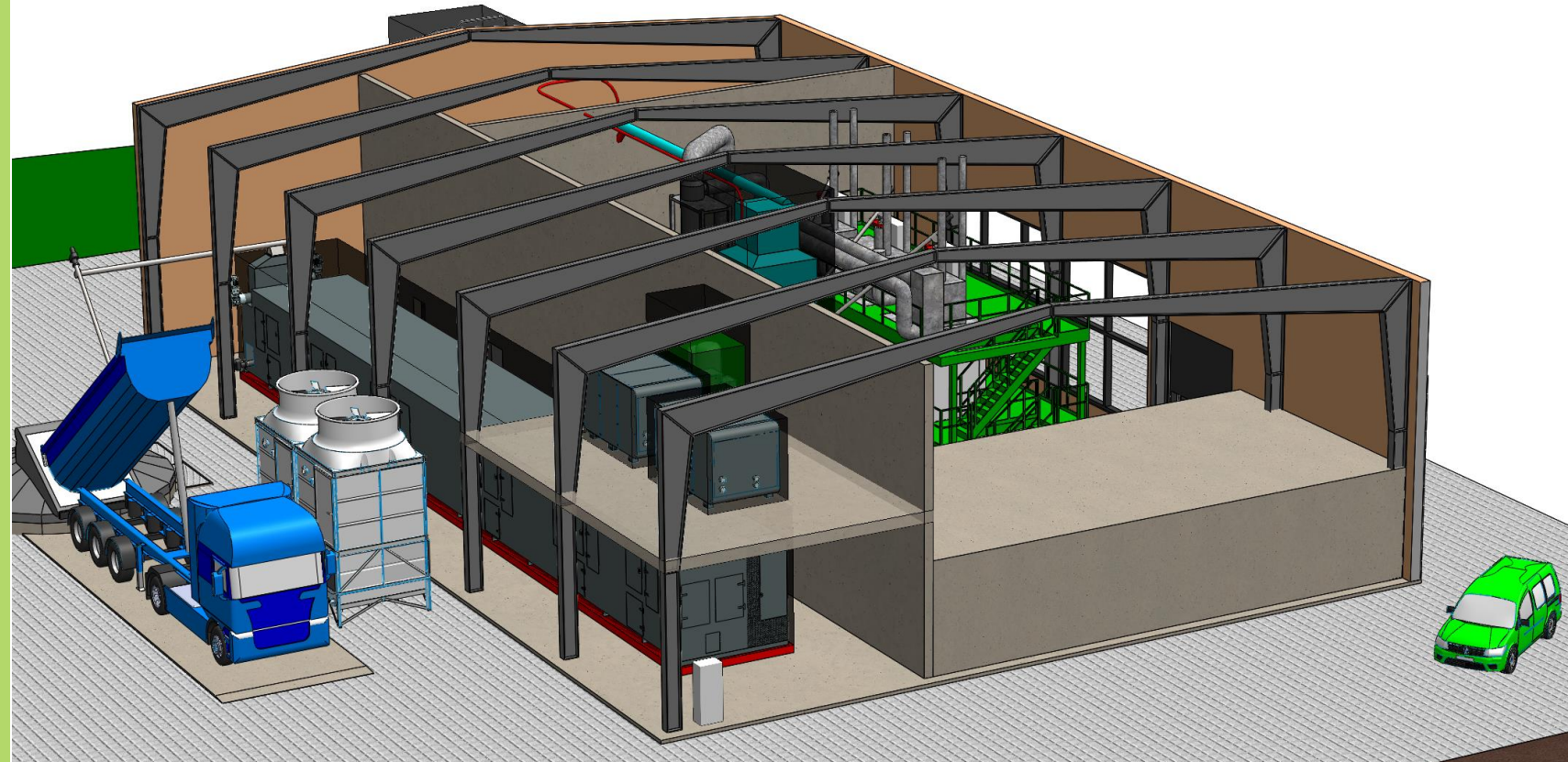
6 x 12 kW microwave
generators

400 kg dry matter / hour

Focus on wastewater
sludge

Projected production:

	Tons / year
Sludge (DM 25%)	10.000
Oil	1.200
Biochar	1.200
Carbon	400
CO ₂ e	1.467



Scalable core process

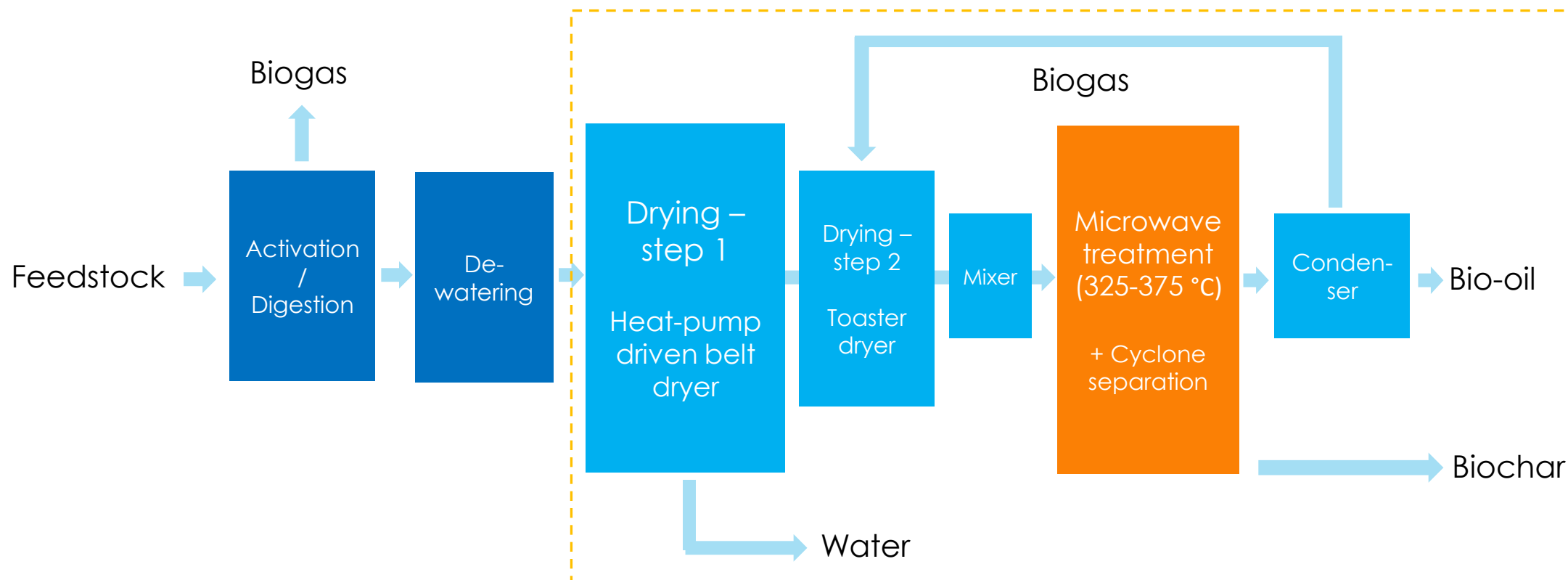
Modular design allows efficient scaling



The core microwave processing unit of OFT8 with three reactor towers.

Integrated process flow

powered by electricity from renewable sources



An interesting biooil from wastewater sludge

Distillation fractions

Wastewater sludge type	Digested -aged	Undigested -aged
Petrol	3,0	6,3
Kerosene	6,8	10,4
Diesel	41,1	44,0
Heavy Fuel Oil	27,9	25,3
Asphalt	11,5	7,4
Carbon Residue	9,7	6,5

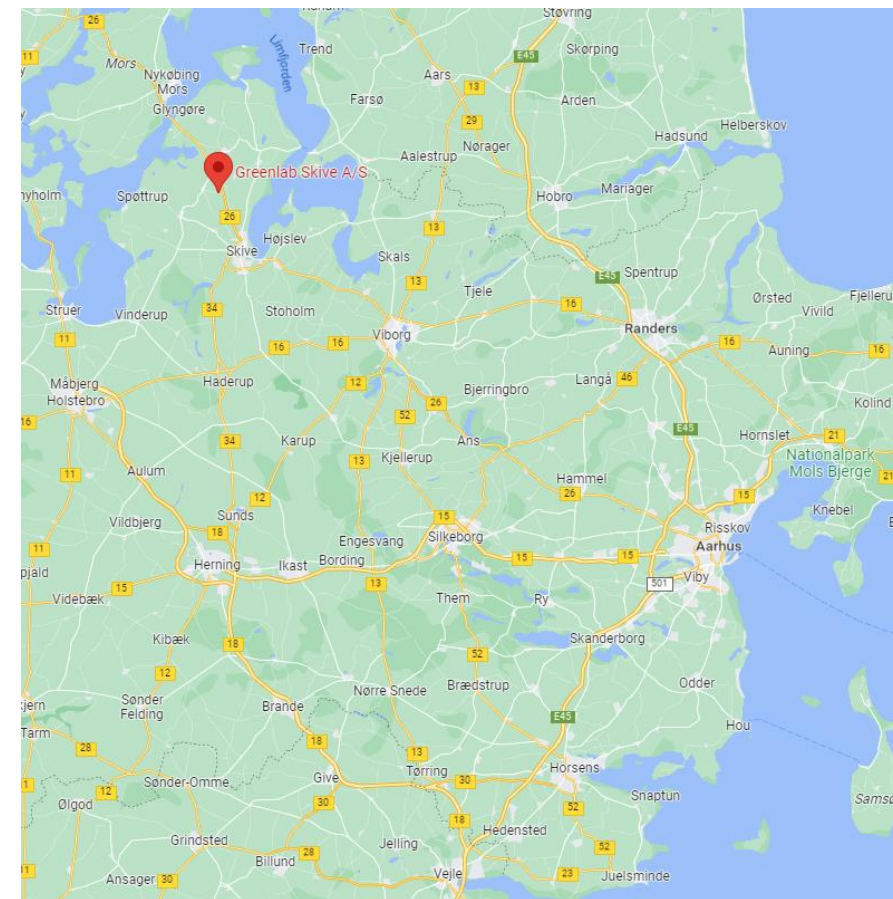
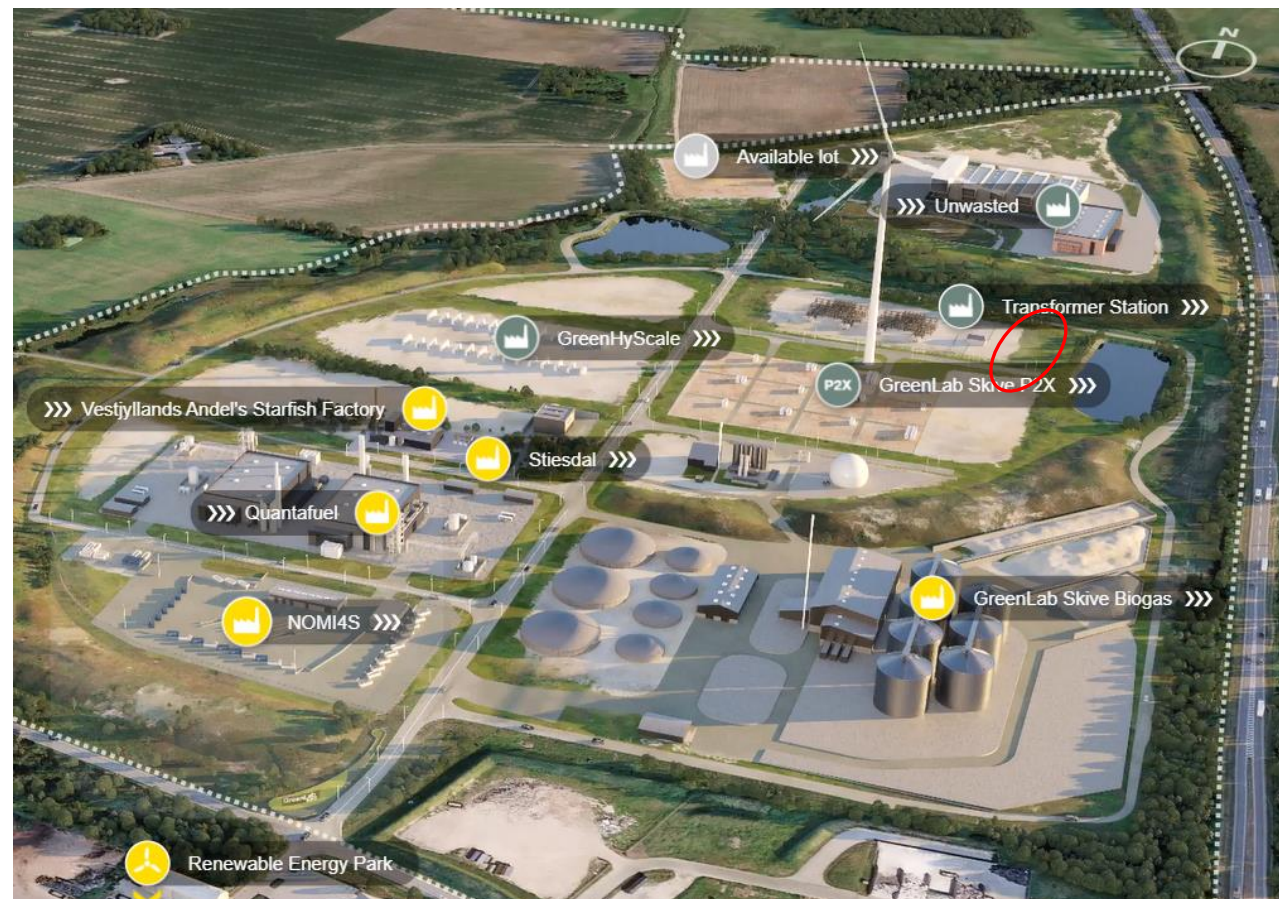
Primary oil off-takers:

- ▣ Maritime transport (as circular biofuel infeed to bunker oil)
- ▣ Refineries (upgrading and refining for high-end usages).

Data from test run with digested and undigested wastewater sludge. Analysis (simulated distillation) carried out by Aarhus University, April 2023. Ageing done by 24 h heating at 100 °C.

First full-scale plant being established in 2025

Located at GreenLab industry park in central Jutland – focus on wastewater sludge



- ❑ Biomass owners purchase OFT production facility.
- ❑ OFT installs, commissions and services the facility. Biomass owner operates.
- ❑ OFT handles end products (oil and char) – if requested.

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Short term focus areas

1. Optimizing the path from oil condensate to attractive maritime biofuels
 - ISO 8217:2017 RMG 380 Marine Residual Fuels / DMA Marine Distillate Fuels.
2. Working with the maritime sector
 - Moving on from fossil fuel standards to new circular fuel standards?
3. Working with the refinery sector – adaptability and flexibility
4. Achieving economies of scale and volume.

MICROWAVE CRACKING FOR BIOFUELS – JANUARY 2024

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FUEL TECHNOLOGY

Organic Fuel Technology A/S

MAKING WASTE VALUABLE

