BTG BIOLIQUIDS COMPANY PRESENTATION

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May 25th 2020, ETIP Bioenergy WG 2 Conversion Webinar

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biomass-to-liquid

AGENDA

Company

Technology

FPBO applications

COMPANY INTRODUCTION

As a ***technology provider*** and ***product leader*** we are committed to the commercial deployment of our fast pyrolysis technology.

Explicitly made from biomass residues which is known as ***second generation*** (2G) or advanced bio fuel which means that it does not compete with the food chain.

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COMPANY MILESTONES

1987 - BTG starts as a spin-off from University of Twente

2005 - fast pyrolysis plant project in Malaysia

2007 - BTG established BTG-Bioliquids

2015 - start up of Empyro in the Netherlands

2016 - cooperation agreement with TechnipFMC
- starting BTG-Bioliquids webshop

2019 - Empyro sold to Twence, the Netherlands
- Green Fuel Nordic Oy, Finland
- Pyrocell, Sweden

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COOPERATION WITH TECHNIP-FMC

A World Leader in the Energy Industry

- Global footprint with ~45,000 people in 45 Countries
- Global expertise in Engineering, Procurement and Construction (EPC)
- Technology leader in Hydrogen, Ethylene, Refining & Petrochemical
- Advancing innovative, green solutions to meet the world's energy challenges

Technip's mission is to deliver safe, sustainable, quality and successful projects

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FIRST COMMERCIAL FPBO PLANT IN THE WORLD AT TWENCE/EMPYRO IN THE NETHERLANDS, IN 24/7 OPERATION SINCE 2015.

Plant Data

Plant Capacity	120 tonnes of dry wood residue /day
Plant Feedstock	Wood Residue
Plant Output per year	
• **Oil**	20 million litres
• **Electricity**	2,200 MWh
• **Steam**	80,000 tonnes
• **CO2- eq. reduction**	24,000 tonnes

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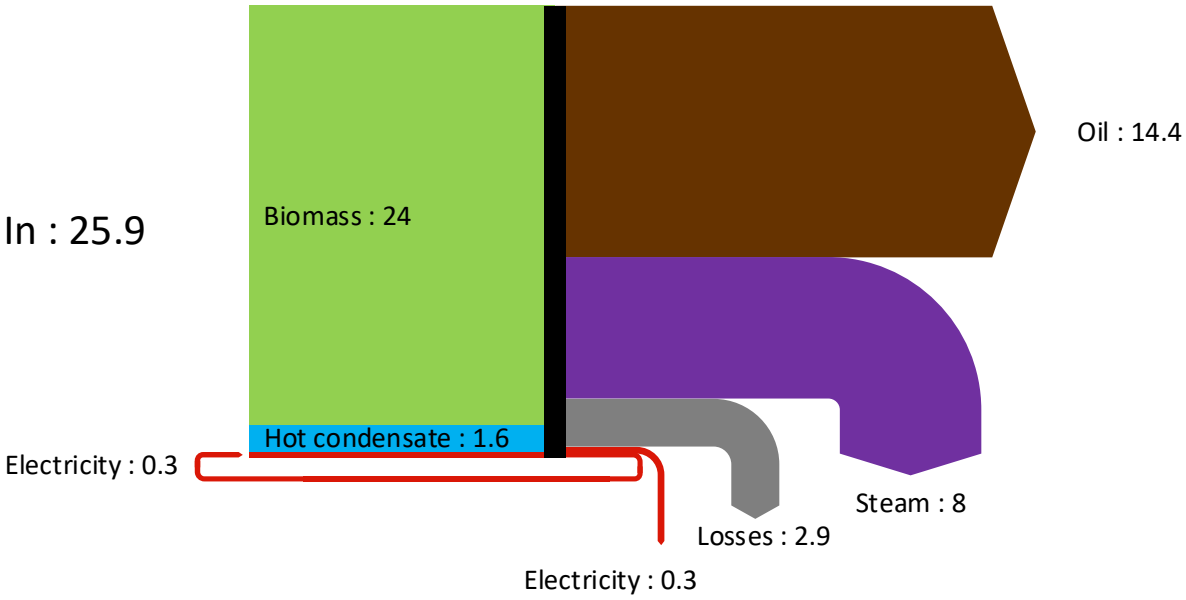
EMPYRO ENERGY BALANCE (MW)
OVERALL EFFICIENCY 85%



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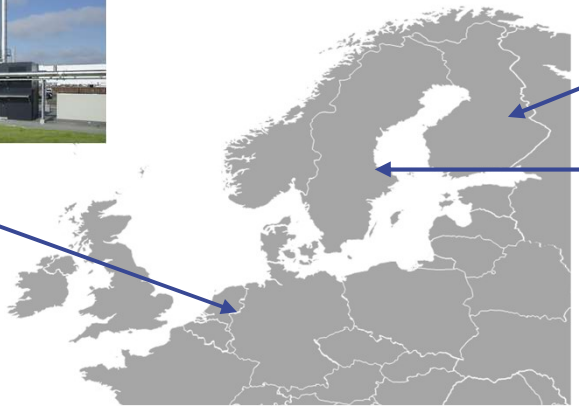
EMPYRO AND MORE

Empyro Twence, Hengelo
The Netherlands



Green Fuel Nordic, Lieksa
Finland

Pyrocell Setra, Gävle
Sweden

GREEN FUEL NORDIC PROJECT (FINLAND)

Plant (start-up 2020)	
Capacity	120 tonnes/day
Feedstock	Saw dust
Output per year	
• **Oil**	20 million litres
• **Electricity**	2,200 MWh
• **Steam**	80,000 tonnes
• **CO2- eq. reduction**	24,000 tonnes

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PYROCELL PROJECT (SWEDEN)
FROM SAWDUST TO TANK

- Cooperation of Setra and Preem
- Production of bio-oil from sawdust - start-up 2021
- Fast pyrolysis technology - annual bio-oil production 25,000 tonnes - GHG reduction vs fossil oil 80-90%
- Equivalent of 15,000 family cars can be powered per year
- Comply with the European RED II directive

Setra

preem

TechnipFMC

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OUR KEY ADVANTAGES

- ***CO2 neutral*** process.
- To ***reduce transport costs*** fast pyrolysis plants located at biomass source.
- ***High operating plant efficiency*** (~ 85%)
- Plant functions ***autonomously*** operated / controlled by ***one operator***.
- Modular design and short erection time at site (8 days of erection realized at Empyro)
- ***Turn key*** plant delivery at ***low CAPEX***.

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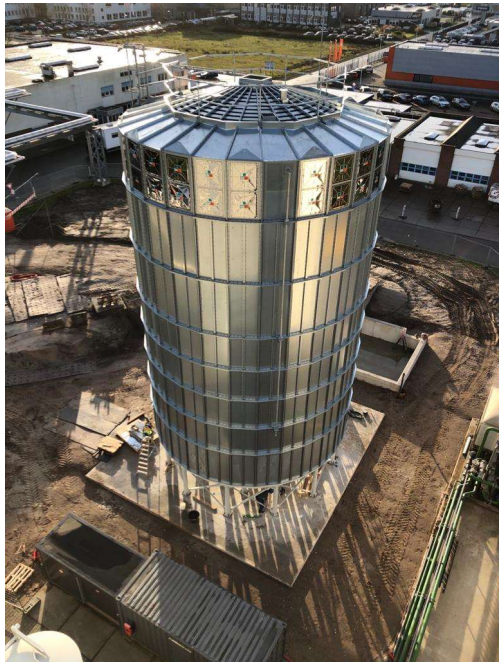
Fast pyrolysis developments: feedstocks

- Main fast pyrolysis process developments are on feedstock diversification
- E.g. new feedstock silo and de-NOx at Empyro allows use of other biomass



BTG BIOLIQUIDS PYROLYSIS TECHNOLOGY

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WHY PYROLYSIS ?

- Works with a variety of biomass feedstocks
- GHG savings well above other biofuels
- Versatile application: heat, power and transportation fuels
- Utilize existing fossil fuel infrastructure
- Viable link agriculture and (petro-) chemical industry
- Renewable feedstock for second generation biofuels

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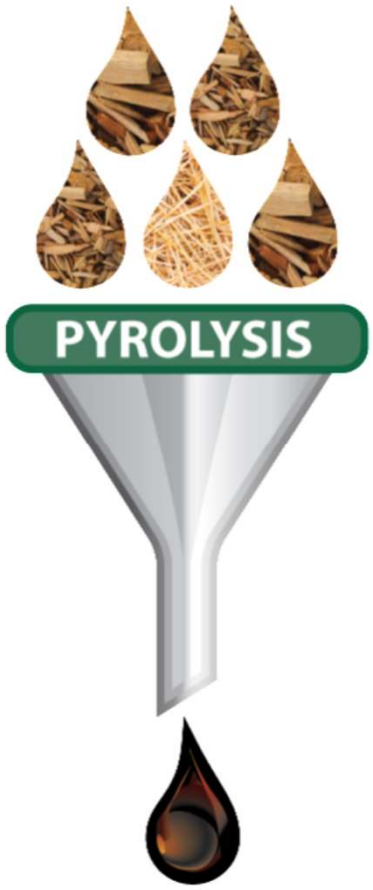

FAST PYROLYSIS TECHNOLOGY

Thermochemical decomposition of biomass through rapid heating (450-600 ℃) in absence of oxygen.

Different types of biomass can be converted into a homogeneous energy carrier: ***Fast Pyrolysis Bio Oil*** (FPBO).

By products are ***heat*** (steam) and ***power*** (electricity).

Typical Pyrolysis Oil Characteristics	
Composition	$C_2H_5O_2$
Density kg/m^3	1100 - 1200
Heating value	17 - 20 GJ/m^3
• Water content	20 - 30 wt.%
• Ash	< 0.1 wt.%
• Acidity (pH)	2.5 - 3

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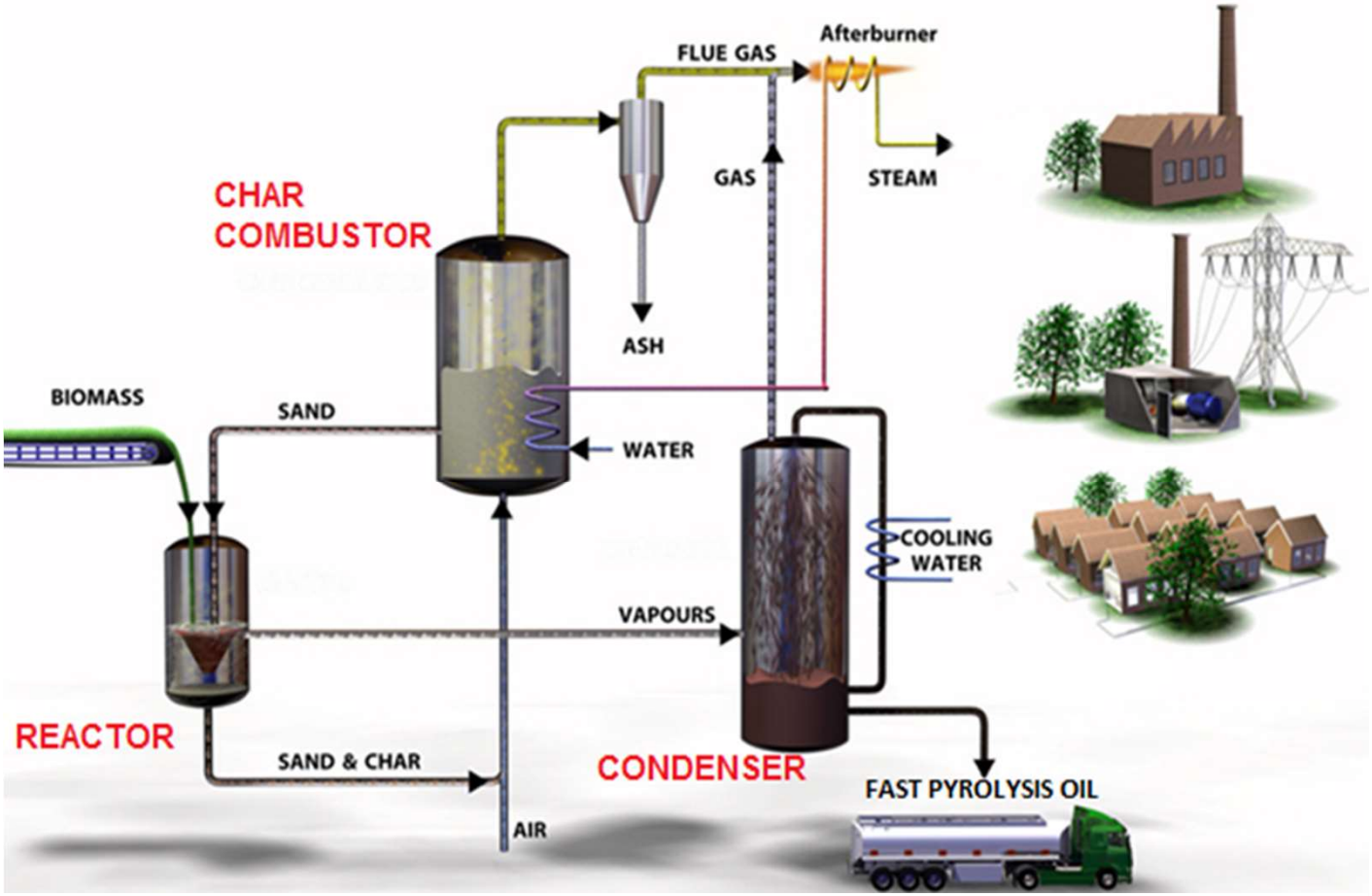
OUR FPBO PROCESS

From biomass to fast pyrolysis bio oil (FPBO).



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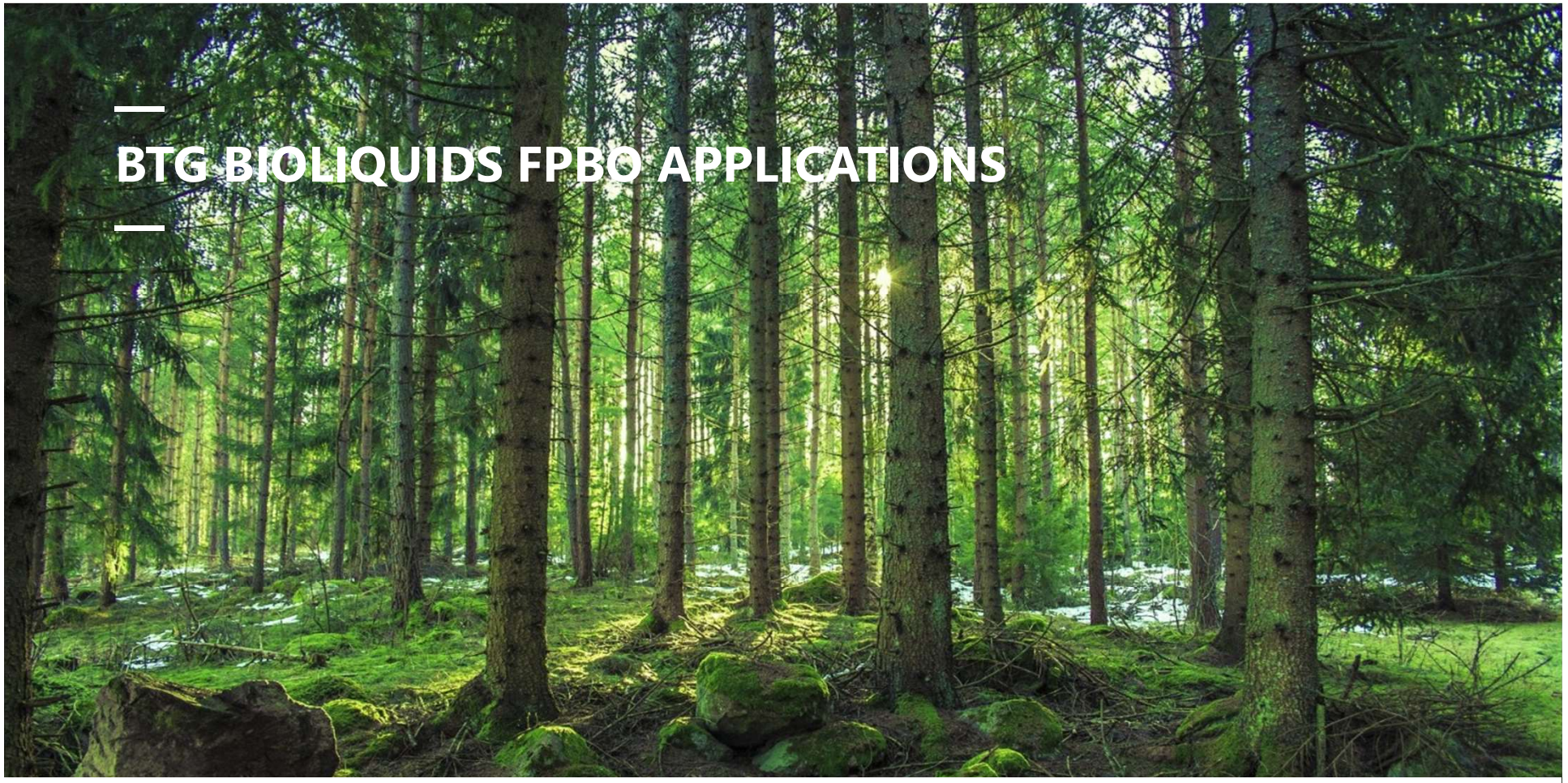
BTG BIOLIQUIDS FPBO APPLICATIONS



FAST PYROLYSIS BIO OIL APPLICATIONS

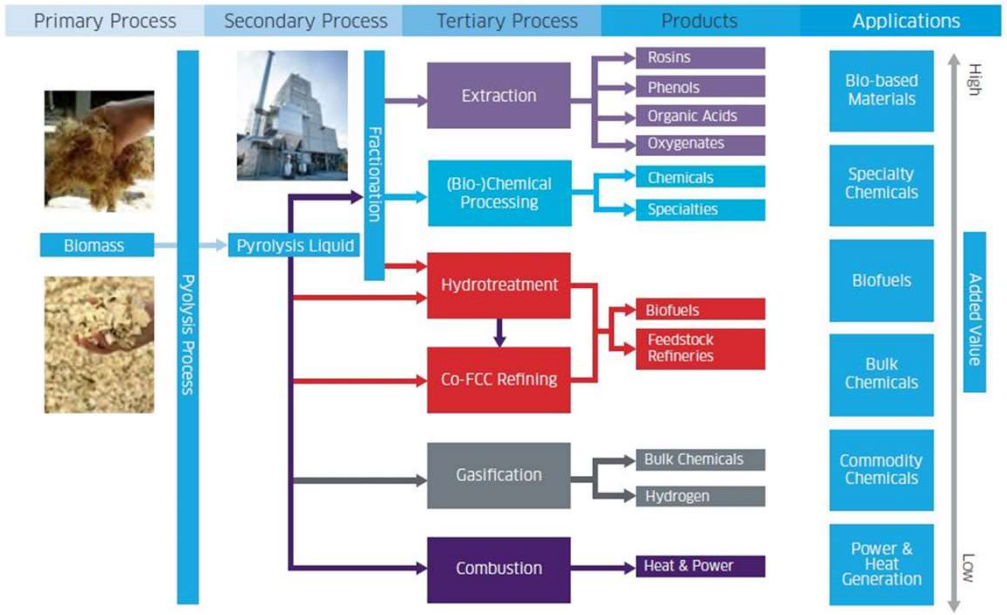


Figure based on BTG Biomass Technology Group B.V. intellectual property

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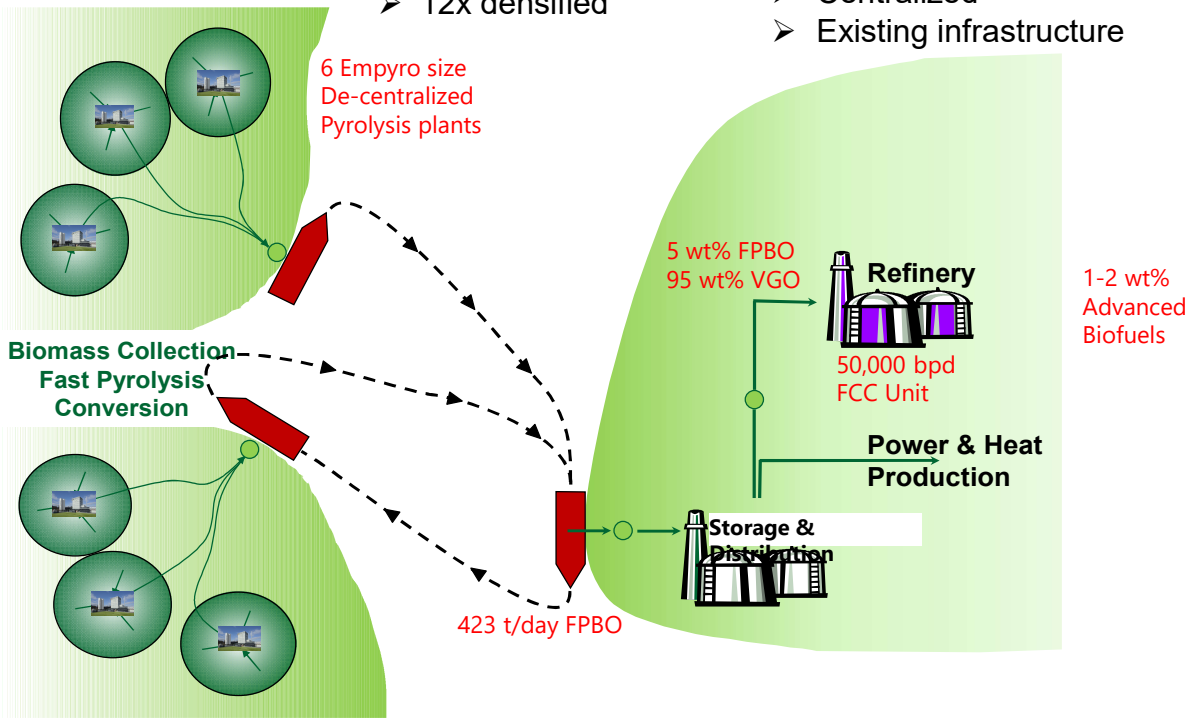
FPBO SUPPLY CHAIN: DECENTRAL PRODUCTION

1. Biomass conversion
- Local processing
- Returning minerals

2. FPBO transport
- Biomass liquified
- 12x densified

3. Processing & distribution
- Centralized
- Existing infrastructure



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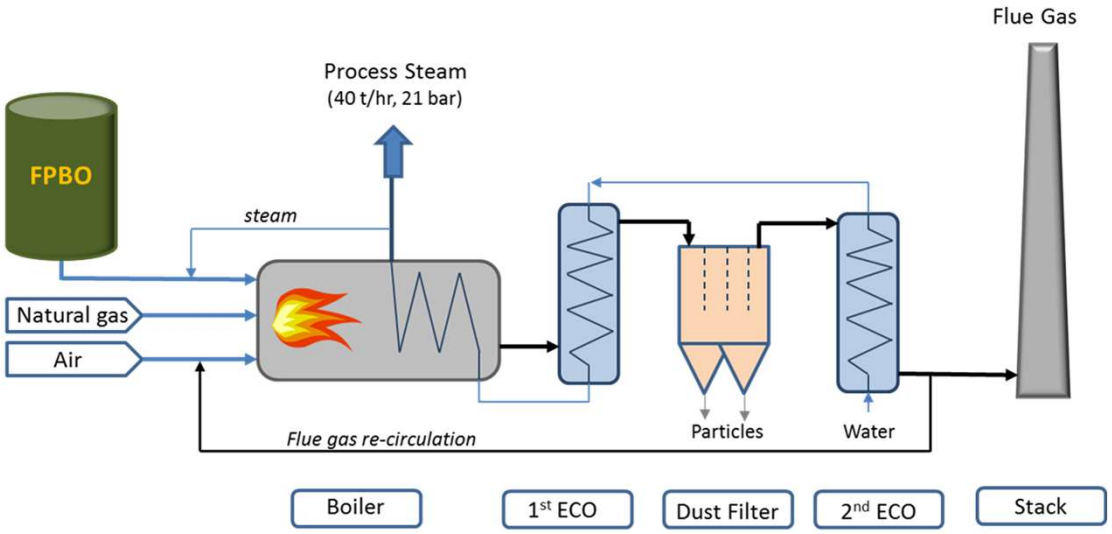
INDUSTRIAL STEAM GENERATION AT FRIESLANDCAMPINA



Schematic drawing of Process Steam Boiler at FrieslandCampina

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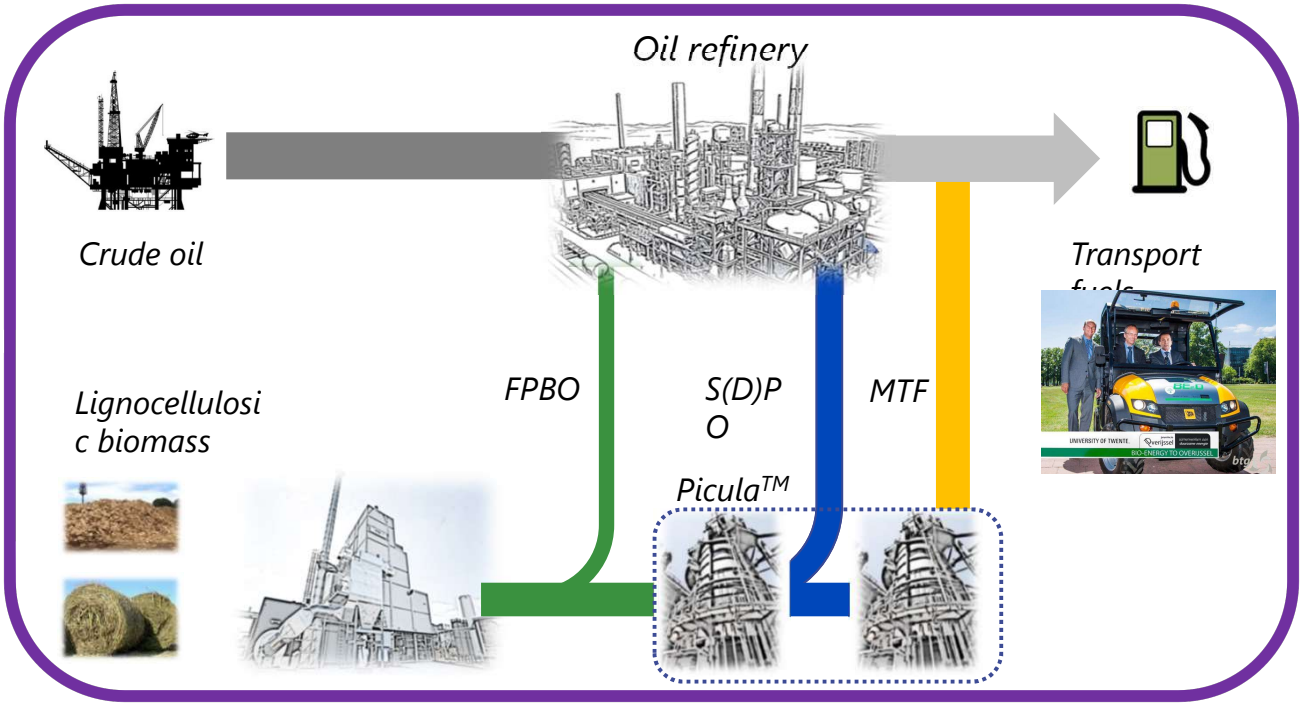
Fast pyrolysis developments: advanced biofuels



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FPBO: crude fast pyrolysis bio-oil
SPO: stabilised pyrolysis oil
SDPO: stabilised & partly deoxygenated PO
MTF: mixed transportation fuels

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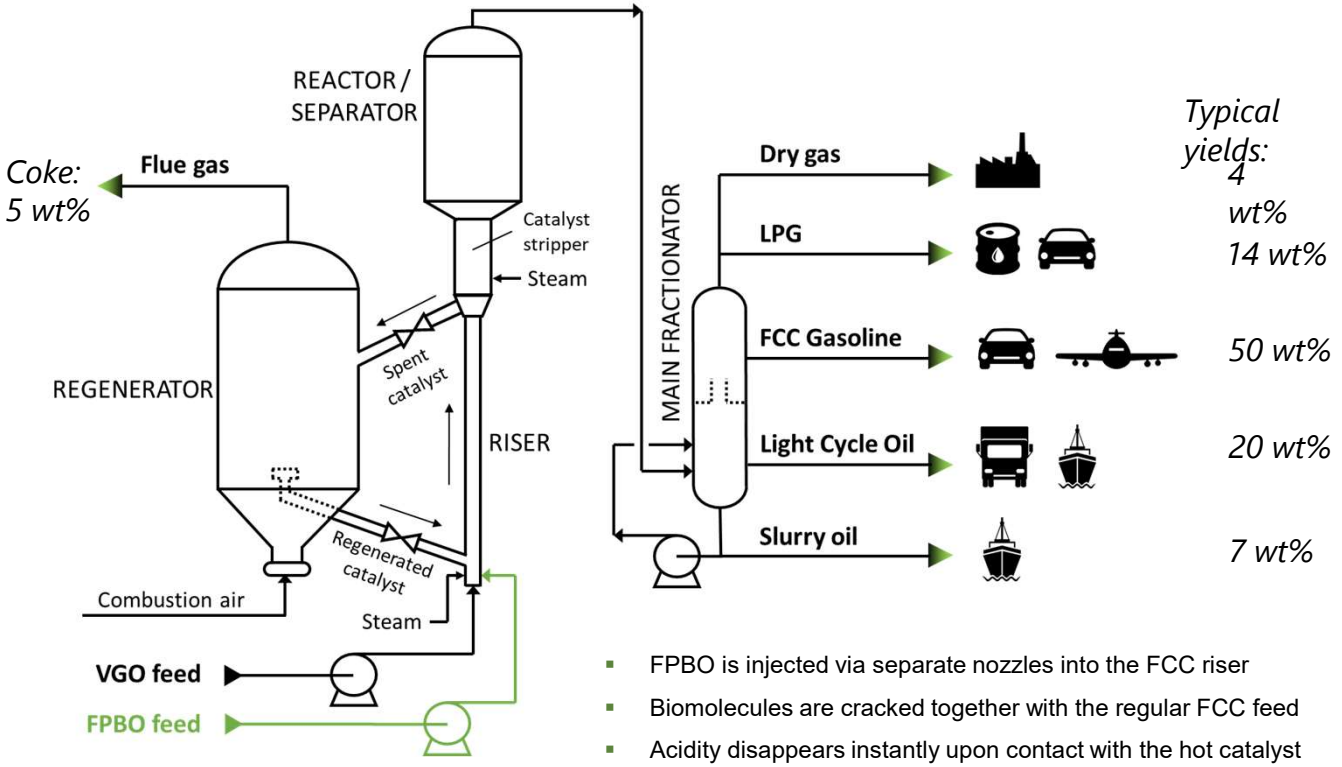
Co-FCC of FPBO: how does it work?



- FPBO is injected via separate nozzles into the FCC riser
- Biomolecules are cracked together with the regular FCC feed
- Acidity disappears instantly upon contact with the hot catalyst
- Green carbon is distributed across the different products

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Fast pyrolysis developments: co-processing

- Preem is the first mover worldwide for co-refining raw FPBO
- EU-RED2 implementation generates a lot of interest from refiners for co-processing of FPBO, being a low-capex and cost-effective solution for meeting the mandate.
- RED2 delegated act on co-processing will prescribe the methodology for green carbon attribution to multiple products.
  - BTL recently published a position paper assessing suitability of the various co-processing methodologies
  - Highlight: C14 analysis not suitable, bookkeeping method needed
  - In-dept discussions with EU policy makers on the topic are ongoing

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SUMMARY AND PERSPECTIVES

- Fast pyrolysis is proven at commercial scale, worldwide capacity is expanding.
- Current FPBO application is as renewable heating oil (replacing e.g. natural gas).
- Co-processing crude Fast Pyrolysis Bio-Oil in FCC units is a low-capex option to comply with RED2.
- More applications of pyrolysis oil under development. Pyrolysis as starting point of bio liquids refinery.

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THANK YOU

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technology for a sustainable future

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