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Market Update on Fast Pyrolysis

European Bioenergy Future Brussels – November 23, 2022





Market Update on Fast Pyrolysis

1. BTG Bioliquids short introduction

2. Commercial production

3. FPBO applications

4. Summary



Company & Technology 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 biofuel which means that it does not compete with the food chain.
- We support our partners in **connecting** the biomass world and the Fast Pyrolysis Bio Oil (FPBO) off-take world.





Our company history & milestones





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



2008

BTG Bioliquids is established by BTG



2015

Start up of Empyro in the Netherlands



2016

Cooperation agreement with TechnipEnergies

> Starting BTG Bioliquids **Webshop**



2020

Start up of **GFN** plant in Finland



2021

Start up of **Pyrocell** plant in Sweden



ABLC Conference 2022

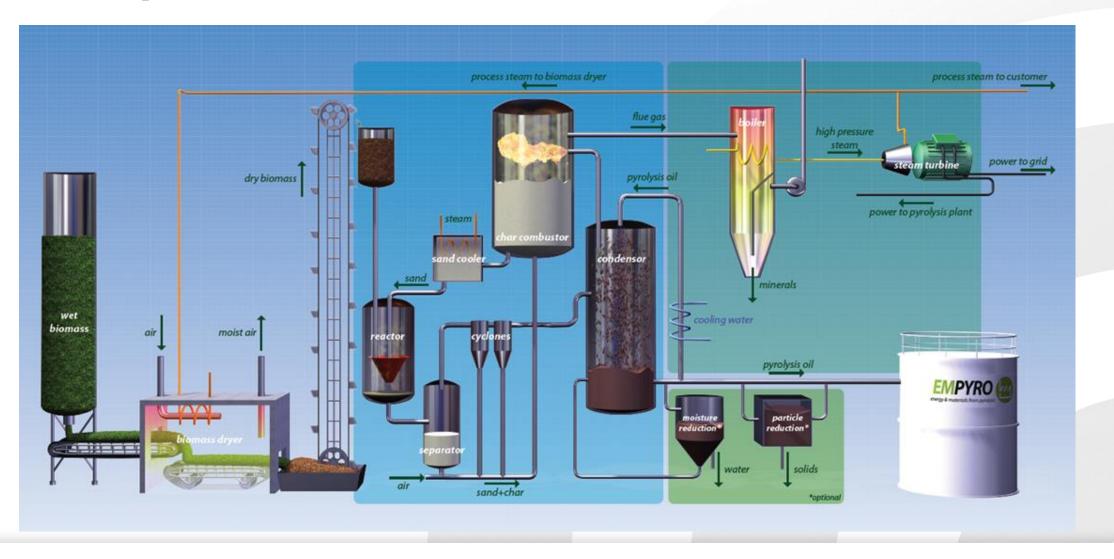
Company & Technology introduction

- Fast pyrolysis is **thermochemical decomposition** of biomass residues through rapid heating (450-600 °C) in absence of oxygen.
- We support customers with different types of biomass residues that can be converted into homogeneous energy carrier Fast Pyrolysis Bio Oil (FPBO) to valorise their residue streams.





Our process from biomass to FPBO





The FPBO supply chain

Biomass conversion

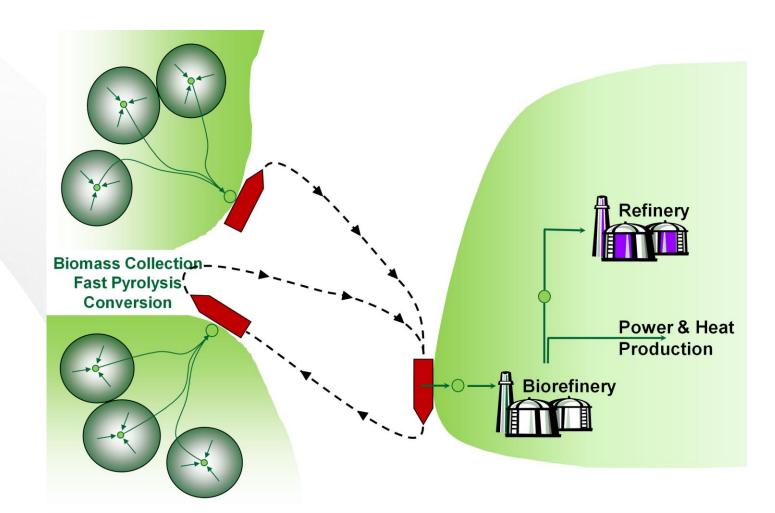
Local processing of biomass residueReturning minerals to the soil

FPBO transportation

- Biomass liquified
- 10x denser than solid biomass

FPBO (co-)processing

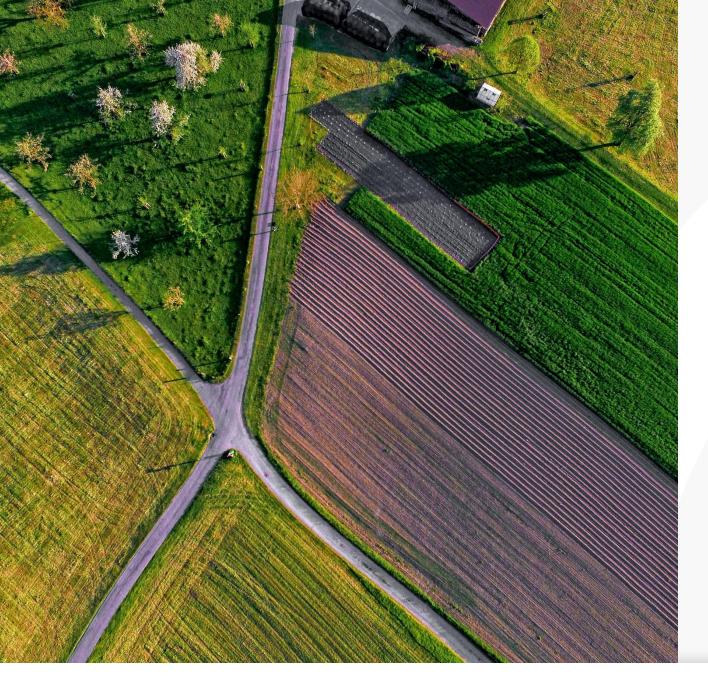
- Centralized location
- Make use of existing infrastructure



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Fast pyrolysis bio oil key markets

- Sustainable transport fuels comply with e.g. RED II and production of RINS
- O Biobased chemicals renewable materials
- Heat application e.g. district heating or peak shaving
- FPBO can replace crude oil in all these sectors
- Our strategy is on the further development of the biorefinery concept





FPBO heat application

At FrieslandCampina in the Netherlands:

- Sustainable heat is used for producing dairy products
- Switch from gas to FPBO provides 90% GHG reduction
- Boiler runs without problems since 2015
- In Finland FPBO is:
- Part of carbon neutral energy strategy of customers Savon Voima Joensuu heating plant and Fortum



Bio based chemicals from FPBO

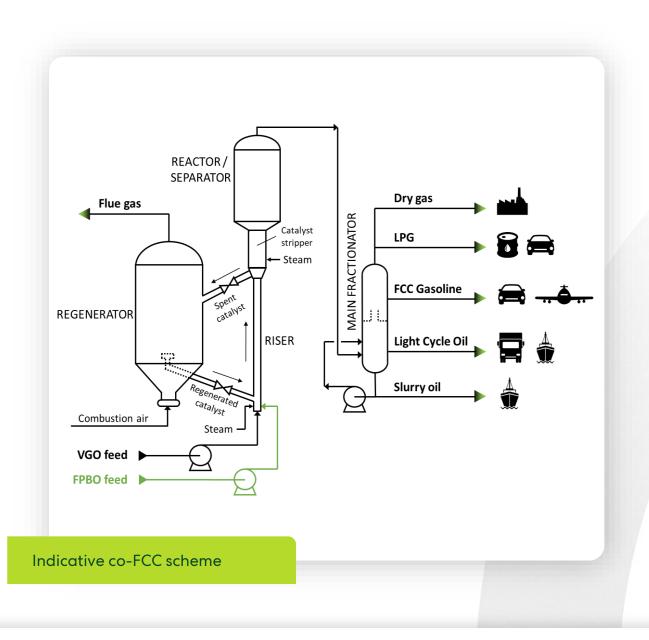
Based on **fractionation** of FPBO; key products are **pyrolytic lignin** and **pyrolytic sugars**

At the **BTG R&D Centre** in the Netherlands we have made e.g.:

- Wood preservation material/modified wood
- Insolation foam
- Glue, resins
- Moulding compounds

Further development and **commercial up-scaling** will be done in cooperation with partner companies.





Sustainable transport fuels

Co-FCC of FPBO how does it work?

• FPBO fed by separate injection line & nozzles

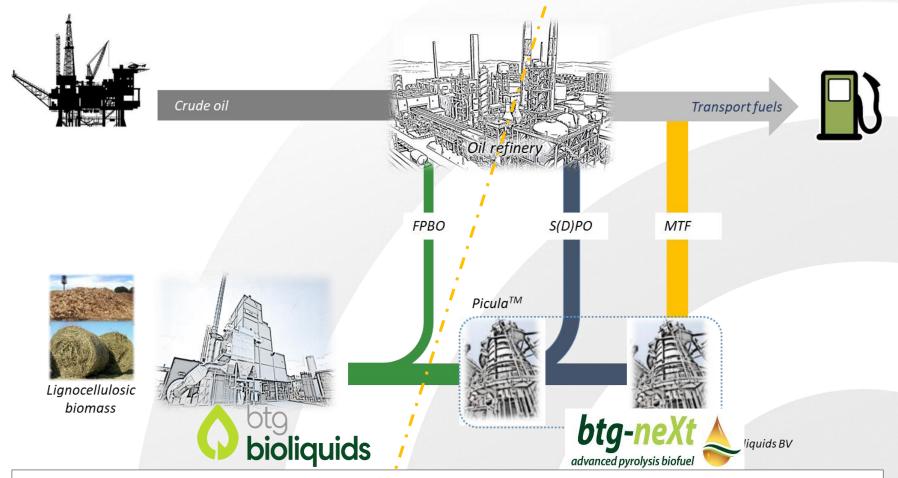
- Biomolecules cracked together with regular feed
- Acidity disappears upon contact with hot catalyst
- Green content distributed across the products
- Commercial FCC operability proven for 5 % FPBO
- Pilot scale operability proven for 10 % FPBO



BTG neXt options to produce a drop-in fuel

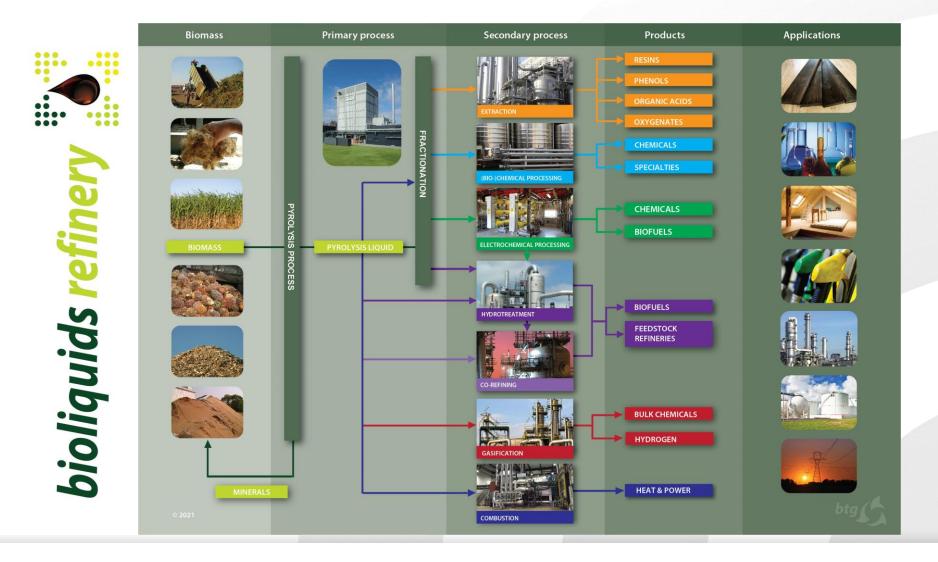
1. Co-feed of **FPBO** with VGO in existing FCC unit

- Demonstrated on fullscale by Preem with cofeeding rate between 1 and 3 % (2022). Max cofeed around 5-10 wt%
- 2. Co-feed of **SPO** with VGO in existing FCC unit
- Higher co-feed ratio's possible (20-30 wt%)
- 3. Stand-alone upgrading of FPBO to drop-in **HPO** (or MTF)
- HPO is fully miscible with fossil fuels



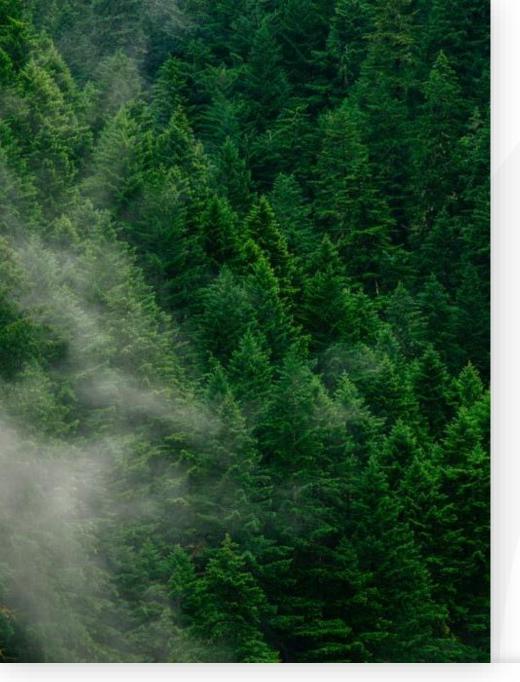
FPBO = Fast Pyrolysis Bio-Oil S(D)PO = Stabilized (Deoxygenated) Pyrolysis Oil HPO (or MTF) = Hydroprocessed Pyrolysis Oil

Bio-liquids refinery



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Summary & Conclusions

 Fast Pyrolysis Bio-Oil production at 3 commercial production plants with BTG Bioliquids technology in Europe, USA to follow soon

ALDERFUELS

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BTG Bioliquids Fast Pyrolysis Technology Chosen by Alder Fuels as Part of

Pioneering Southeast Facility

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Alder Fuels & BTG Bioliquids partnership

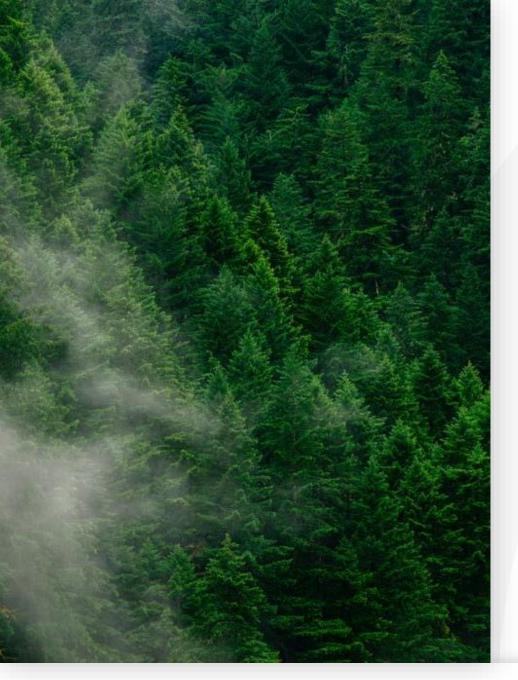
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October 27, 2022 - Alder Fuels selected BTG Bioliquids Fast Pyrolysis Technology in producing Sustainable Aviation Fuels.

First step into the North American market!

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• Advanced biofuels from FPBO co-processing has high potential

Low CAPEX, Short time-to-market, Fast GHG emissions reduction

• Feasibility of FPBO co-processing in FCC is proven up to 5 wt-%

- > Demonstrated at commercial scale, favourable gasoline yield
- > Exact yields depend on unit, feedstock and process conditions

• Other refinery pathways of FPBO possible

> Hydrotreating, Hydrocracking, Gasification (Fischer-Tropsch)

FPBO bio-based chemical applications at various stages of maturity

> Wood preservation, paint, resins, insolation foam, ...





BTG Bioliquids

we replace fossil fuels

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