

Market Update on Fast Pyrolysis

European Bioenergy Future
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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



1987

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

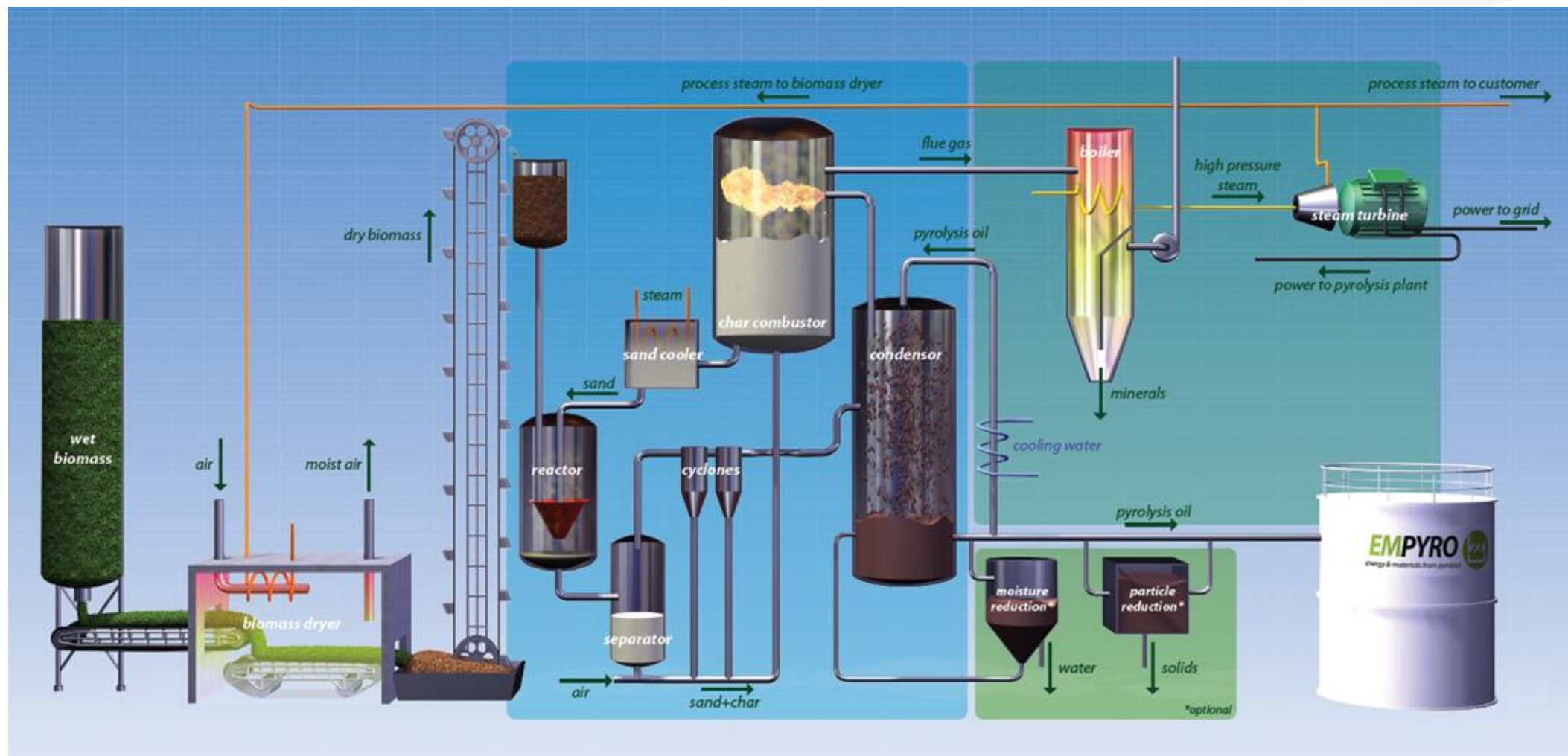
Start up of **Pyrocell** plant in Sweden

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

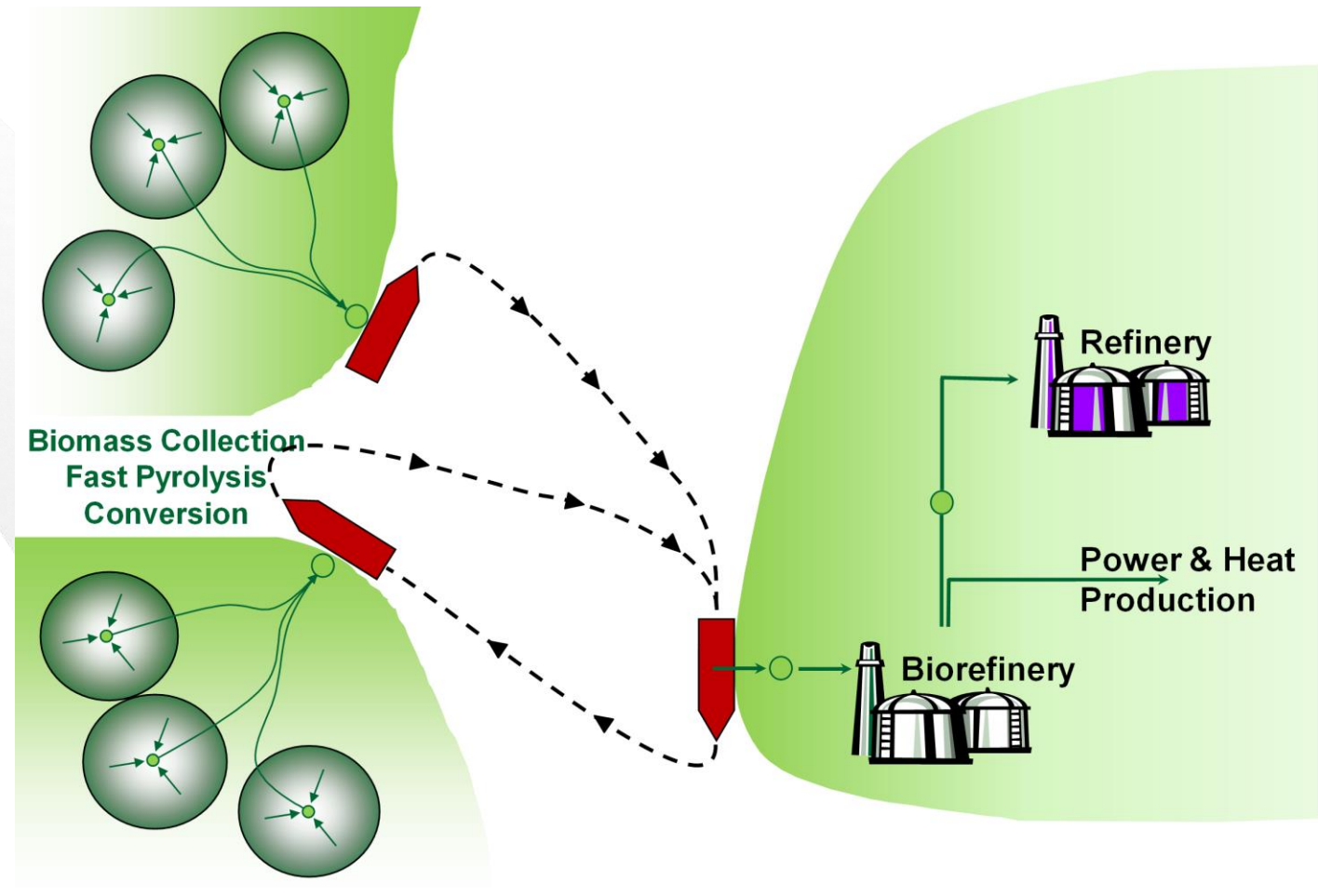
- Local processing of biomass residue
- Returning minerals to the soil

FPBO transportation

- Biomass liquified
- 10x denser than solid biomass

FPBO (co-)processing

- Centralized location
- Make use of existing infrastructure



Commercial production plants

Key figures:

- Biomass feedstock – wood residue
- Biomass input – 36.000 ton/year
- FPBO output – 24.000 ton/year



Empyro Twence, Hengelo
The Netherlands - 2015

March 2015
Start commercial
production !



GFN, Lieksa
Finland - 2020

December 2020
Start commercial
production !



Pyrocell Setra, Gävle
Sweden - 2021

September 2021
Start commercial
production !



Fast pyrolysis bio oil **key markets**

- Sustainable transport fuels - comply with e.g. RED II and production of RINS
- 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
- Insulation foam
- Glue, resins
- Moulding compounds

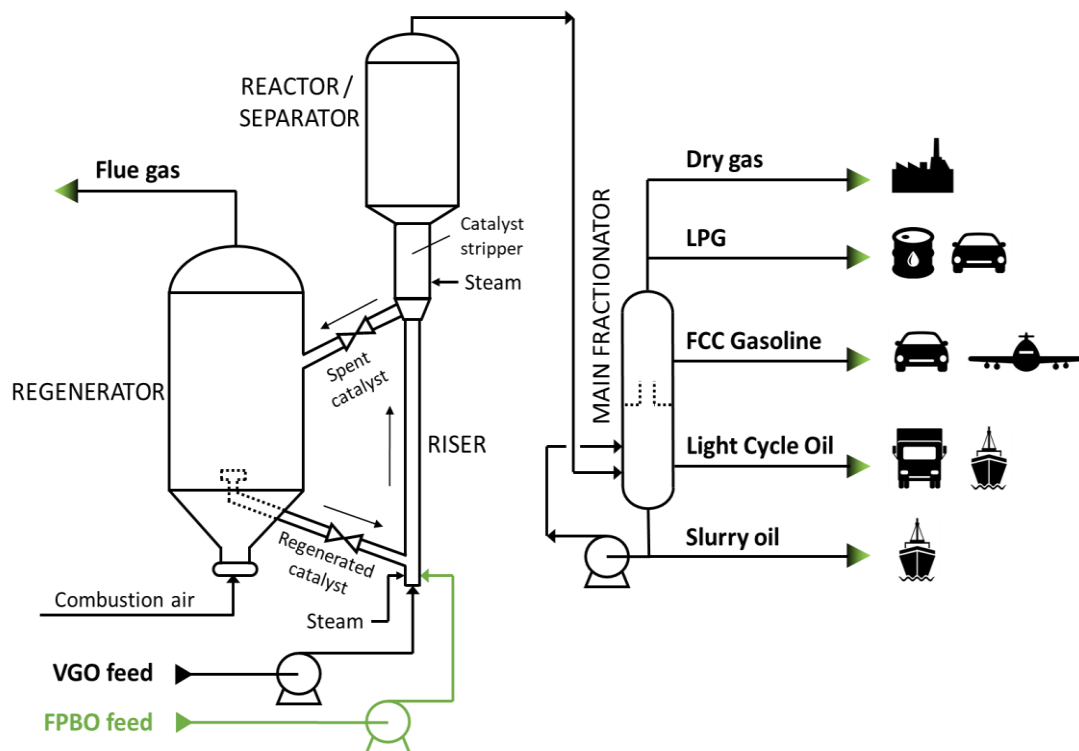
Further development and **commercial up-scaling** will be done in cooperation with partner companies.



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



Indicative co-FCC scheme

BTG neXt options to produce a drop-in fuel

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

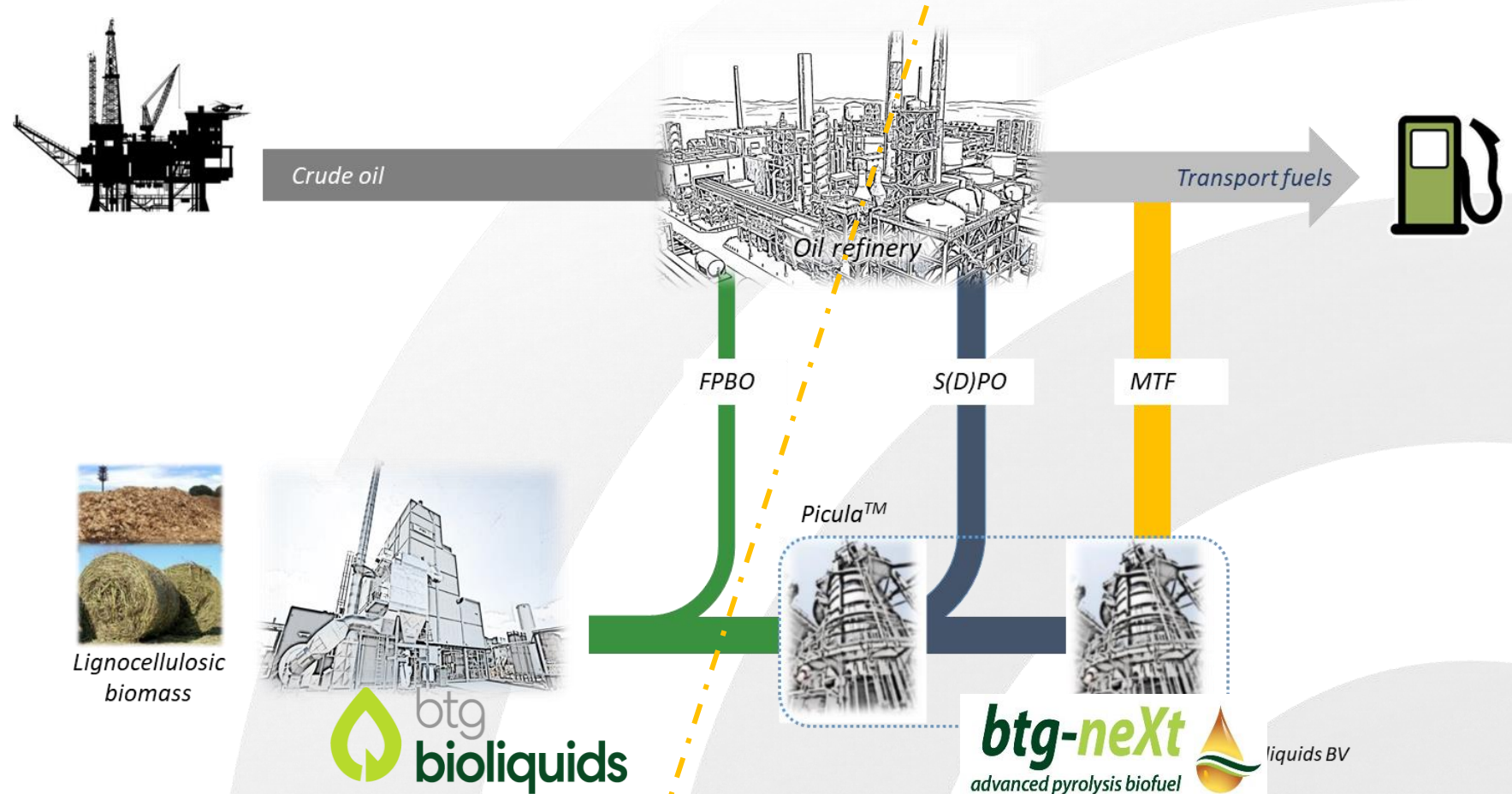
🔥 Demonstrated on full-scale by Preem with co-feeding rate between 1 and 3 % (2022). Max co-feed around 5-10 wt%

2. Co-feed of **SPO** with VGO in existing FCC unit

🔥 Higher co-feed ratio's possible (20-30 wt%)

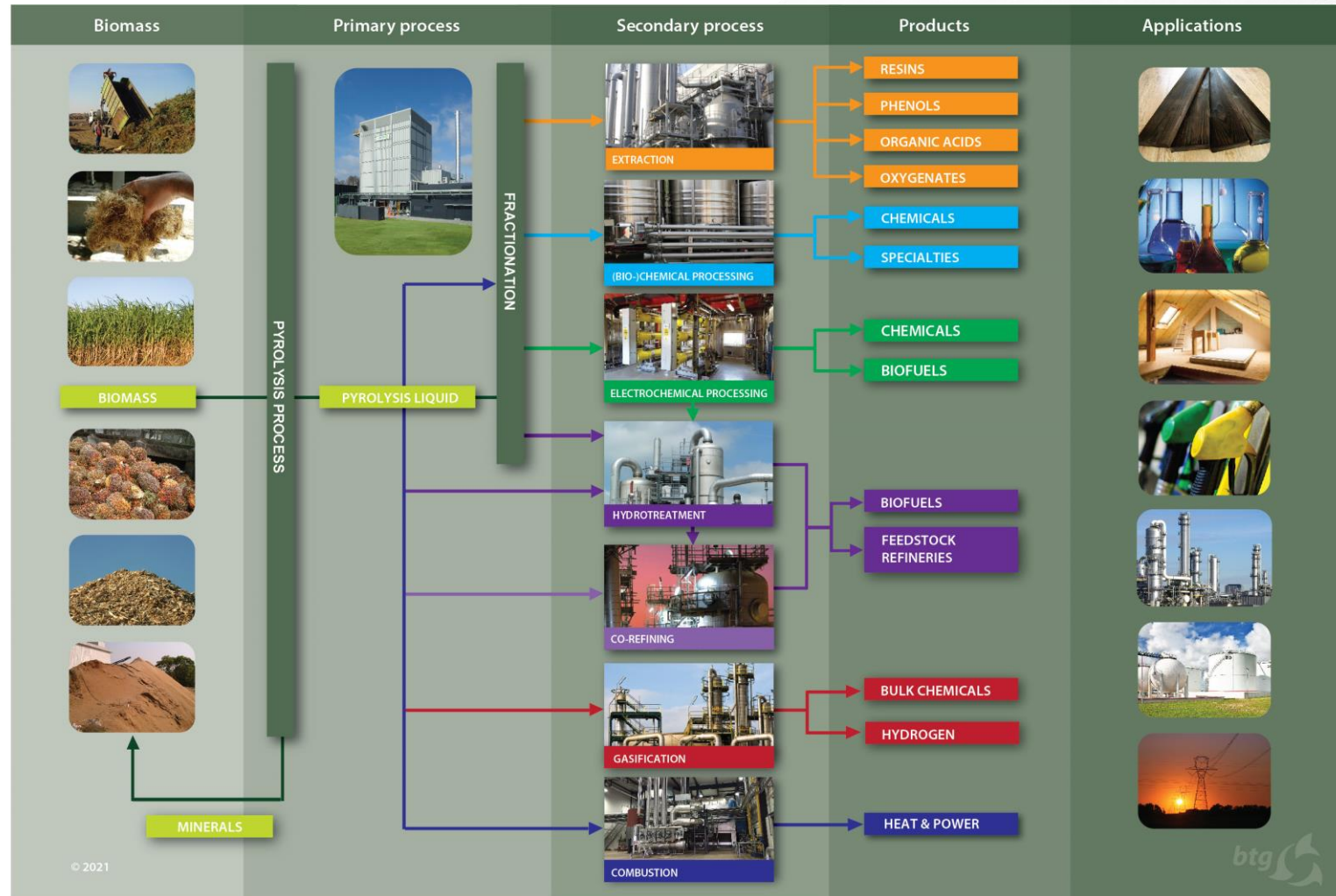
3. Stand-alone upgrading of FPBO to drop-in **HPO** (or MTF)

🔥 HPO is fully miscible with fossil fuels



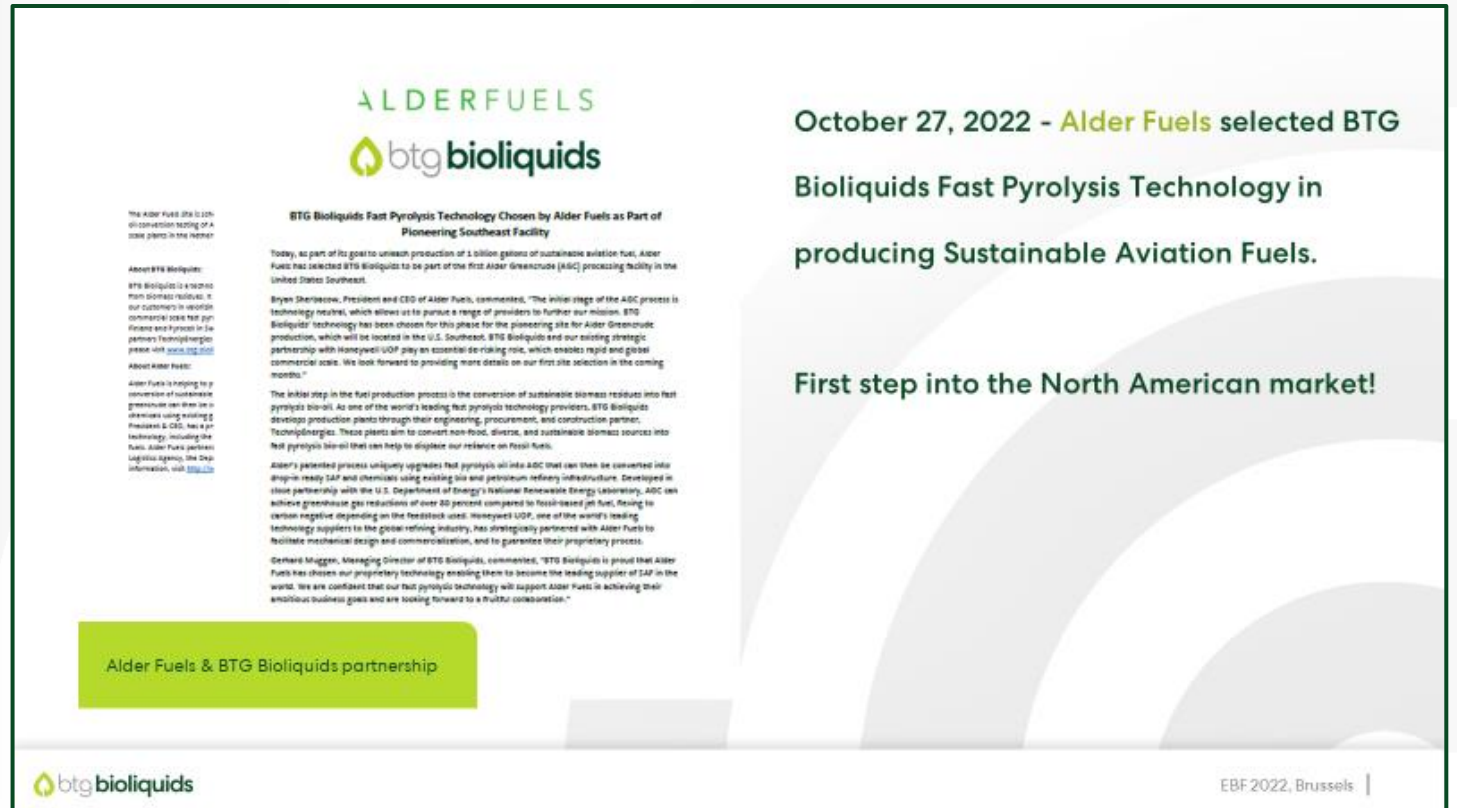
FPBO = Fast Pyrolysis Bio-Oil
S(D)PO = Stabilized (Deoxygenated) Pyrolysis Oil
HPO (or MTF) = Hydroprocessed Pyrolysis Oil

Bio-liquids refinery



Summary & Conclusions

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



The image shows a press release graphic for Alder Fuels and BTG Bioliquids. It features the logos of both companies at the top. The main headline reads: "October 27, 2022 - Alder Fuels selected BTG Bioliquids Fast Pyrolysis Technology in producing Sustainable Aviation Fuels." Below this, a sub-headline states: "First step into the North American market!". The body of the text describes the partnership, mentioning that Alder Fuels is a leading sustainable aviation fuel producer and that BTG Bioliquids is a leading fast pyrolysis technology provider. It also mentions that the technology will be used to produce sustainable aviation fuel at a commercial scale. The graphic includes a green button at the bottom that says "Alder Fuels & BTG Bioliquids partnership". The BTG Bioliquids logo is also present at the bottom left, and the text "EBF 2022, Brussels" is at the bottom right.

ALDERFUELS
btg bioliquids

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

First step into the North American market!

Alder Fuels & BTG Bioliquids partnership

btg bioliquids

EBF 2022, Brussels



Summary & Conclusions

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



BTG Bioliquids

we replace fossil fuels