COMSYN & FLEXCHX Webinar 19 January 2021, 10:00-12:30 CET

Compact Gasification and Synthesis for Flexible Production of Transport Fuels and Heat

Gasification Technologies for small-to-medium scale syngas plants

Esa Kurkela, VTT

COMSYN

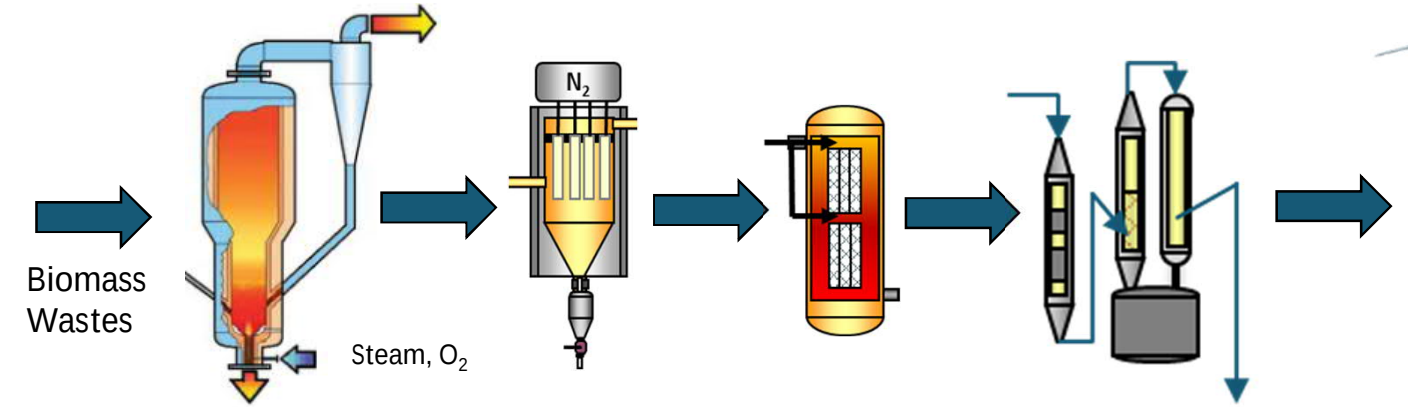
FLEXCHX

VTT ENERSTENA INERATEC DLR HELEN LIETUVOS ENERGETIKOS INSTITUTAS AB KAUNO ENERGIJA NESTE

ORLEN UniCRE GKN SINTER METALS wood. AFRY Grönmark JM Johnson Matthey

Key steps in gasification based synfuels process

Electrolysis can be integrated in several ways to boost syngas production and to increase carbon efficiency



Selection of the optimal gasifier depend on target scale and feedstock

- Pressurized O_2-blown CFB for > 150 MW input
- Dual Fluidized-Bed steam gasification for 50 – 150 MW
- Pressurized Staged Fixed-Bed gasifier for 10 – 50 MW (TRL 5)

Synthesis gas production at different scale

MATURITY

Ready for commercialisation
> 150 MW_{th}

PRESSURISED CFB OXYGEN-BLOWN GASIFICATION

LOW-PRESSURE DUAL FLUID-BED STEAM GASIFICATION

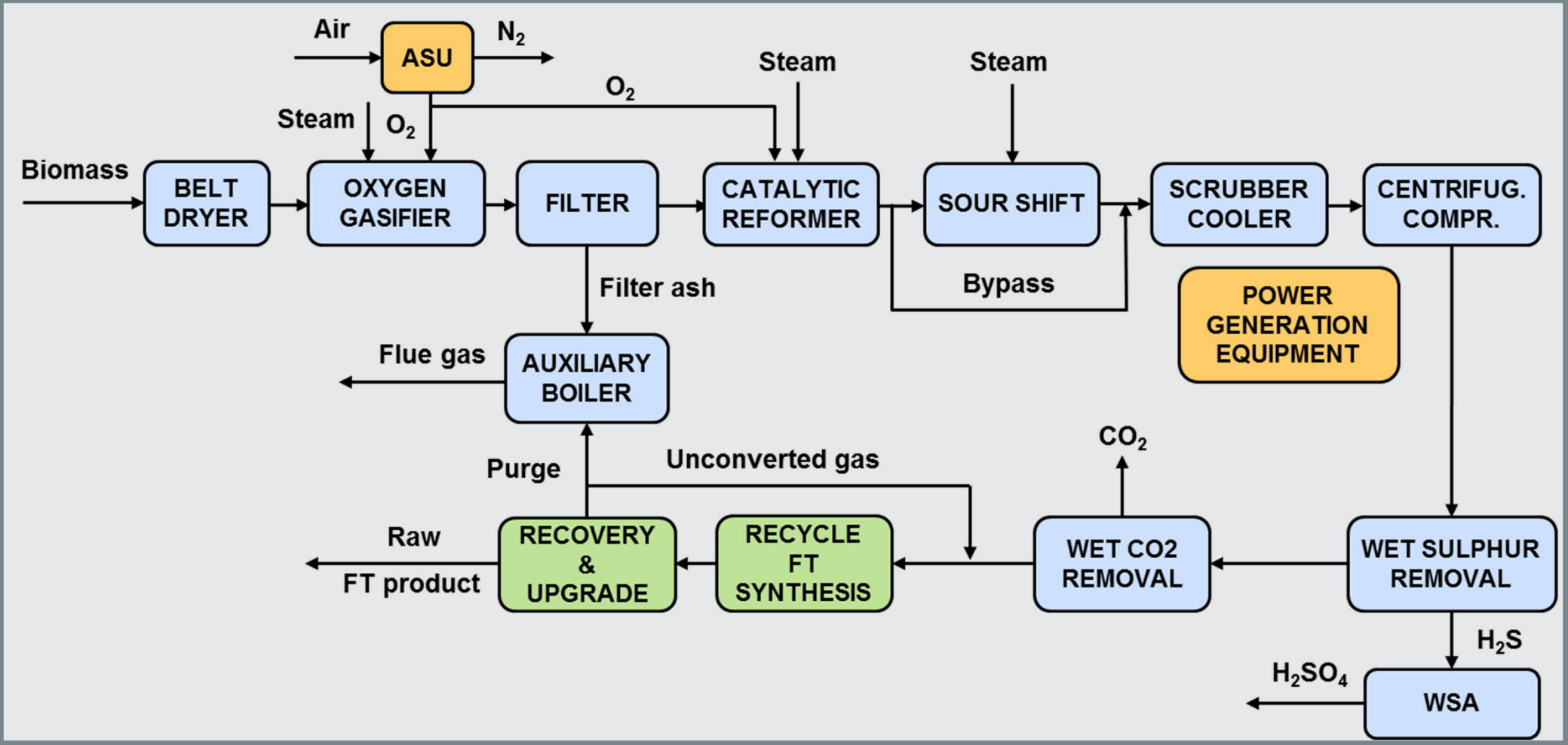
Developed to TRL 5-6
~ 50 – 150 MW_{th}
- National project BTL2030
- H2020-project COMSYN
- H2020-project REDIFUEL
- H2020-project BioSFera

PRESSURISED FIXED-BED OXYGEN-BLOWN GASIFICATION

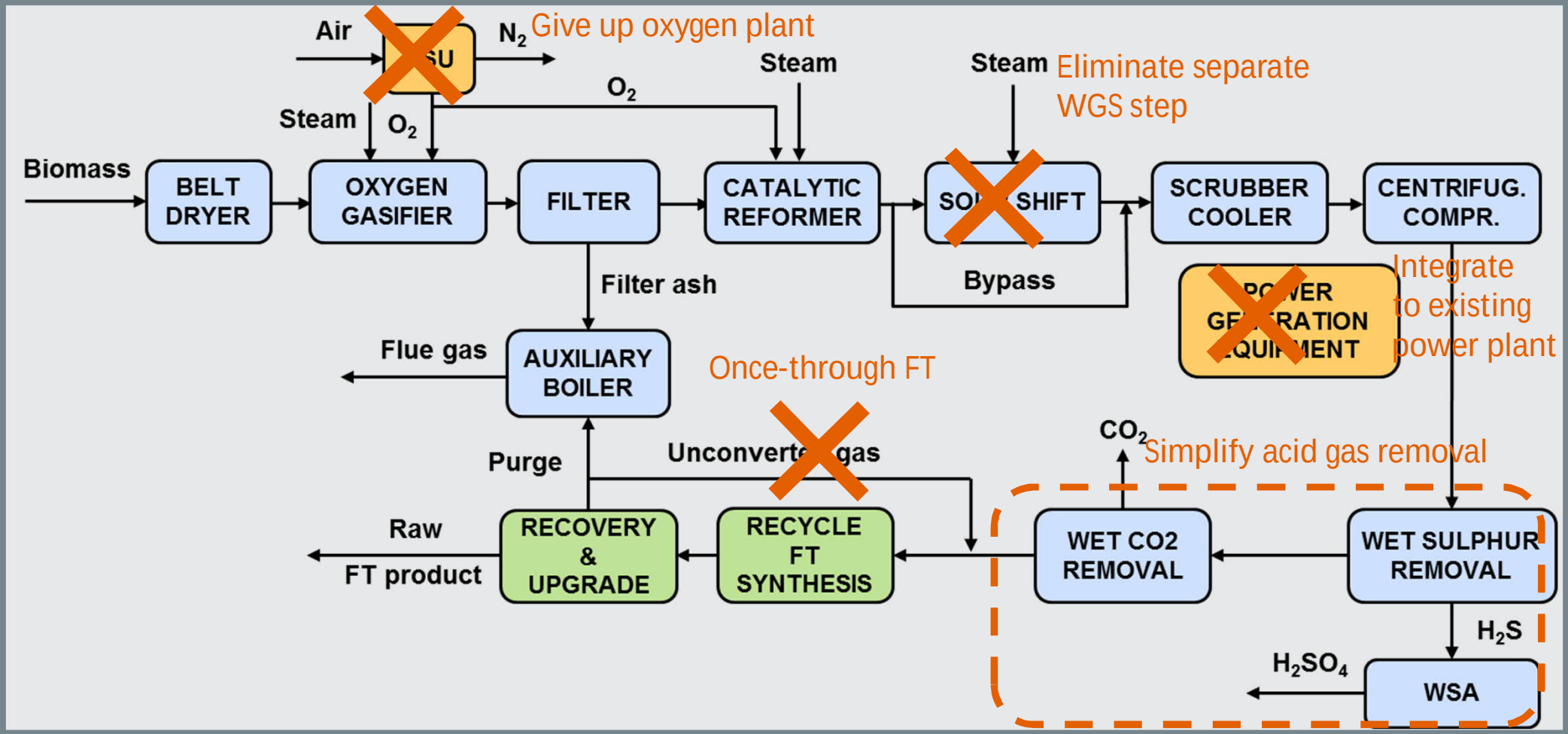
Developed to TRL5
< 50 MW_{th}
- H2020-project FLEXCHX

SCALE

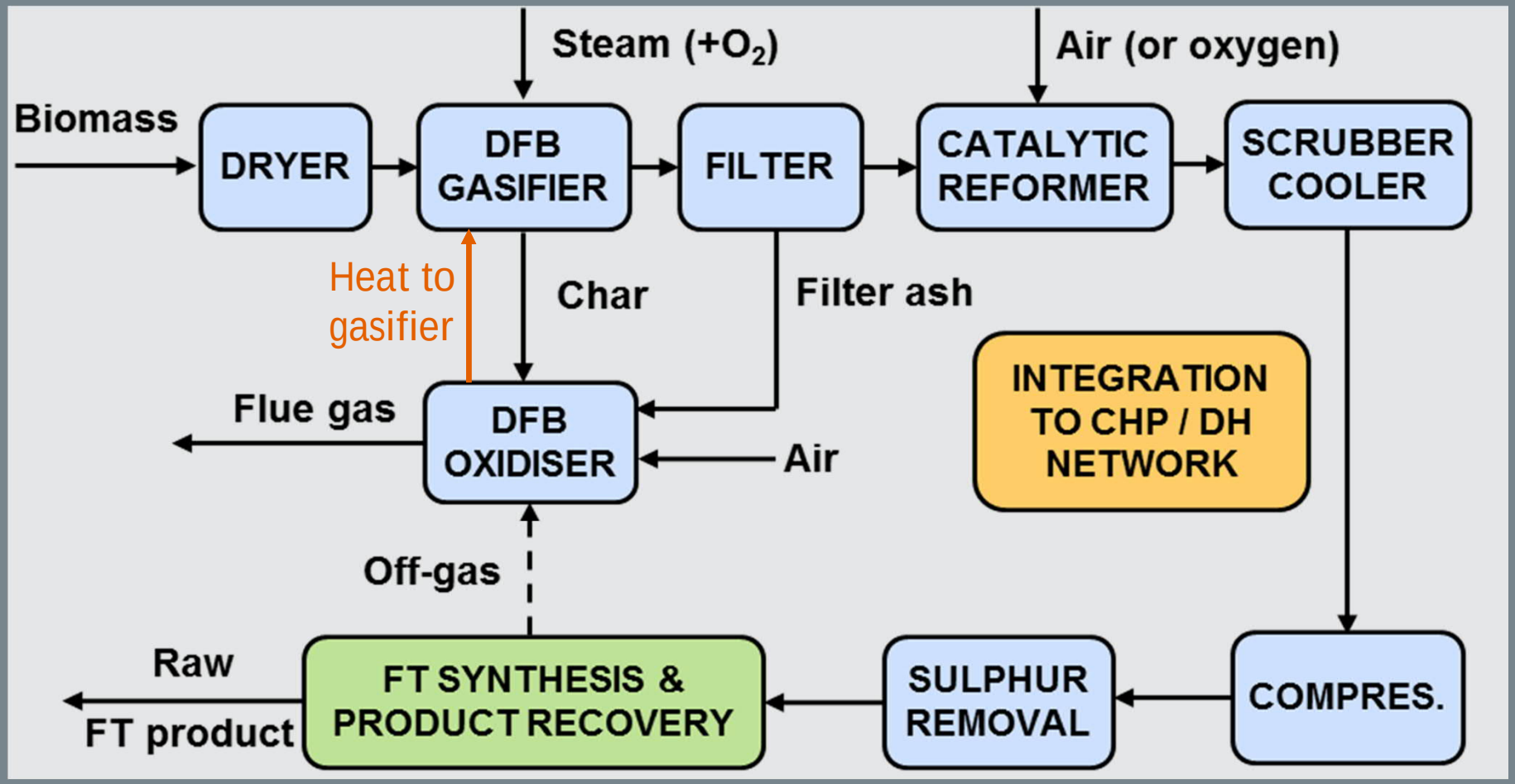
Large-scale BTL plant based on pressurized oxygen-blown fluidized-bed gasification



Simplified design for medium scale production of transport fuels – COMSYN approach

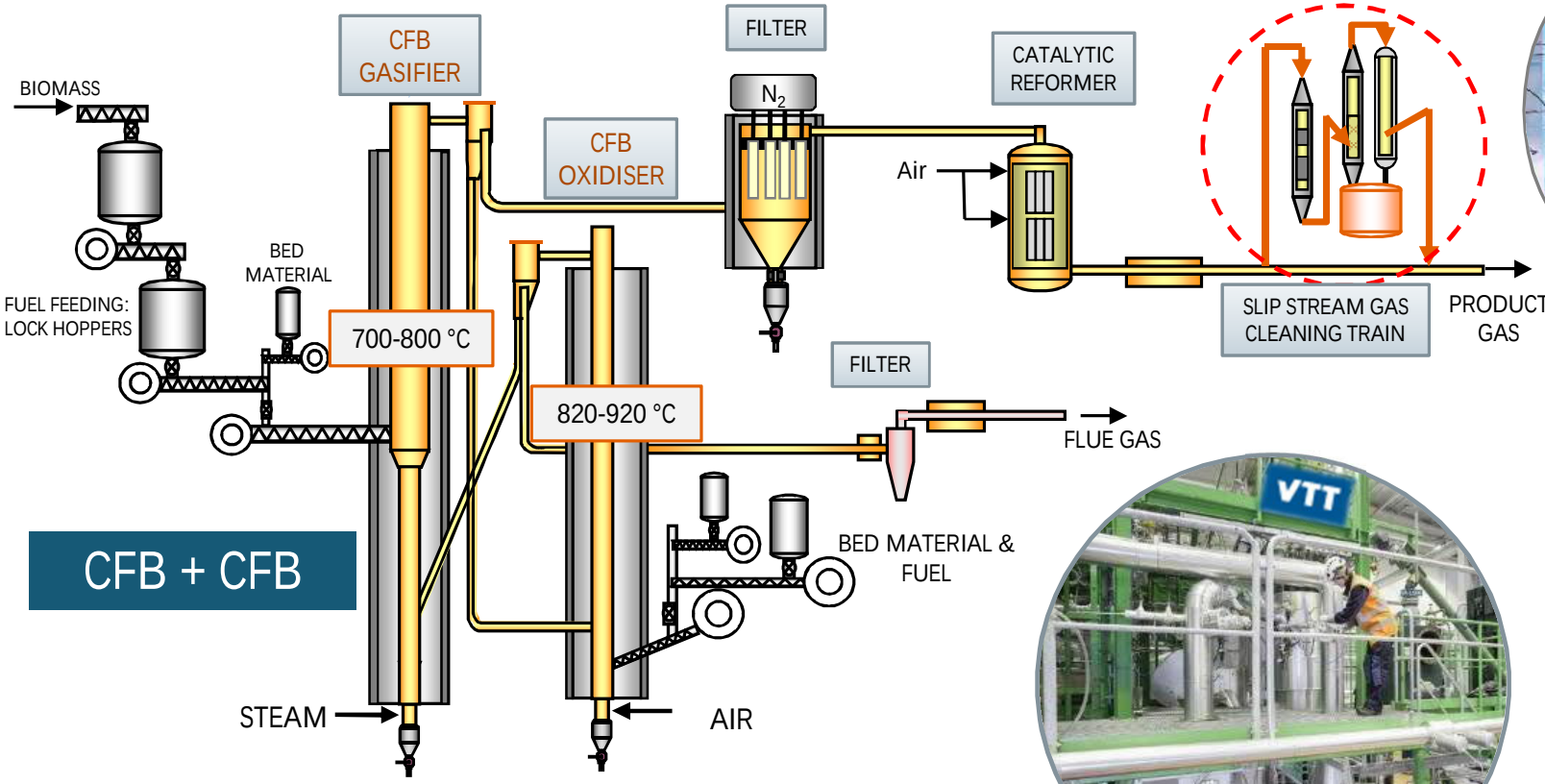


Medium-scale Low CapEx process for combined FT liquids and heat production



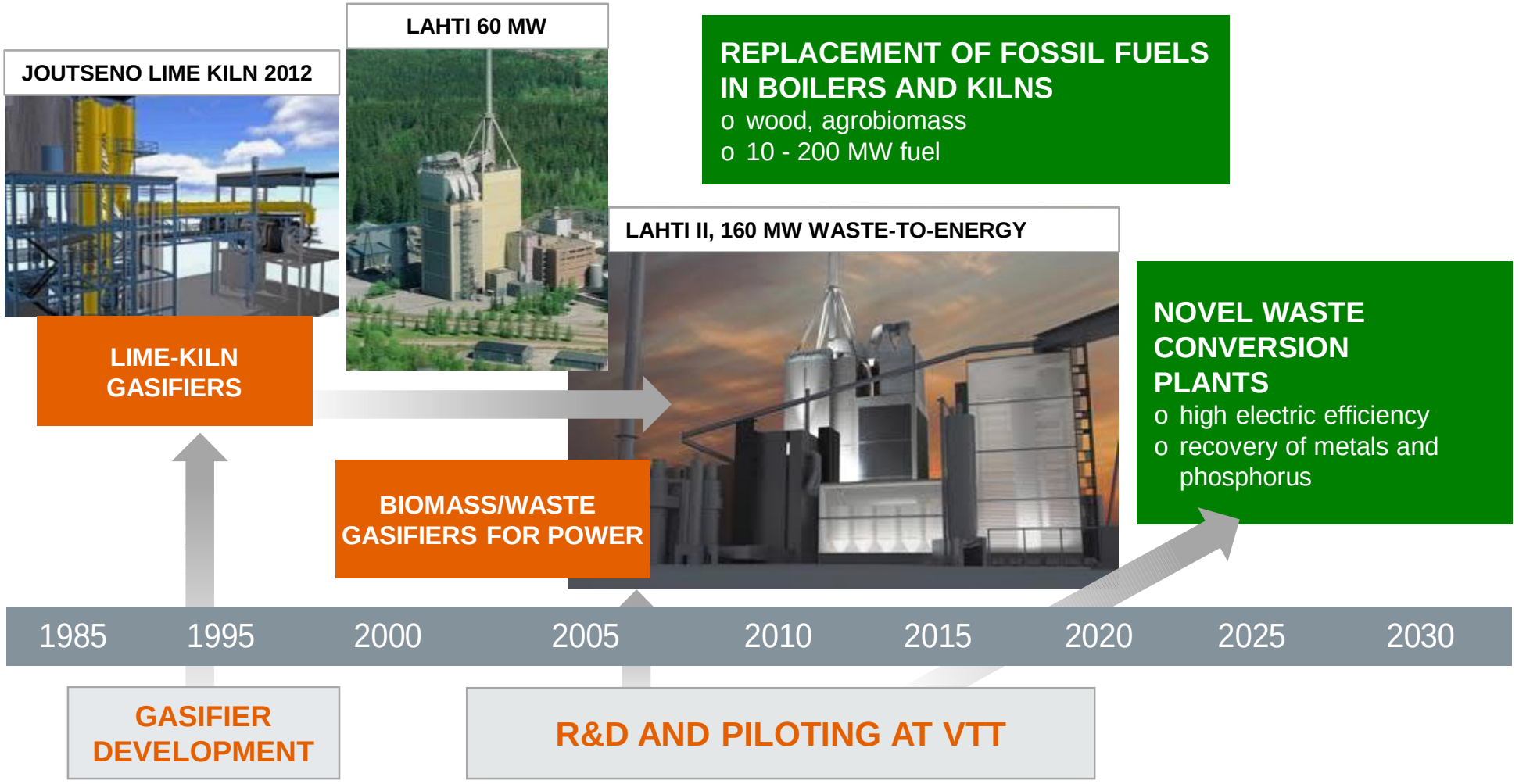
DFB pilot at Bioruukki

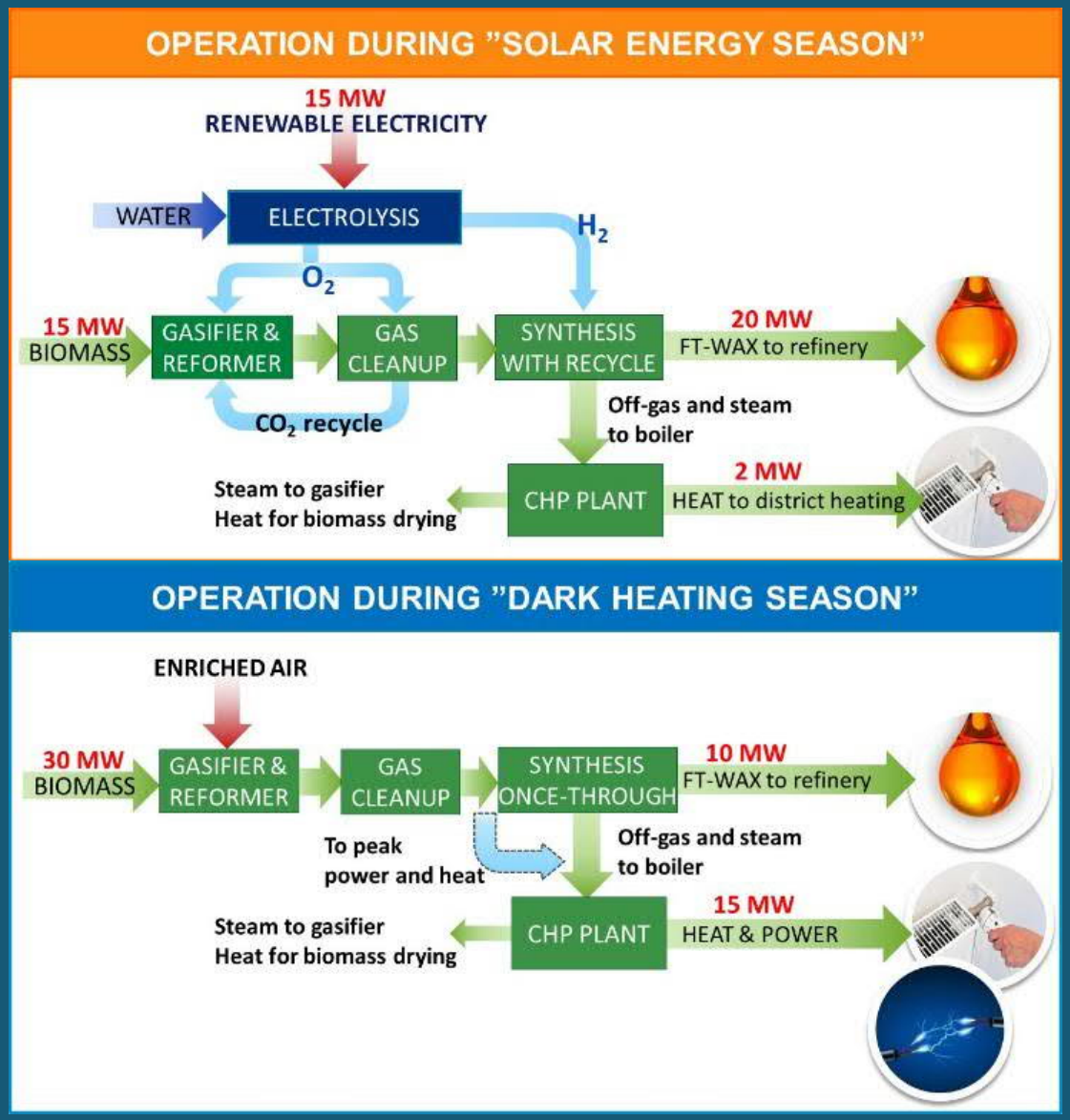
basic gasification concept of COMSYN project



VTT Technology Publication
https://www.vttresearch.com/sites/default/files/pdf/technology/2018/T347.pdf

Syngas concepts based on CFB reactors can be designed based on industrial experiences from fuel gas applications





Basic idea of FLEXCHX

- To realise a process for **optimal use of the seasonal solar energy supply and available biomass resources**
- Satisfy the seasonal demand for heat and power, and to produce low-GHG fuels for the transport sector
- This concept can be best realized in oxygen-blown gasification processes

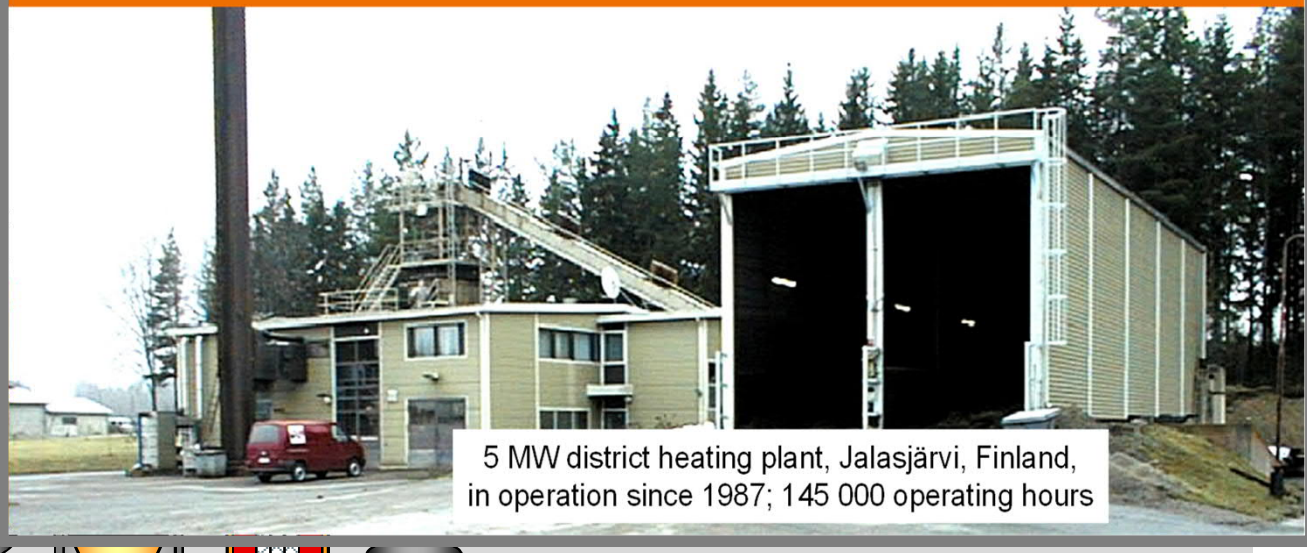
Pressurised Stag
Gasificati

Gasification proces
Industrial target: 5 - 5

UPDRAFT GASIFIER "BIONEER" for boilers & kilns

VTT

- tar containing gas
- high carbon conversion
- 10 commercial plants in Finland and Sweden
- Robust, reliable and fully automated plants



5 MW district heating plant, Jalasjärvi, Finland, in operation since 1987; 145 000 operating hours

Process validation at SXB pilot plant

Three test campaigns in February - June 2020

1.

- Test run SXB 20/07 with bark pellets and wood chips
- 4 Set Points, Total gasification time: 58 hours

2.

- Test run SXB 20/11 with wood, bark and sunflower husk pellets
- 7 Set Points, total gasification time: 70 hours

3.

- Test run SXB 20/24 with wood and sunflower husk pellets
- 7 Set Points, total gasification time: 85 hours

WOOD

BARK

WOOD CHIPS

SUNFLOWER HUSK

Validation tests for the complete gasification, gas cleaning and FT-synthesis process

- **Total gasification operation: 213 h**
- **Operation time with integrated gasification/FT: 174 h**
- **FT products produced during the test: roughly 173 kg**

Raw material and final product

FLEXCHX project has received funding from the European Union's Horizon 2020 research and innovation Programme under Grant Agreement No 763919.

Conclusions

- Three gasification processes have been developed in Finland for converting biomass residues to clean synthesis gas
  - Pressurized steam/oxygen-blown CFB gasifier for large plants > 150 MW (TRL 7)
  - Dual fluidized-bed steam gasifier for intermediate size, 50-150 MW (TRL 5)
  - Pressurized fixed-bed gasifier for smaller plants, < 50 MW (TRL 5)
- Catalytic reformer plays a key role in converting tars and hydrocarbon gases into syngas and in controlling the H_2-to-CO ratio of syngas
- Biomass gasification can be efficiently integrated to electrolysis:
  - Recycling of CO_2 maximizes the conversion of biomass carbon to CO
  - Additional H_2 can be readily used to convert CO to FT products
  - Electrolysis O_2 is used in the gasifier and in the reformer
  - The same process can be operated with biomass alone when power is expensive