



FLEXCHX

Flexible hybrid process for combined production of heat, power and renewable feedstock for refineries

Esa Kurkela

VTT Technical Research Centre of Finland Ltd



Joint Workshop of Task 39 and Task 44

Role of biofuels production / biorefineries in grid balancing

25.11.2020

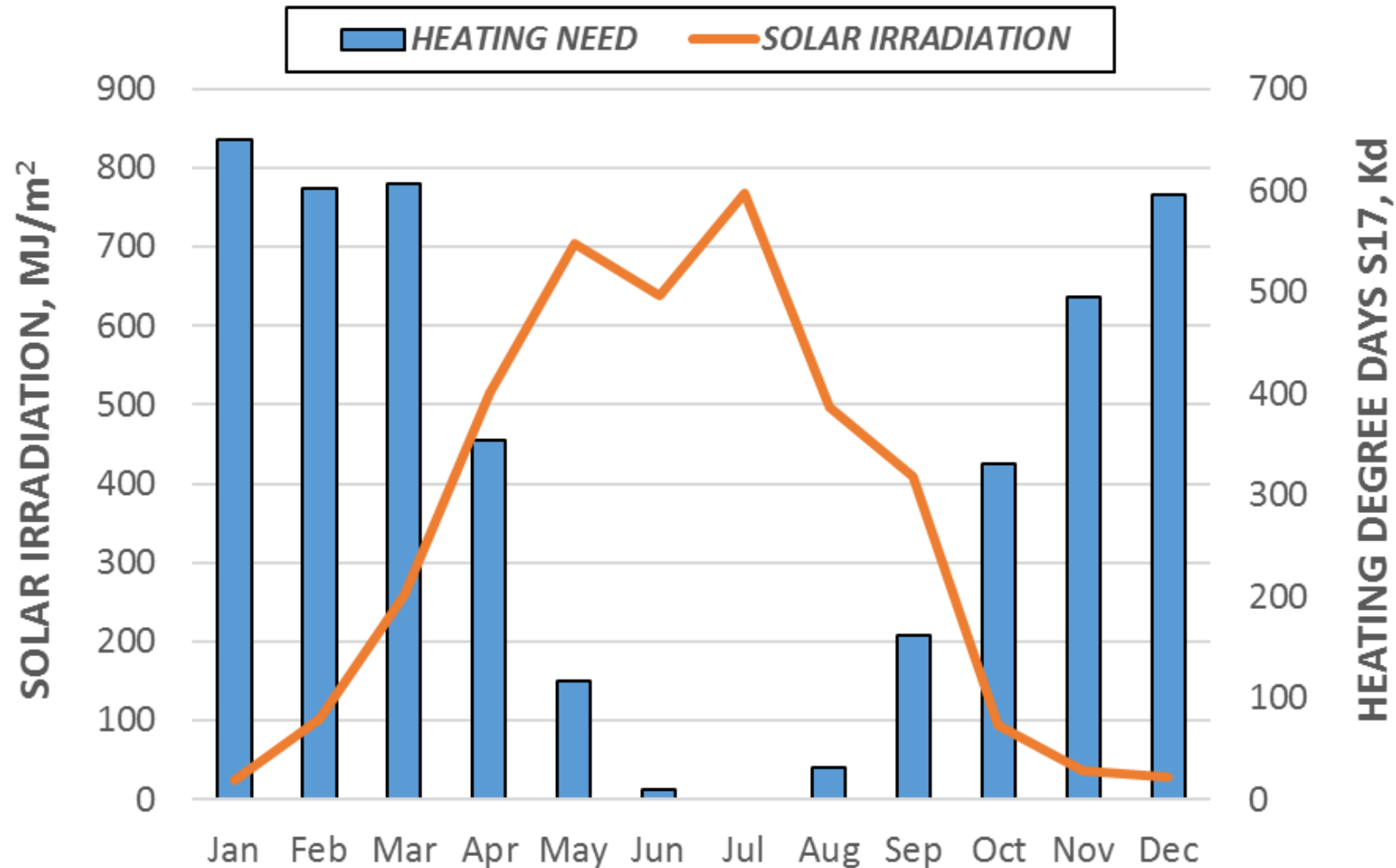
The VTT logo, consisting of the letters "VTT" in white on an orange square background.

FLEXCHX

Background: energy transition

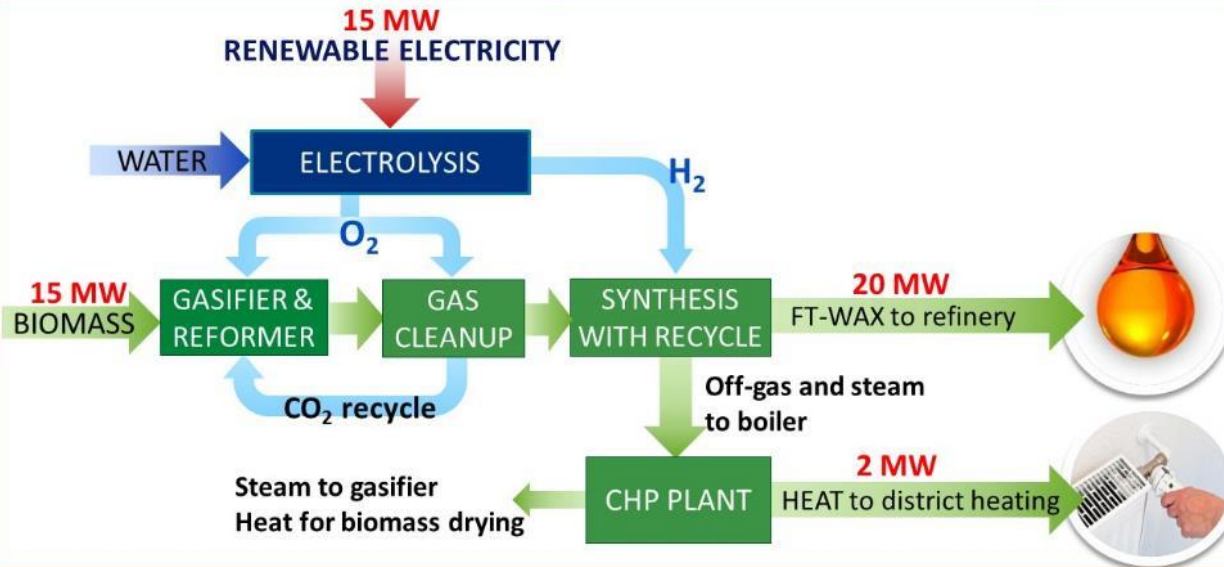
- The share of variable renewable energy (wind and solar) is strongly increasing and will become the main source of electricity production in Europe by 2050
- Thermal power plants are facing challenges in the changing energy system and should be operated flexibly – balancing power production and electricity storing needed
- These changes will be challenging for CHP systems, which have been the backbone of the district heating in many countries of North-Europe
- FLEXCHX will offer CHP and district heating companies and the bioenergy community new business possibilities in combining fuel and heat production

Seasonal mismatch between solar energy supply and heating demand in the Northern Europe

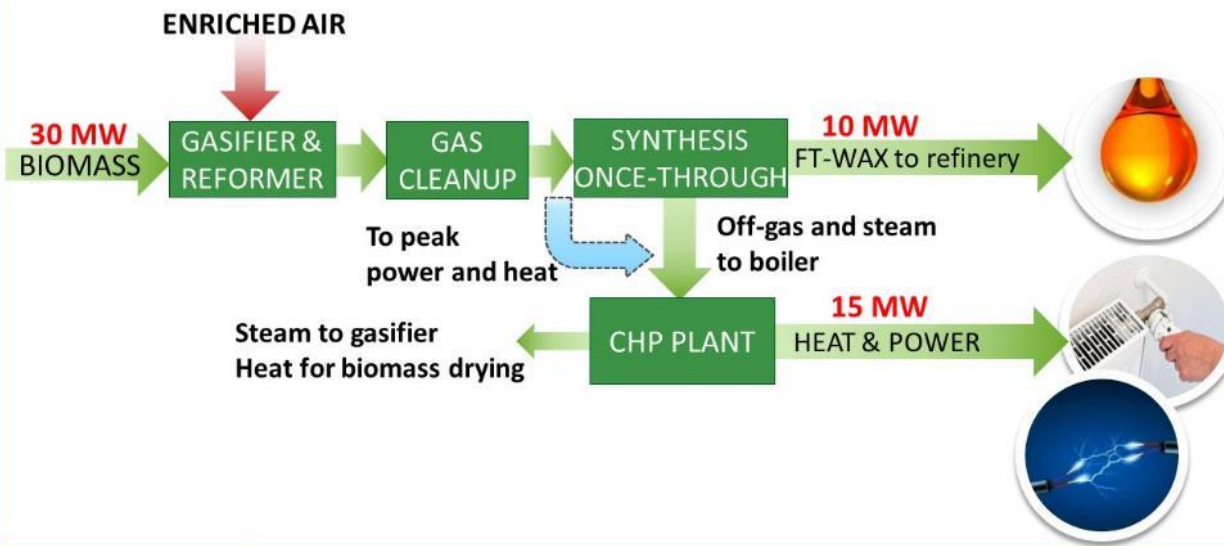


Data for a typical year in Southern Finland

OPERATION DURING "SOLAR ENERGY SEASON"



OPERATION DURING "DARK HEATING SEASON"

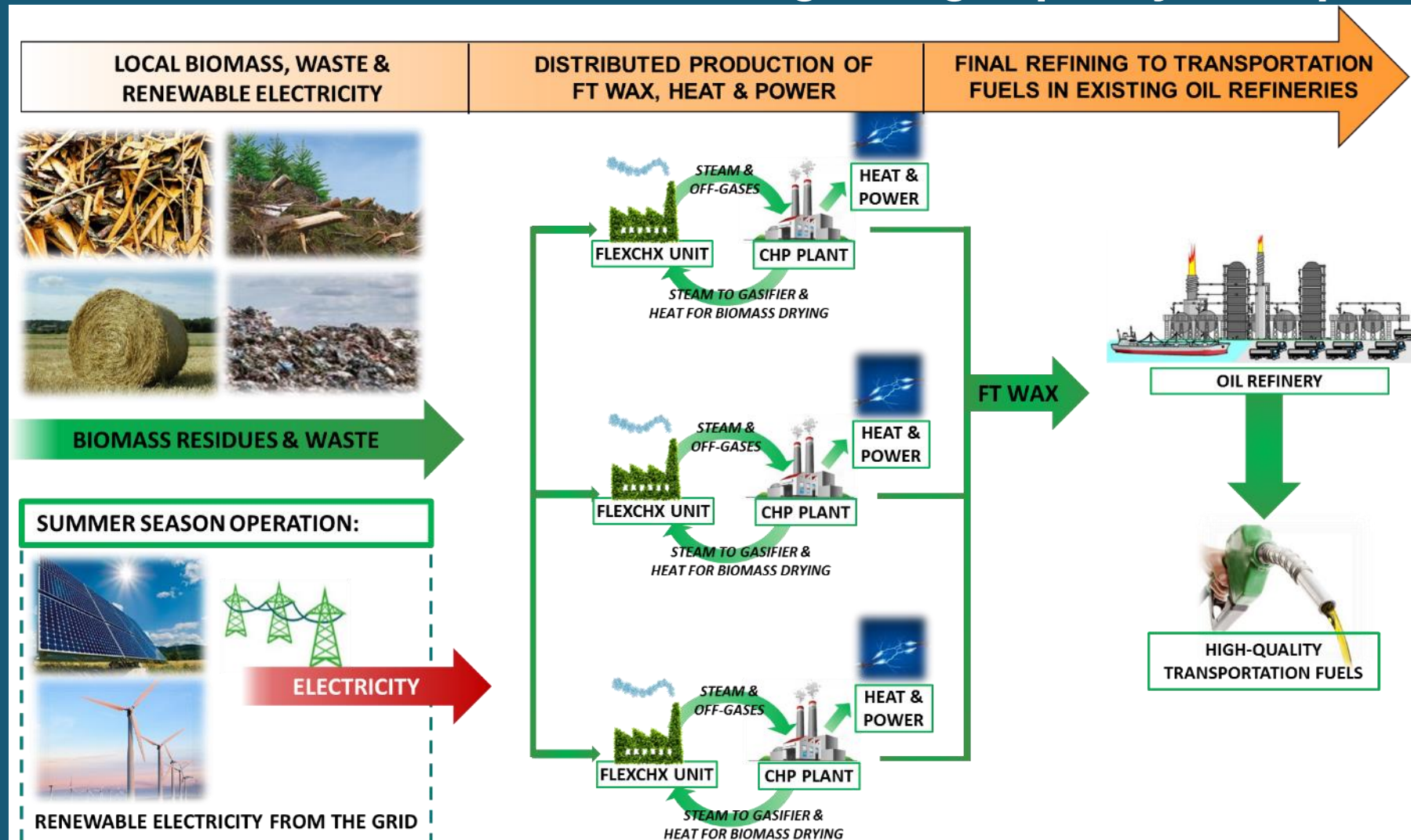


Basic idea of FLEXCHX

- 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.

FLEXCHX

The conceptual idea of distributed production of heat, power and Bio-FT products combined with centralized refining to high-quality transportation fuels

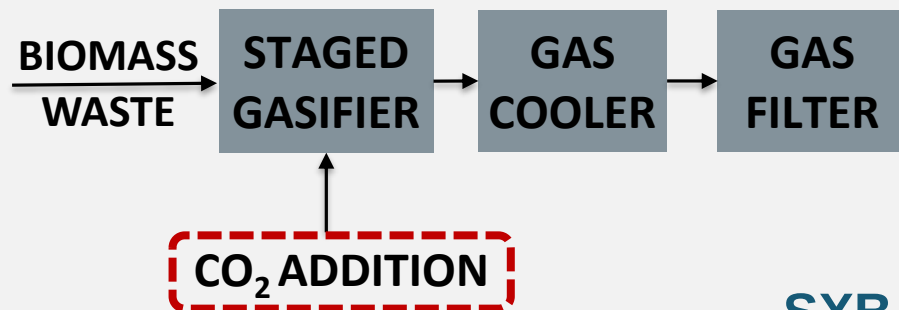


The production concept has been developed and tested at VTT's Piloting Centre Bioruukki in 2018-2020

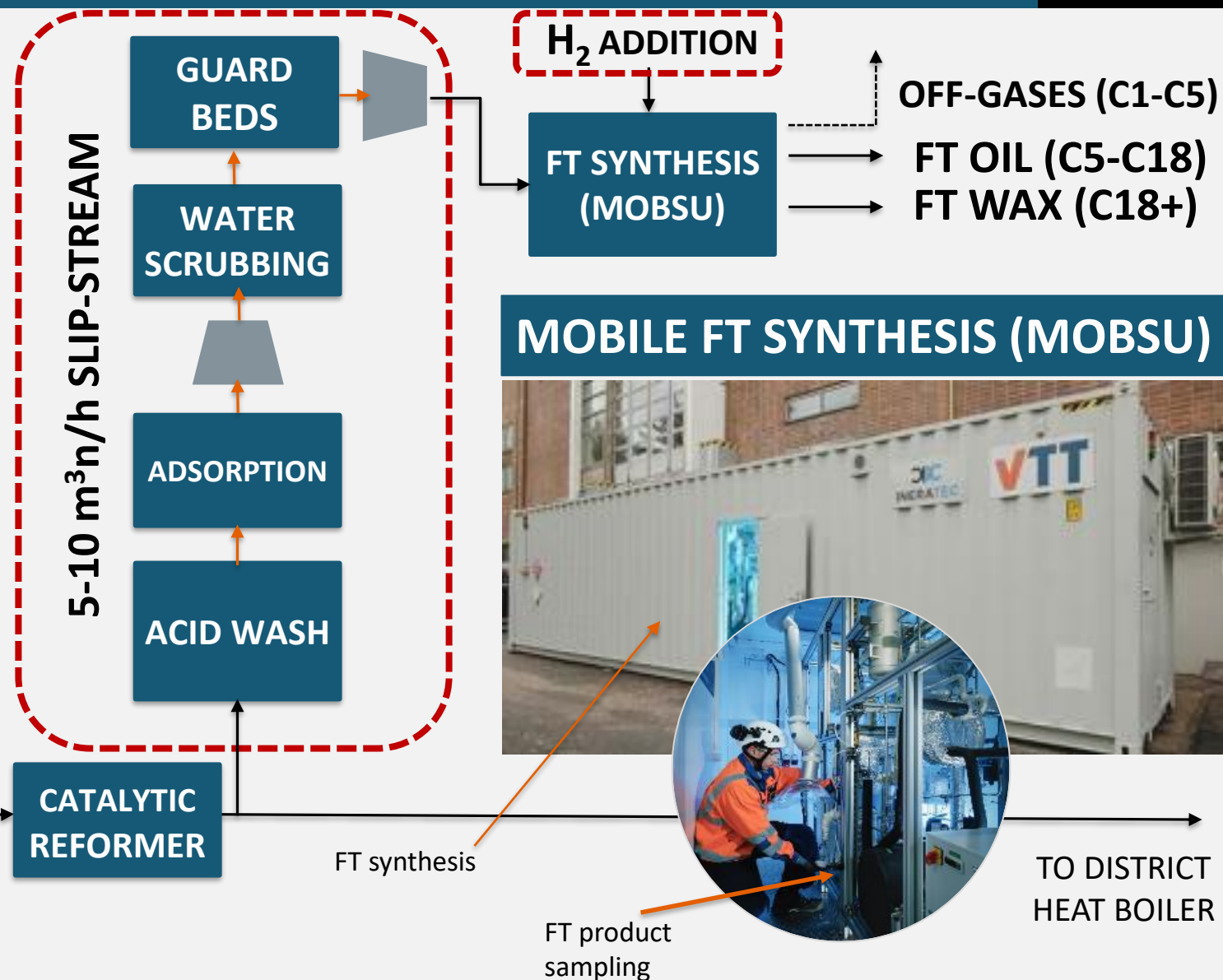
VTT

TRL3-4 → TLR5

1 MW SXB PILOT PLATFORM



SXB gasification pilot plant



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

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



Wood pellets



Forest residue



Bark pellets



Wood chips



Sunflower husk pellets



Raw material and final product

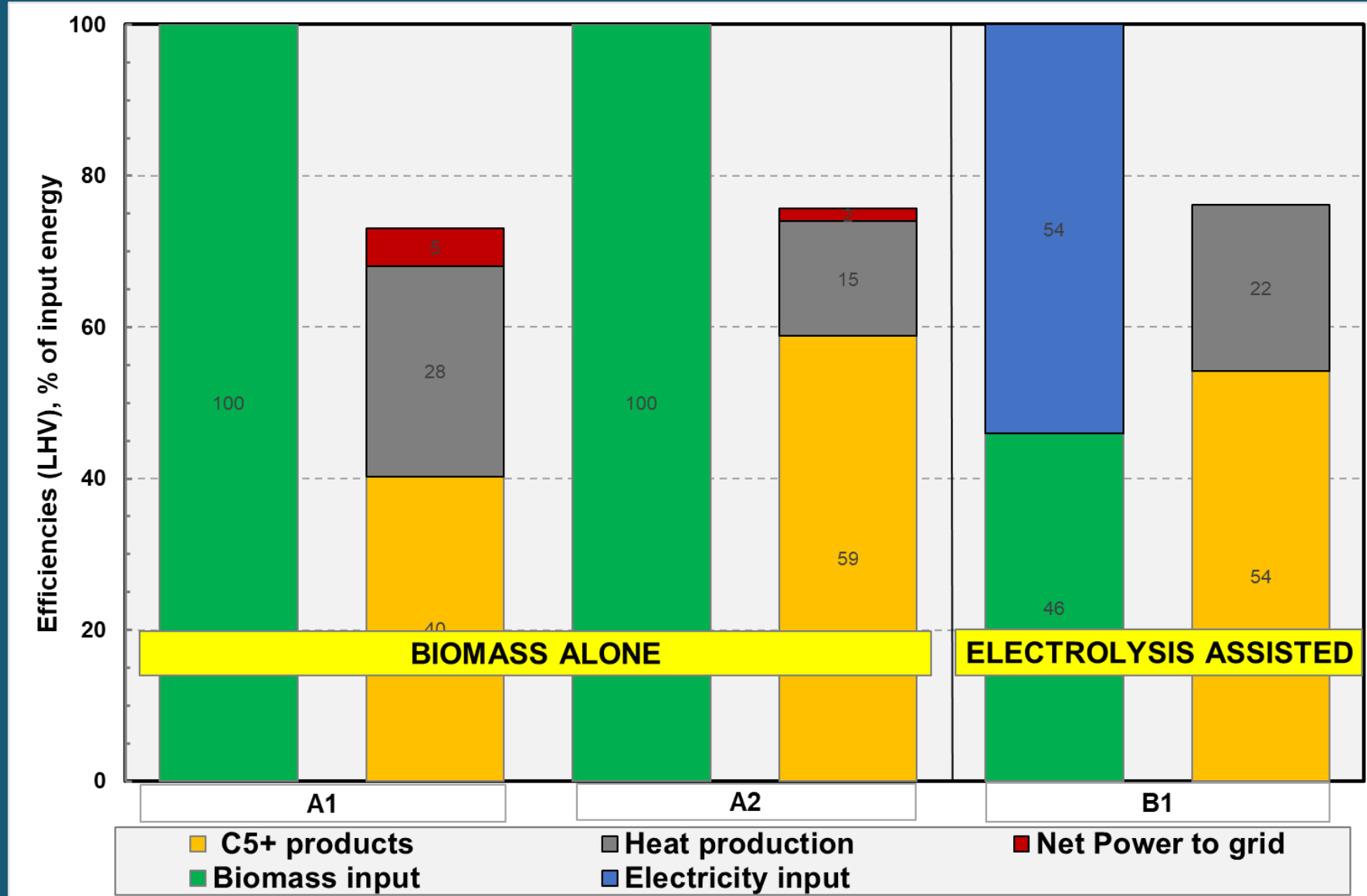
Preliminary concept development studies

Case	A1	A2	B
Input energy	Biomass alone	Biomass alone	Biomass + electricity
Gasifier operation	Enriched air + steam Target performance	99 % pure O ₂ + steam Target performance	99 % pure O ₂ + CO ₂ recycle Target performance
Gasifier outlet T, °C	830	830	830
Reformer outlet T, °C	850	850	850
CH ₄ conversion, %	80	80	80
FT operation	Once through	Tail gas recycle to reformer	Tail gas recycle to reformer
Per-pass CO conversion in FT, %	60	70	70
Ft selectivity to C ₅₊ products, %	91	91	91
Electrolysis efficiency to LHV of H ₂ , %	-	-	75

On-going detailed simulation and case studies will be completed and reported by April 2021

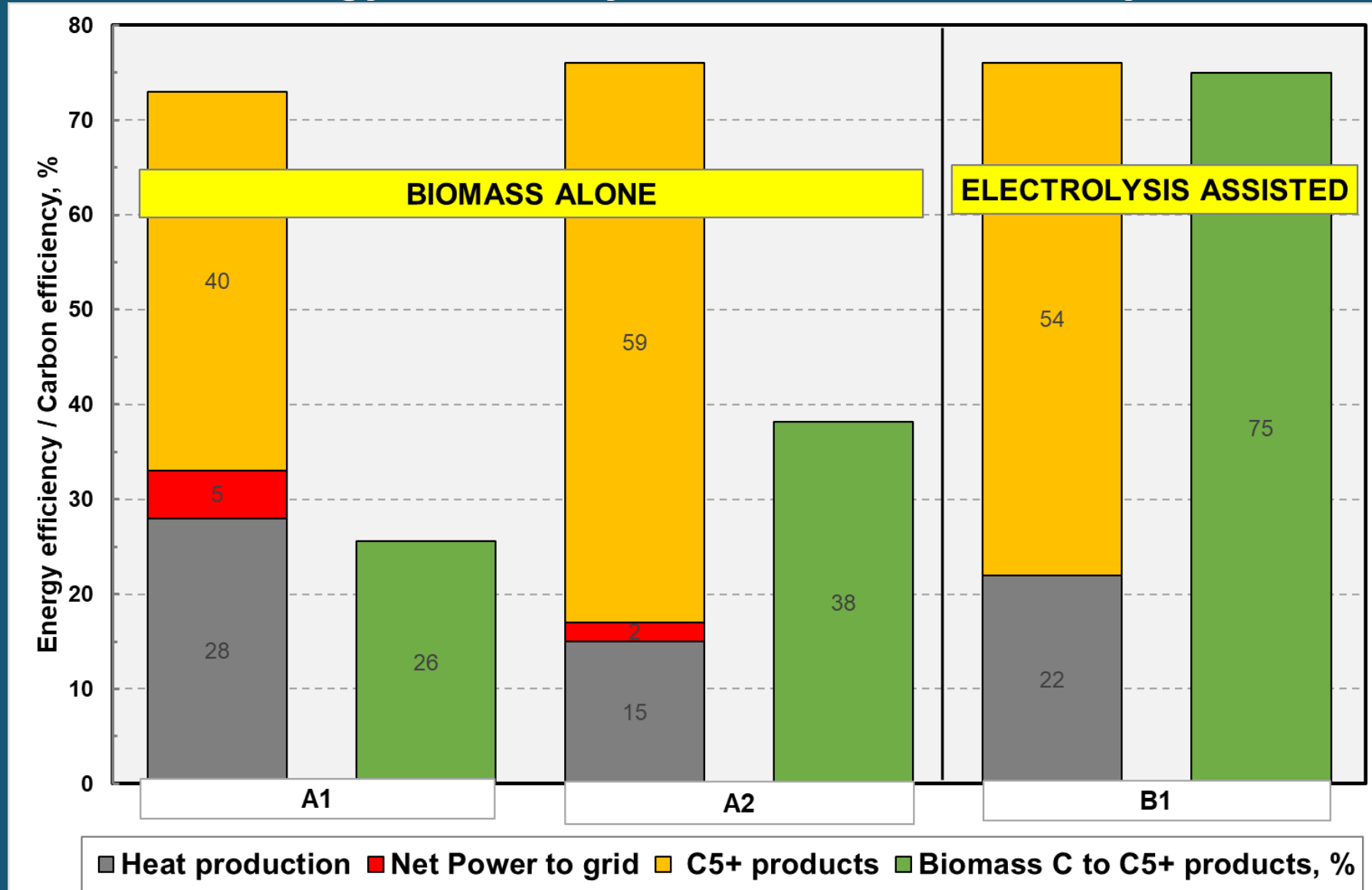
Results of preliminary process evaluation studies

Estimated overall energy balance



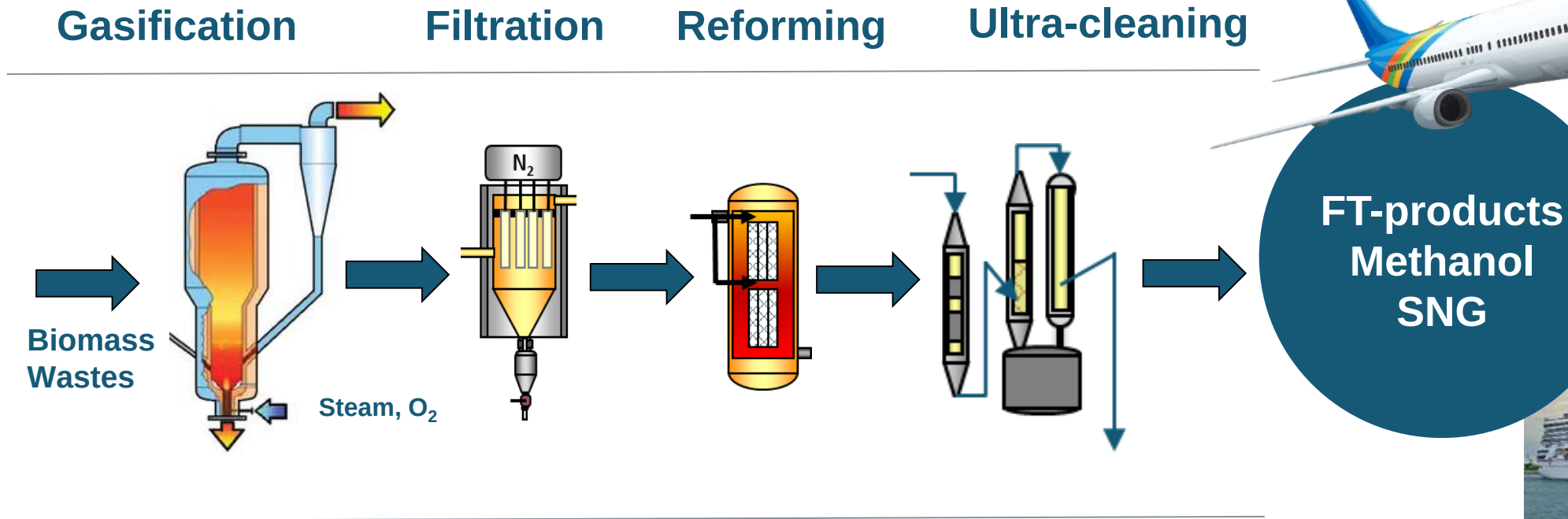
Results of preliminary process evaluation studies

Energy efficiency and carbon efficiency



Key steps in gasification based synfuels process

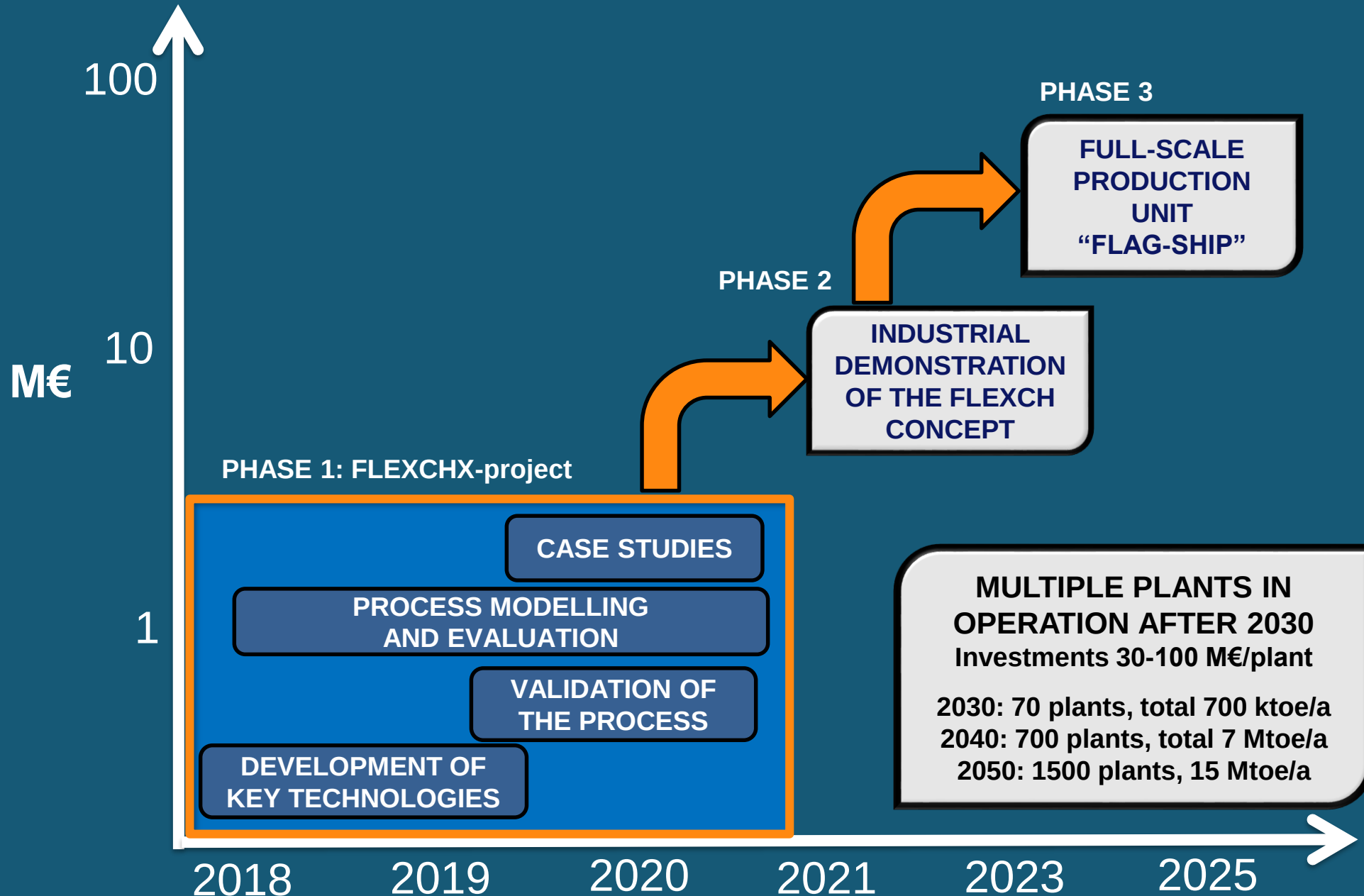
- Electrolysis can be integrated in several ways



Selection of the optimal gasifier depend on target scale and feedstock

- Pressurized O₂-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)

FLEXCHX - from RTD to business



Webinar 19 January 2021, 10:00-12:20 CET

Registration open  www.lyyti.in/comsyn_flexchx

Latest results of two
research projects funded
by the EU Horizon 2020
COMSYN and FLEXCHX.

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



Flexible combined production of power, heat and transport fuels from renewable energy sources

FLEXCHX

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



- Acronym: FLEXCHX
- Funding scheme: RIA
- Duration: 36M, March 2018 – April 2021
- H2020 funding: 4 489 545 €
- Coordinator: Esa Kurkela, VTT
- Project Officer: Daniel Maraver de Lemus
- Consortium: VTT (Finland), Enerstena (Lithuania), INERATEC (Germany), Deutsches Zentrum Fuer Luft - Und Raumfahrt e.V., Germany-DLR (Germany), HELEN (Finland), Kauno Energija (Lithuania), Lithuanian Energy Institute (Lithuania), NESTE Engineering Solutions (Finland), Johnson Matthey (UK) and Grönmark (Finland)

