

IEA Task 33

Kuulumisia Suomesta
Greetings from Finland
25.11.2019



Gasification activities in Finland

Large scale operational plants

1. Joutseno, Metsä Fibre
2. Lahti Energia – Kymijärvi I & II
3. Varkaus, Stora Enso & Corenso
4. Vaasa, Vaskiluodon Voima
5. Äänekoski, Metsä Fibre

+ at least 2-3 plants under consideration.

Suppliers/ technology development

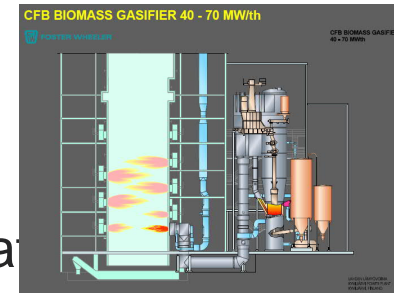
- Andritz
- Sumitomo SHI FW Energia Oy
- Valmet
- Volter
- VTT



Large scale Operational Plants

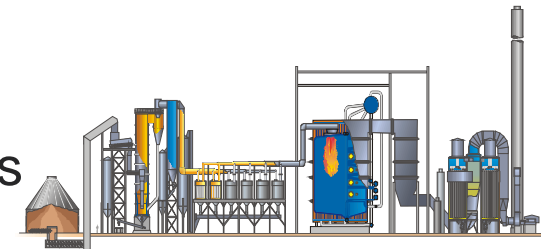
Kymijärvi I /Lahti Energia

- CFB Gasifier (SFW)
- Biofuels, 70 MW, gas to PC boiler
- PC and the gasifier was shut down spring 2019 and commercial operation



Kymijärvi II/Lahti Energia

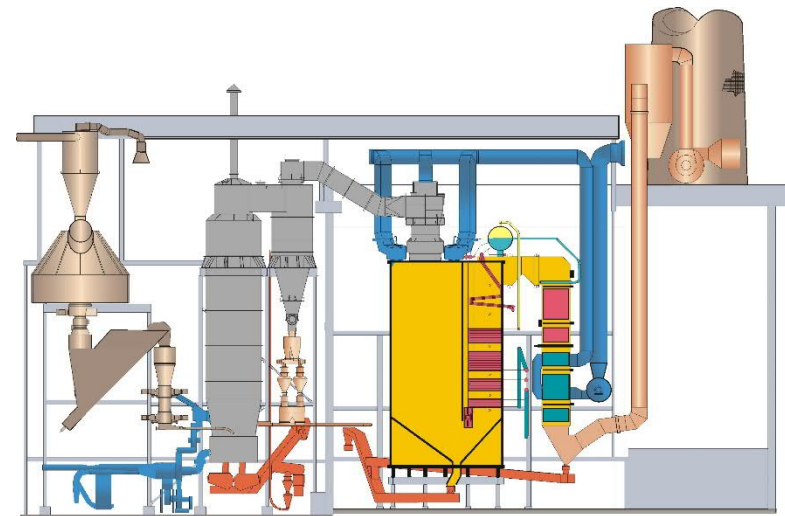
- Start up 2012
- 2 CFB gasifiers (Valmet) 160 MW (= 2*80) fuel
- RDF, different contaminated waste wood fractions
- 7 years of commercial operation, ongoing



Large Scale Operational Plants

Corenso Gasifier / Varkaus, Finland

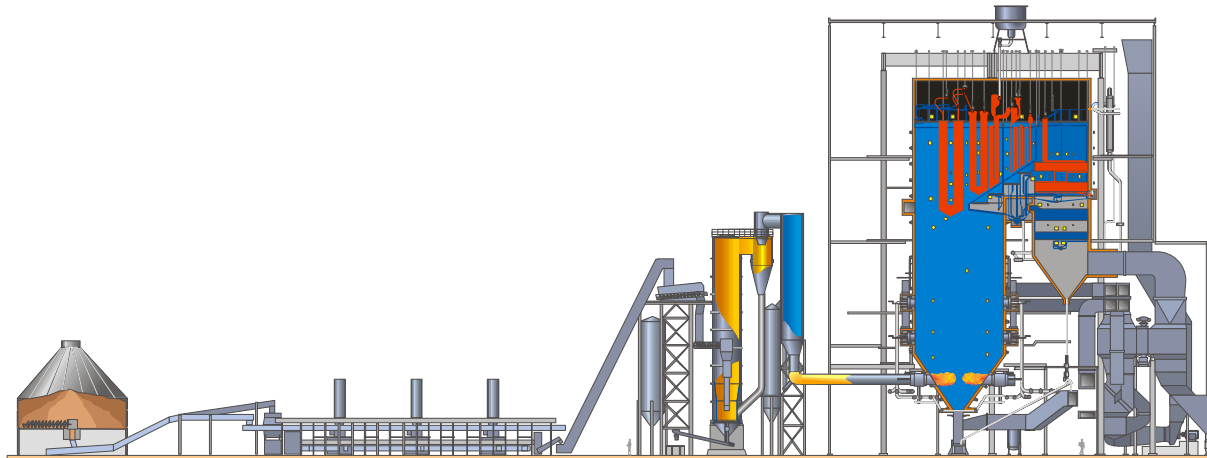
- ▶ In commercial operation since 2001
- ▶ 50 MW BFB Gasifier (SFW)
- ▶ Complete recycling of liquid cartoons (milk and juice packaging)
 - ▶ Fibres separated and recycled back to (core)board manufacturing
 - ▶ Gasification of aluminium containing plastic (PE) reject
 - ▶ Metallic aluminium separated from the gas stream and recycled back to industry
 - ▶ Gas substituting heavy fuel oil in the power plant



Large scale Operational Plants

- **Vaskiluoto**

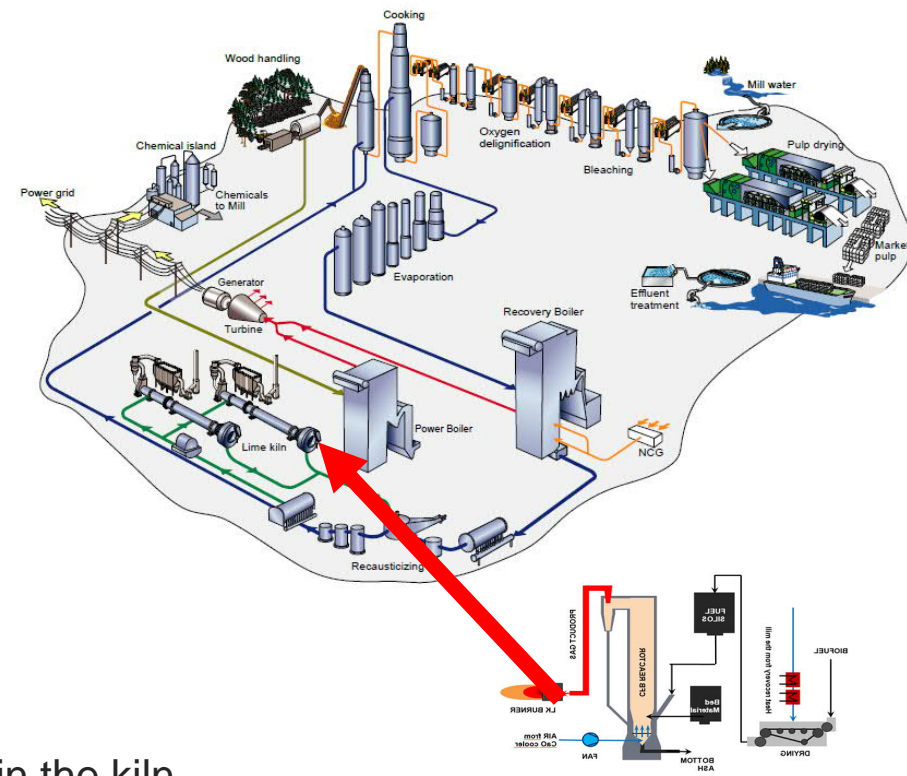
- In Commercial operation since 2013, ongoing
- 140 MW CFB gasifier (Valmet) , wood, bark, forest residues, stumps etc. and peat
- Hot gas delivered directly to one through PC boiler
- Replacing annually round 40 % of coal



Large scale Operational Plants

Lime kiln gasifiers substituting oil/gas in pulp mill lime kilns

- Varkaus (Stora Enso / SFW)
 - In operation since 2009 (also used as a FT test plant)
 - 12 MW
 - Bark, wood residues
 - Replacing heavy fuel in the kiln
- Joutseno (Metsä Fibre / Andritz)
 - In operation since 2012
 - 48 MW
 - Bark, wood residues
 - 100 % replacement of NG in the kiln
- Äänekoski /(Metsä Fibre/ Valmet)
 - In operation since 2017
 - 85 MW
 - Bark, wood residue
 - 100% replacement of bio/heavy fuel oil in the kiln



THE ANDRITZ GROUP



ANDRITZ is a globally leading supplier of plants, equipment, systems and services for hydropower stations, the pulp and paper industry, the metalworking and steel industries, and solid/liquid separation in the municipal and industrial sectors as well as for animal feed and biomass pelleting.

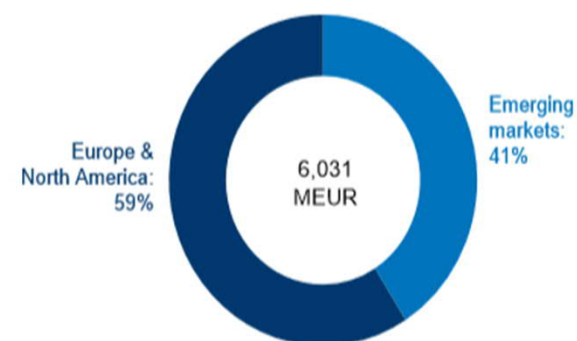
Global presence

Headquarters in Graz, Austria; over 280 production sites and service/sales companies worldwide

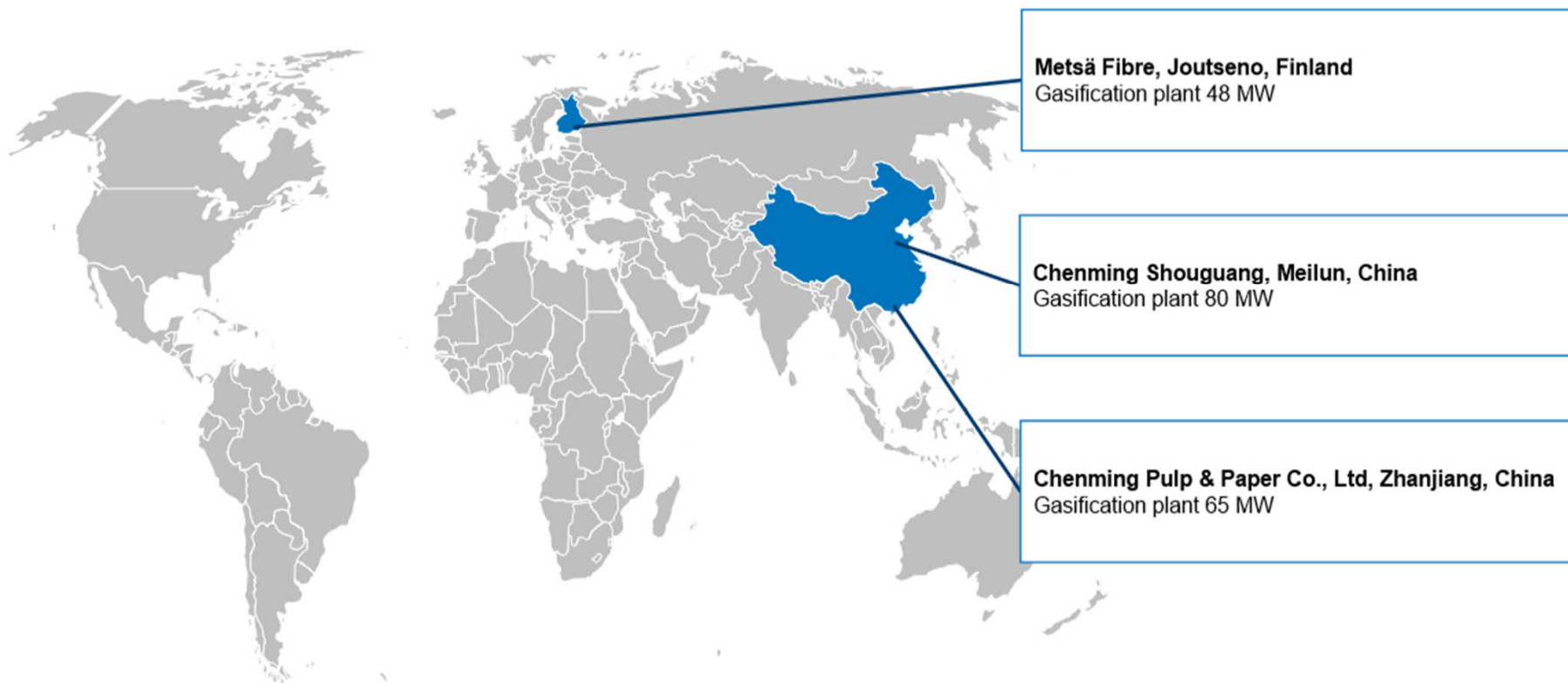
KEY FINANCIAL FIGURES:

	UNIT	2018	2017
Order intake	MEUR	6,646.2	5,579.5
Order backlog (as of end of period)	MEUR	7,084.3	6,383.0
Sales	MEUR	6,031.5	5,889.1
Net income (including non-controlling interests)	MEUR	219.7	265.6
Employees (as of end of period; without apprentices)	-	29,096	25,566

SALES BY REGION 2018 (%)



RECENT CIRCULATING FLUIDIZED BED (CFB) GASIFIER PROJECTS





FOSSIL FUEL REPLACEMENT IN PULP MILL LIME KILNS

CFB biomass gasification technology

- **Technology**

CFB gasification plant, belt dryer, biomass and ash handling equipment, multi-fuel lime kiln burner and auxiliaries.

- **References**

Metsä-Fibre Joutseno:	48MW, 100% replace NG, 600 t/d lime kiln, nordic HW & SW barks, start 2012.
Chenming Zhanjiang:	65MW, 100% replace HFO, 800 t/d lime kiln, eucalyptus chips screening fines and bark, start 2015.
Chenming Meilun:	80MW, 1200 t/d lime kiln, eucalyptus chips screening fines, start 2019.

- **Experiences**

Despite variations in fuel properties (moisture, heating values), CFB plant provides a steady heat supply to lime kiln.
Burnt lime quality is satisfactory with no accumulation of NPEs and reaction with burnt lime.
Satisfactory payback.

- **Contact**

For further information, please contact: Mr. Jean Taillon at ANDRITZ.



Sumitomo SFW Fluidized Bed Gasification

Juha Palonen

SUMITOMO SHI FW Energia Oy



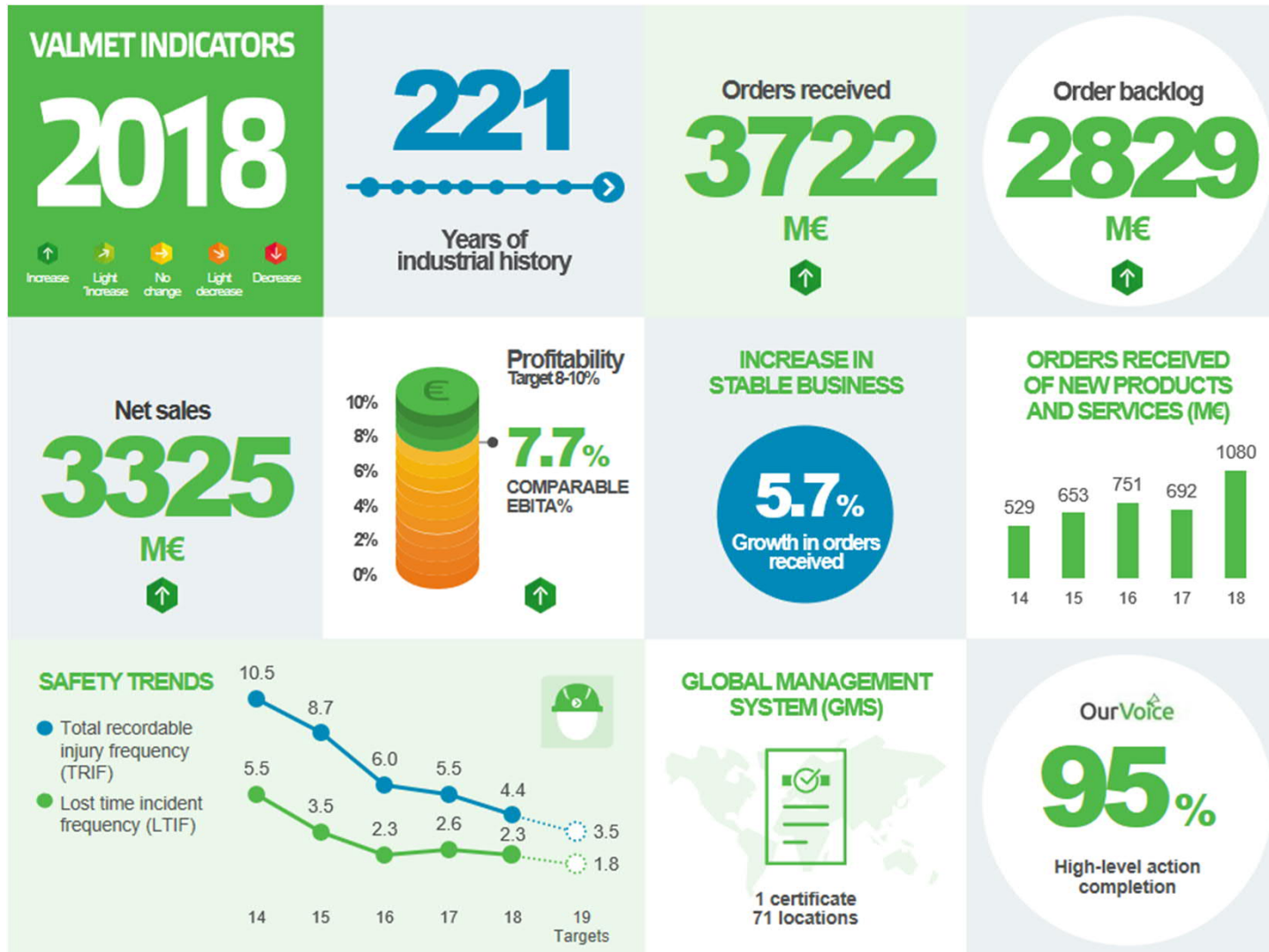
Sumitomo SHI FW Gasification Status

Commercial scale applications / Daily business

- ▶ In addition to normal daily business
 - ▶ Service activities and process development/modifications on customer plants
- ▶ Further scale up in MWs
- ▶ Design development for more challenging fuels and for different fluidizing media (O₂ enrichment, etc)

Development work / Future applications

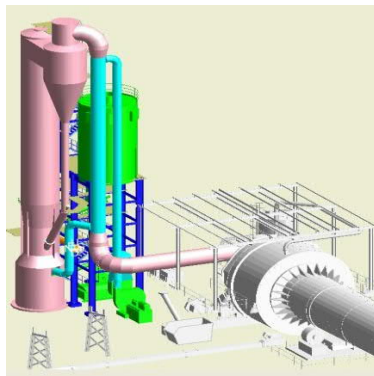
- ▶ Main focus at the moment
 - ▶ Target on transportation sector fuels and biochemicals
- ▶ Development projects going on
 - ▶ Pilot tests and model development
 - ▶ Different gasification processes for different scopes
 - ▶ Expanding of fuel range



Valmet CFB Gasifier

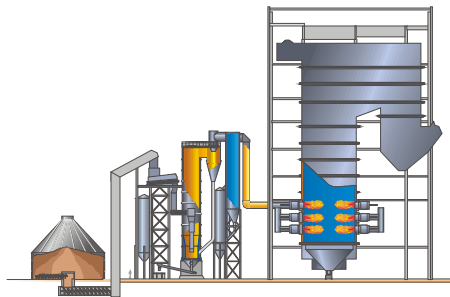
Product gas for industrial kilns

- Woody biomass, bark, peat and waste
- 20 – 110 MW_{fuel} units
- Typically includes a dryer
- Dusty product gas
- References for Limekilns
 - OKI, Indonesia 2 * 110 MW
 - Äänekoski, Finland 87 MW
 - Huangang, China 50 MW
 - Confidential, Brazil 2*87 MW



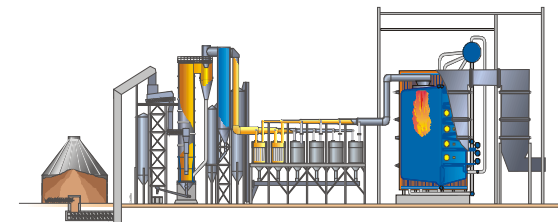
Product gas for power boilers

- Woody biomass, bark, peat and waste
- Superior electrical efficiency
- **Existing boilers**
- 50 – 300 MW_{fuel} units
- If needed, can include a dryer and gas cleaning
 - Vaskiluodon Voima, Finland 140 MW



Product gas from waste for power production

- Waste-derived fuel
- 50 – 150 MW_{fuel}
- High electrical efficiency
- Typically a new gas boiler (existing boiler is also an option)
- Gas cleaning included
 - Lahti Energia, 160 MW



YOUR OWN ELECTRICITY FROM **WOOD**





Manufacturer of small wood fuelled combined heat and power plants. We enable our customers to increase their energy independency and to create new business from renewable energy sales. Volter power plants provide both heat and electricity all-year-around regardless of weather conditions.

Founded in 1997 by Finland's current prime minister Juha Sipilä. Company was later sold to its employees and has focused in the current field since 2009.

Currently all sales come from outside of Finland where the units are manufactured. Key market areas are UK, Italy, Japan and North-America. Our target for turnover in 2020 is 39M€.

Fuel feeding

Reactor, wood chips are converted into wood gas

Primary gas cooling and heat recovery

Gas filtering

Secondary gas cooling and heat recovery

Control panel

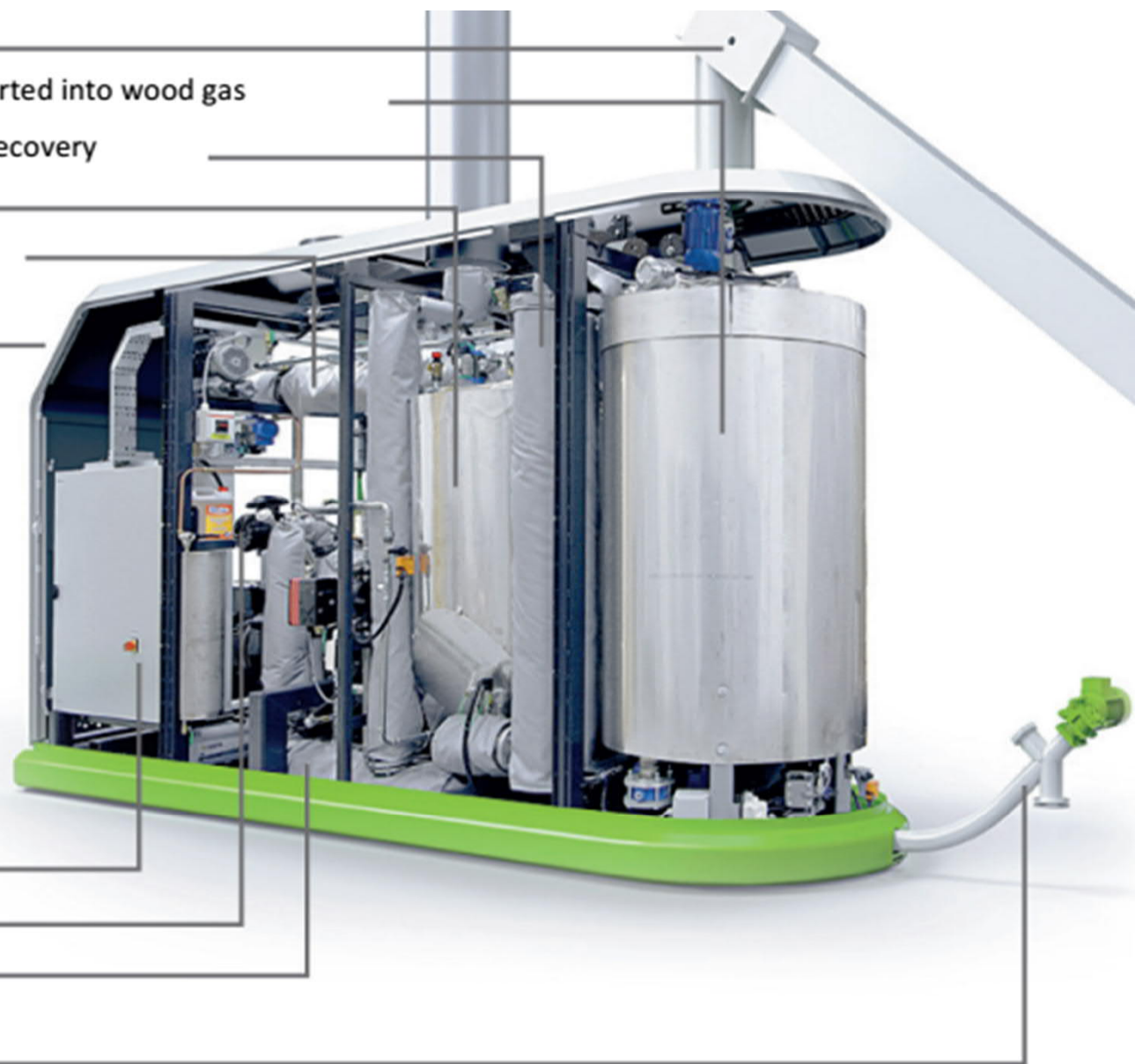
Automation cabinet

Gas motor

Exhaust gas cooling and heat recovery

Ash removal

YOUR OWN ELECTRICITY FROM **WOOD**



Market

- Units delivered to more that 10 different countries
- Several multi unit installations
- 110+ units sold to date



YOUR OWN ELECTRICITY FROM **WOOD**





Our young and energetic group is filled with different personalities, which together form a strong team. By exploring our products you can feel the passion we share for uncompromised quality and functionality.

Our Values: Passion, Bravery and Care



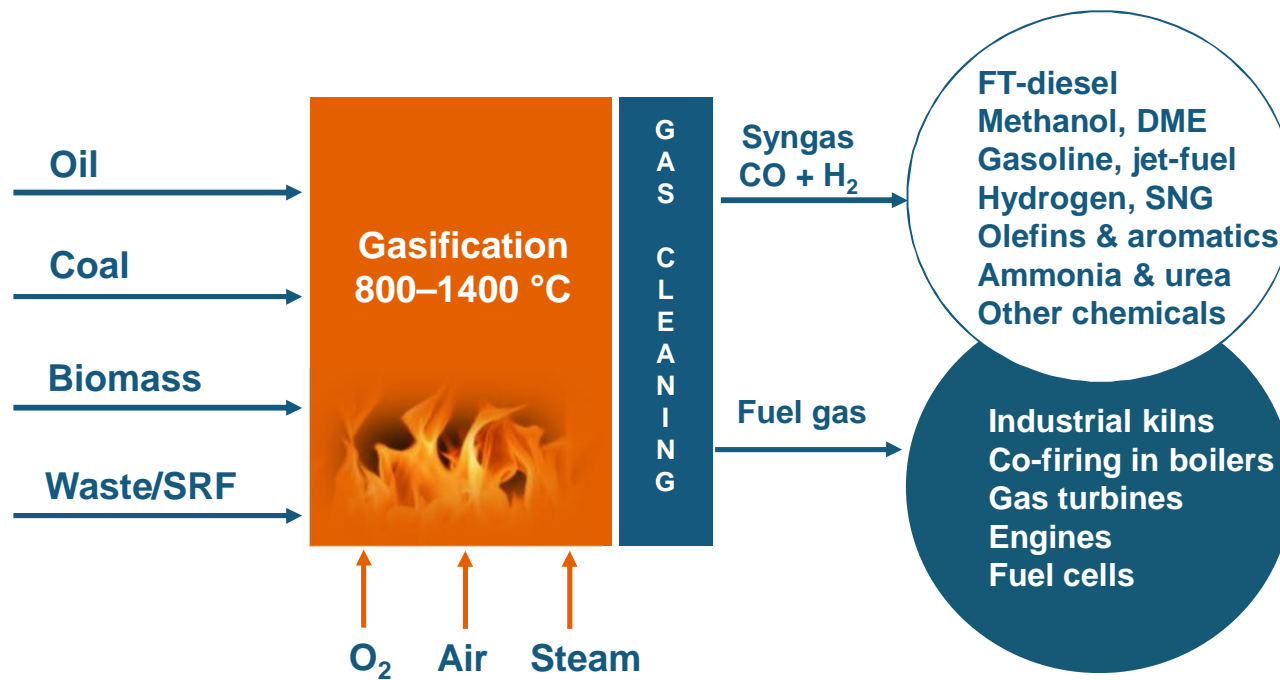


Transportation fuels from biomass via gasification route

Esa Kurkela
VTT Technical Research Centre of Finland Ltd
Espoo

January 2019

Conversion of low-grade feedstock to valuable Products

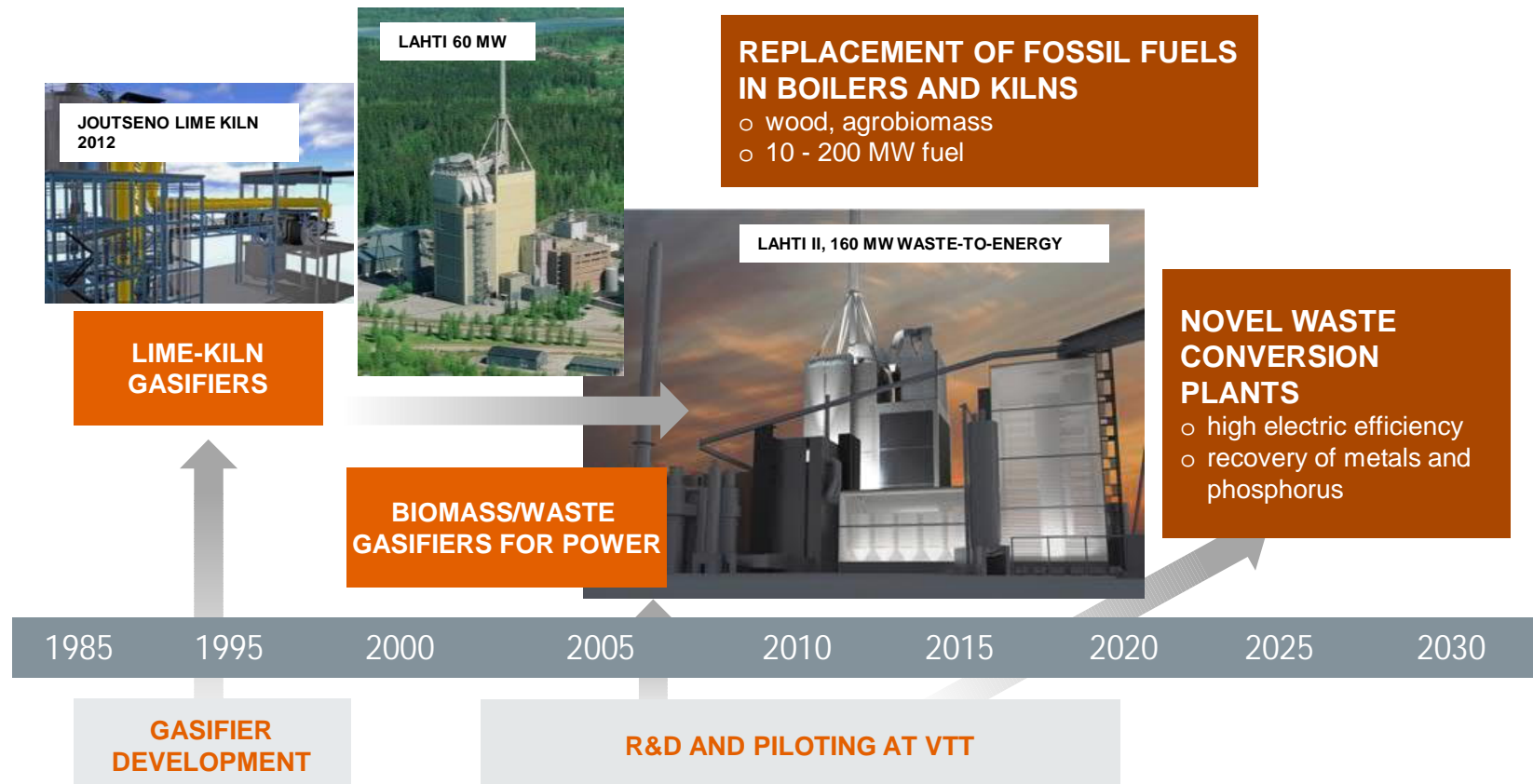


Wide feedstock basis

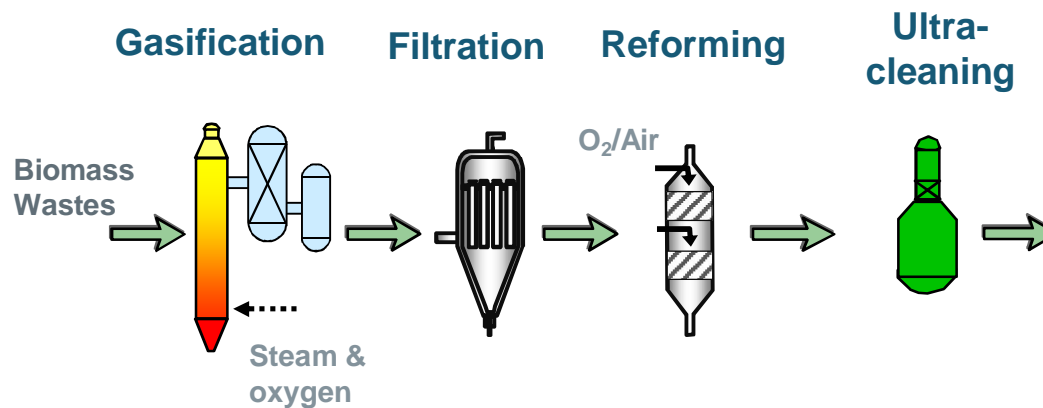
High-Quality Final Products

Biomass and waste gasification for boilers and kilns

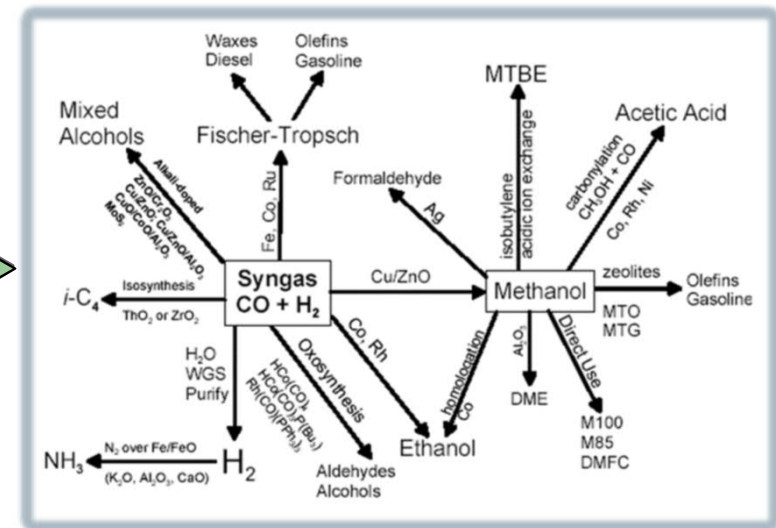
- Industrial experience in Finland since 1980's



Key steps in gasification based synfuels process



Syngas toolbox



Selection of the optimal Gasifier depend on target scale

- Pressurized O_2 -blown CFB for > 150 MW input
- Dual Fluidized-Bed steam gasification for 70 – 150 MW
- Pressurized Staged Fixed-Bed gasifier for 10 – 70 MW

Biomass gasification for biofuels and bio-chemicals

- Long experience of medium-to-large scale synthesis gas technologies



1985

1995

2000

2005

2010

2015

2020

2025

2030

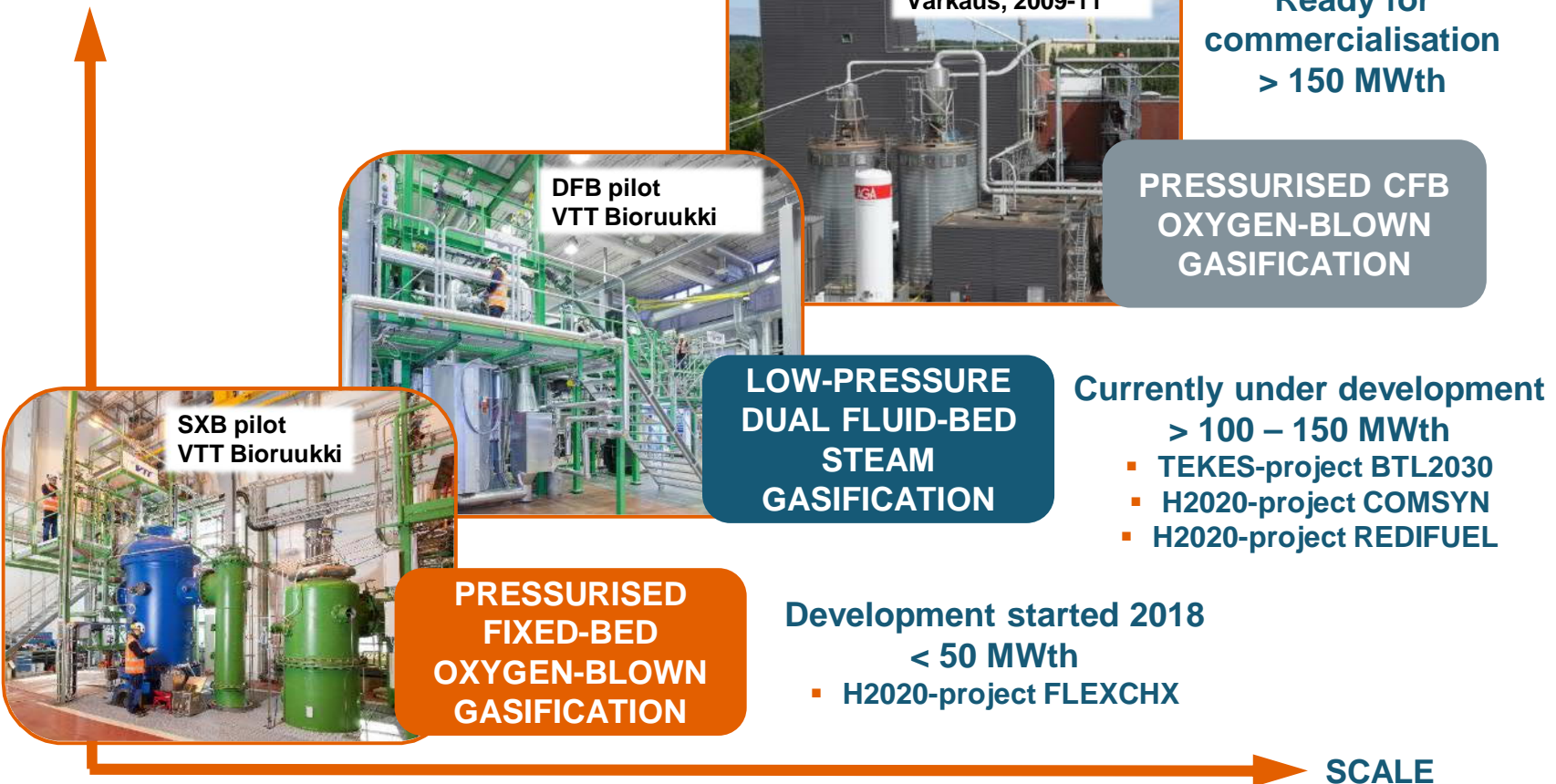
COAL GASIFIER
APPLIED FOR
PEAT AND WOOD

LARGE-SCALE GASIFICATION
SPECIALLY DEVELOPED
FOR WOOD FEEDSTOCKS

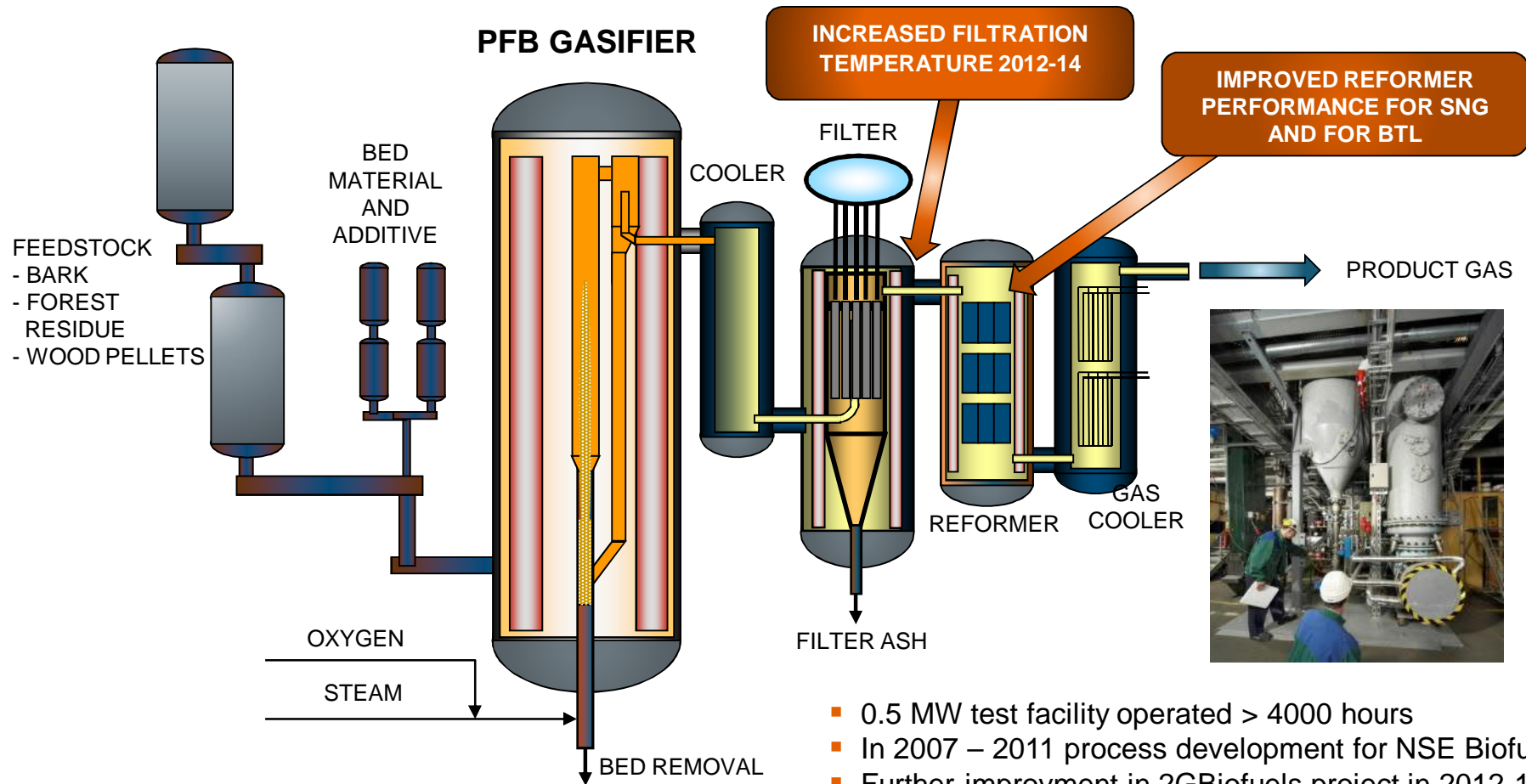
NEW PROCESS FOR SMALLER
SCALE AND WITH LOWER CAPEX

Synthesis gas production at different scale

MATURITY



O₂-Blown CFB Gasification – PDU at VTT in 2007 - 2013



Why commercial gasification and synthesis plants are not yet under construction?

Economic challenges of first-of-a-kind (FOAK) plants

- Investment typically 50% higher than for mature plants
- Large > 100 ktoe/a plants require 500 -1000 M€ investment
- Financing of FOAK carries significant risk component

Significant political uncertainties

- Binding targets for renewable fuels missing
- Long-term support for large-scale flag ship projects too expensive
- Complex sustainability issues

HVO and first generation biofuels have so far satisfied the market

Smaller plant size and simplified processes needed!

- Reducing CapEx a key
- Maximise integration benefits – biomass logistics, heat integration
- Use local residues and wastes to ensure sustainability

Integrating production of fuels and chemicals from biomass and residues to existing industries to improve competitiveness

Several local sites with CHP integration



- Forest and agricultural residues
- Industrial and municipal wastes
- Integration to district heating, forest, chemical or metal industries

Transport of intermediate products



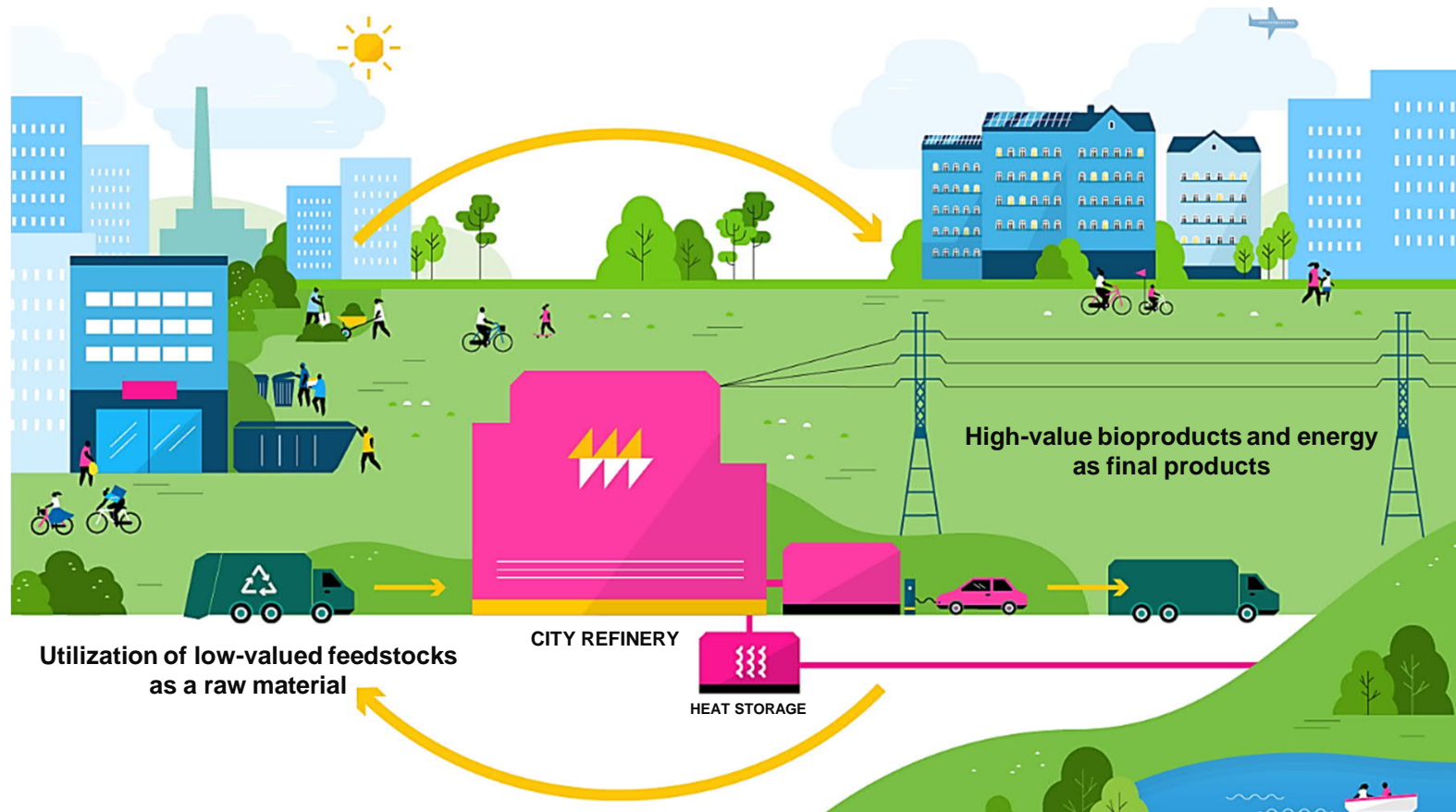
- Pyrolysis oil
- Methanol
- Synthetic hydrocarbons (FT)
- Synthetic methane (SNG)

Large-scale refineries or chemical industries



- Co-refining
- Drop-in transportation fuels
- Olefins for renewable packaging materials
- Basic chemicals, fertilisers
- Aromatics

CITY REFINERY – CRITICAL DEMONSTRATOR



LOW-VALUE FEEDSTOCKS



CITY REFINERY



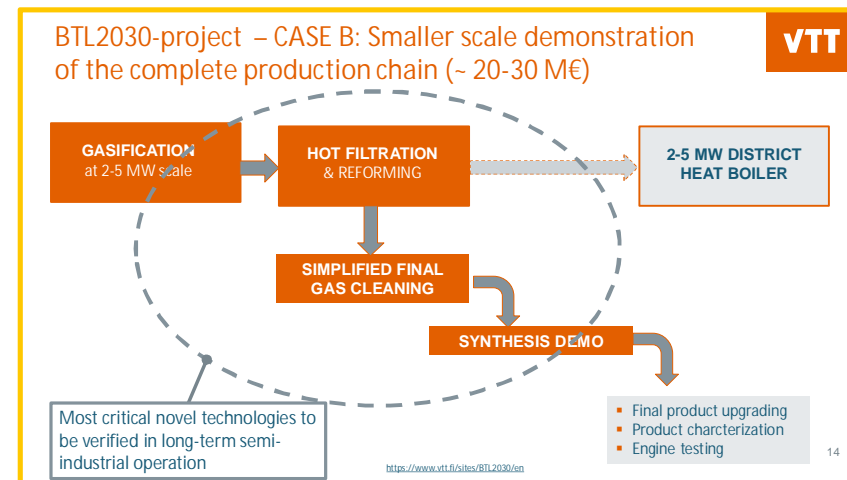
HIGH VALUE END PRODUCTS

HELEN

DEMONSTRATION FOR ENTERING INTO FLAGSHIP

- Objectives

- To lower the technical risks related to key enabling technologies
- To gain long-term experience on process performance with different feedstock
- To test effects of new process developments and to define an optimal process concept



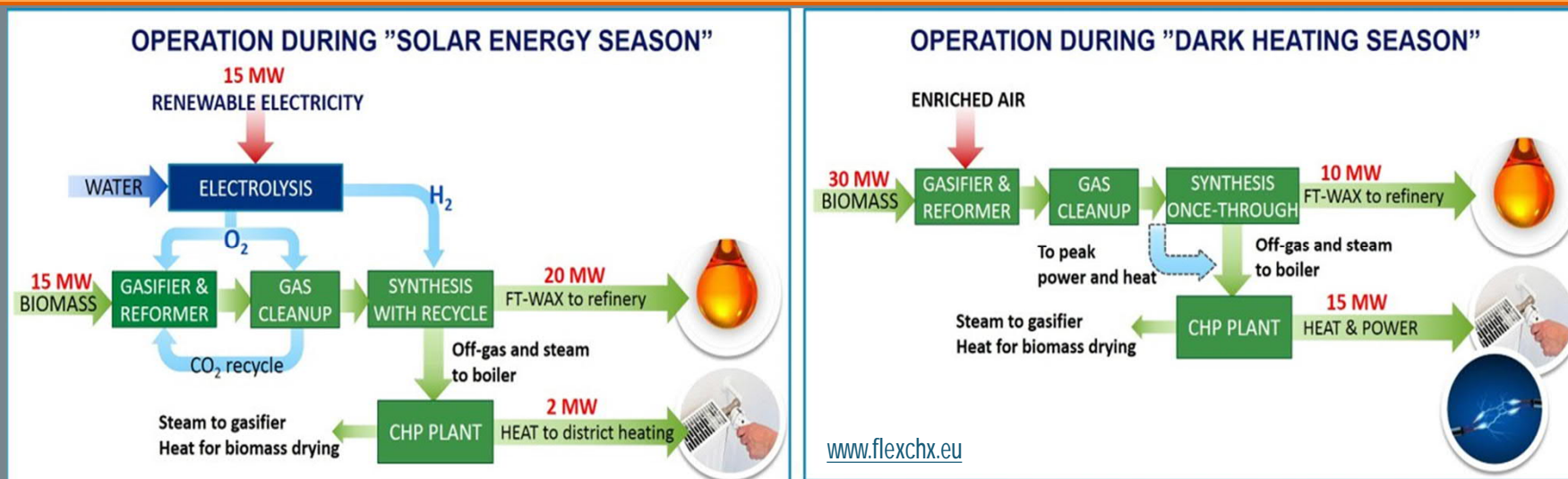


FLEXCHX

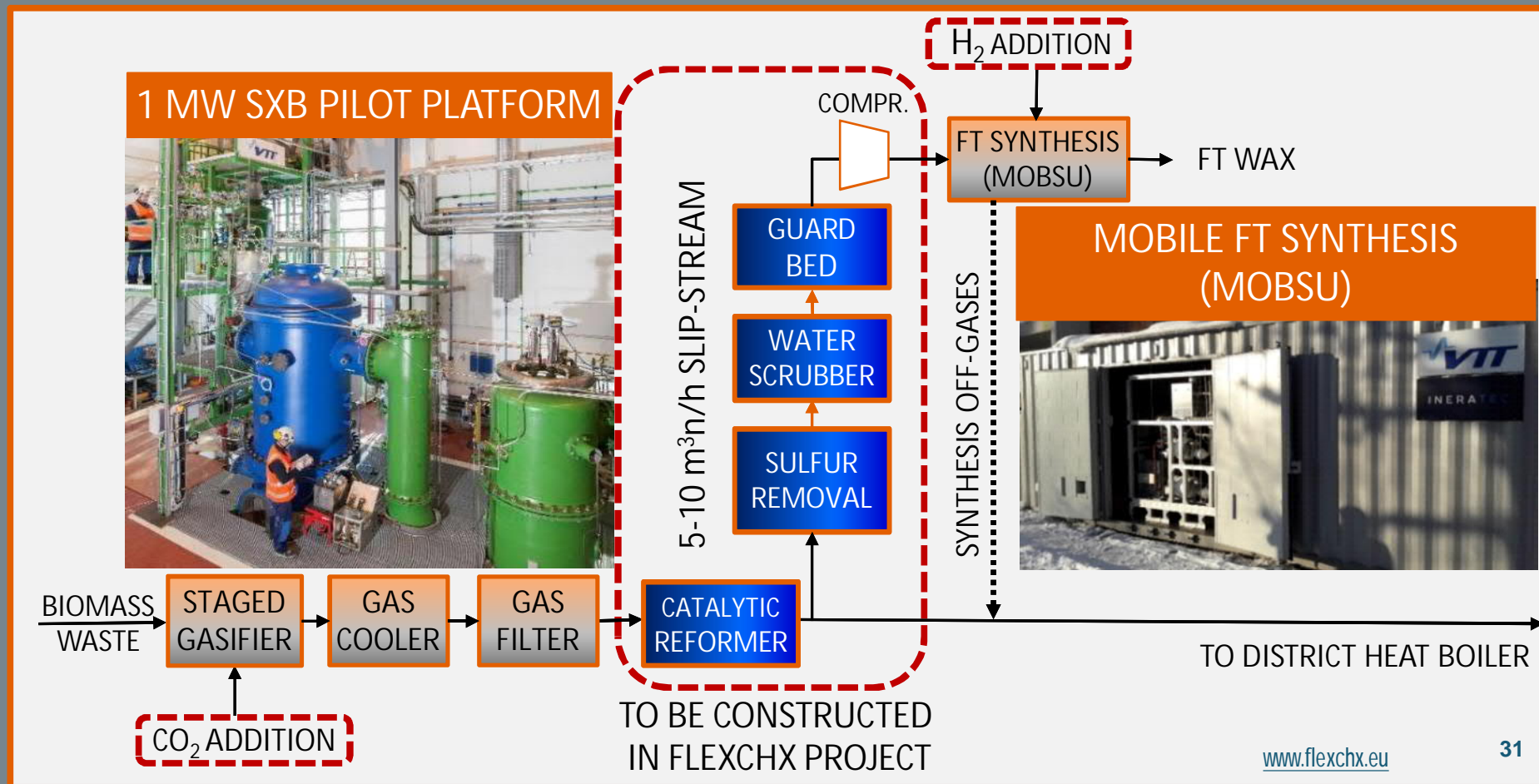
Flexible combined production of power, heat and transport fuels from renewable energy sources

Project duration: 1.3.2018-28.2.2021; Budget: 4.86 million €

The **vision** is to realise a process for optimal use of the seasonal solar energy supply and available biomass resources to satisfy the seasonal demand for heat and power, and to simultaneously produce low-GHG fuels for the transport sector.



FLEXCHX: Main experimental facilities





Thank you !

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