

# IEA Task 33

Kuulumisia Suomesta

Greetings from Finland



# 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

## Suppliers/ technology development

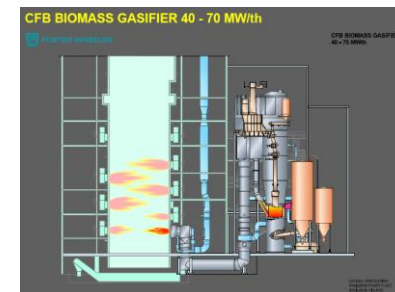
- Andritz
- Sumitomo SHI FW
- Valmet
- Volter
- VTT



# Large scale Operational Plants

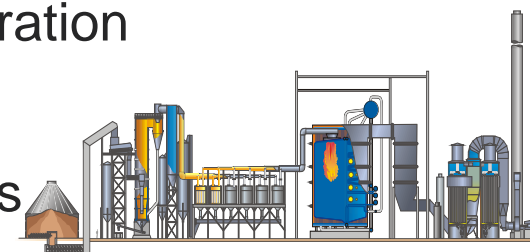
## Kymijärvi I /Lahti Energia

- In commercial operation, over 275 000 hrs
- CFB Gasifier (SFW)
- Biofuels, 70 MW, gas to PC boiler
- 20 years of commercial operation



## Kymijärvi II/Lahti Energia

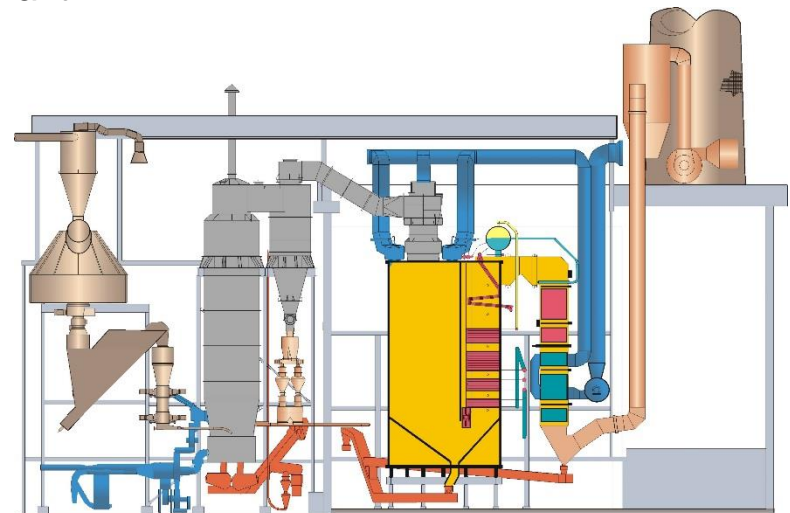
- In commercial operation, over 30 000 hrs of operation
- 2 CFB gasifiers (Valmet) 160 MW (= 2\*80) fuel
- RDF, different contaminated waste wood fractions
- 6 years of commercial operation, ongoing



# Large Scale Operational Plants

## Corenso Gasifier / Varkaus, Finland

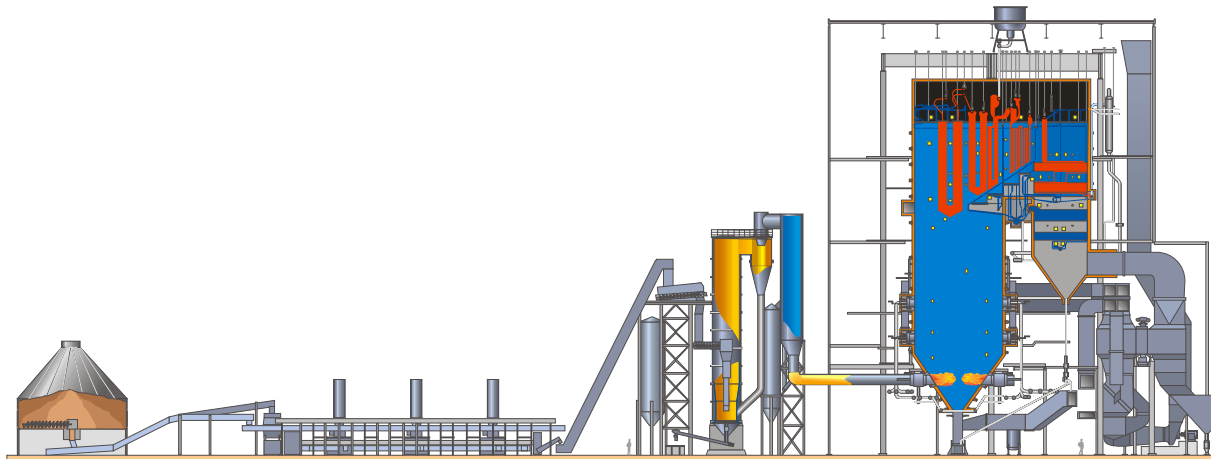
- ▶ In commercial operation since 2001
- ▶ 50 MW BFB Gasifier (FW/SFW)
- ▶ Complete recycling of liquid cartons (milk and juice packaging)
  - ▶ Fibres separated and recycled back to (core)board manufacturing
  - ▶ Gasification of aluminium containing plastic (PE) reject
  - ▶ Metallic aluminium separated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



# Large scale Operational Plants

- **Vaskiluoto**

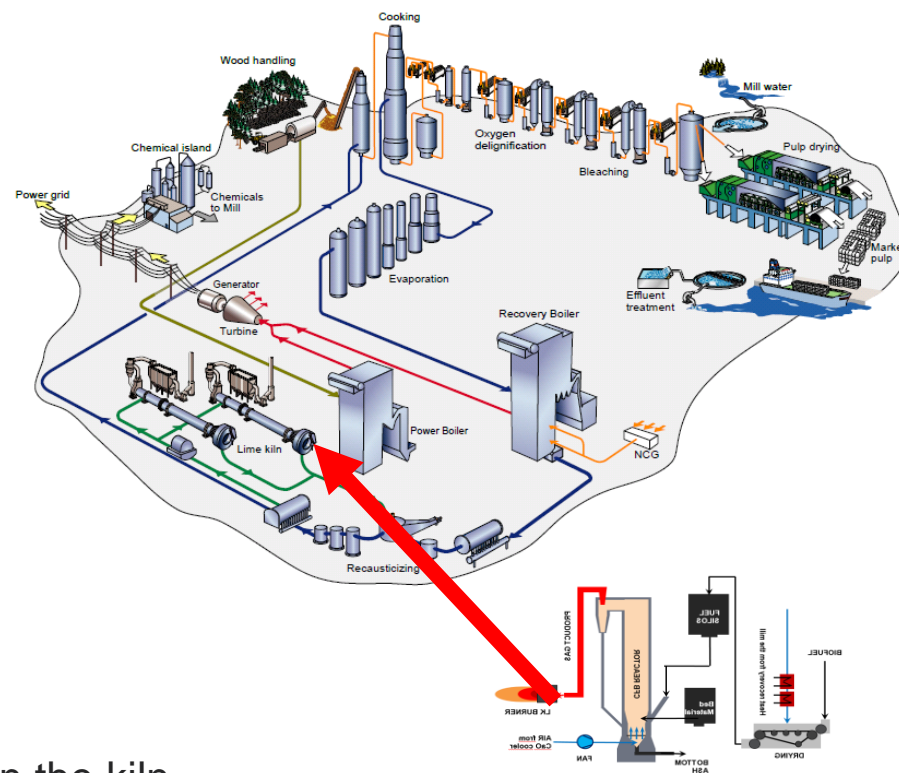
- In Commercial operation since 2013, ongoing
- 140 MW CFB gasifier (Valmet) , wood, bark, forest residues, stumps etc. and peat
- Hot gas delivered directly to one through PC boiler
- Replacing annually round 40 % of coal



# Large scale Operational Plants

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

- Varkaus (Stora Enso / FW-SHI)
  - 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.

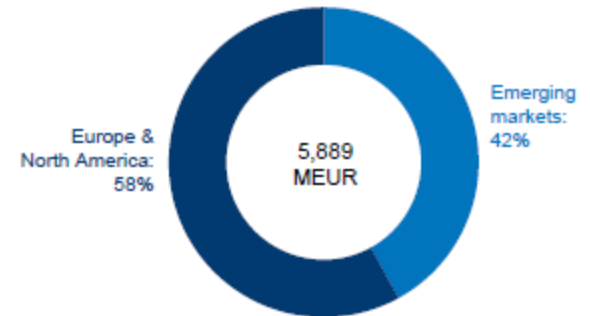
## Global presence

Headquarters in Graz, Austria; over 250 production sites and service/sales companies worldwide

### KEY FINANCIAL FIGURES:

	UNIT	2017	2016
Order intake	MEUR	5,579.5	5,568.8
Order backlog (as of end of period)	MEUR	6,383.0	6,789.2
Sales	MEUR	5,889.1	6,039.0
Net income (including non-controlling interests)	MEUR	265.6	274.8
Employees (as of end of period; without apprentices)	-	25,566	25,162

SALES BY REGION 2017 (%)





# FOSSIL FUEL REPLACEMENT IN PULP MILL LIME KILNS

ANDRITZ Carbona Circulating Fluidized Bed (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, nordics HW & SW barks, start 2012.  
Chenming Zhanjiang: 65MW, 100% replace HFO, 800 t/d lime kiln, euca chips screening fines and bark, start 2015.  
Chenming Meilun: 80MW, 1200 t/d lime kiln, eucalyptus chips screening fines, under construction.

- **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 SHI FW Fluidized Bed Gasification

Juha Palonen

SUMITOMO SHI FW Energia Oy

09.04.2018



# Sumitomo SHI FW Gasification Status

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## **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 (O<sub>2</sub> 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 INDICATORS**

# 2017

↑ Increase
↗ Light Increase
↔ No change
↘ Light decrease
↓ Decrease

# 220

Years of industrial history

Orders received

# 3272

M€

Order backlog

# 2292

M€

Net sales

# 3159

M€

Profitability Target 8-10%

# 7.2%

COMPARABLE EBITA%

**INCREASE IN STABLE BUSINESS**

# 5.9%

Growth in orders received



**Leap Forward**

488 End users from Services in Finland started using new ERP system

Infor LN

**GLOBAL REPUTATION SCORE**

Strong good

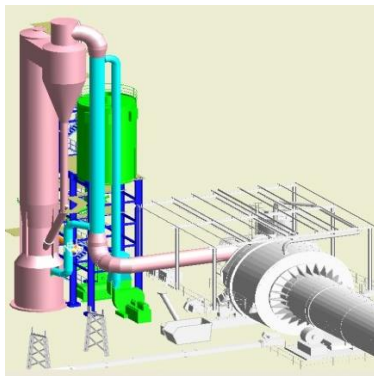
# 3.80

Customers' rating scale 1-5

# Valmet CFB Gasifier

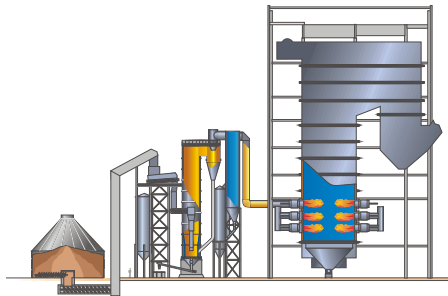
## Product gas for industrial kilns

- Woody biomass, bark, peat and waste
- 20 – 110 MW<sub>fuel</sub> units
- Typically includes a dryer
- Dusty product gas
- References for Limekilns
  - OKI, Indonesia 2 \* 110 MW
  - Äänekoski, Finland 87 MW
  - Huangang, China 50 MW



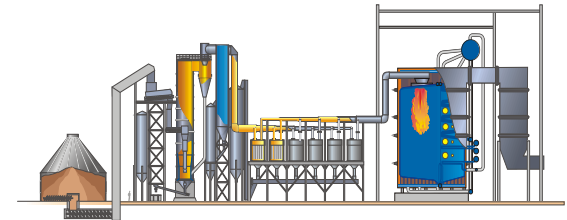
## Product gas for power boilers

- Woody biomass, bark, peat and waste
- Superior electrical efficiency
- **Existing boilers**
- 50 – 300 MW<sub>fuel</sub> 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<sub>fuel</sub>
- 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



# Market

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





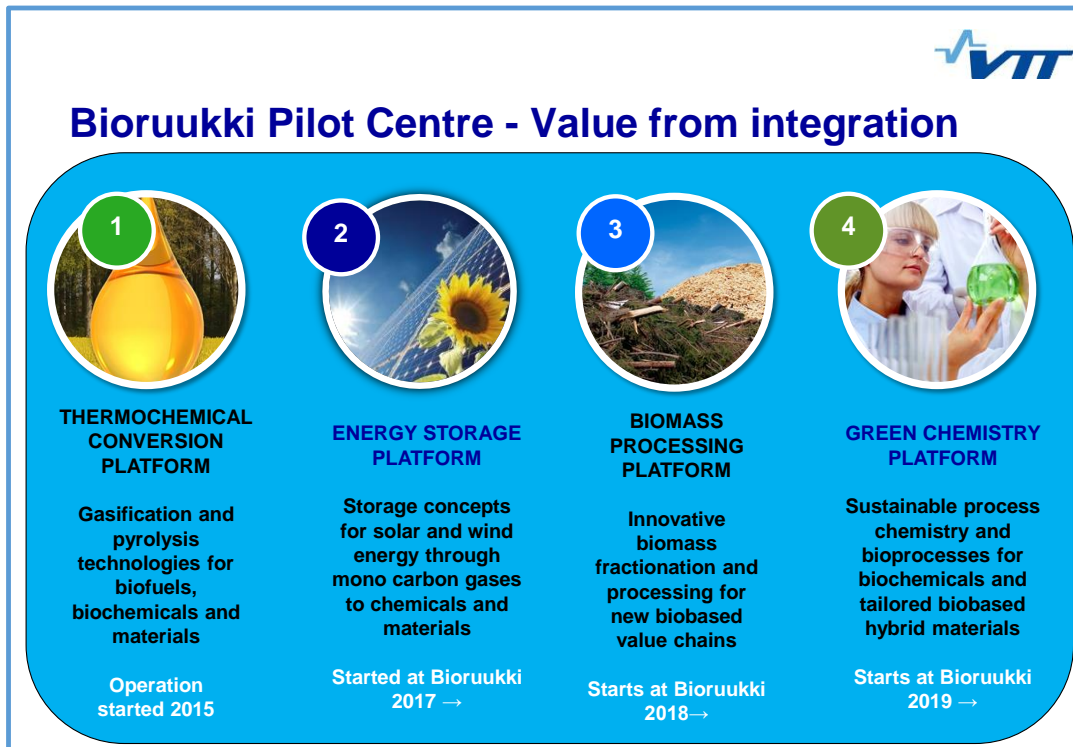
Our young and energetic group is filled with different personalities, which together form a strong team. By exploring our products you can feel the passion we share for uncompromised quality and functionality.

*Our Values: Passion, Bravery and Care*



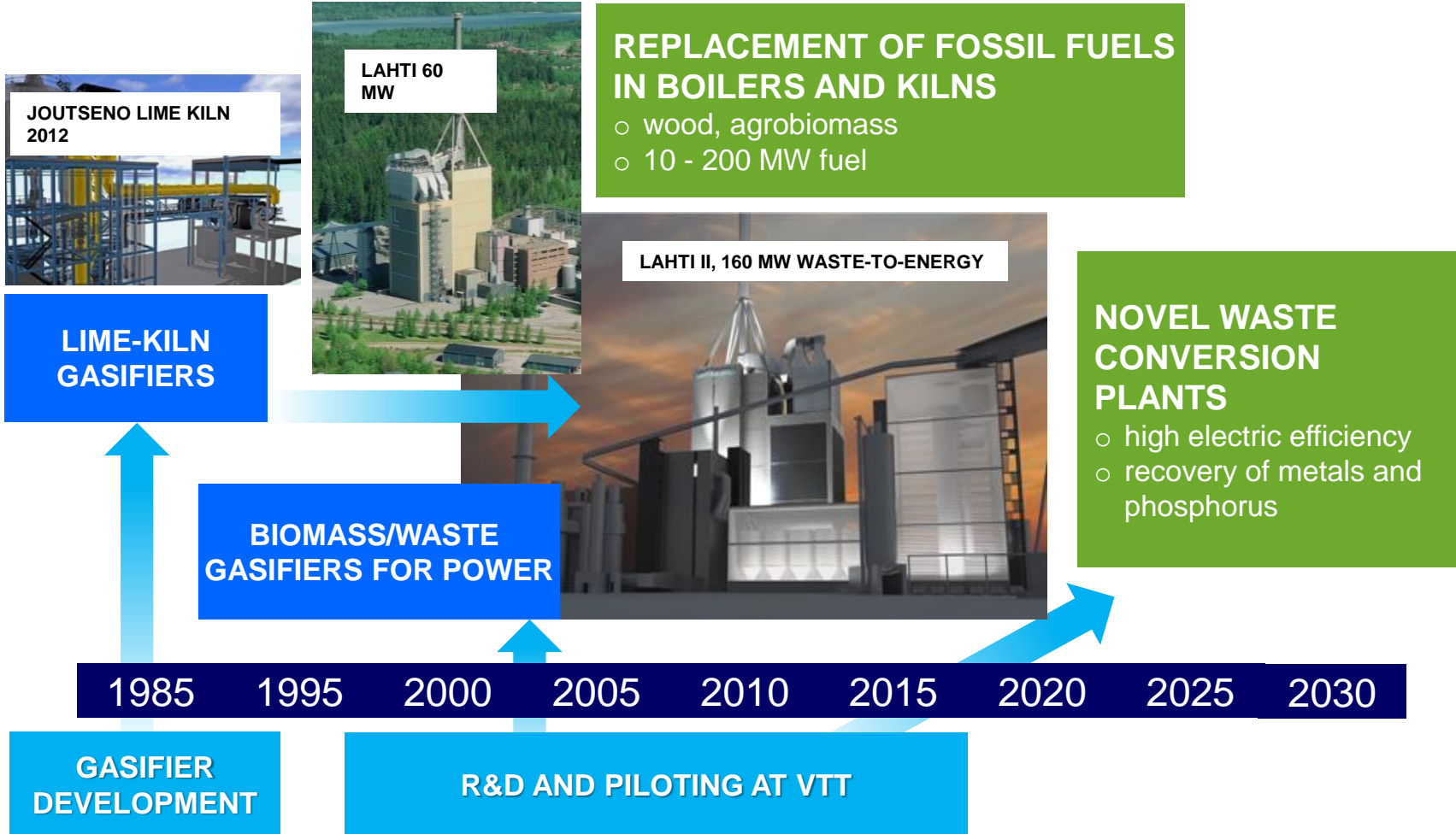
## ■ VTT Technical Research Centre of Finland

- VTT has carried out gasification R&D since early 1980's
- VTT's present experimental R&D center Bioruukki is located in Espoo
- Gasification and pyrolysis test facilities form the key part of the thermochemical conversion platform at Bioruukki
- The thermochemical conversion team has 25 employees and is co-operating with other VTT teams (e.g. catalytic conversion, process modelling etc.)



# Biomass and waste gasification for boilers and kilns

- Industrial experience in Finland since 1980's



## The use of biomass residues for de-centralized production of power, heat and cooling

- Fluidized-bed and grate boilers are commercially available for large scale energy production > 5-10 MWe – total efficiency in CHP is good
- Small-scale downdraft gasification systems and engine-generators available for high-quality wood chips in the smallest size class < 500 kWe (e.g. Volter)
- **Very few (if any) technically and economically sound alternatives for 1-5 MWe size range in spite of numerous trials since 1980's**
- New staged fixed-bed gasifier in pilot development stage at VTT



Staged fixed-bed gasifier pilot plant at VTT, October 2017

### Status and activities in 2018

- 1 MW Pilot plant constructed and commissioned in 2017
- Co-operation with Enerstena, Lithuania
- Steam boiler applications replacing oil
- CHP by gas engines
- H2020 proposal for pressurized operation with a gas turbine – small BiG-GT process
- Syngas by pressurized steam-oxygen gasification – EU project FLEXCHX

# Biomass gasification for synthesis applications

**MATURITY**



NSE Demo plant  
Varkaus, 2009-11

Ready for  
commercialisation  
> 150 MWth



DFB pilot  
VTT  
Bioruukki

**PRESSURISED  
CFB OXYGEN-  
BLOWN  
GASIFICATION**

Currently under development  
> 100 – 150 MWth  
TEKES-project BTL2030  
H2020-project COMSYN

**LOW-PRESSURE  
DUAL FLUID-BED  
STEAM  
GASIFICATION**

Development started 2016  
< 50 MWth  
EAKR-project GASGEN  
H2020-project FLEXCHX



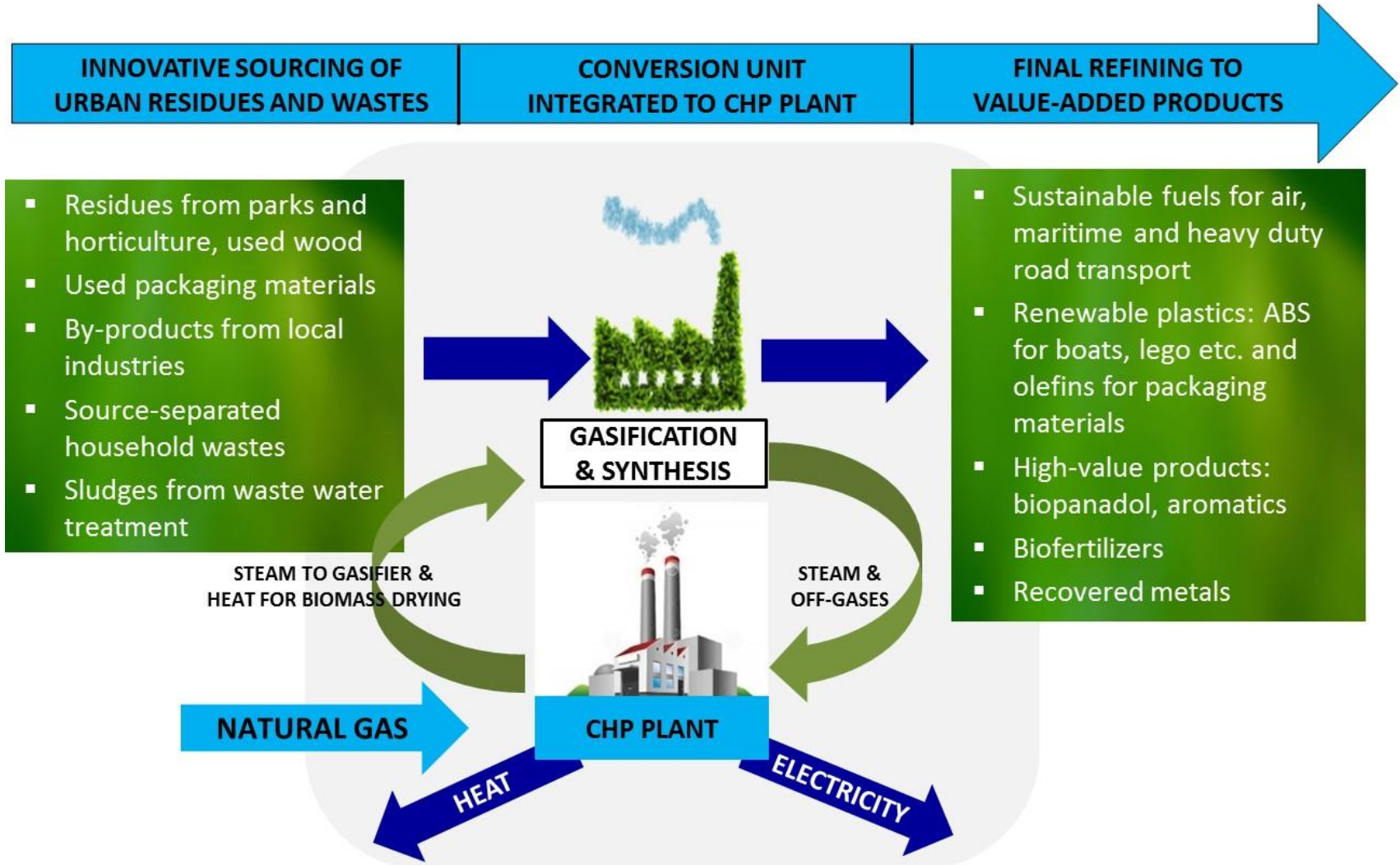
SXB pilot  
VTT Bioruukki

**PRESSURISED  
FIXED-BED  
OXYGEN-BLOWN  
GASIFICATION**

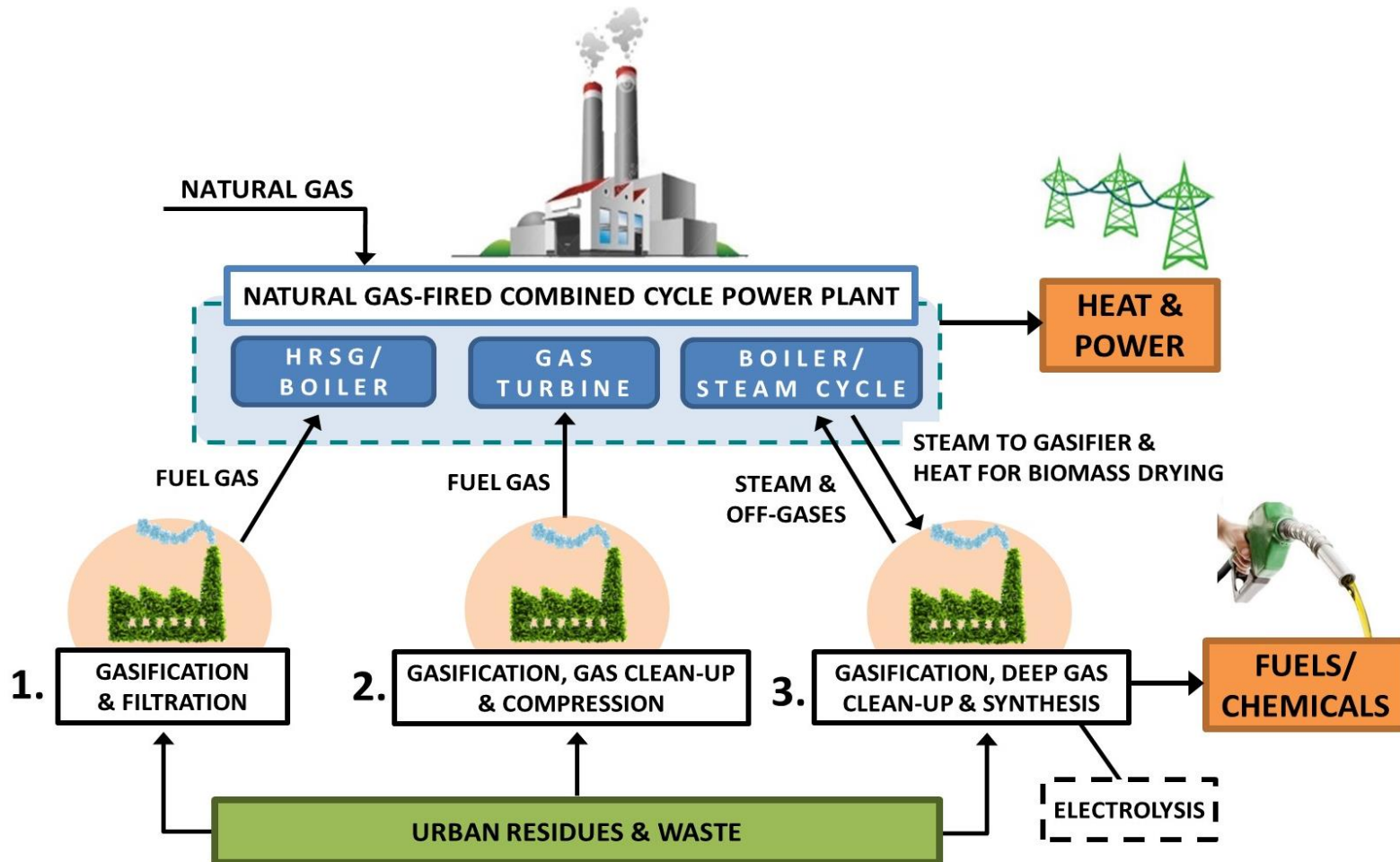


**SCALE**

# CITY3GEN concept for co-utilizing biomass and wastes at large natural gas combined cycle plants



# Process alternatives of CITY3GEN to integrate the use of biomass/waste at NGCC power plants

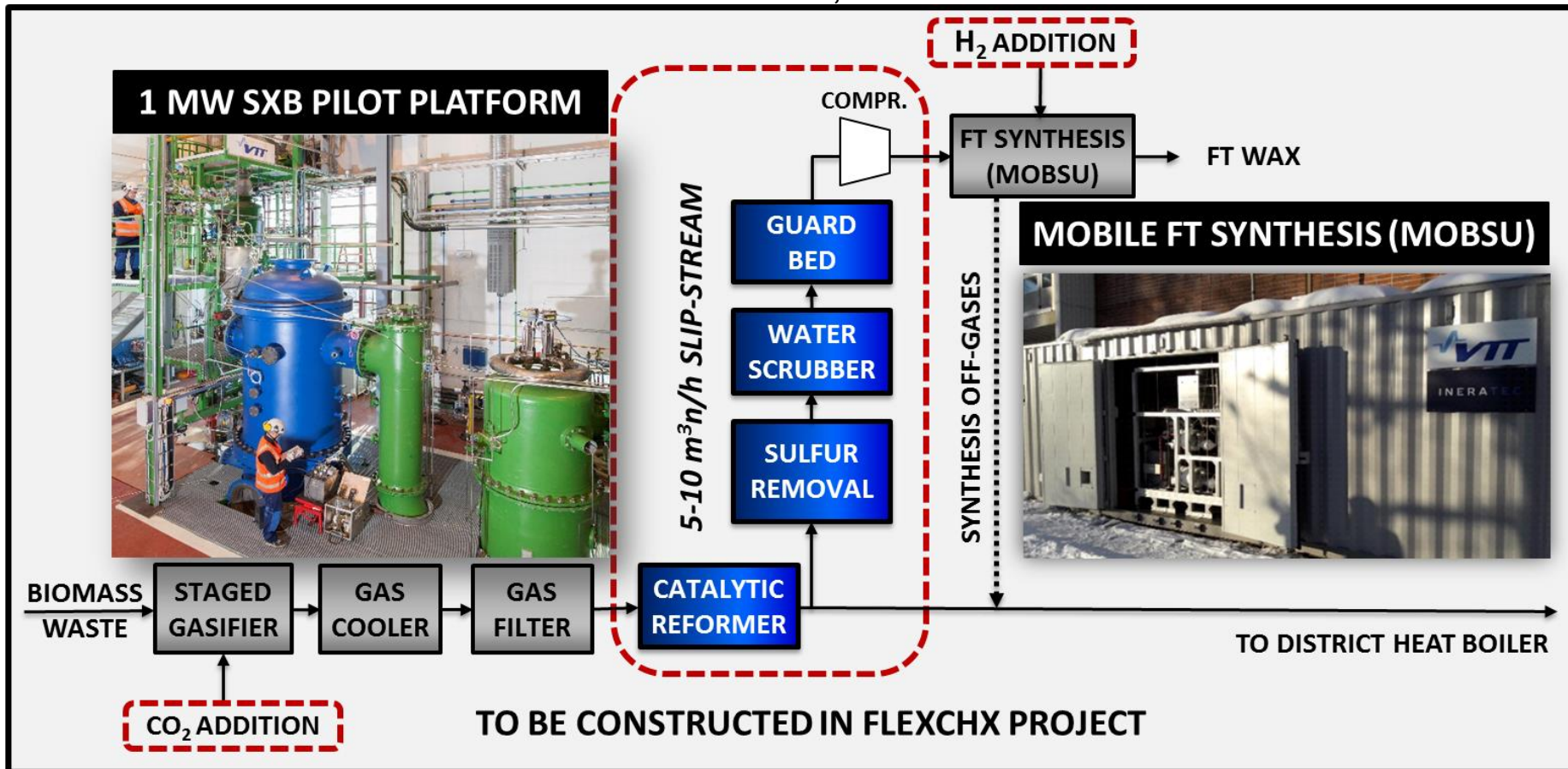




## H2020-project FLEXCHX

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

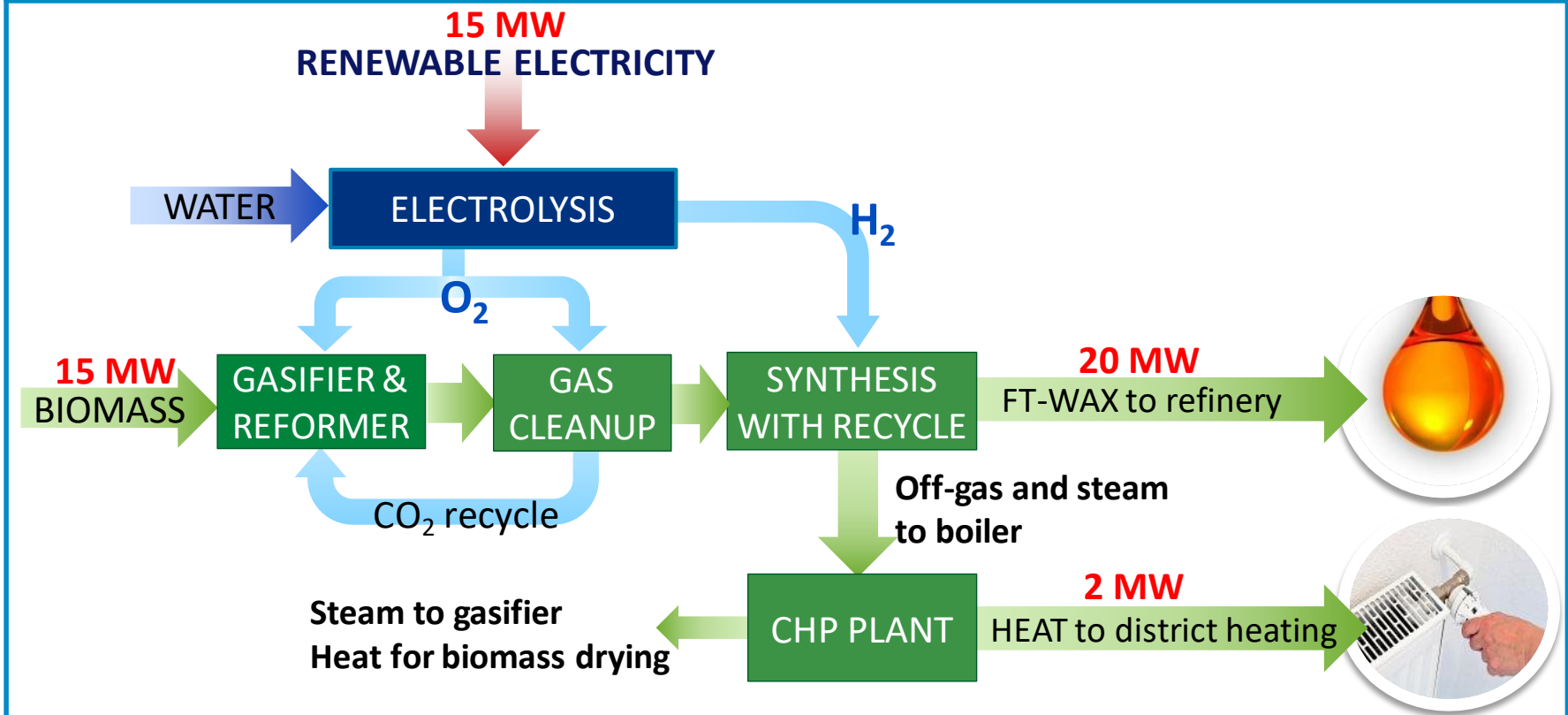
- Duration: 1.3.2018 – 28.2.2020; EU contribution: 4 489 545 €





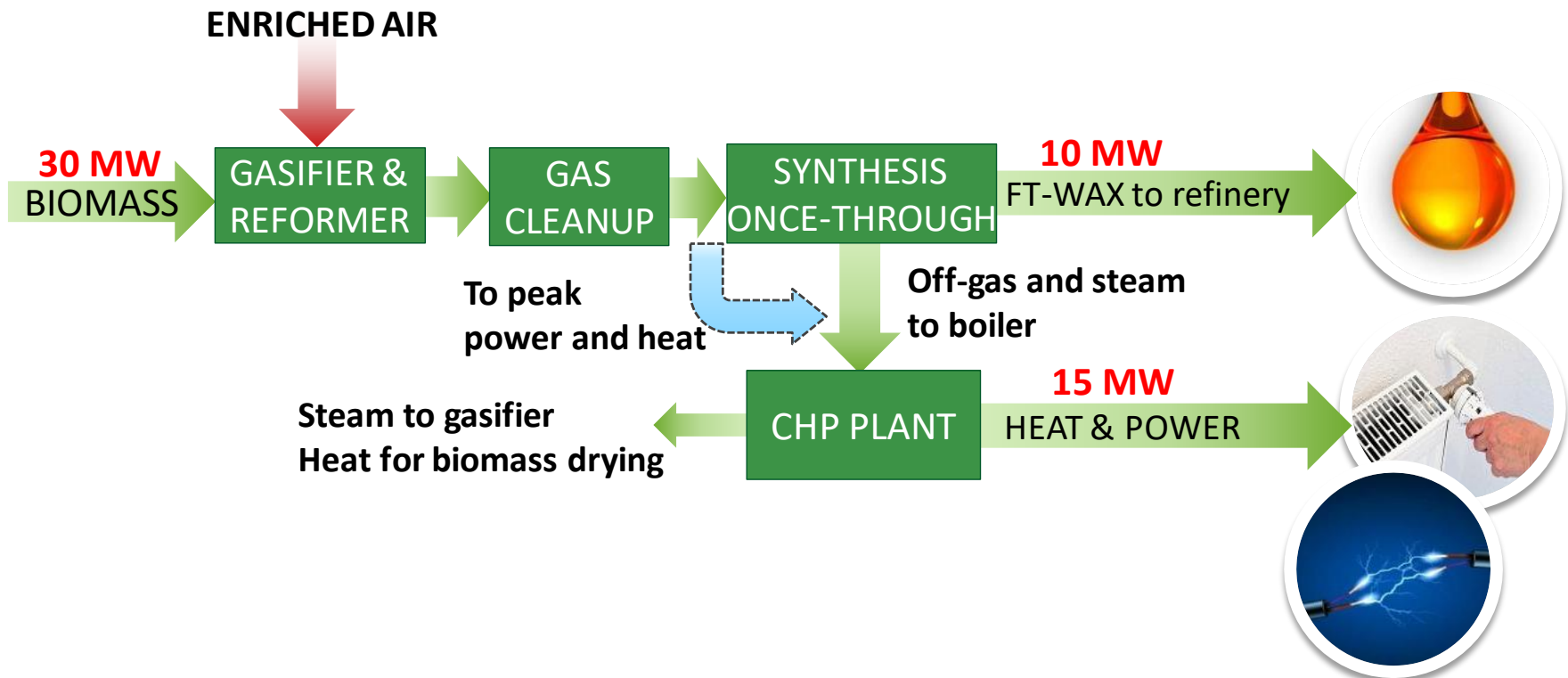
# Flexible combined production of power, heat and transport fuels from renewable energy sources

## OPERATION DURING "SOLAR ENERGY SEASON"



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

## OPERATION DURING "DARK HEATING SEASON"





**Thank you !**

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