

GoBiGas:

An Industry Relevant State-of-The-Art Reference
for Advanced Biofuel Production via Gasification

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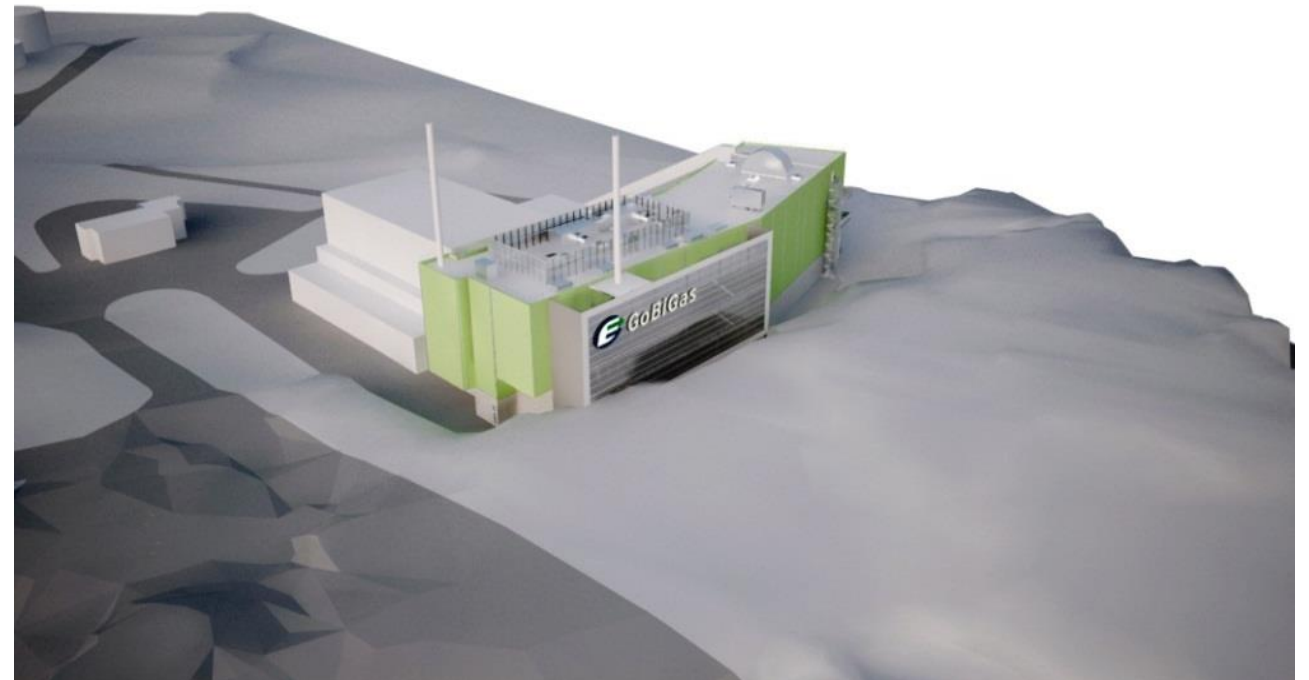
Site Manager Freddy Tengberg, GoBiGas - Göteborg Energi

GoBiGas – First-of-its-Kind

- First in the world for high quality biomethane from biomass through gasification



- First Swedish plant to inject biomethane into the national grid



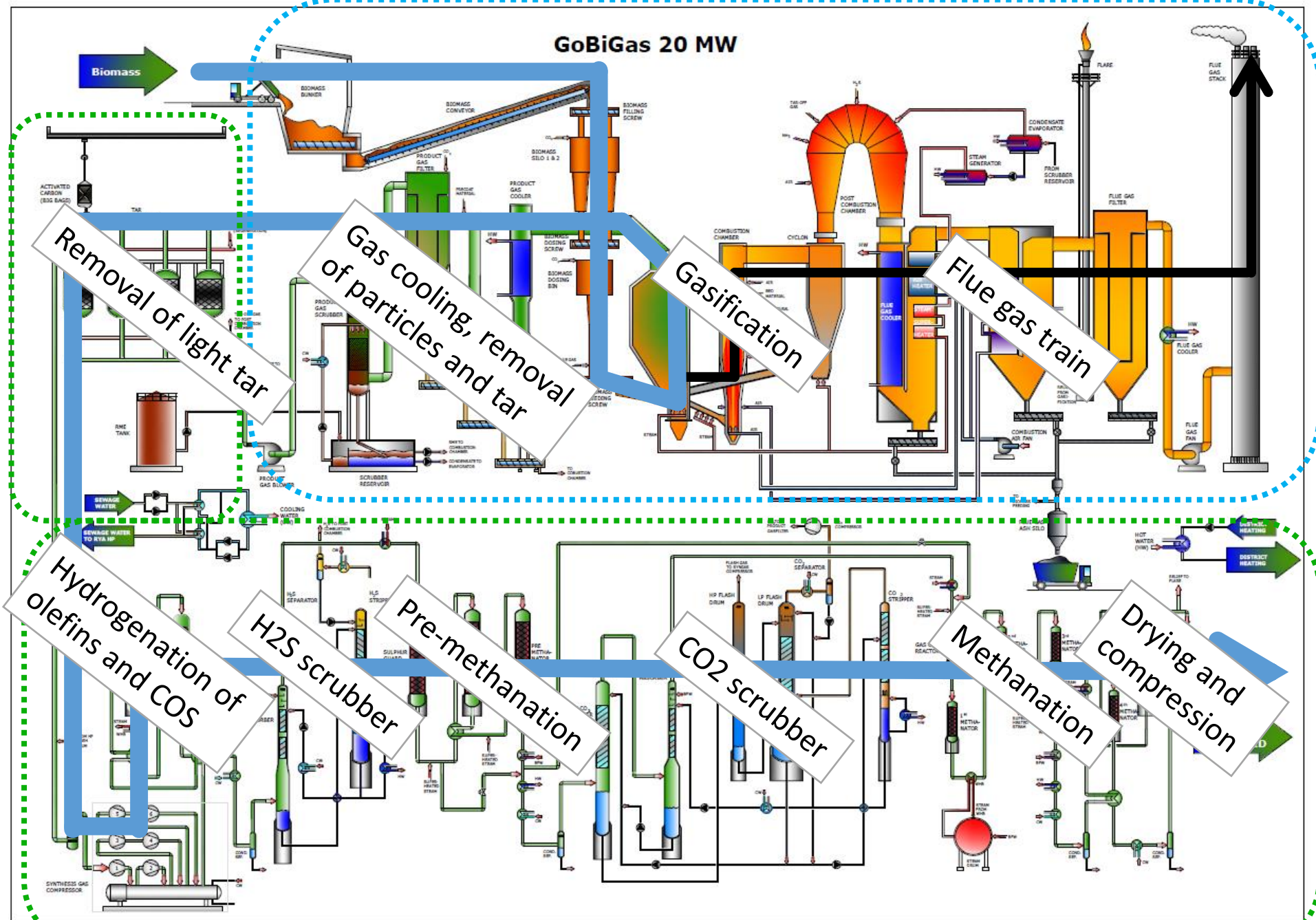
Gothenburg Biomass Gasification Project (GoBiGas)



- Two phases:
 1. 20 MW Biomethane
(32 MW fuel, 6 dry ton biomass/h)
 2. 80 – 100 MW Biomethane
(125-150 MW fuel 25-30 dry ton biomass/h)
- Phase 1, demonstration, to build experience for the second commercial phase
- Performance goal of demonstration
 - Biomass to Biomethane ≥ 65 %
 - Biomass to Energy ≥ 90 %
 - 8,000 hours continuous operation per year

GoBiGas 20 MW

öteborg Energi
Flue gas



Removal of light tar

Gas cooling, removal of particles and tar

Gasification

Flue gas train

Hydrogenation of olefins and COS

H2S scrubber

Pre-methanation

CO2 scrubber

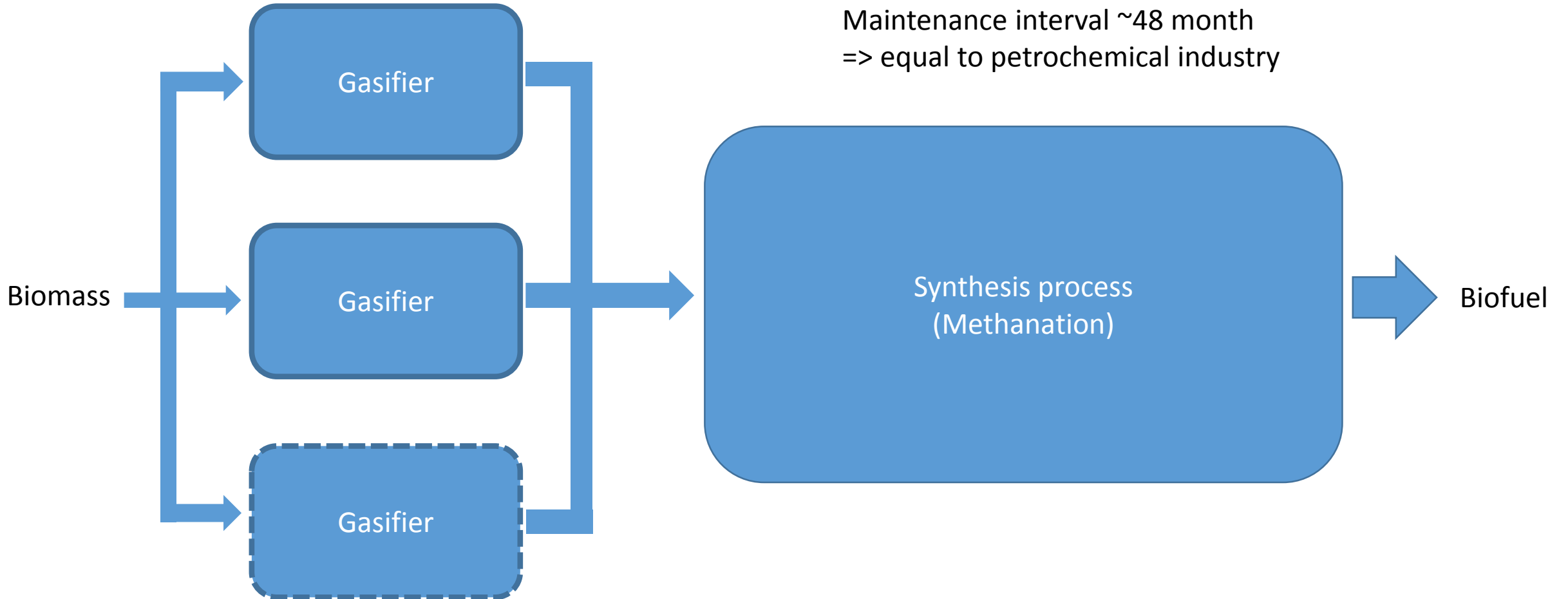
Methanation

Drying and compression

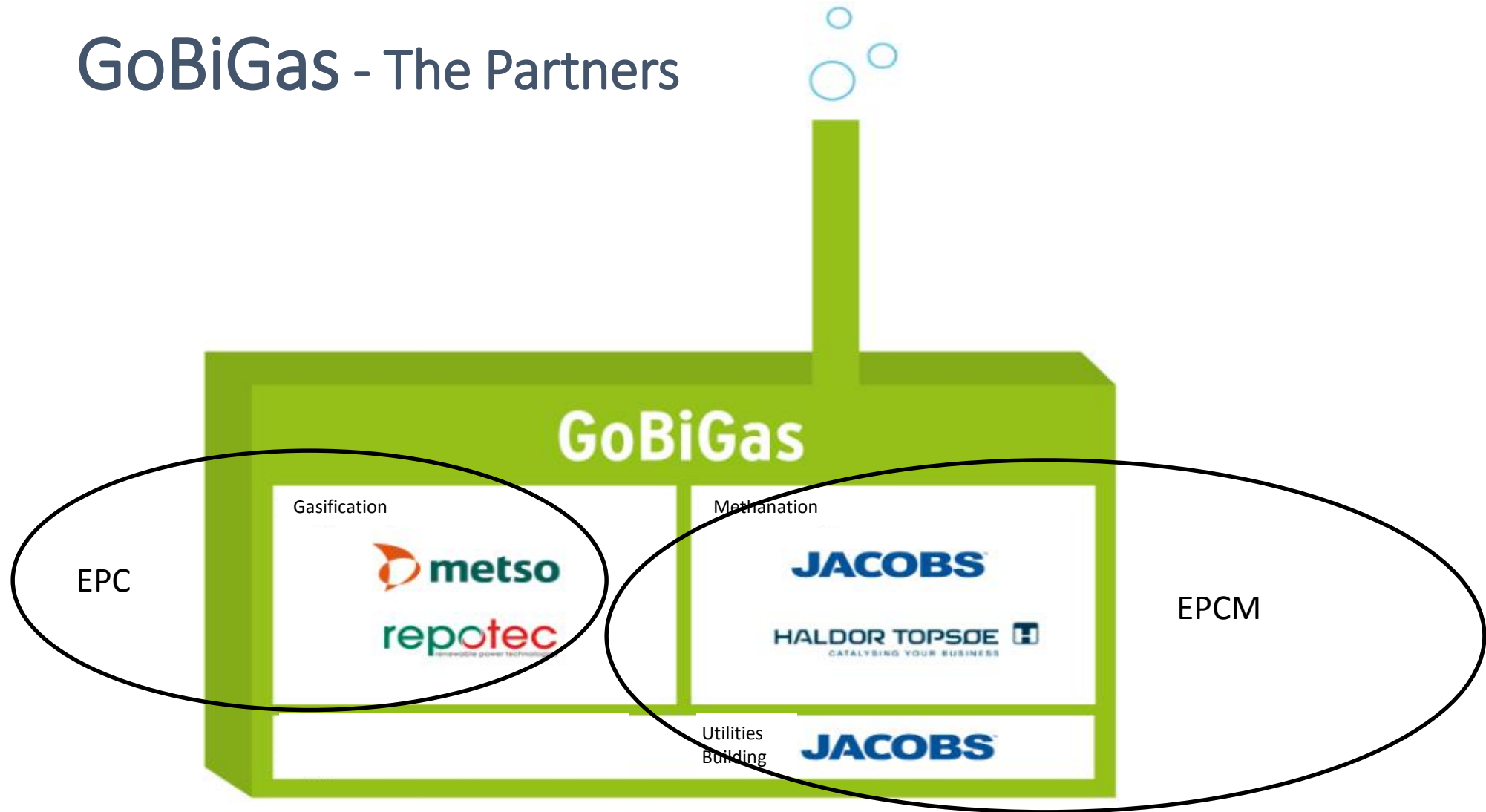
Biomethane

Commercial plant

Maintenance interval 12-18 month
=> equal to forest industry



GoBiGas - The Partners



Development of Gasification technology

Retrofit of commercial designs of fluidized boilers



2-4 MW

Gothenburg



2 MW

Yokohama



15 MW

Kujan Indonesia

Target

Production of
Fuels, Materials,
Chemicals
>100 MW

Upscaling of dedicated gasification design



32 MW

Gothenburg



8 MW
Güssing

FIRST GENERATION



8.5 MW
Oberwart

SECOND GENERATION



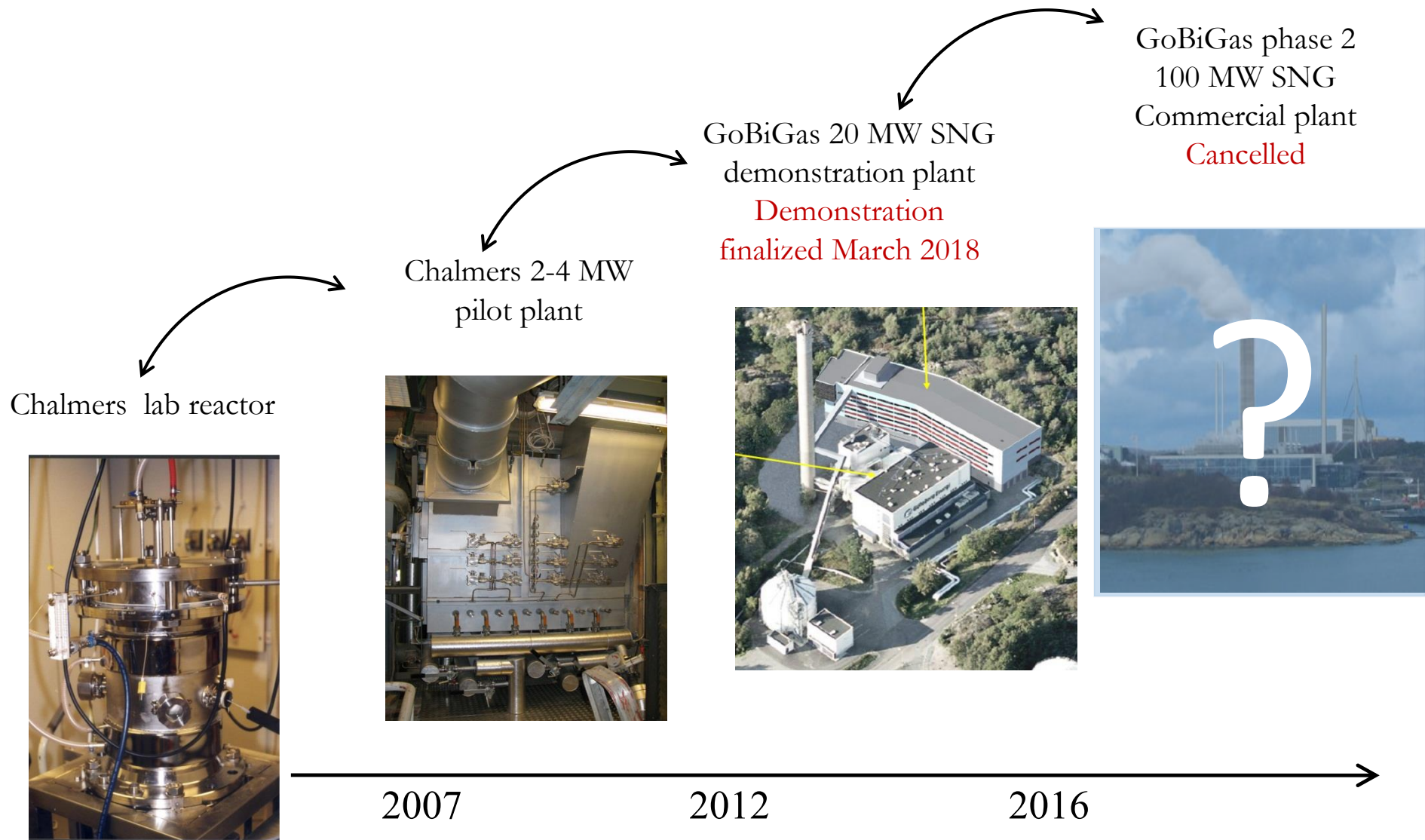
15 MW
HGA Senden

THIRD GENERATION

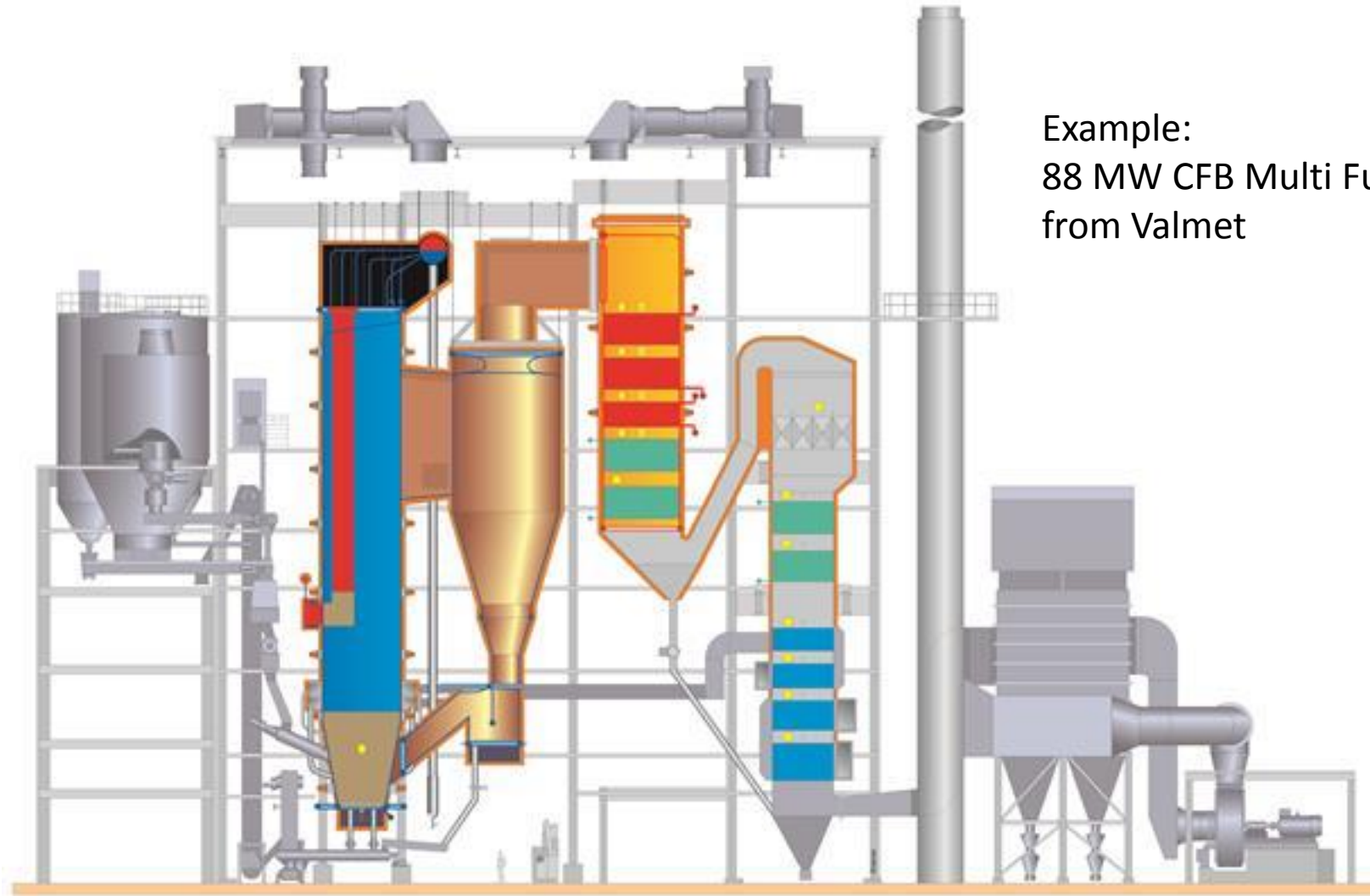
Target

Decentralized
Heat and Power
Production
<50 MW

Handling of uncertainty related to the gasification



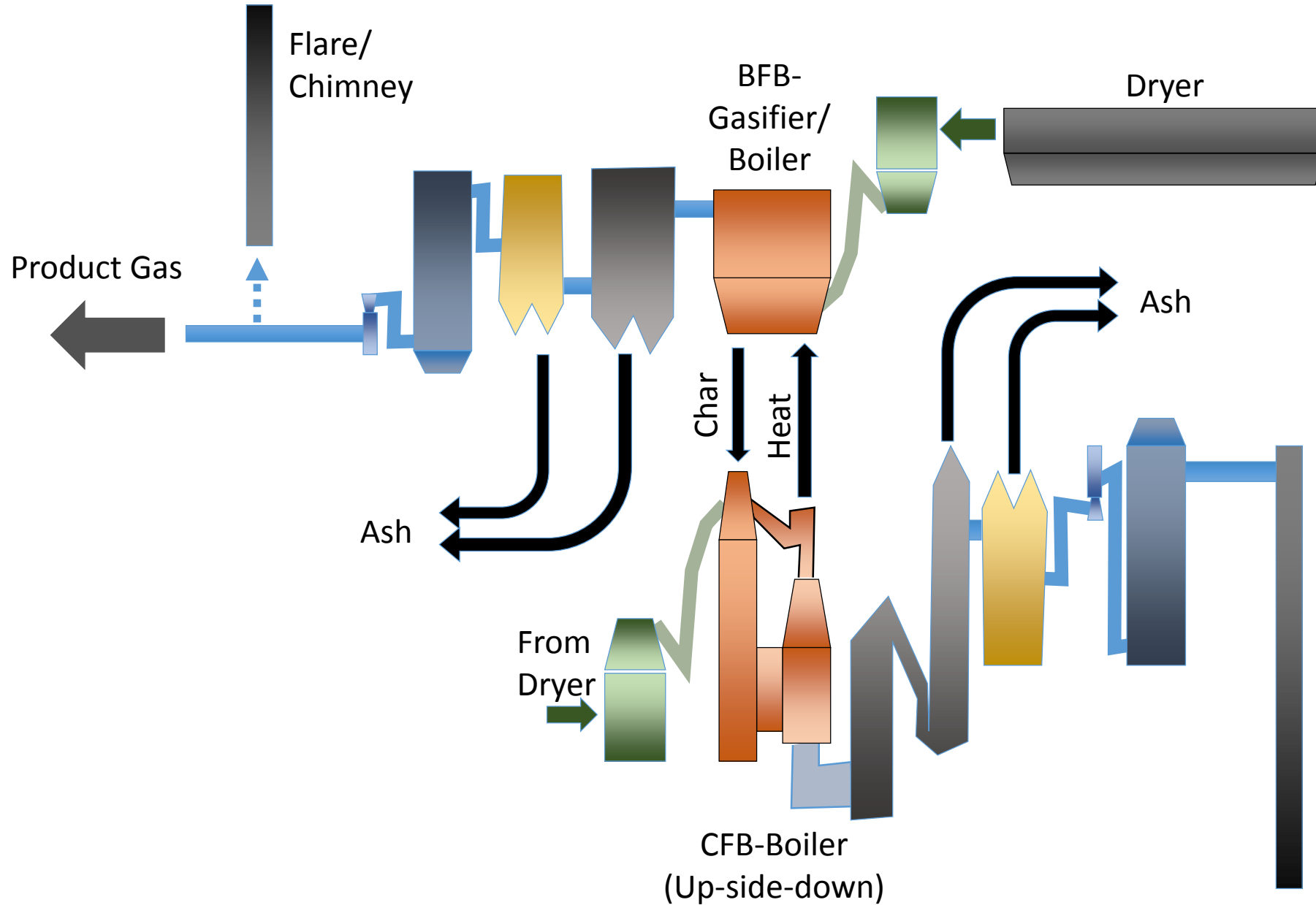
Basis of Selected Gasification Technology



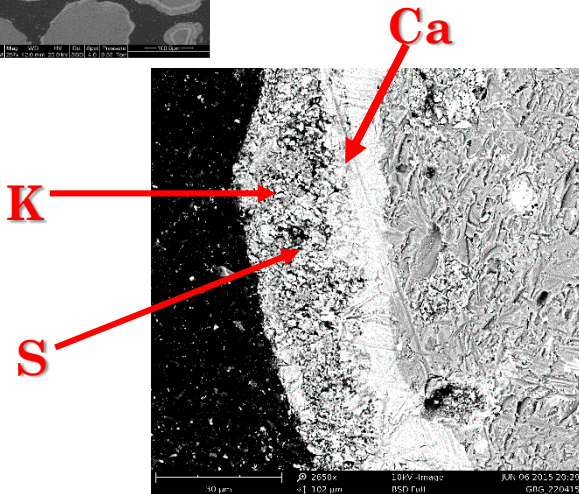
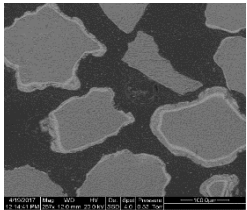
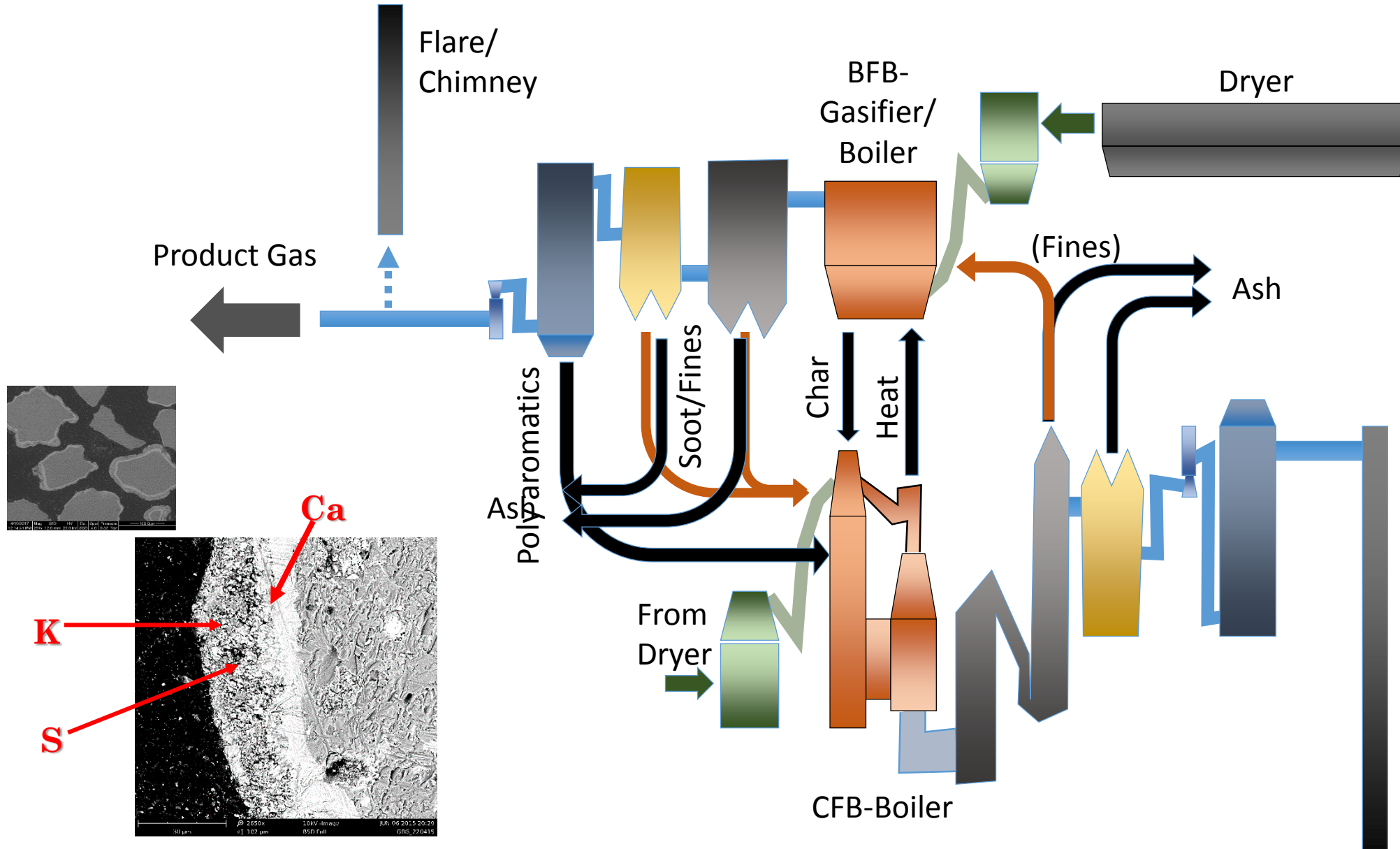
Example:
88 MW CFB Multi Fuel Boiler
from Valmet

Reference: <http://www.endswasteandbioenergy.com/article/1229053/paper-mills-multi-fuel-boiler-generate-88mw>

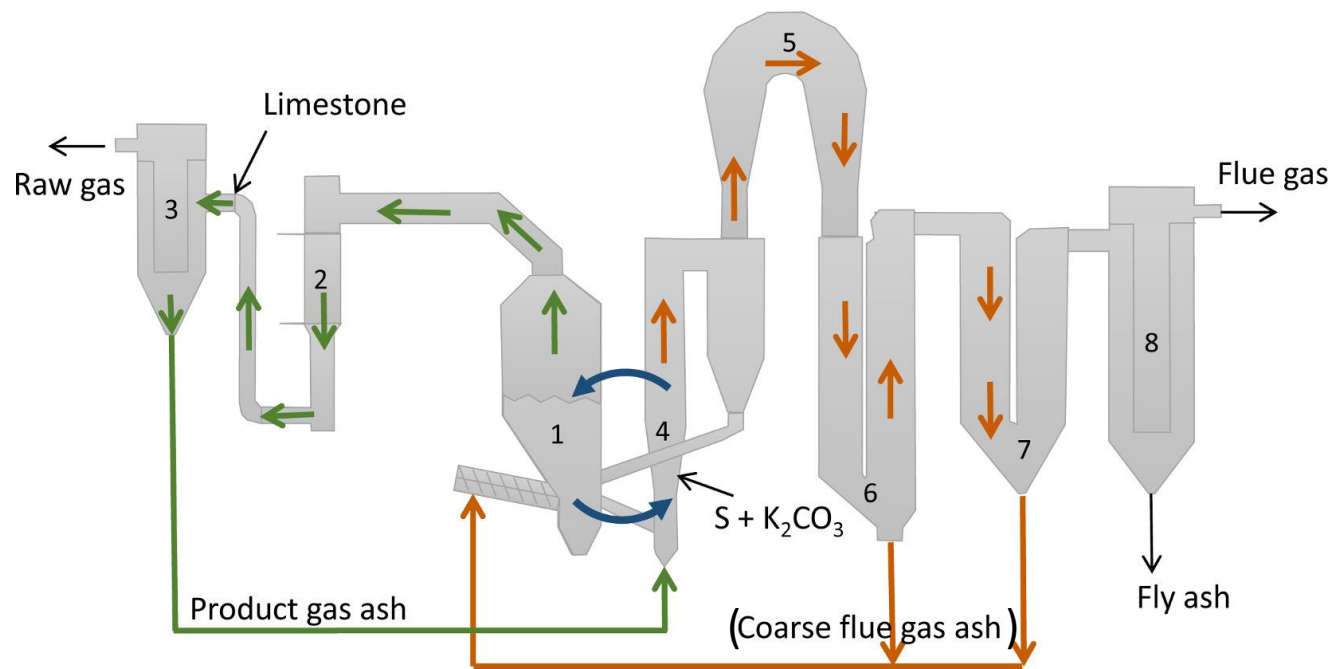
The Gasification Process



The Gasification process

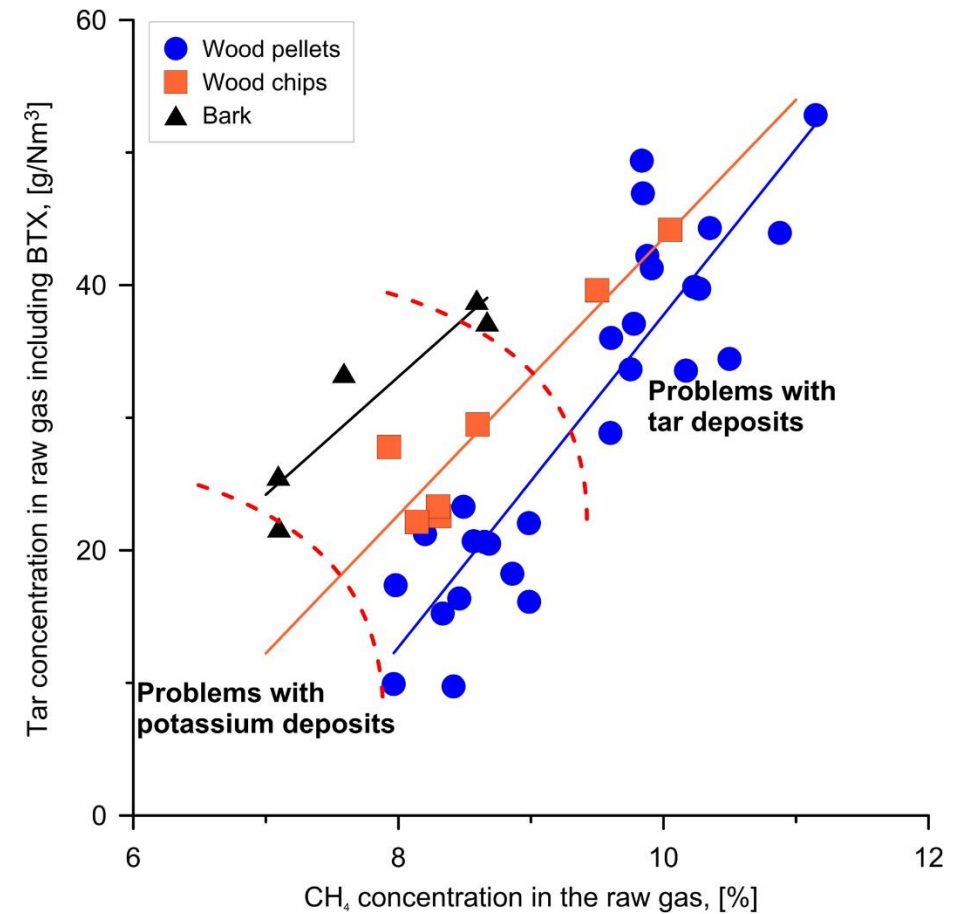


Control of the Gasification Process



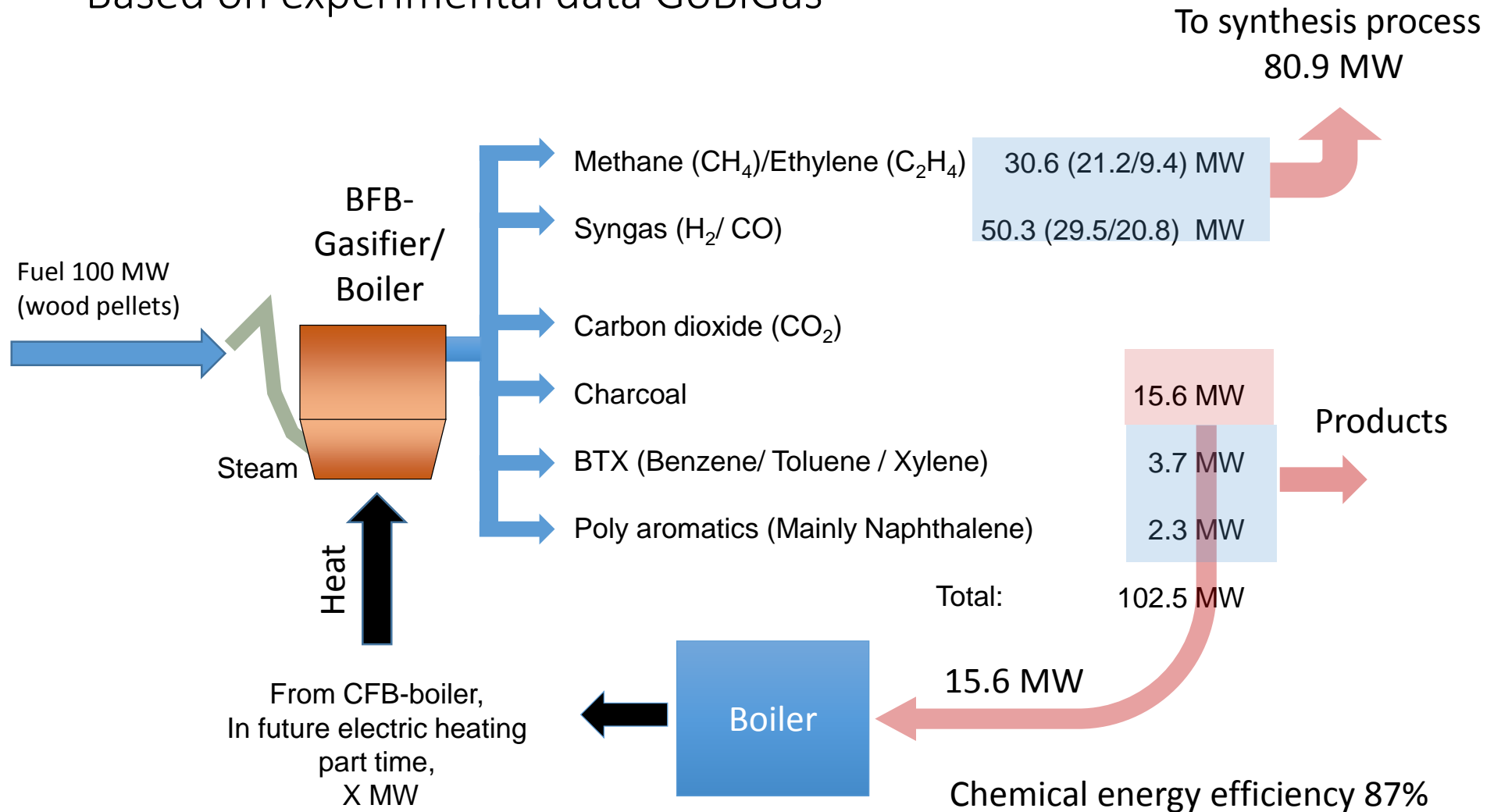
- 1 Gasifier
- 2 Product gas cooler
- 3 Product gas filter
- 4 Combustion chamber

- 5 Post combustion chamber
- 6 Convection path and flow reversal space
- 7 Convection path and flow reversal space
- 8 Flue gas filter

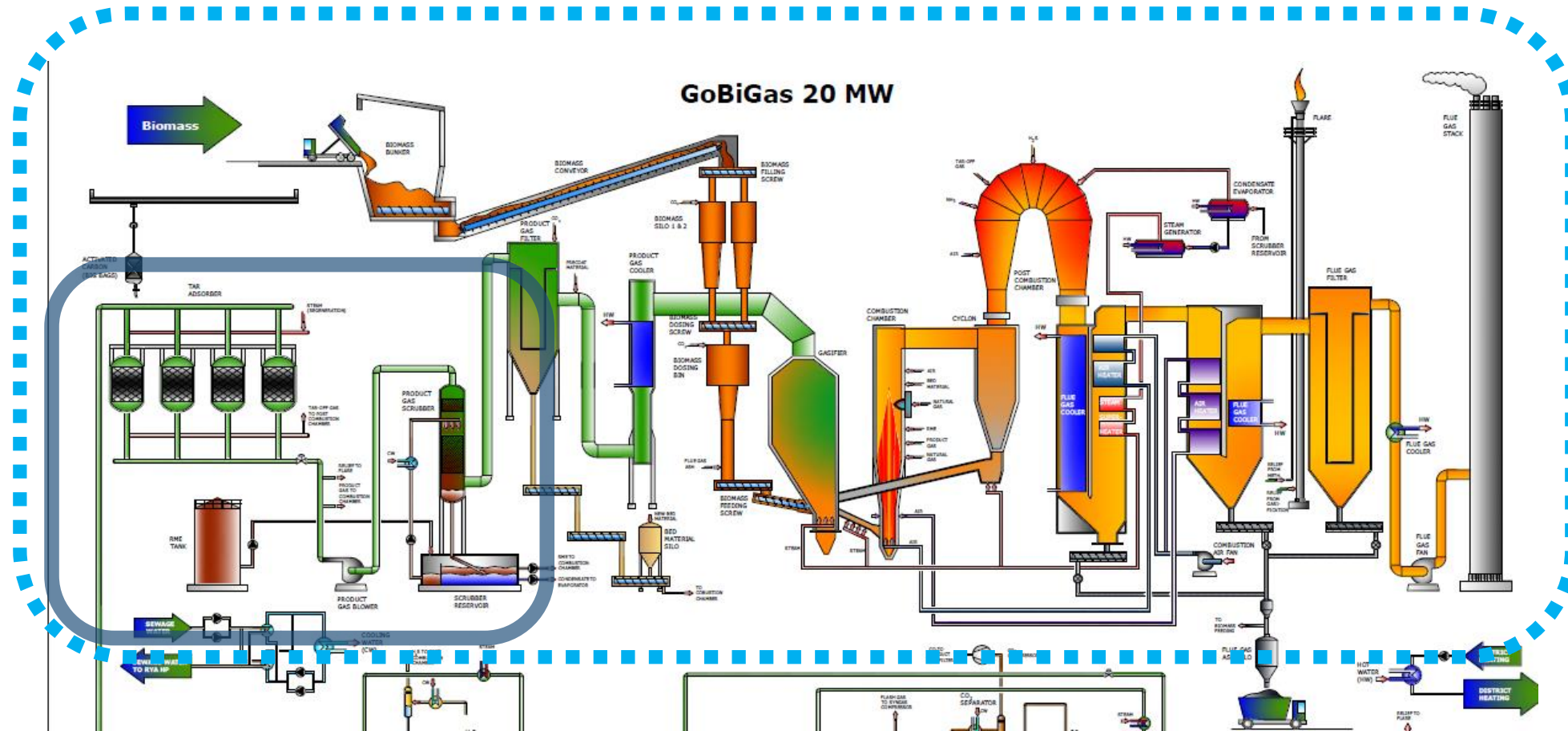


Performance of the Gasification - Optimized Commercial Process

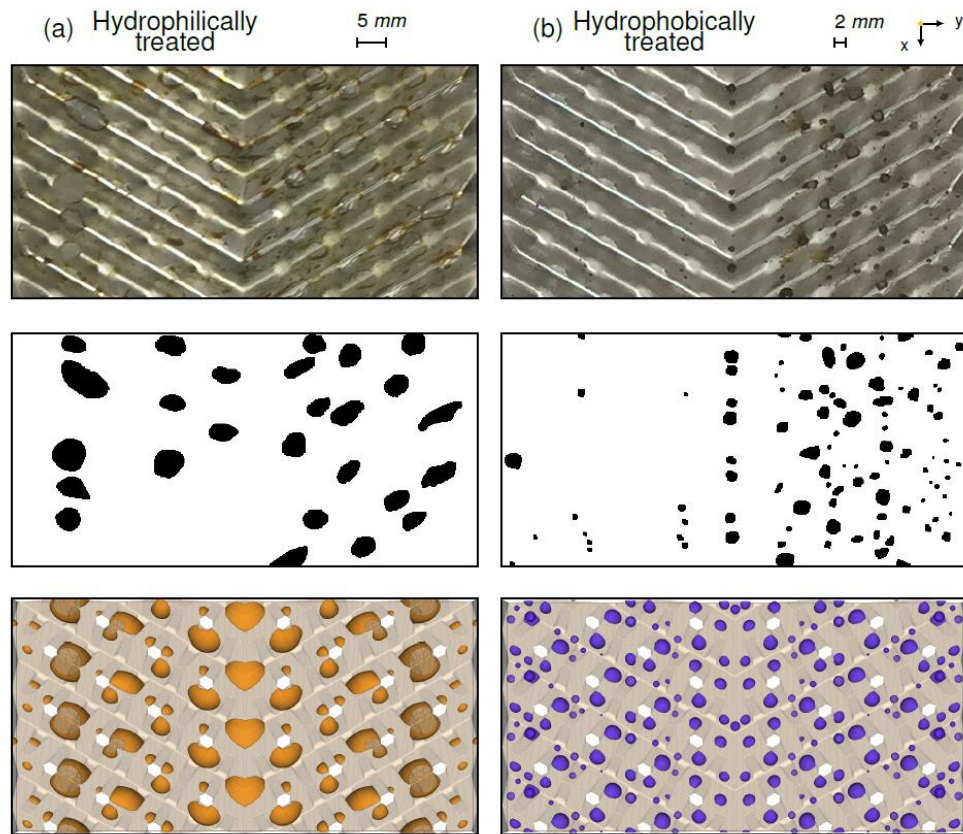
Based on experimental data GoBiGas



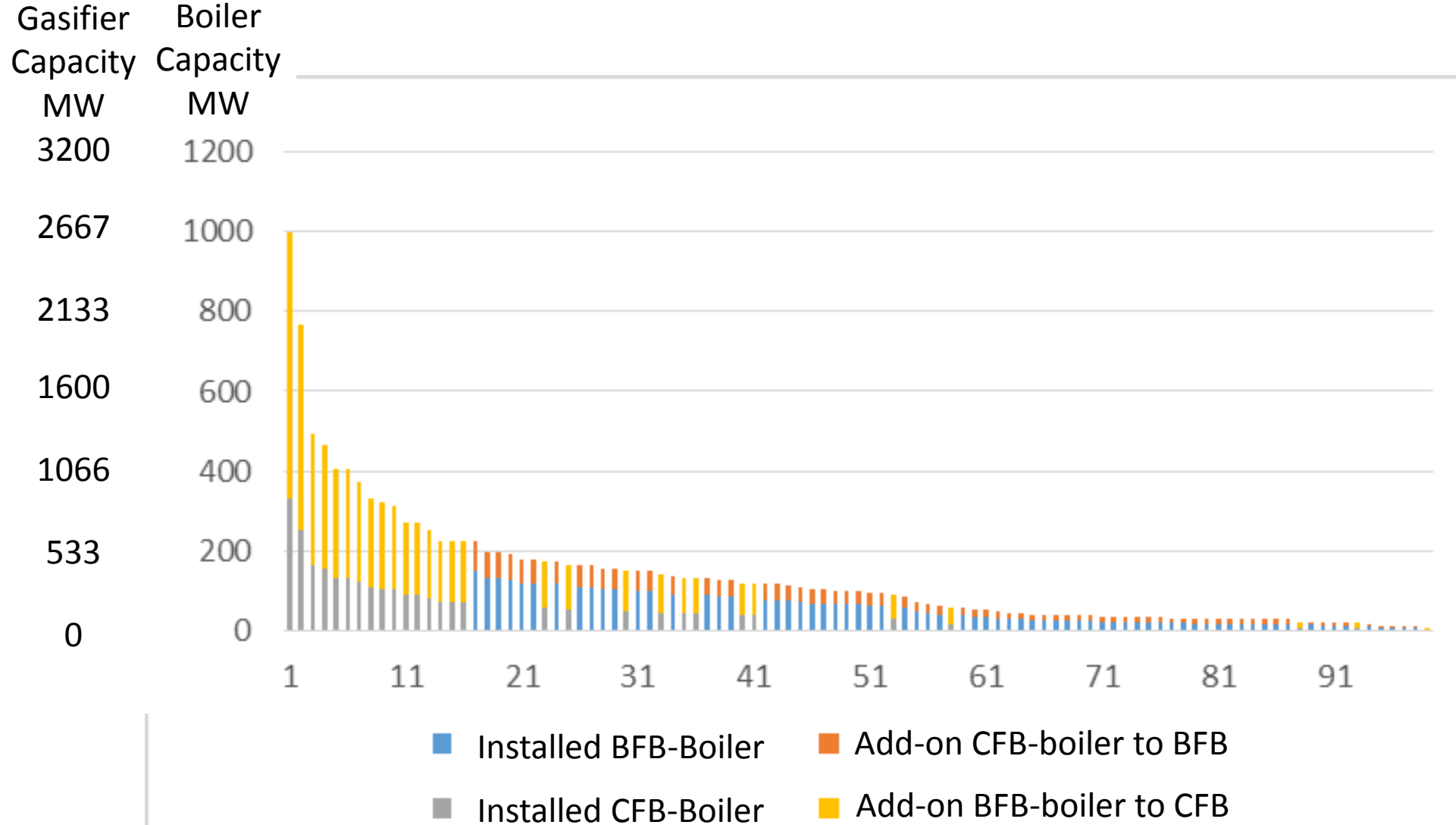
Conditioning of the Gas



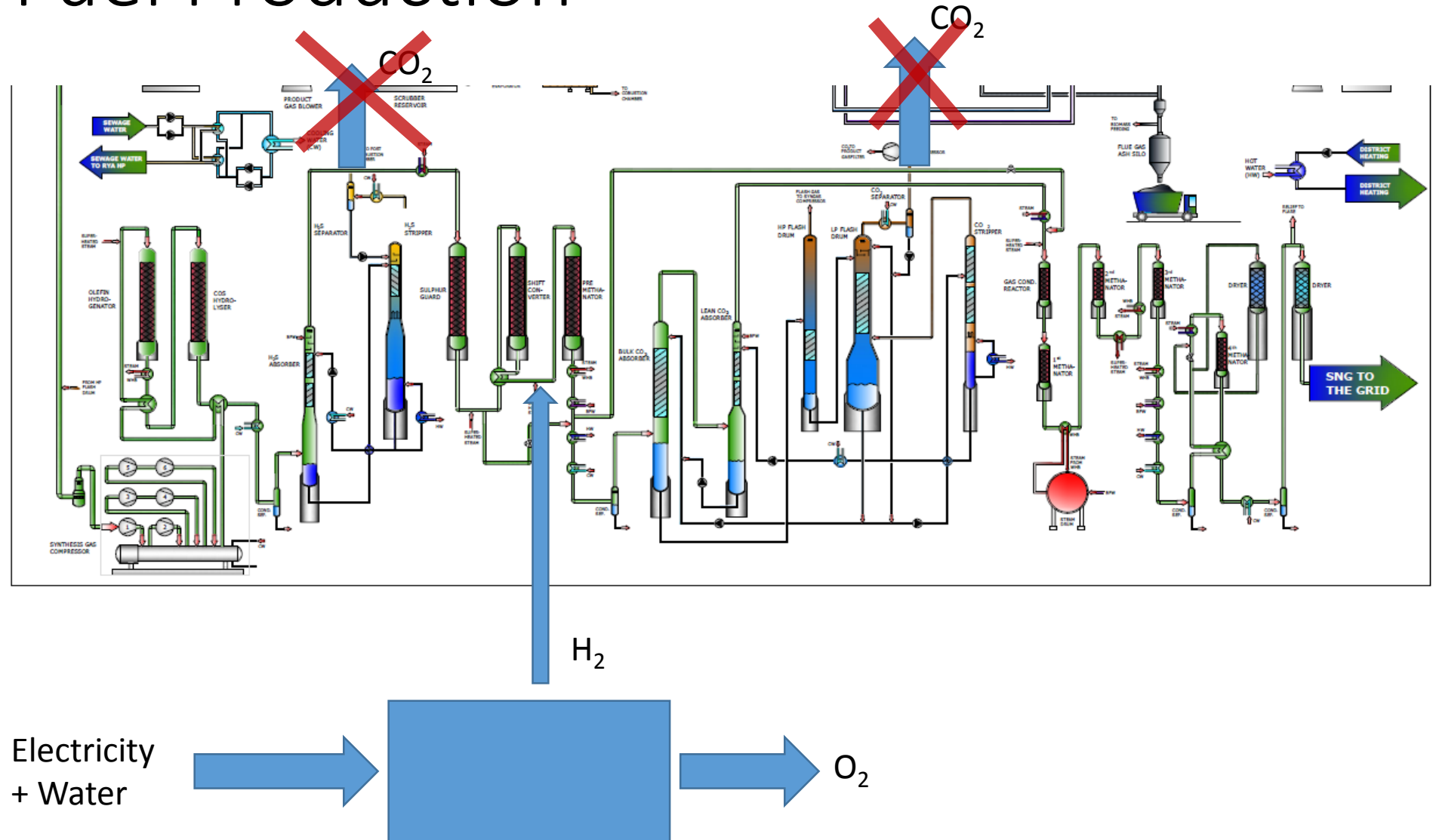
Self-Cleaning Plate Heat Exchangers



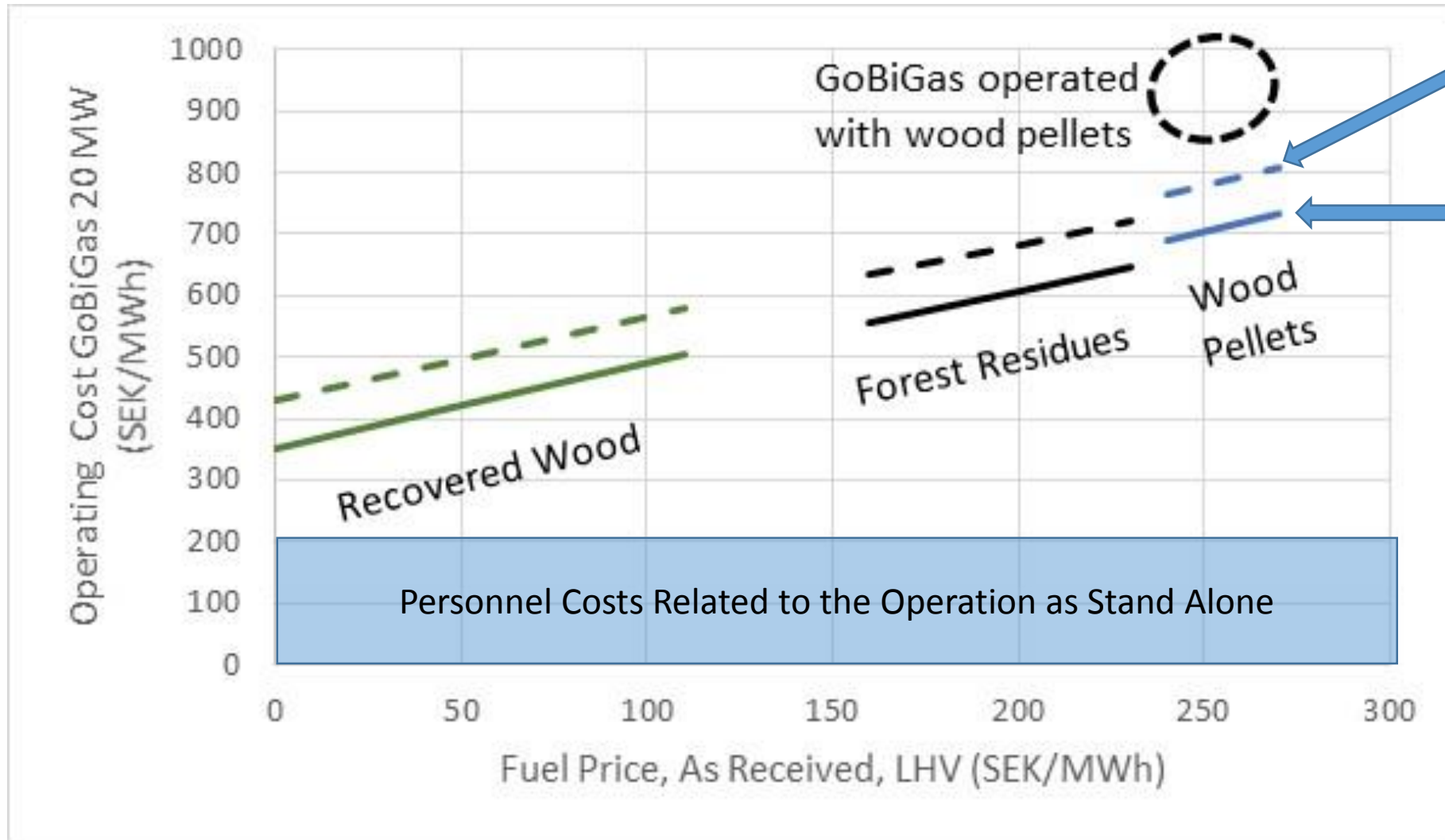
Potential of Transferring Fluidized Bed Boilers to Gasifiers/Pyrolyzers in Sweden



Electro Fuel Production



Operating Cost, Demonstration Unit

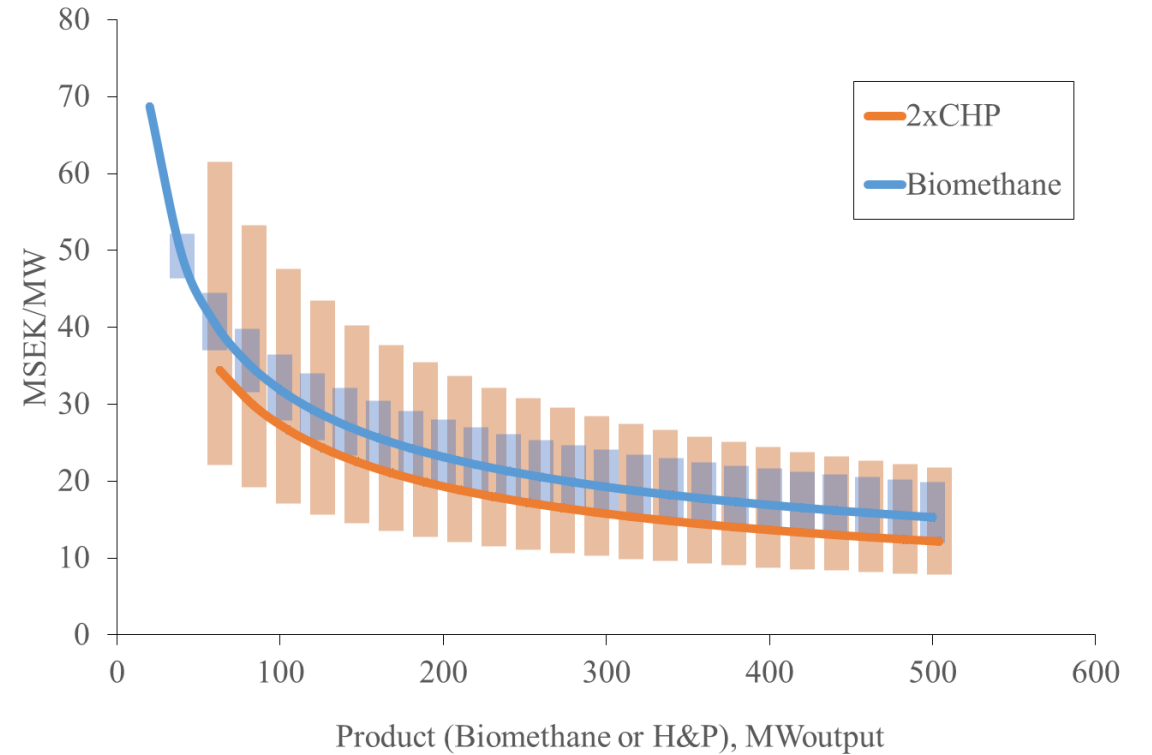
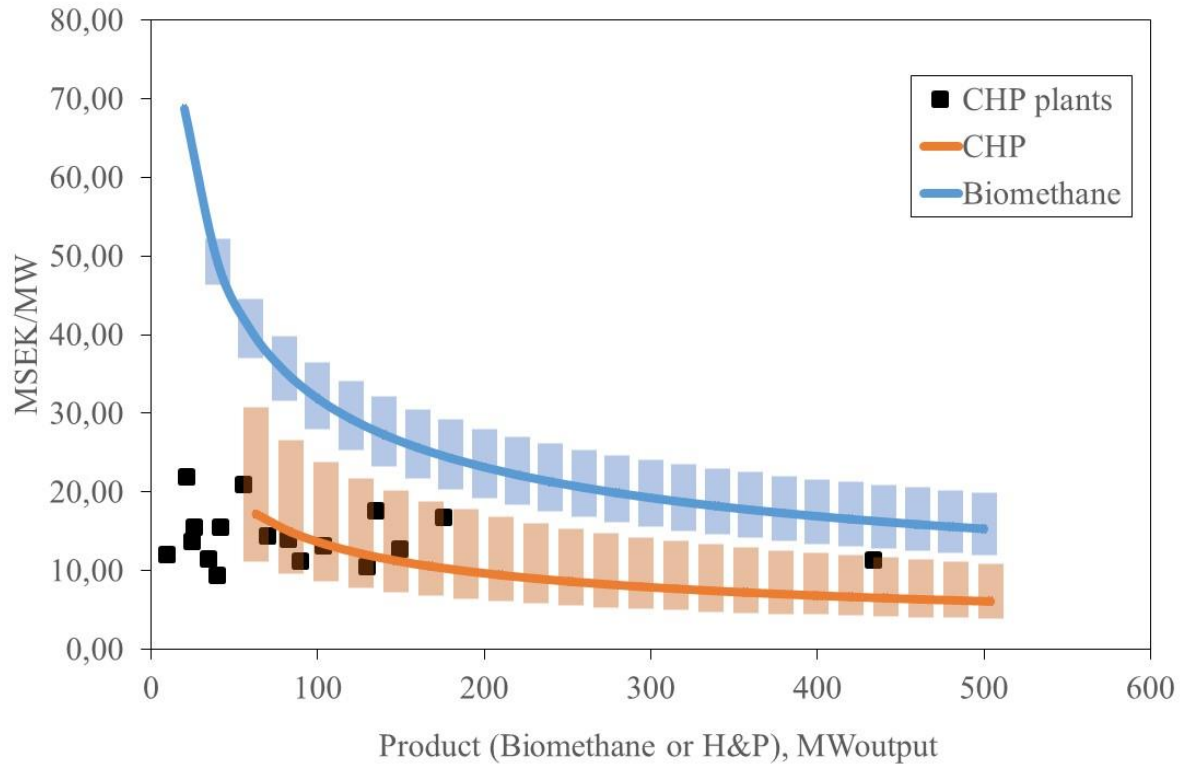


With identified modification of existing process

With identified modification, new plant

Investment Cost for a Commercial Plant

Convert SEK to Euro: divide by 10



Production Costs for a Commercial Plant

	Commercial plant 20 MW SEK/MWh (€-cent/liter gasoline eq.)		Commercial plant 100 MW SEK/MWh (€-cent/liter gasoline eq.)		Commercial plant 200 MW SEK/MWh (€-cent/liter gasoline eq.)	
Capital cost, depreciation	430	(38.7)	199	(17.9)	145	(13.1)
Capital cost, interest (5%)	258	(23.2)	120	(10.8)	87	(7.8)
Development cost	43	(3.9)	20	(1.8)	15	(1.4)
Operation costs (excluding feedstock)	352	(31.7)	166	(14.9)	132	(11.9)
Feedstock Cost	217	(19.5)	217	(19.5)	217	(19.5)
Total cost	1300	(117.0)	722	(65.0)	596	(53.6)

Conclusions

- Demonstration met all pre-set performance goals and made the technology ready for commercial implementation
- Demonstration has provided vital information on how to operate the gasification section in an industrial scale
- Demonstration plant could not reach commercial break-even at today's conditions and is therefore mothballed

Thank you

Questions?