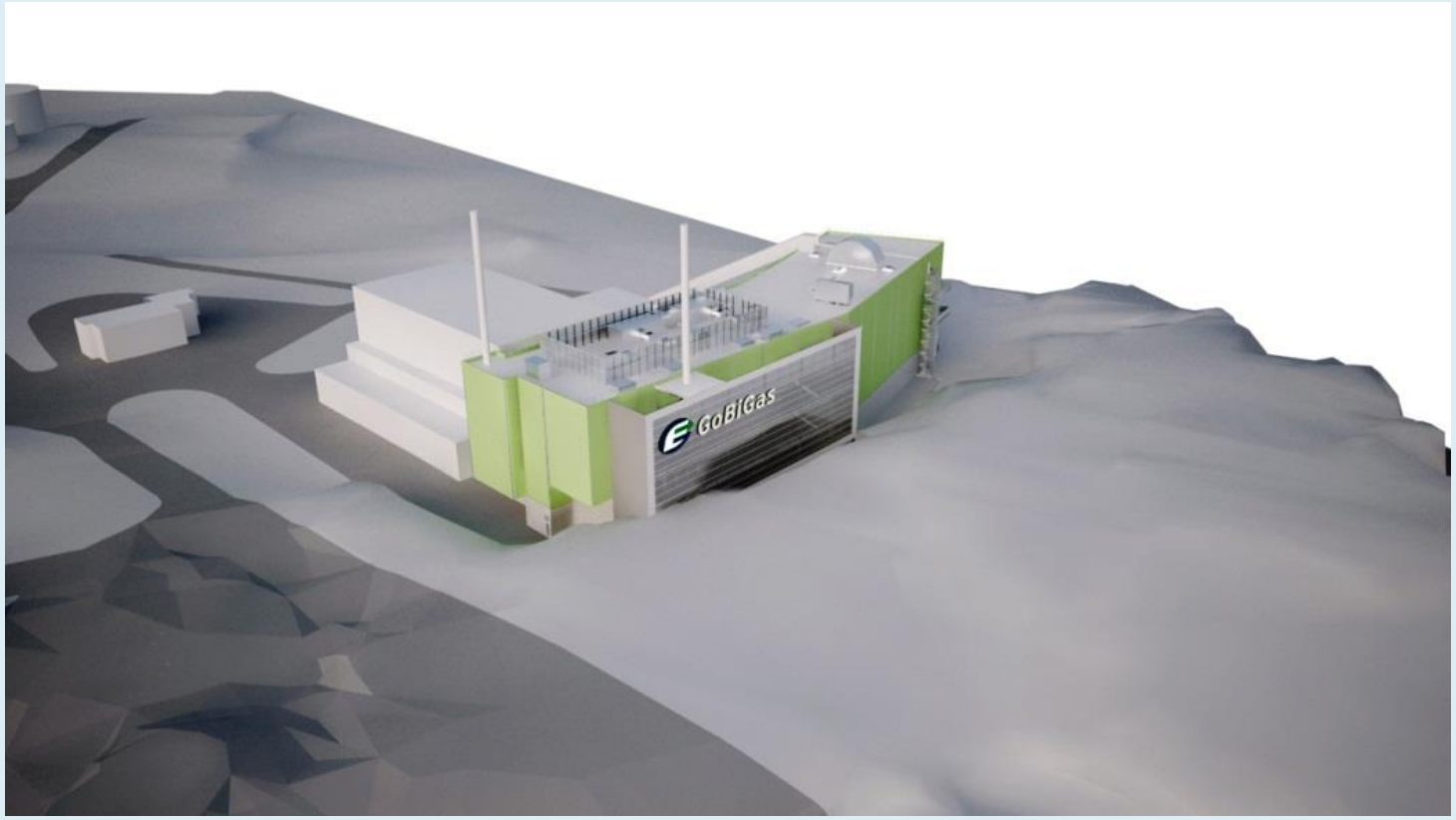


Development and experiences from operation of wood-based biomethane plant GoBiGas

Lars Holmquist, Public Affairs, Göteborg Energi AB

Gothenburg 19 May 2017

Göteborg Energi

Biogas potential

Biogas has a wide range of biomass feedstock.

Cities	Agriculture	Forestry
		
Sludge Household waste Industry org waste Landfill	Manure Rest-products Energy crops	Residues from forest & industry

Göteborg Energi

GoBiGas – Pioneering New Technology

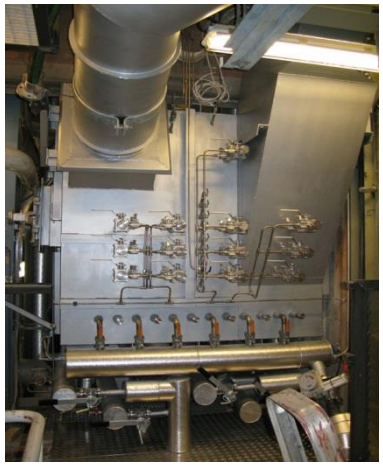
- The world's first plant for bio methane from biomass through gasification
- The first Swedish plant to inject bio-methane into the interregional grid

Göteborg Energi

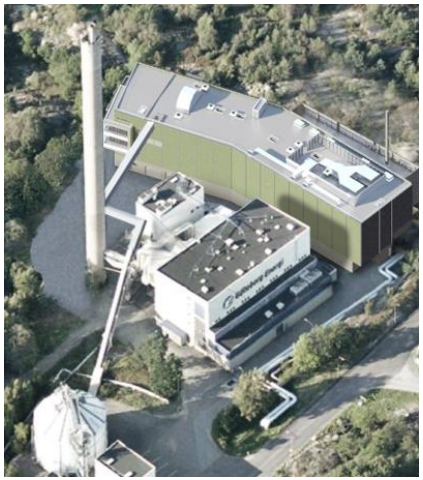
GoBiGas – Step-by-Step Development

Chalmers
Lab-Reactor

"The Chalmers Gasifier"
Chalmers 2-4 MW
Pilot Plant



GoBiGas Phase 1
20 MW bio-methane
Demonstration Plant



GoBiGas Phase 2
80-100 MW bio-methane
Commercial Plant

Göteborg Energi

GoBiGas – Demonstrate - Commercialize?

Phase 1: 20 MW

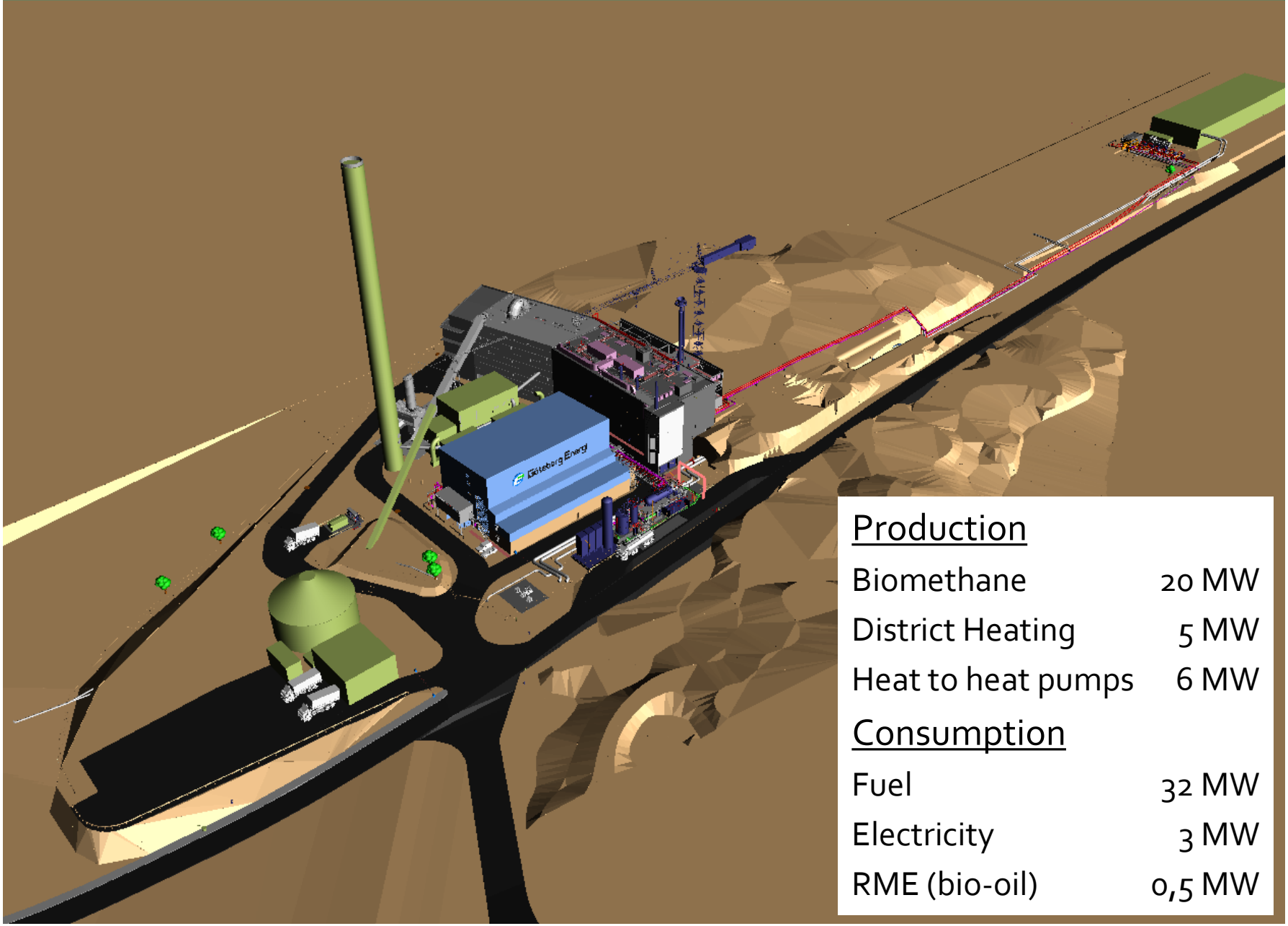
Demonstration Plant, partly financed by the Swedish Energy Agency

Phase 2: 80-100 MW

Commercial Plant - *after* proof of Phase 1 *and* secured financing

Selected project by the EU-commission in NER 300

Göteborg Energi



Production

Biomethane	20 MW
District Heating	5 MW
Heat to heat pumps	6 MW

Consumption

Fuel	32 MW
Electricity	3 MW
RME (bio-oil)	0,5 MW

Göteborg Energi

Main suppliers
Strategy for implementation

Gasification – Contract with Metso Power in Gothenburg.

- Metso Power has a license agreement with Repotec from Austria.
- Reference plants: Güssing, Austria and Senden, Germany

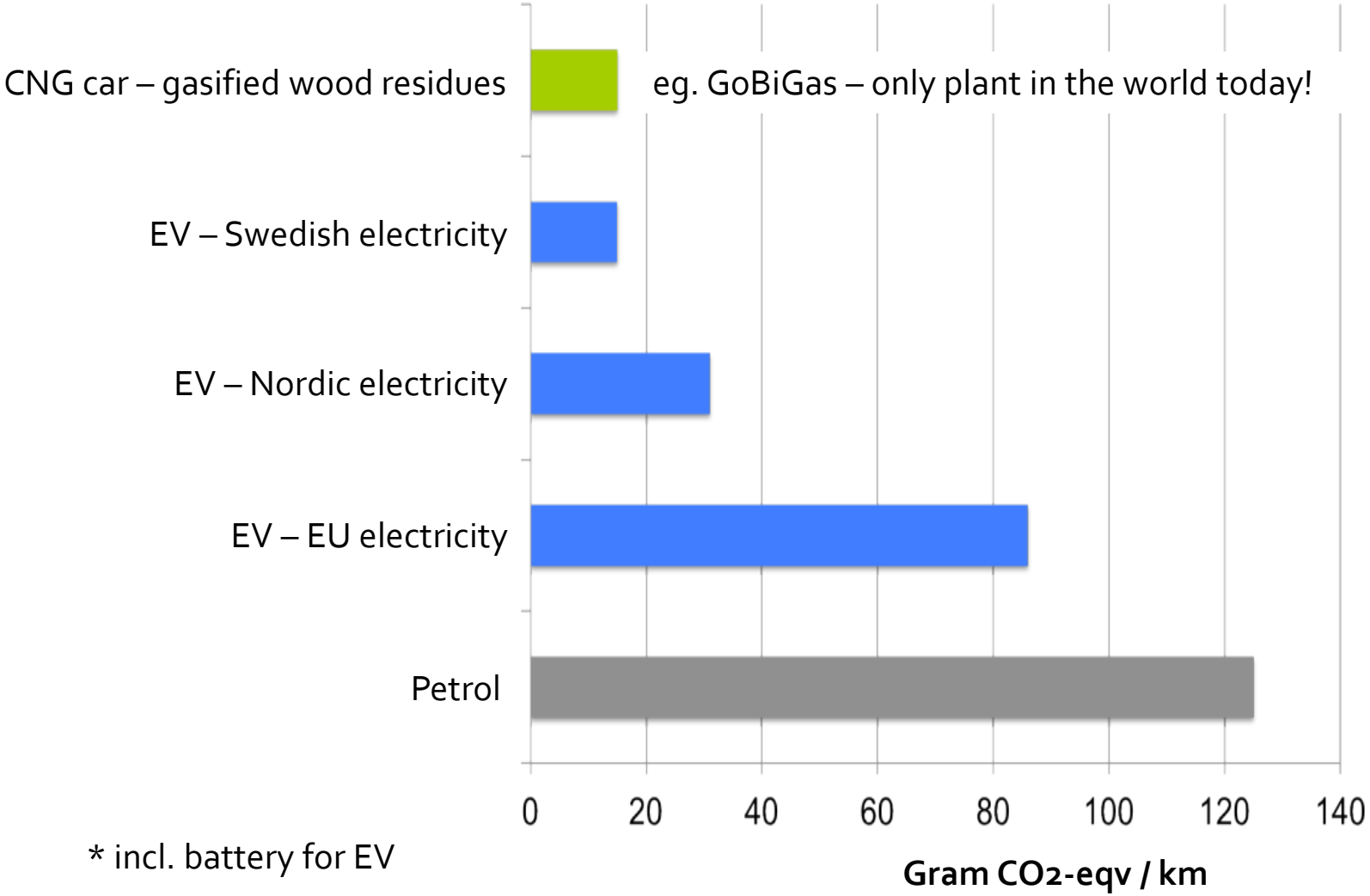
Methanation – Contracts with Haldor Topsoe from Denmark design/ license and catalyst supply.

EPCM –Contract with Jacobs Process BV from the Netherlands.

- **E**ngineering, **P**rocurement, **C**onstruction **M**anagement
- Overall coordination

Göteborg Energi

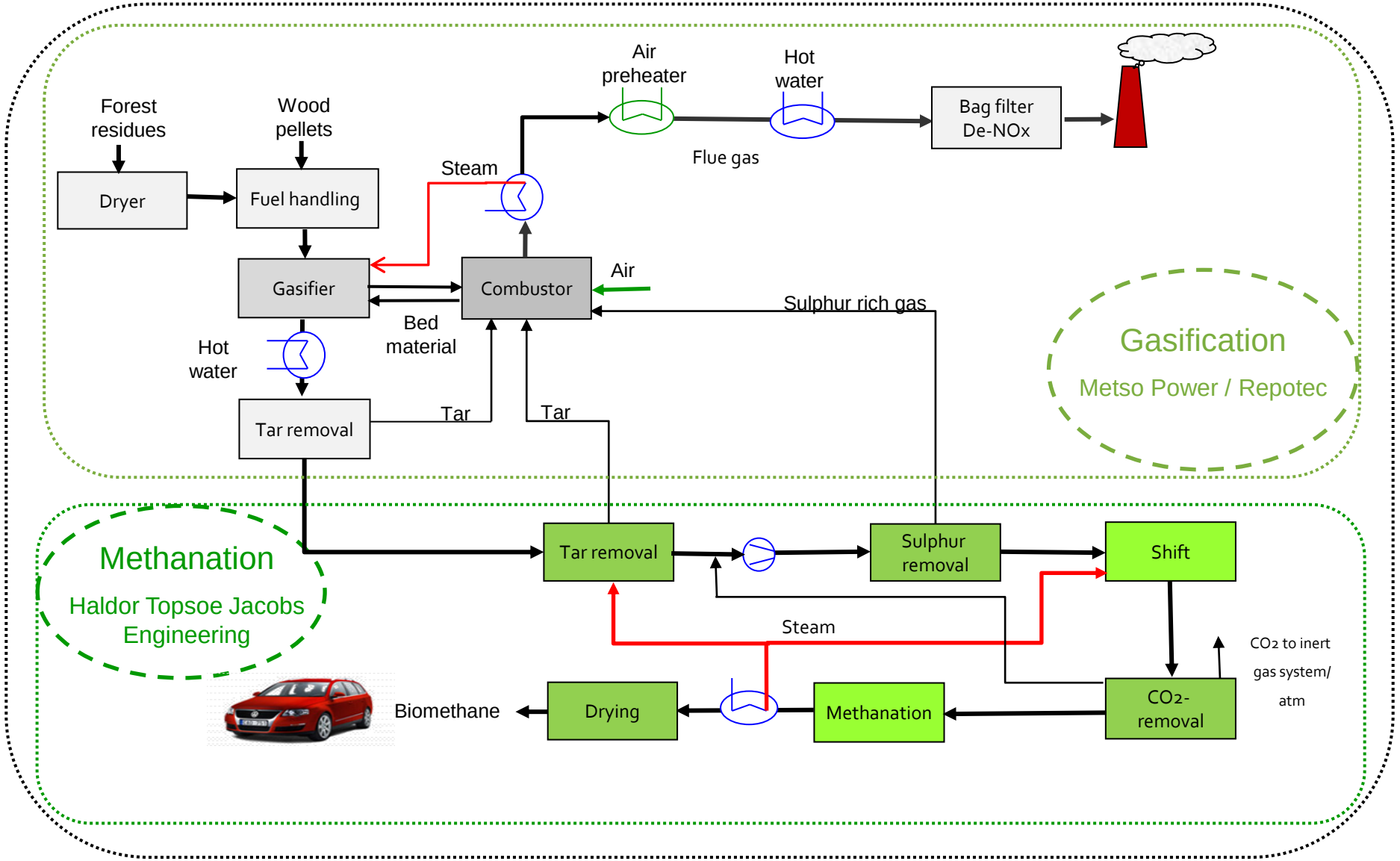
Well-to-wheel emissions* - Greenhouse gases



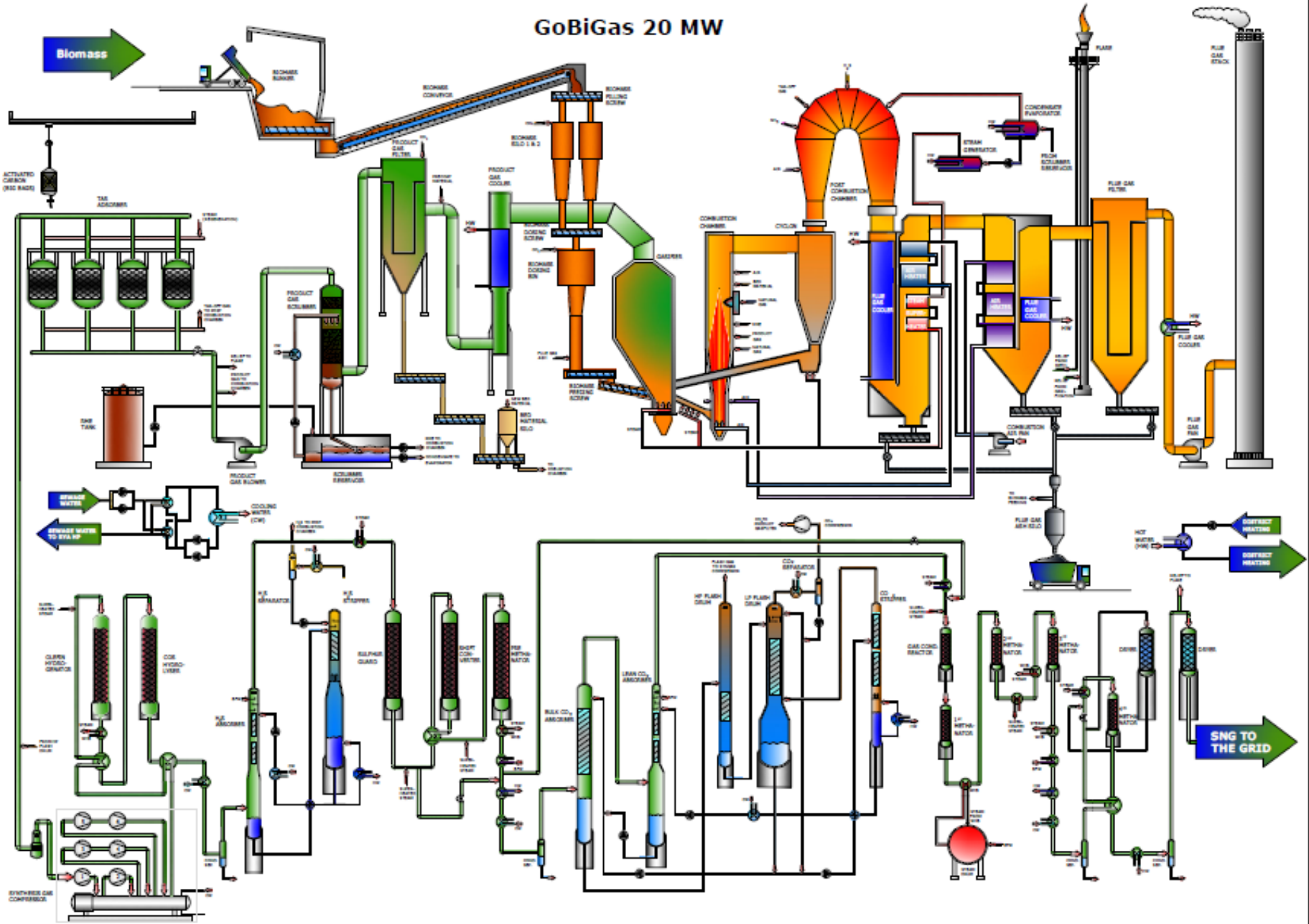
* incl. battery for EV

Göteborg Energi

Technical principles



Göteborg Energi



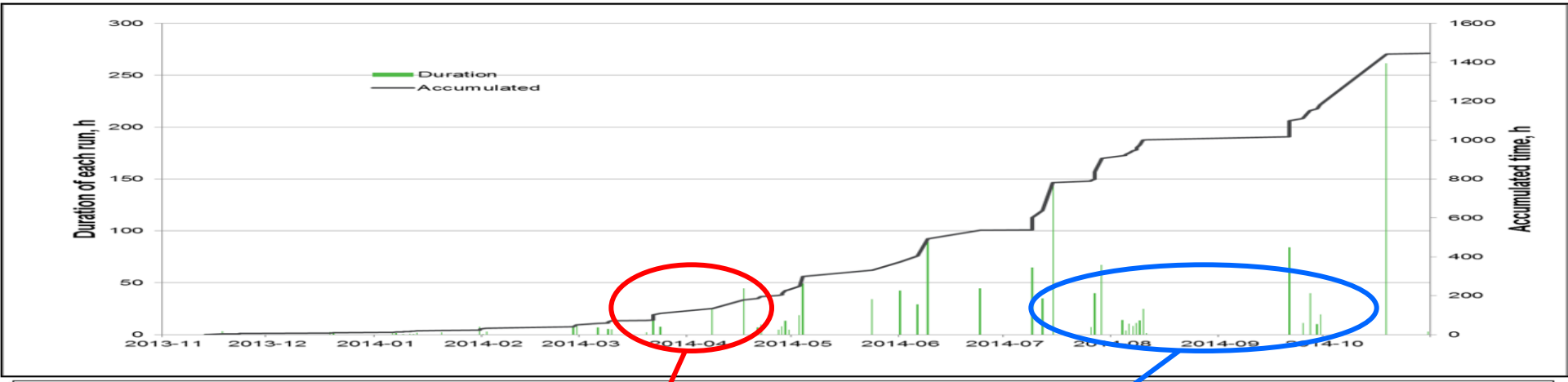
Göteborg Energi

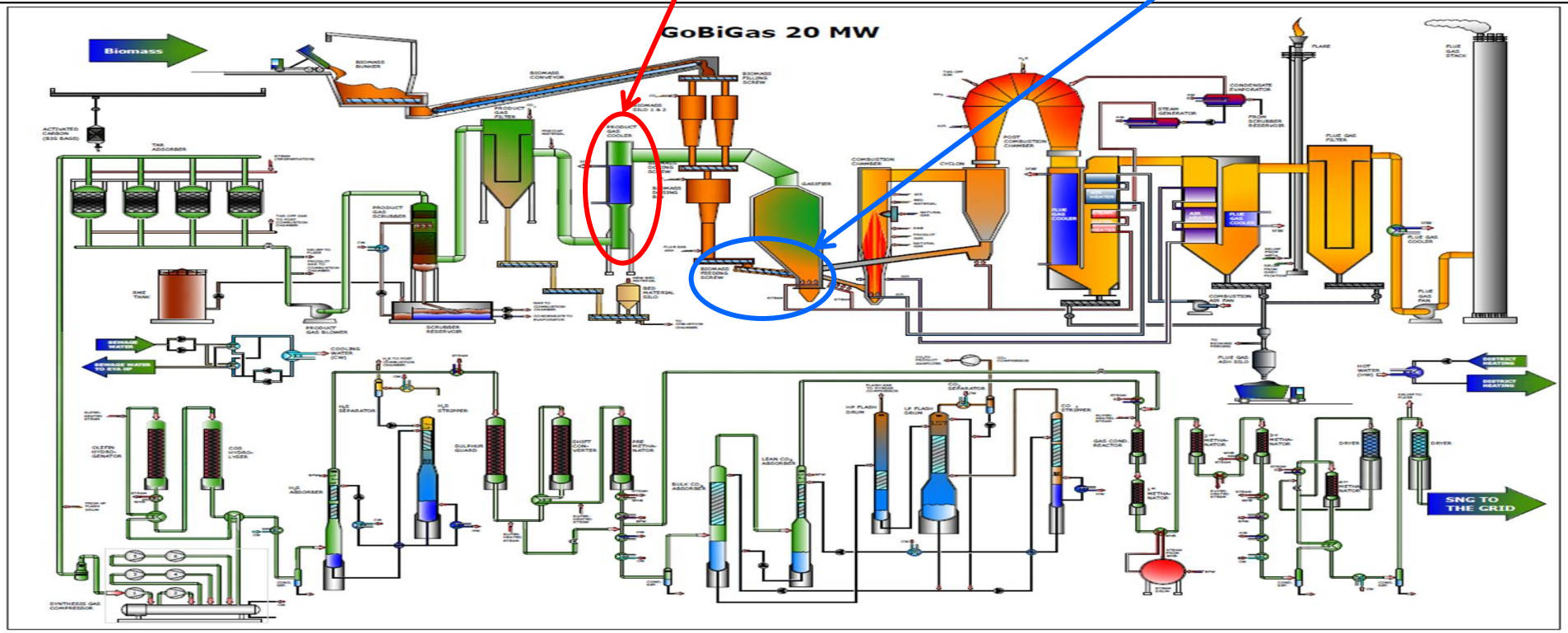
2013 – Demonstration plant in place

- Industrial-scale demonstration:
- 20 MW (2200 Nm3/hr) Bio-methane
- 5 MW District heating
- Biomass to bio-methane > 65 %
- Operation 8000 h/year
- Can supply 16,000 cars yearly with fuel.

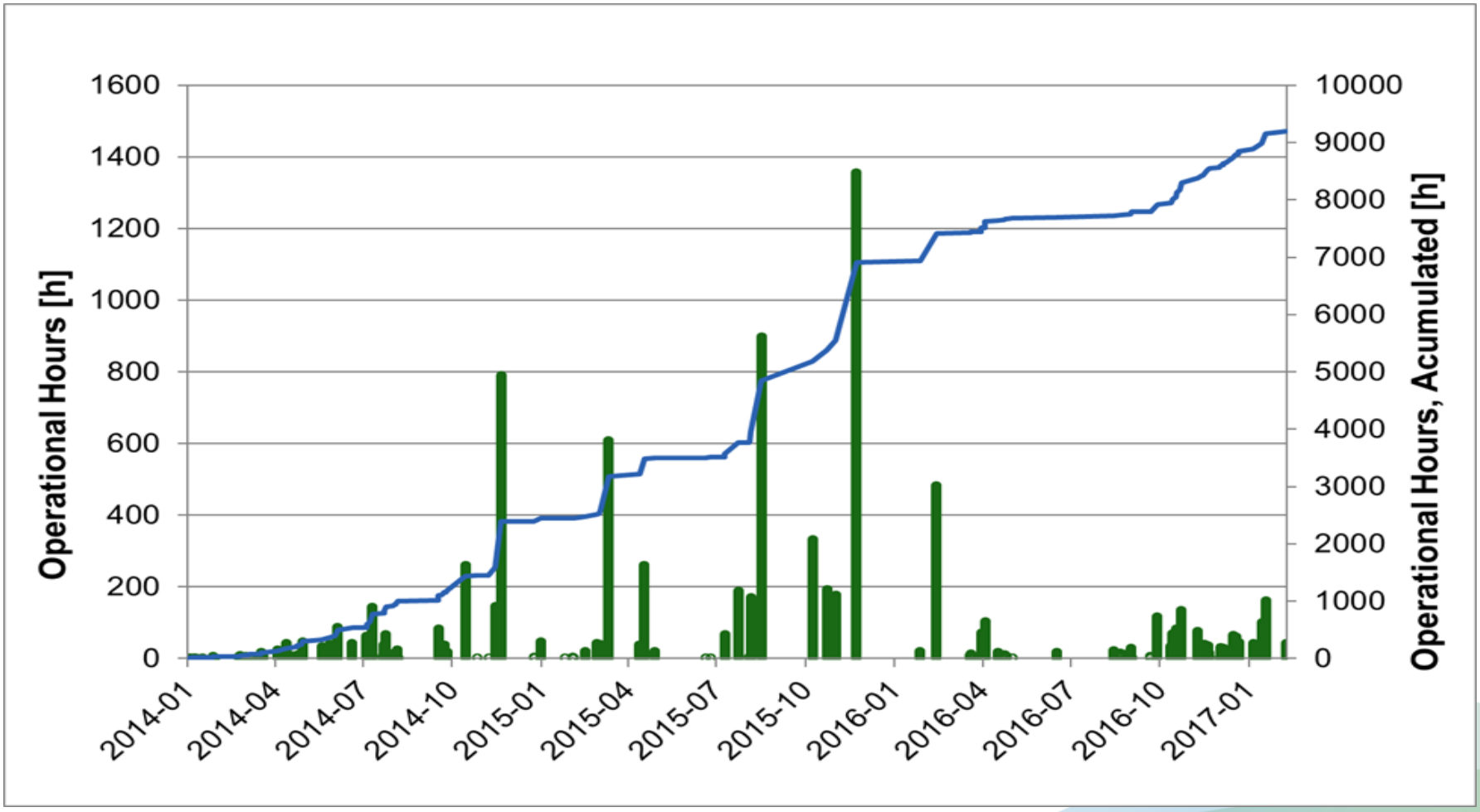
Göteborg Energi

Two major challenges



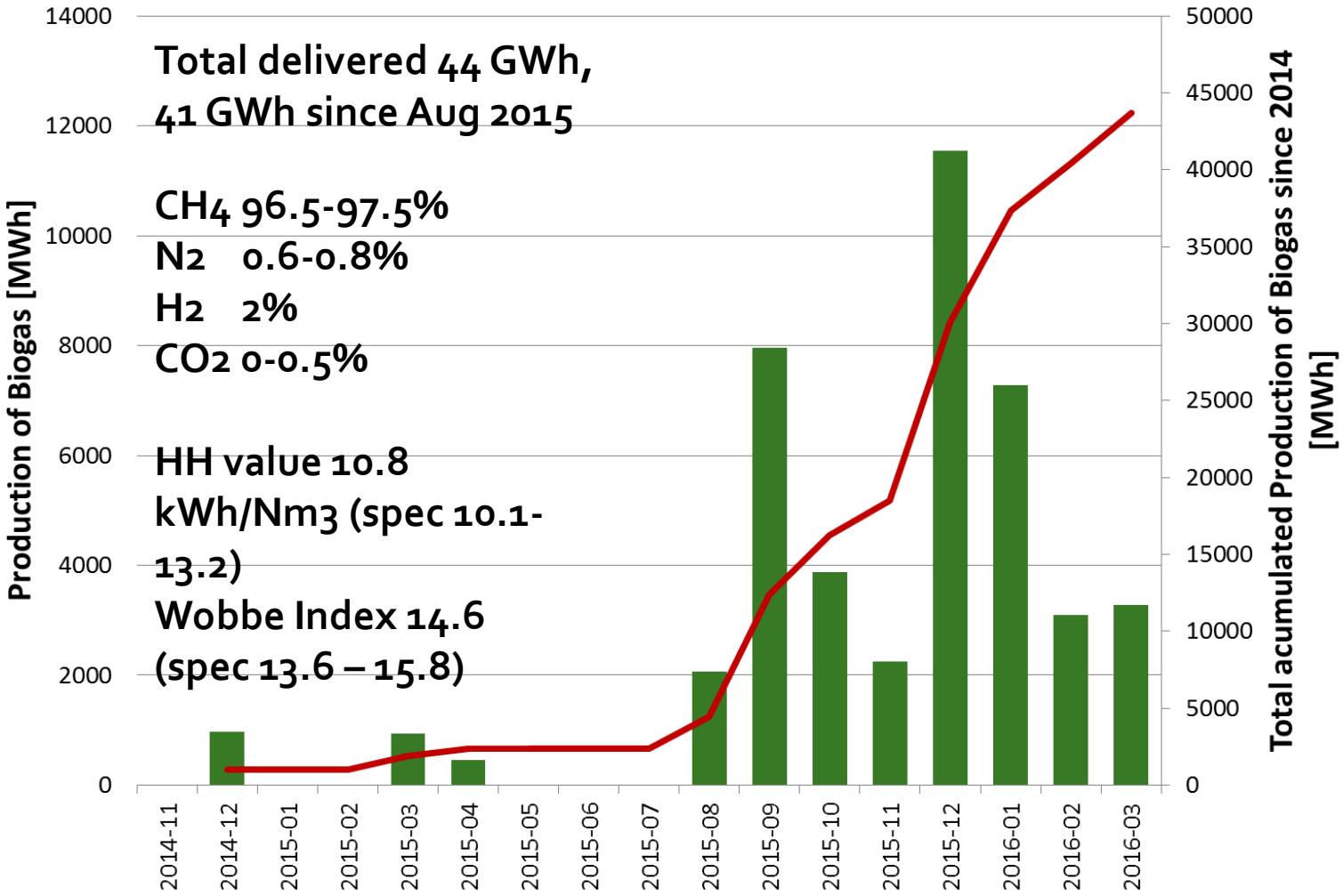


Almost 10 000 hours of gasification



Göteborg Energi

Biogas to the Grid



Göteborg Energi

The story so far

2005- 2009	The idea develops (feasibility studies, choice of technology etc)
Sept 2009	22 million euro grant from the Swedish Energy agency (subject to approval from DG COMP)
Dec 2010	Approval from DG COMP
Dec 2010	Investment decision
Dec 2013	Construction completed, commissioning starts
Dec 2014	First biomethane to the grid
Autumn 2015	Production process is getting more stable
2016	Fuel switch to forest residues
Early 2017	Back to pellets

Göteborg Energi

GoBiGas as a development site

- Ongoing and planned research projects:
- Evaluation of GoBiGas 2014-20
- BioProGReSs 2014-17
- Ash and bed material effects …2014-16
- Online measurements with FTIR.. 2014-15
- New instruments for online measurement … 2014-16
- Choice of suitable additives to bed material…2014-17
- Development of measurements facilties at GoBiGas 2015 - 17

Göteborg Energi

The GoBiGas demonstration plant has proven the possibilities of gasification. It is viable to produce renewable and CO2-neutral bio-methane on a commercial scale.

Göteborg Energi