Energiforsk

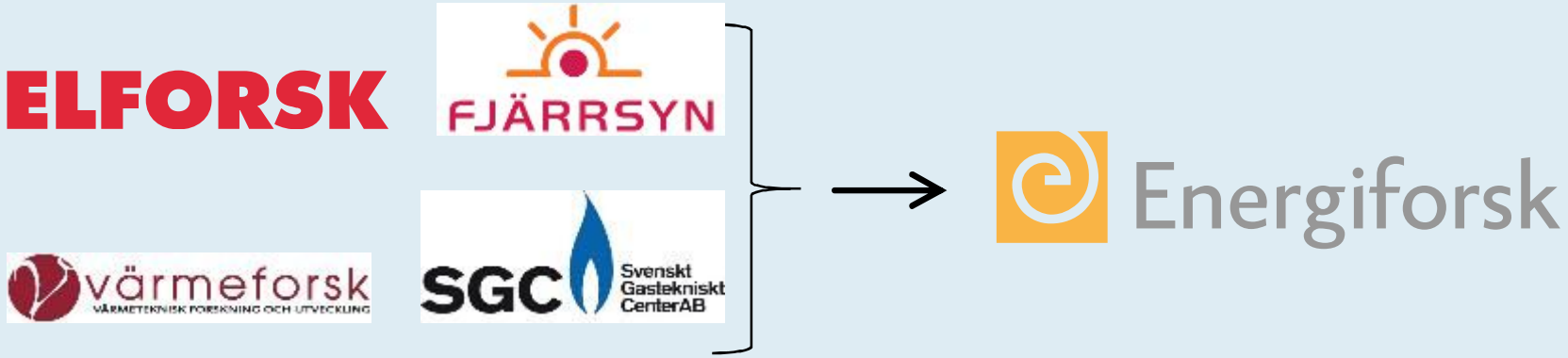
GobiGas

- Bio-Methane from Forest Residues

Jonas Dahl

Bröndby 17 November 2015

Energiforsk –Swedish Energy Research Centre (new organization since 1 Jan 2015)



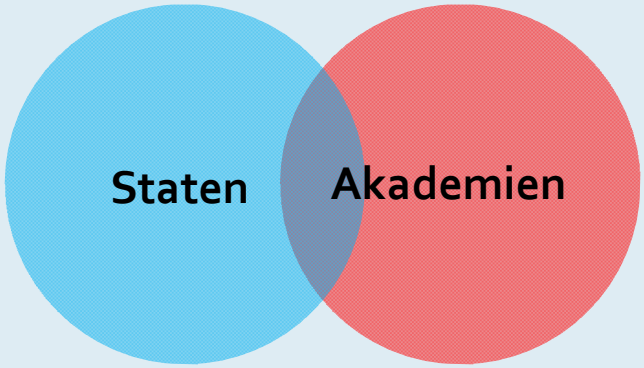
Owners : Swedish electric power association (30%) - Svensk Energi AB
Swedish Power grid owner (20 %) - Svenska Kraftnät
Swedish district heating association (20 %) - Svensk Fjärrvärme
Swedish gas association (15 %) - Energigas Sverige
The Swedish TSO (15 %) - Swedegas AB

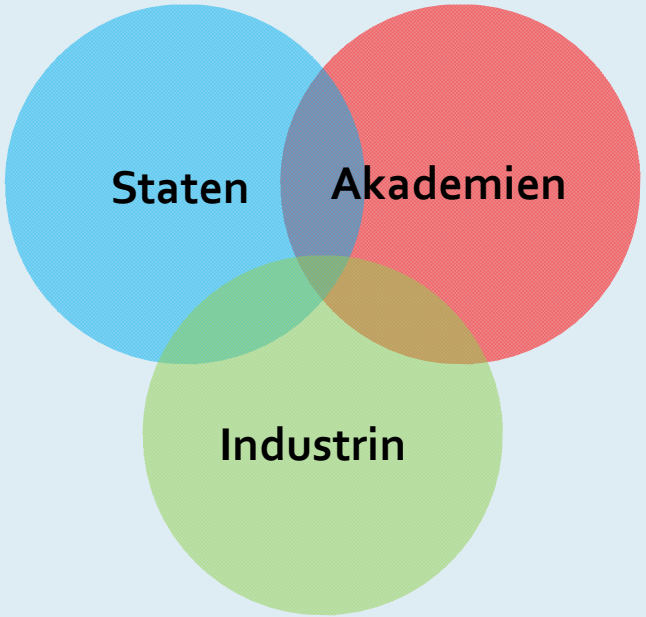
SVENSKA KRAFTNÄT
SVENSKA energi
ENERGIGAS SVERIGE
Svensk Fjärrvärme
swede gas

Energiforsk in short

- Office in Stockholm and Malmö, Sweden
- 21 employees, annual turn-over (2015) 23 MEUR
- *Core business*: To develop new knowledge and financing opportunities for developing energy R&D that leads to a more sustainable and efficient future energy system

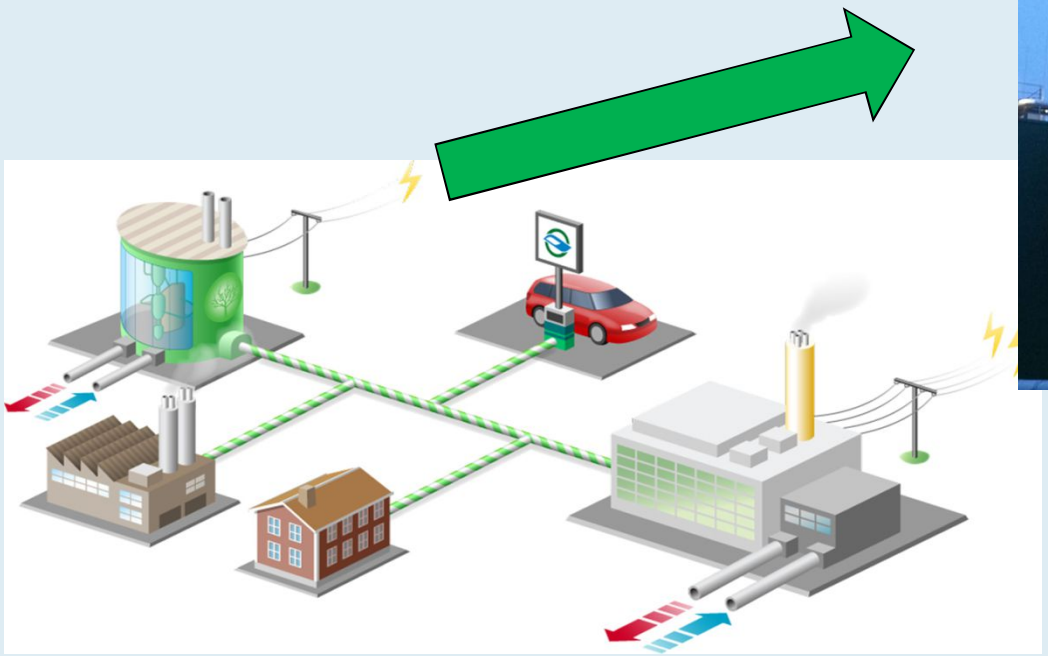
Staten direkt vs. Trippel-helix





The Story of the GoBiGas Project
From Vision to Plant in Operation

Ingemar Gunnarsson Göteborg Energi



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

Quick history of GobiGas

- 2005 - Project started
  - Feasibility studies developed - bio-methane production from forest residues –
  - Comparing different gasfication & methanation technologies
- 2006 - Ambition to build a commercial sized plant, delivering 100 MW biomethane
  - Decision to split in 2 phases
  - A demonstration plant (20 MW) to be followed by a commercial plant (100 MW)
- Sept 2009 - Awarded funding from the Swedish Energy Agency sept 2009 for Demo
  - (220 mil SEK => 25 % of estimated CAPEX at time => current bill 1, 5 bil SEK)
- 2010 (Dec 16) - Board decision to implement after EU approved government support
- 2011 – 2012 Engineering & Construction
- 2012 - 2013 Construction & Commissioning
  - **13/11 2013 First period of gasification**
- 2014 - 2015 Start-up
  - ***15/12 2014, 18:40, The first delivery of SNG out on the gas grid***
- 2015 Production! With troubleshooting and optimization of operation

The GoBiGas Site – Phase 1 & 2

Phase 1 – Demonstration Plant (20 MW, Bio-SNG)
Partly financed by the Swedish Energy Agency

15 000 cars
400 buses

Phase 1

Phase 2

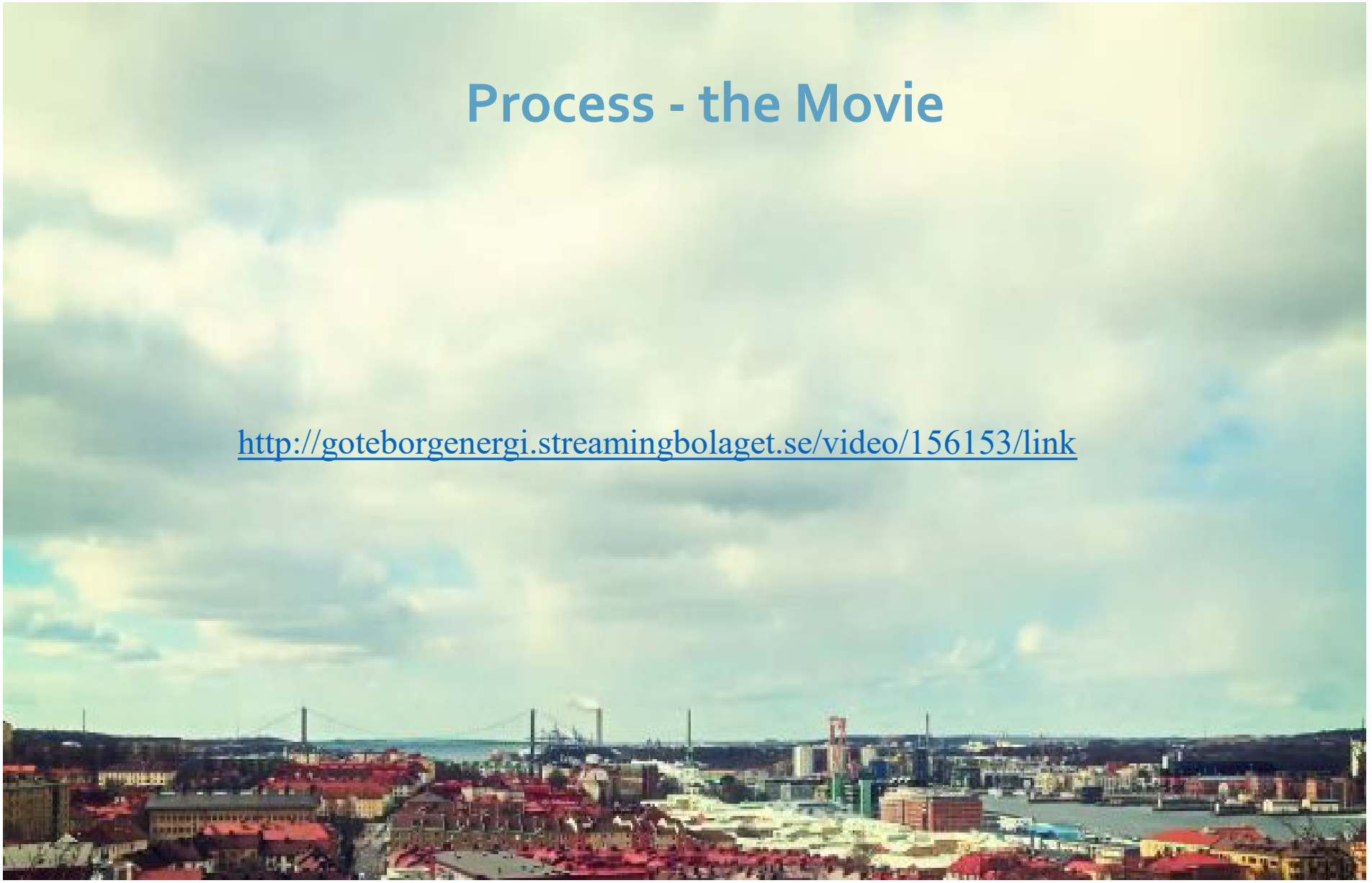
Phase 2 – Commercial Plant *after* proof of Phase 1 *and* secured financing (100 MW Bio-SNG)
Selected project by the EU-commission in NER 300

~100 000 cars

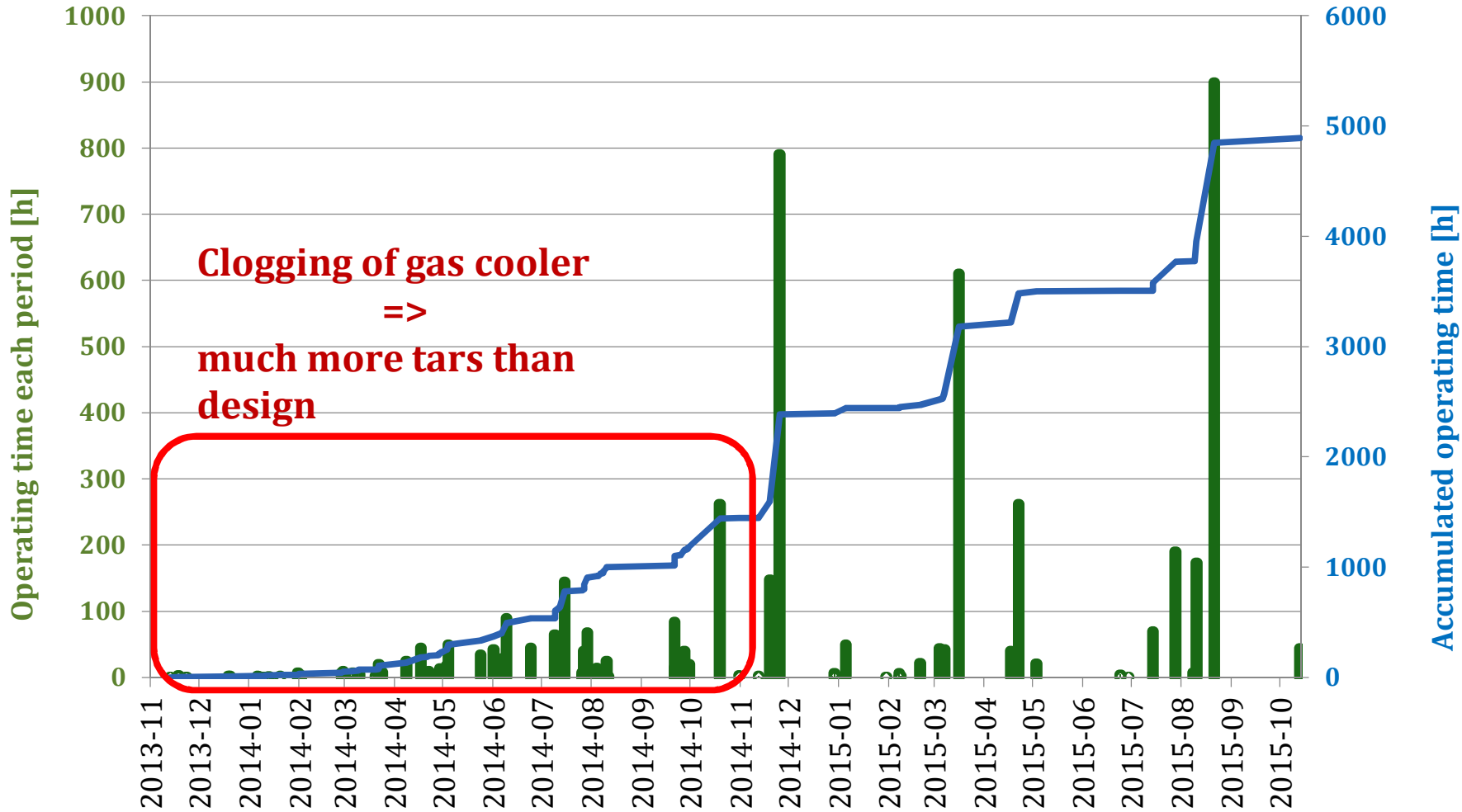
Göteborg Energi

Process - the Movie

http://goteborgenergi.streamingbolaget.se/video/156153/link



Gasification Sept 30 2015: 5000 hrs (wood pellets)



Reference installations - gasification

Güssing, Austria

- Repotec technology 1/4 the size compered to GoBiGas
- Gas-fueled motor 2 MW el and 4,5 MW district heating
- In operation since 2002 (> 60 000 h)

Senden, Germany

- Repotec technology ½ the size compered to GoBiGas
- Production of electrical power and district heating
- In operation autumn 2012

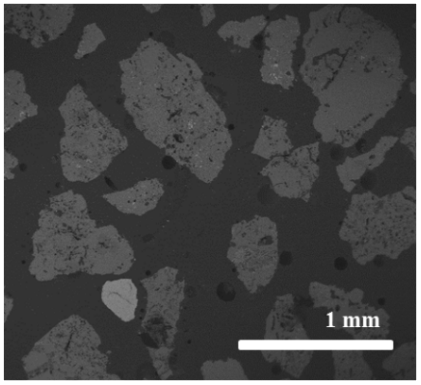
Same technology but
much less or no issues with tars !

How We Handle Tars

- Activate the Olivine (Mg,Si,Fe)
- What makes the olivine "active"? How is this activity achieved?
- Addition of K_2CO_3 activates olivine

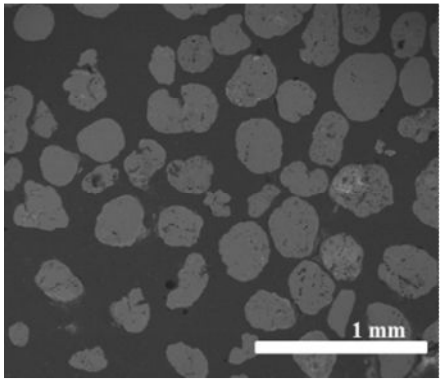
	Before K	After K
Total tar* (g/m3)	43,1	13,1
Total tar, excl. BTX (g/m3)**	21,8	4,4

Fresh olivine



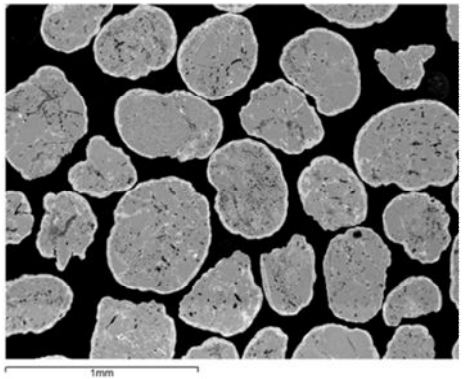
Analysis: Dr. Pavleta Knutsson

Used olivine



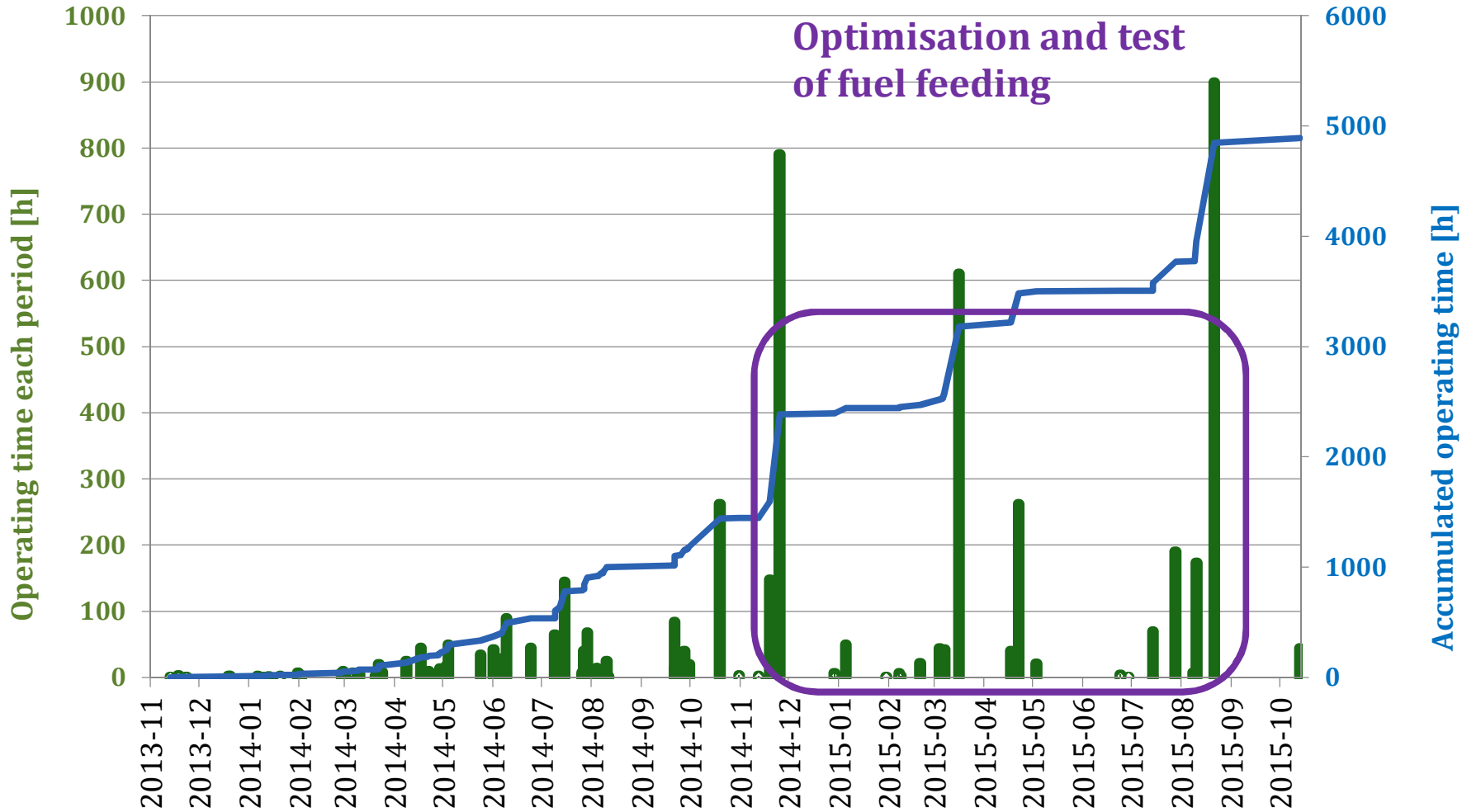
Analysis: Dr. Pavleta Knutsson

Used olivine after K_2CO_3



Analysis: TOP ANALYTIC, BSE-image

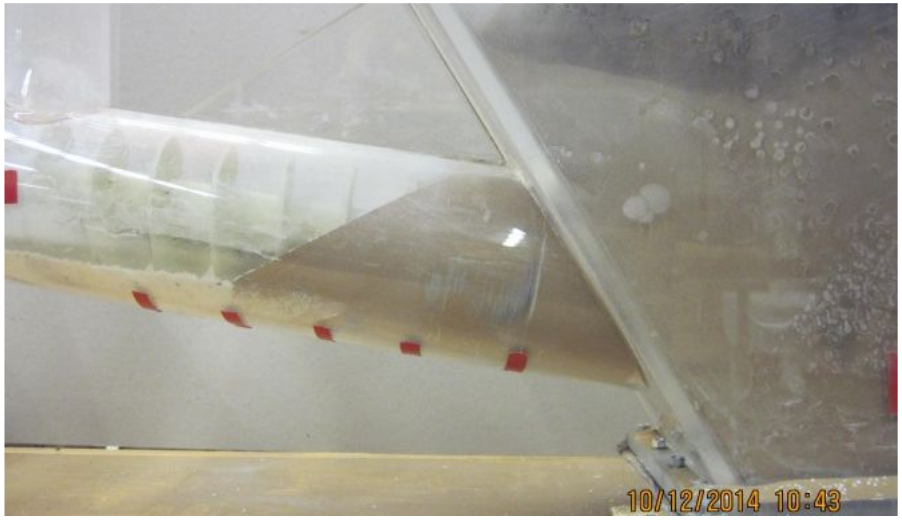
Gasification Sept 30 2015: 5000 hrs (wood pellets)



Fuel feeding system

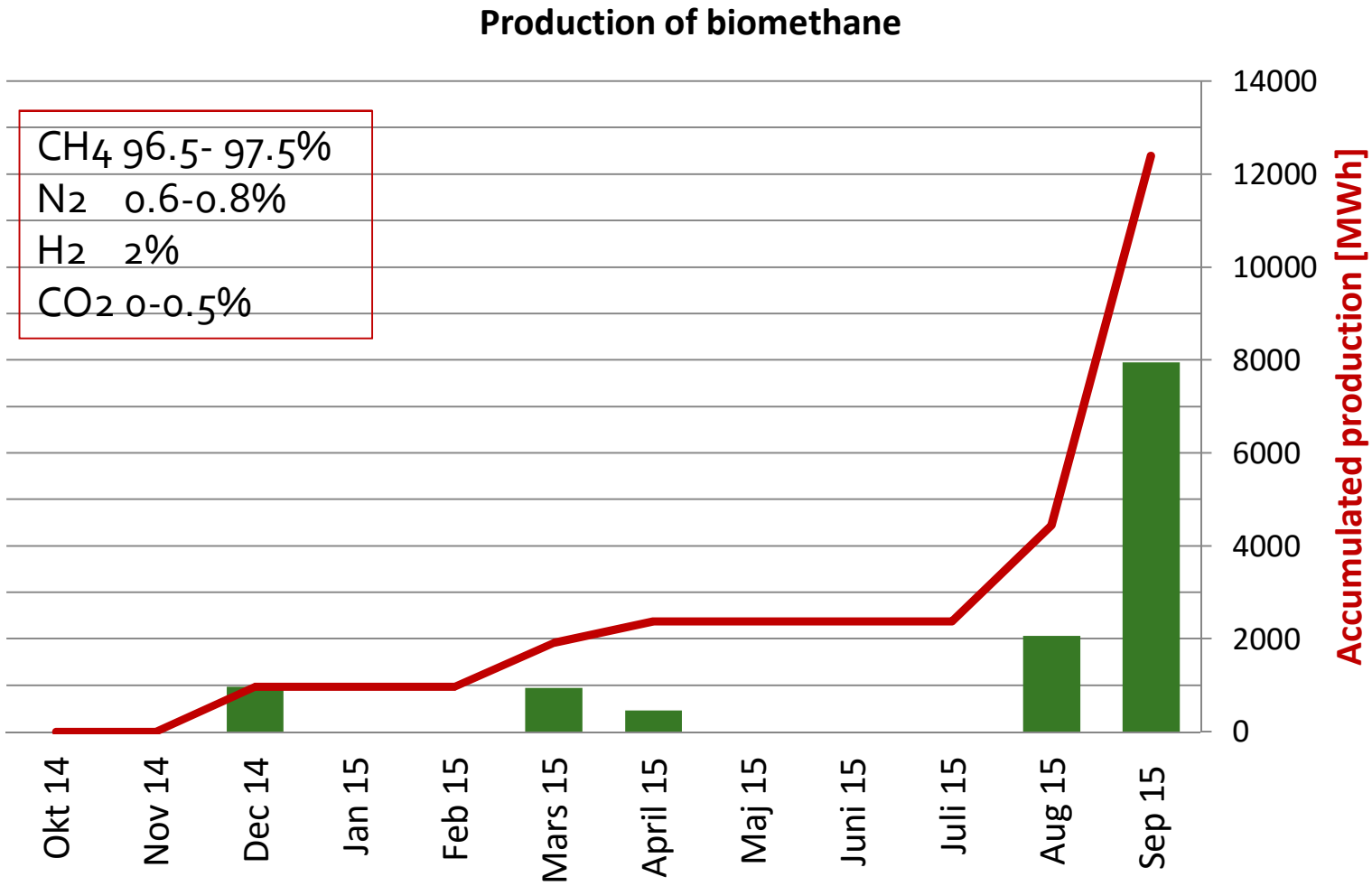
(pressure differences, backflow of hotgas in feedingsystem, …)

Carbonisation in the feedings screw



Picture by Dr. Claes Breitholtz at Valmet Power AB

Bio-Methane to grid until September 2015



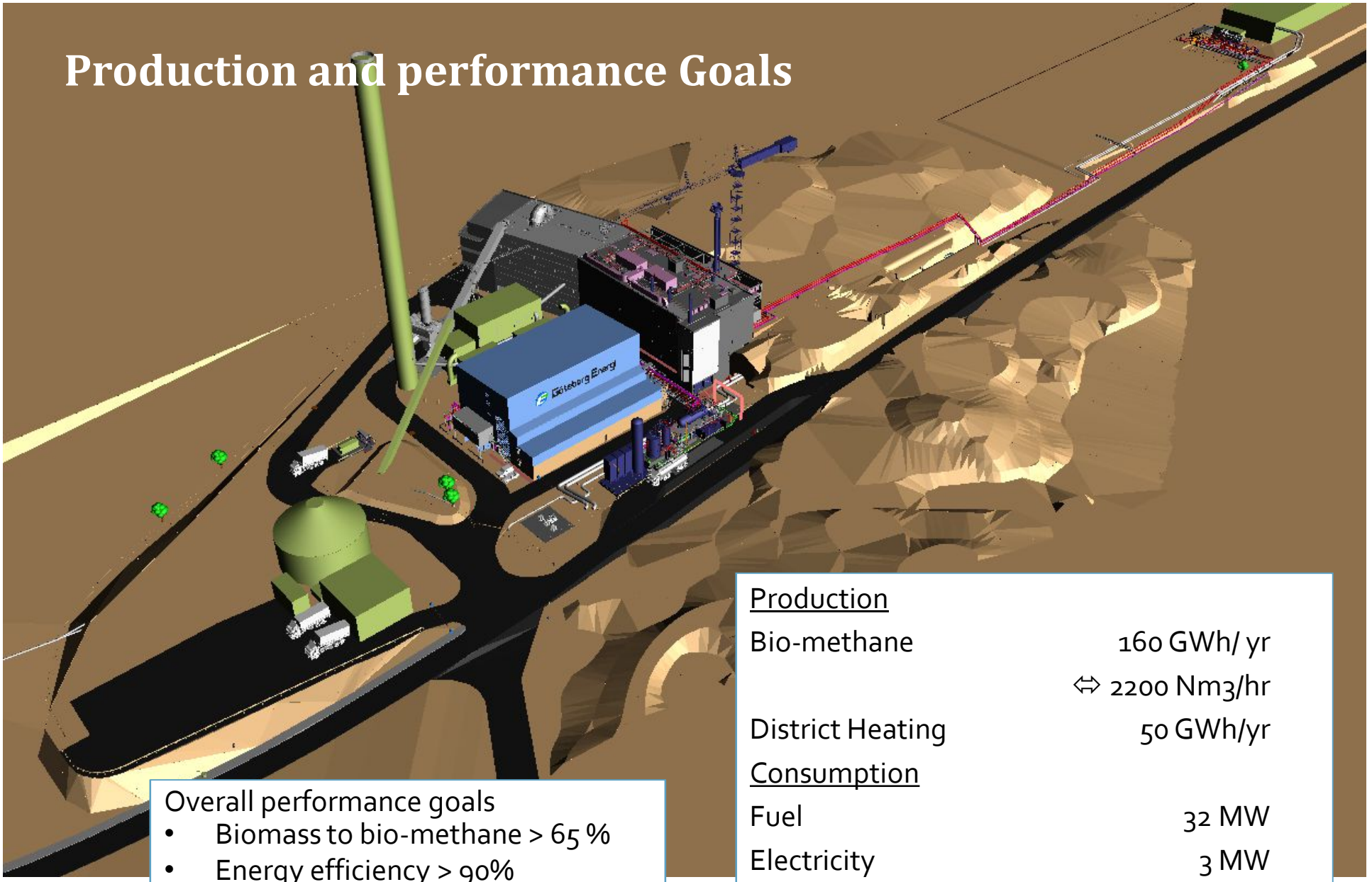
Rest products

- RME and activated carbon, separated tar from raw gas cleaning are combusted in the combustion part of the gasifier

- Currently, no bottom ash due to low ash content of wood pellets . All ash is removed as filter fly ash which is partly reintrodued due to content of activated bed material

- Fly ash is send to deposit due to Cr6 in the olivine sand => other bed materials in the future would omite this

Production and performance Goals



Production	
Bio-methane	160 GWh/ yr
	⇔ 2200 Nm3/hr
District Heating	50 GWh/yr
Consumption	
Fuel	32 MW
Electricity	3 MW
RME (bio-oil)	0,5 MW

Overall performance goals
- Biomass to bio-methane > 65 %
- Energy efficiency > 90%
- Operation 8000 h/year

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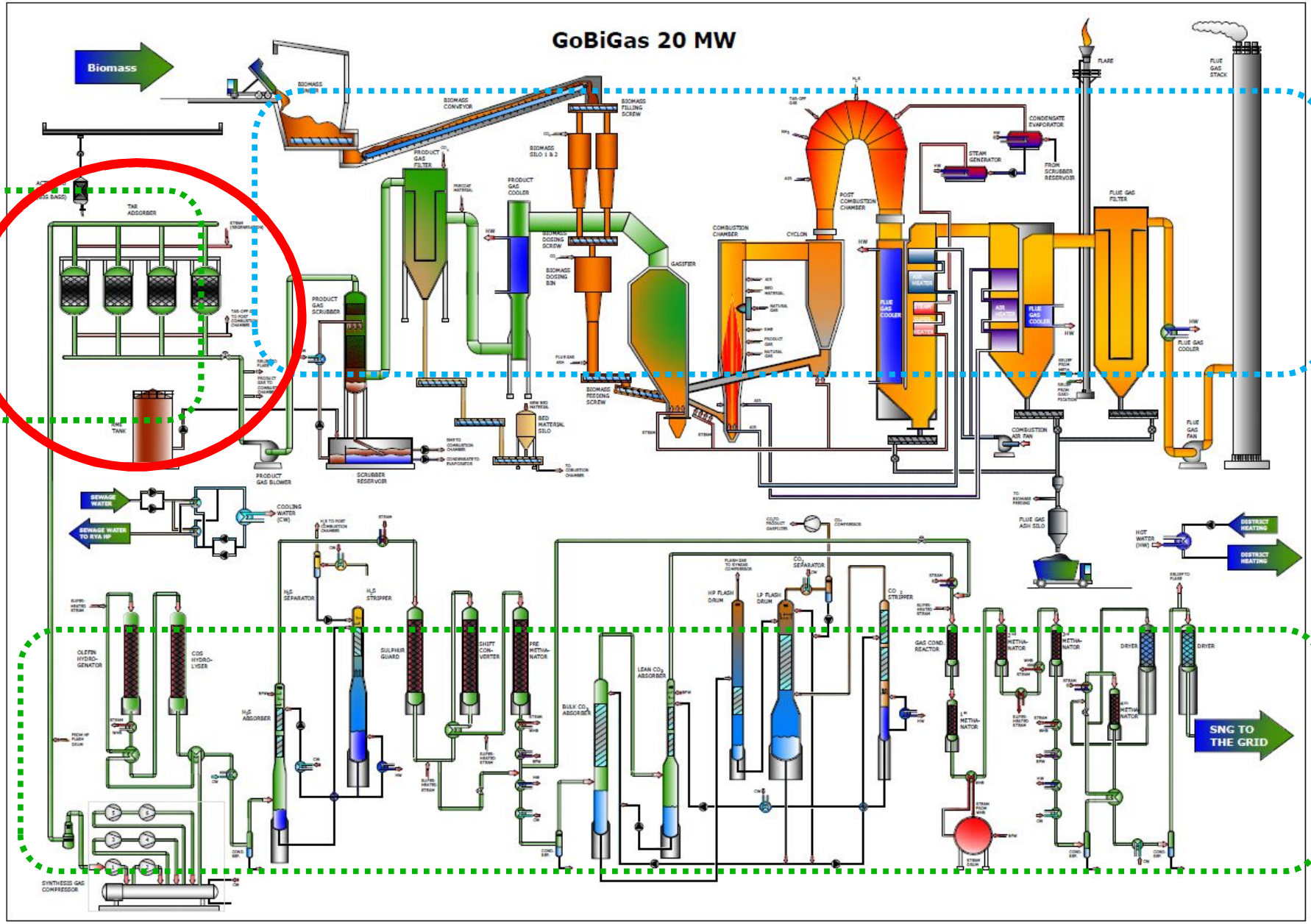
Efficiency of Gasification Process

	Gasification Process	Max Biomethane
Cold Gas Efficiency Gasification reactor	84.2 %	69.0 %
Cold Gas Efficiency Gasification process	76.5 %	62.7 %
Total Efficiency (Cold Gas + District heating)	85.4 %	
Heat Losses	14.6 %	
Heat Loss to Flow Gas	2,0%	
Heat Loss to Cooling Water	9,6%	
Heat Loss to Surrounding	3,0%	

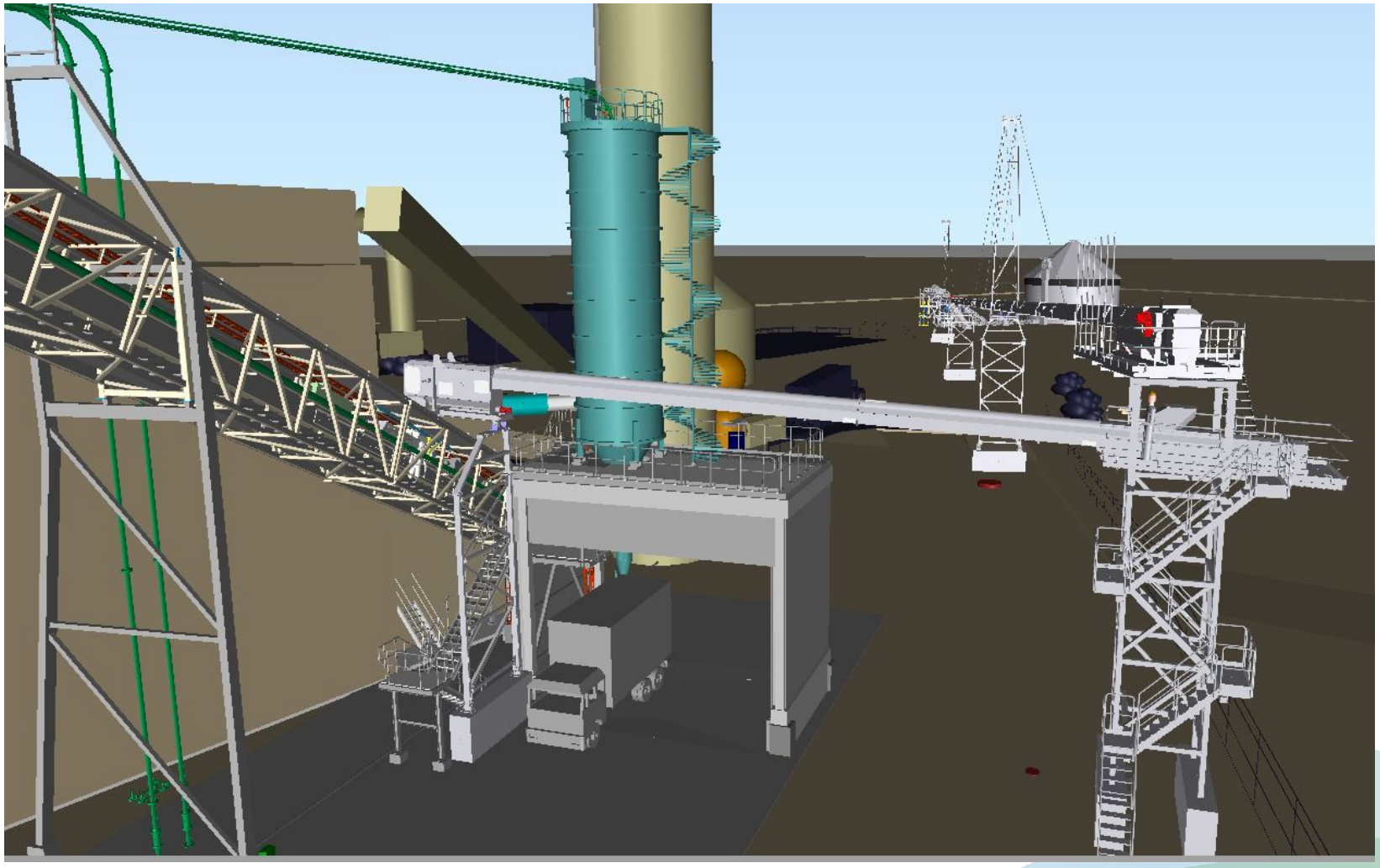
- The gasification process has been successfully demonstrated for syngas production of up to 6900m_n^3/h


GoBiGas 20 MW
Biomass
SEWAGE WATER
SEWAGE WATER TO RYA HP
DISTRICT HEATING
DISTRICT HEATING
SNG TO THE GRID

Conclusions

- GoBiGas is now online
- Major hurdles have been solved in the gasification stage and the gasifier now operates at full load.
  - Alkali needs to be in balance to achieve sufficient reduction and simplification of tars
  - Fuel feeding into the bed needs attention and reconstruction is probably required to enable 8000h/year operation
- Optimization of carbon filter beds for benzene removal now restricts the unit to go to full load

Forest residues reception & conveying – 2016
(wood chips, feb 2016)



Commercial Success or not ? Phase 2 ?
Variable Oil Prices

Project Start **Pilot Study** **Investment Decision** **Construction of Plant** **Start Up and Operation**

Göteborg Energi

Thank you for your attention!

www.goteborgenergi.se
www.gobigas.se