GoBiGas

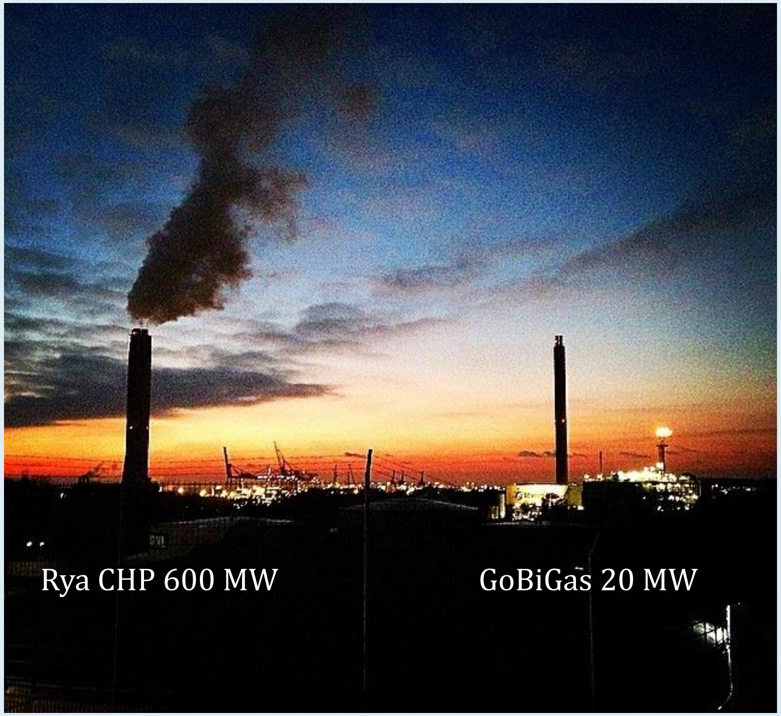
Technical successes and economic challenges

Göteborg Energi

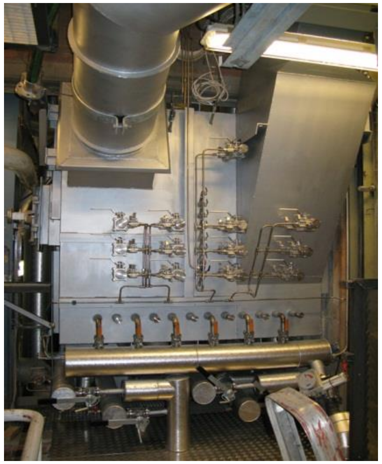
Eric Zinn EPTP 160621

GoBiGas – Pioneering New Technology

- The world's first plant for bio-methane from biomass through gasification
- Injects bio-methane into the transmission grid, potentially reaching all of Europe

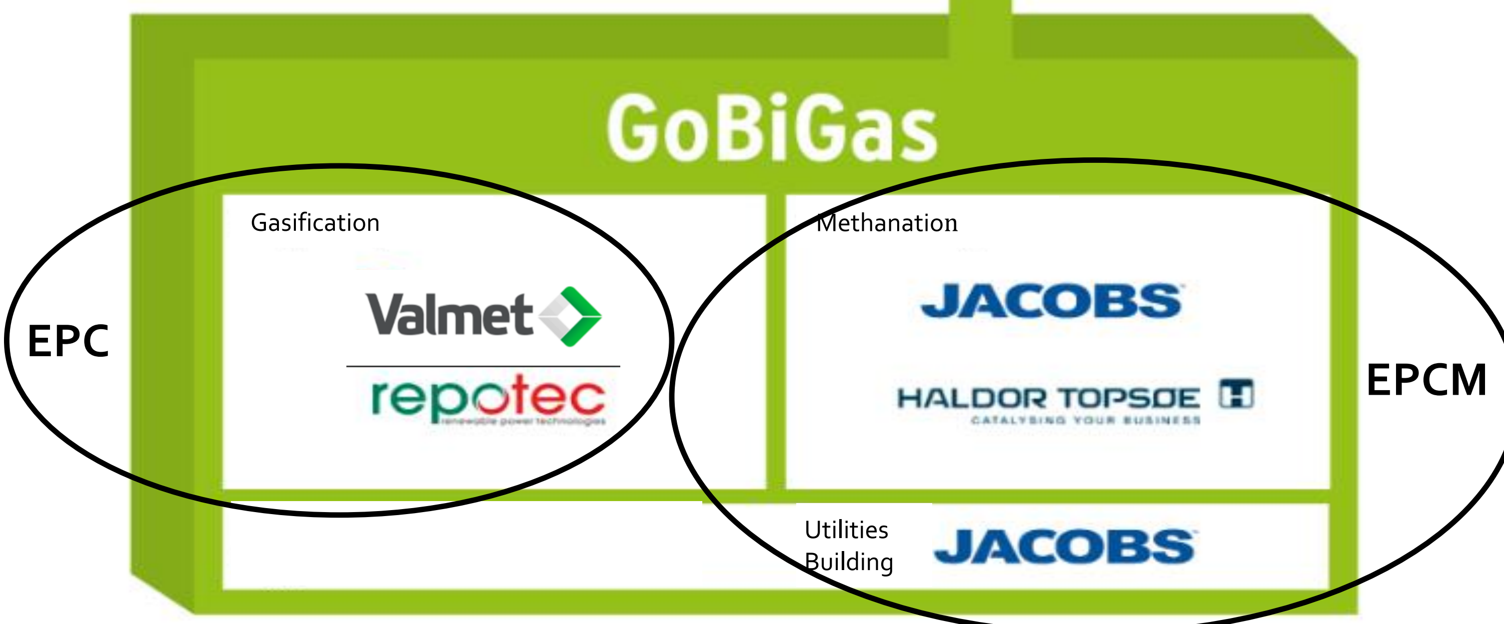


GoBiGas - Partners



CHALMERS
UNIVERSITY OF TECHNOLOGY

Swedish Centre for Biomass Gasification (SFC)
R&D gasifier 2 MW
Prof. Henrik Thunman
~ 20 PhD students



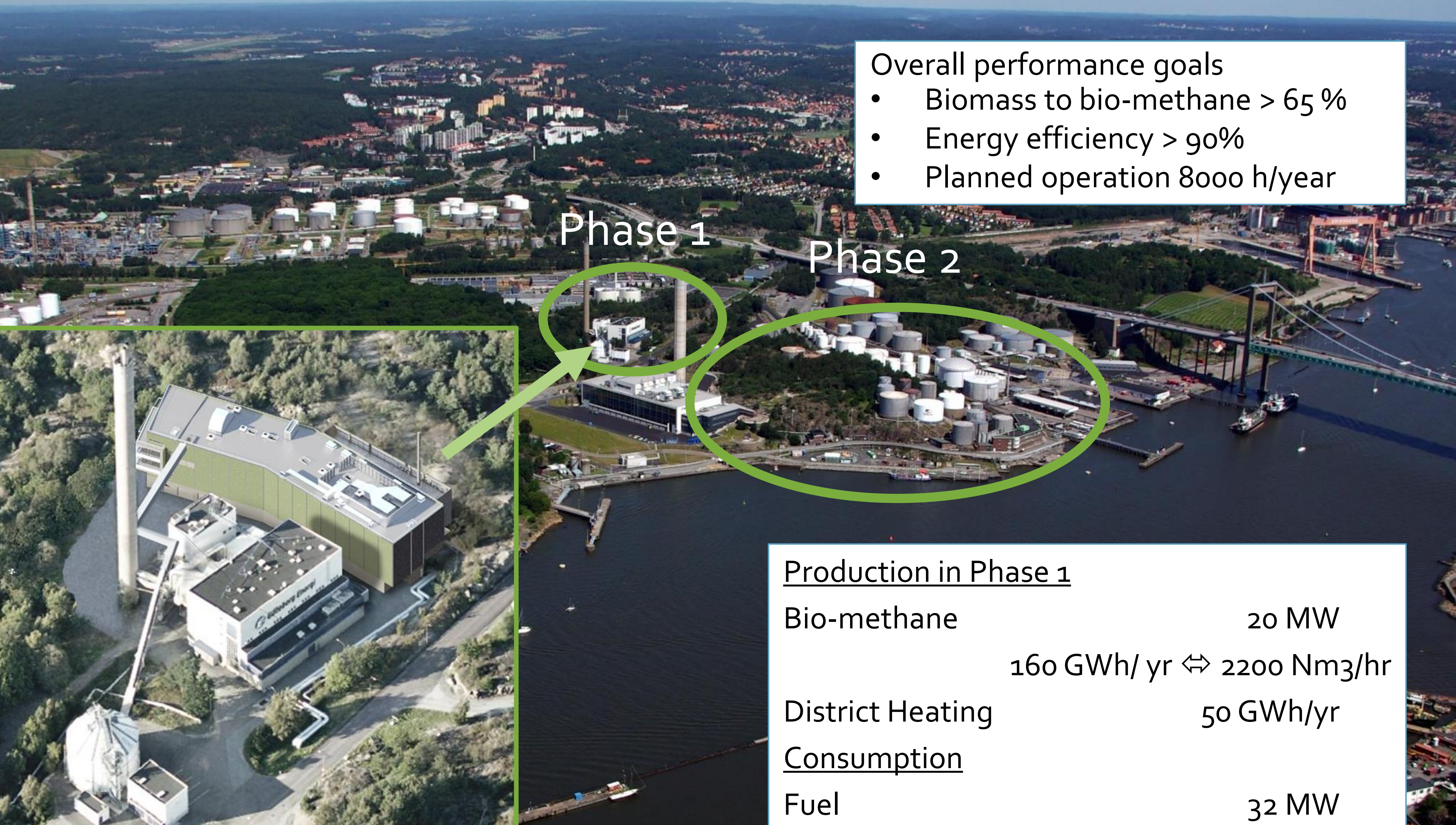
The GoBiGas project

- The first plant in the world to produce bio-methane from biomass continuously through gasification
  - Using forest residues as feed stock
  - Polygeneration – producing fuel and heat

- Injects bio-methane into the transmission grid for:
  - Vehicle fuel
  - Fuel to CHP or heat production
  - Feedstock to process industry

- Commercializing the technology in two phases:
  - Phase 1 - 20 MW demo plant, partly financed by Swedish Energy Agency
  - Phase 2 - 80 – 100 MW commercial plant, when the technology is proven in phase 1 and the market conditions are sufficient
  - Phase 2, a selected project by the EU Commission in NER300 but is currently not being developed.

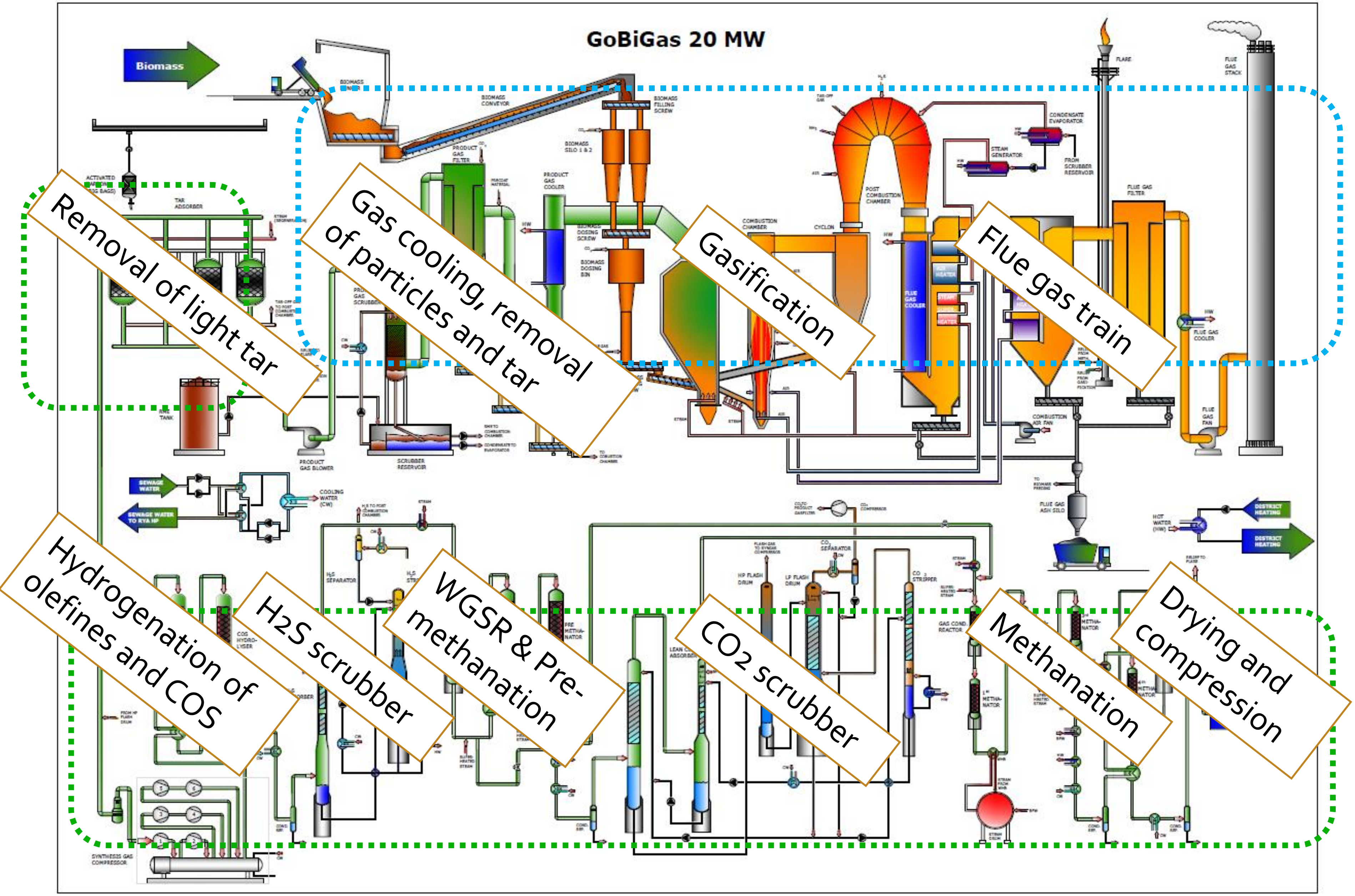
The GoBiGas sites for Phase 1 & 2



Overall performance goals

- Biomass to bio-methane > 65 %
- Energy efficiency > 90%
- Planned operation 8000 h/year

<u>Production in Phase 1</u>	
Bio-methane	20 MW
	160 GWh/ yr ⇔ 2200 Nm3/hr
District Heating	50 GWh/yr
<u>Consumption</u>	
Fuel	32 MW
Electricity	3 MW
RME (bio-oil)	0,5 MW



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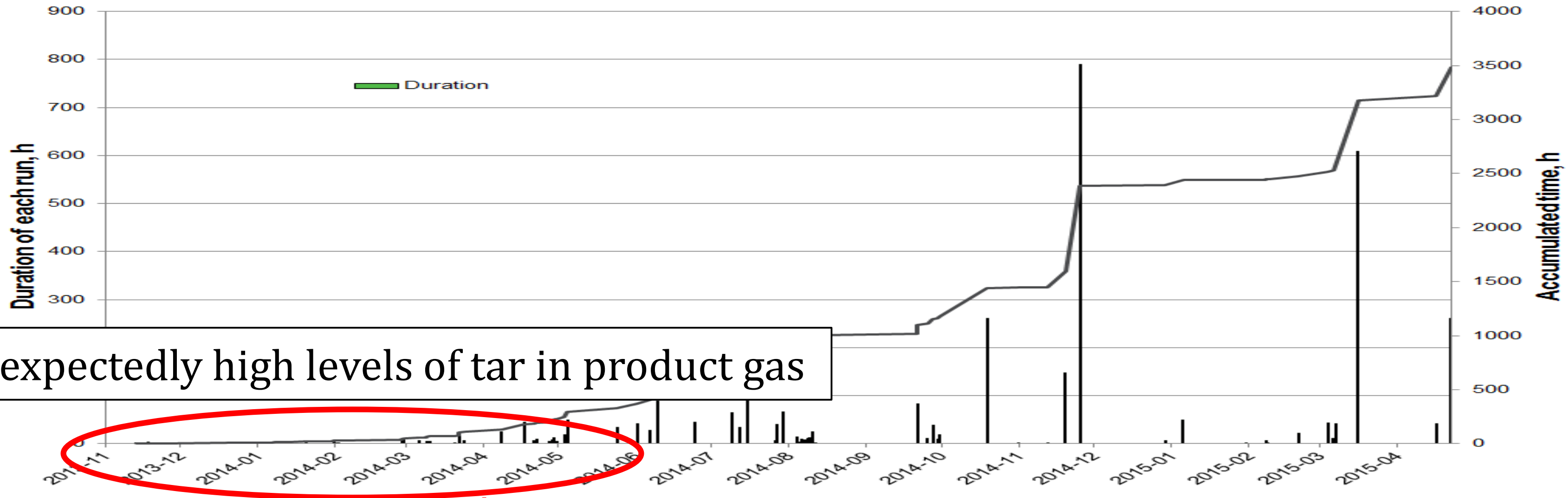
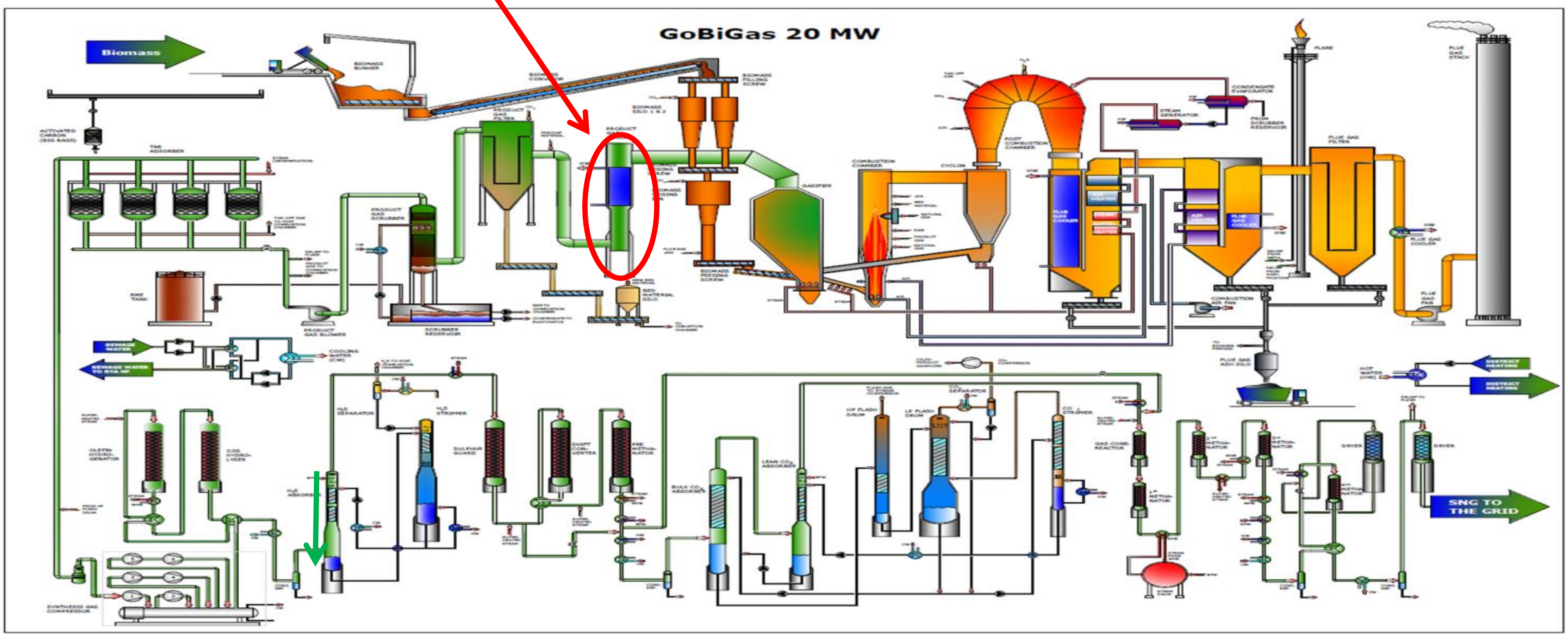
Check out the video! http://goteborgenergi.streamingbolaget.se/video/156153/link

Technical successes



Duration
Duration of each run, h
Accumulated time, h
900
800
700
600
500
400
300
4000
3500
3000
2500
2000
1500
1000
500
0
2013-12
2014-01
2014-02
2014-03
2014-04
2014-05
2014-06
2014-07
2014-08
2014-09
2014-10
2014-11
2014-12
2015-01
2015-02
2015-03
2015-04
Unexpectedly high levels of tar in product gas



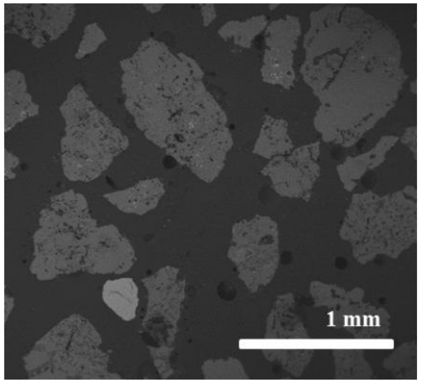
GoBiGas 20 MW
Biomass
SNG TO THE GRID

How did we reduce tars?

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

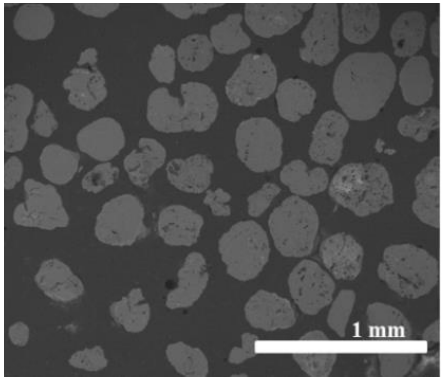
	Before K2CO3	After K2CO3
Total tar* (g/m3)	43,1	13,1
Total tar, excl. BTX (g/m3)**	21,8	4,4

Fresh olivine



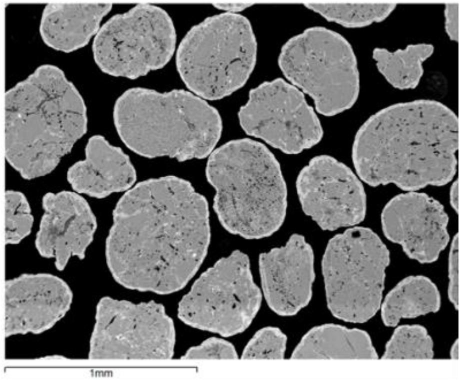
Analysis: Dr. Pavleta Knutsson

Used olivine

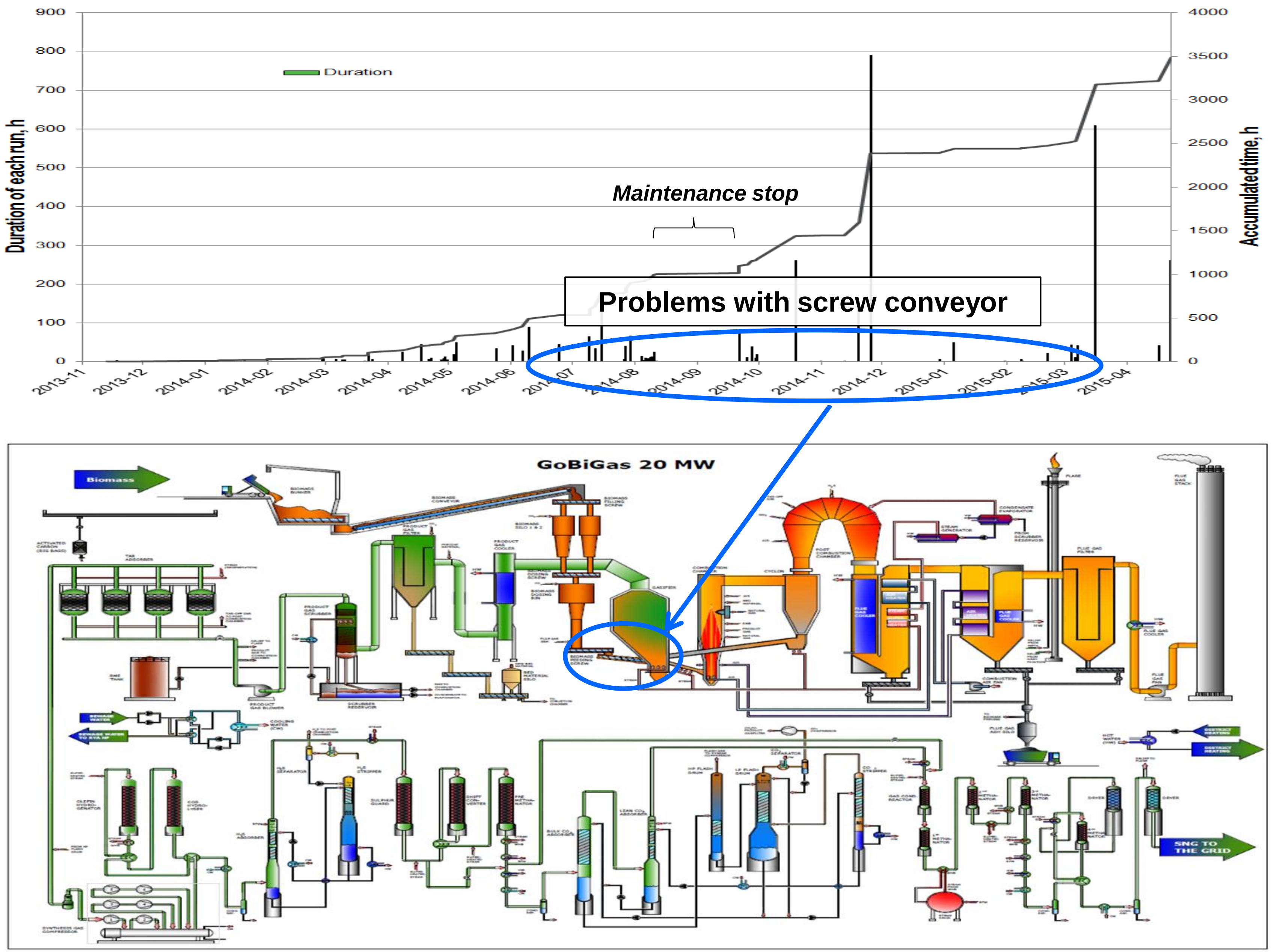


Analysis: Dr. Pavleta Knutsson

Used olivine after K_2CO_3



Analysis: TOP ANALYTIC, BSE-image



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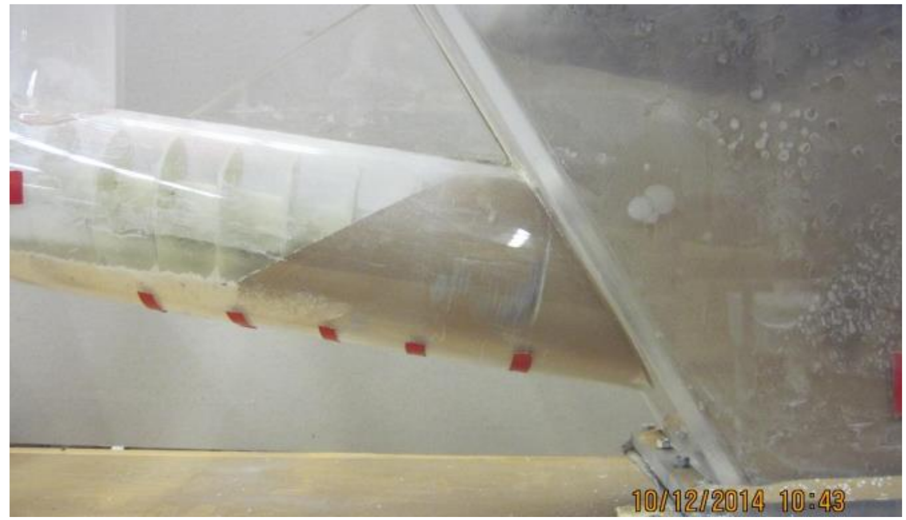
Improving the screw conveyor technique



Pictures: Dr. Claes Breitholtz, Valmet Power AB

GoBiGas - status

- 29 GWh biogas delivered in total in 2015.
- 26,5 GWh delivered to transportation, 74 % CO2 reduction (RED).
- Record of two months of continuous delivery of bio-SNG.
- 100 % capacity in gasification.
- 80 % capacity in methanation due to high levels of benzene.
- Currently changing feedstock to wood chips.

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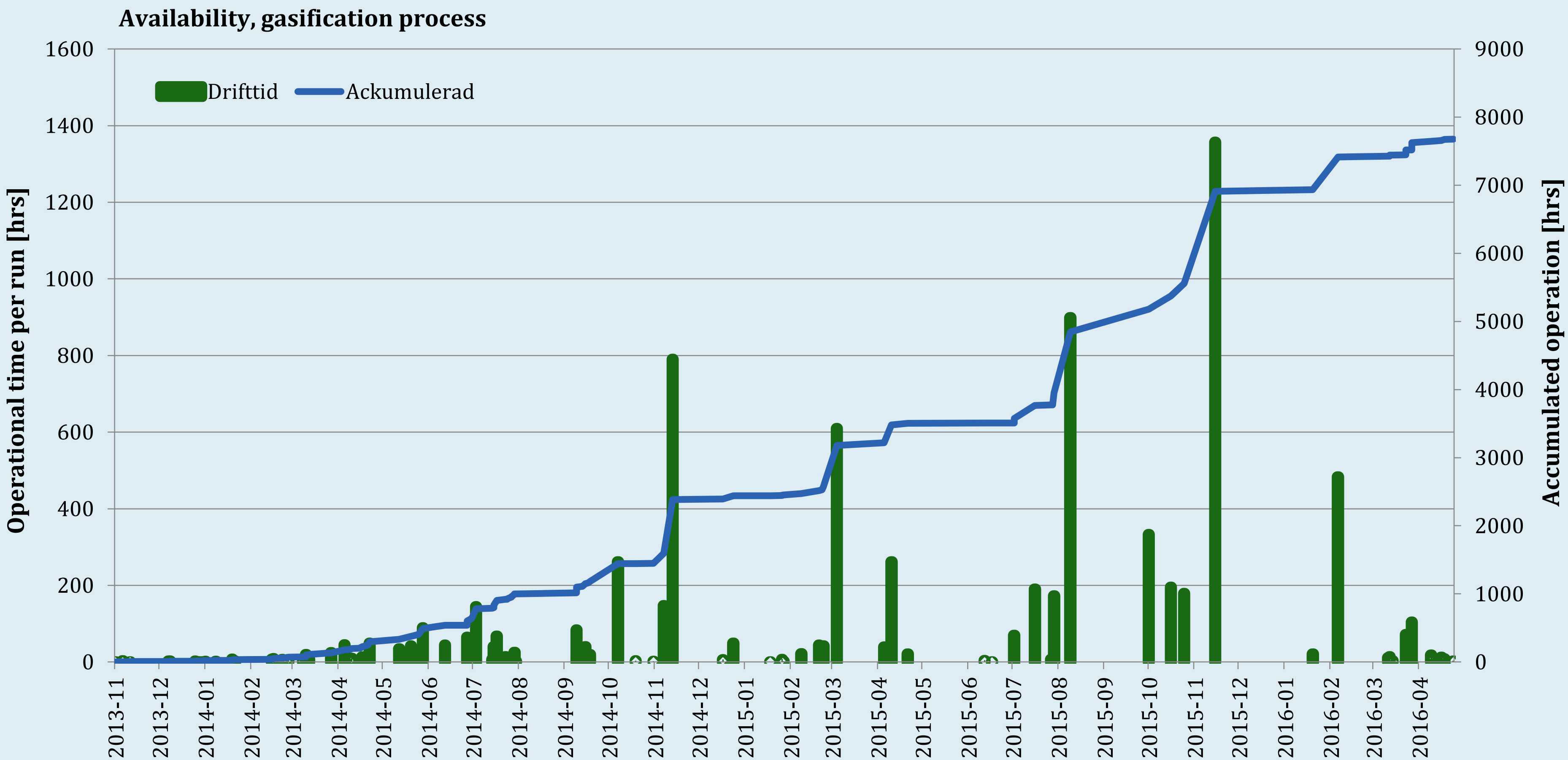
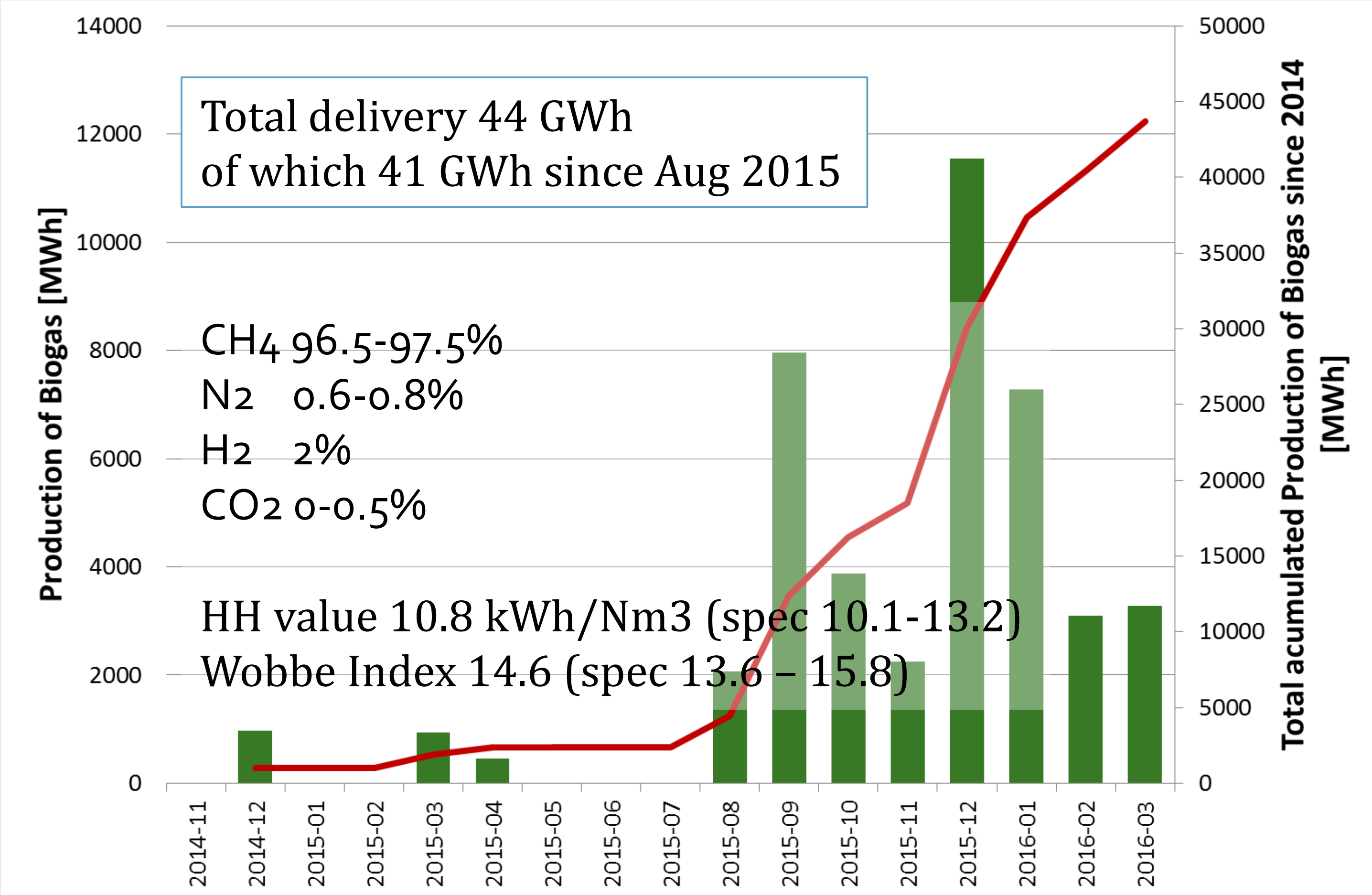
GoBiGas - status

Gasification in operation >7500 hours



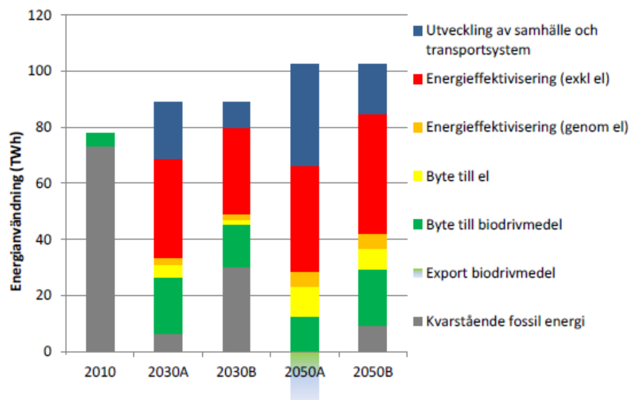
GoBiGas - status



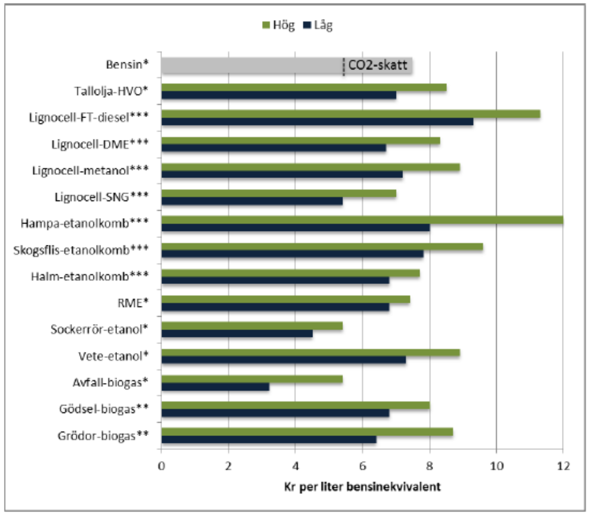
Commercially viable?

- Possibly in DE, NL, FR, IT, UK, DK – which all have ambitious support schemes which include biogas and/or bio-SNG.
- Currently not in SE, where we await long-term regulations and support schemes for biogas.

Figur S.1 **Vägtrafikens användning av fossil energi med och utan åtgärder (TWh). Toppen av staplarna visar utvecklingen utan åtgärder (dvs. hur stor energianvändningen skulle ha blivit om dagens fordonspark och bränslen använts vid de olika årtalen med trafikutveckling enligt Naturvårdsverkets referensscenario). De gråa fälten visar återstående fossil energi efter åtgärder. Negativa värden avser export av bioenergi**



Figur 10.12 **Uppskattade produktionskostnader för olika biodrivmedelssystem, uttryckt som kr per liter bensinekvivalent**



Källa: Börjesson et al (2013). Låg (blå) respektive hög (grön) stapel illustrerar möjliga variationer i råvarukostnader (biogas, RME och etanol från grödor) alternativt processutformning (etanolkombinat och drivmedel via termisk förgasning). Graden av osäkerhet i produktionskostnaderna indikeras med * = liten osäkerhet, ** = viss osäkerhet, respektive *** = stor osäkerhet. Produktionskostnaden för HVO är inkluderad i figuren i efterhand, liksom kostnaden för bensin där koldioxidskatt också är inkluderad.

The Swedish government knows that bio-SNG needs to be a part of its targets.

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 beds for benzene removal now restricts the unit to go to full load
  - Condensation and heat recovery
- Expecting challenges with chips
  - Moisture, impurities, etc.

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Thank you for your attention!

www.goteborgenergi.se
www.gobigas.se