GoBiGas
Experiences from the Initial Operation

Malin Hedenskog

Operations Manager GoBiGas

Göteborg Energi

Göteborg Energi

- Sweden's largest municipal energy company
- Core businesses: District heating, Electricity, Natural Gas, IT
- 1,000 employees
- € 600 million turnover
- Producing and selling biogas since 2006.

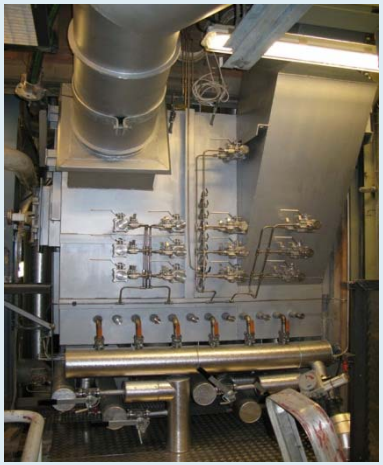
GoBiGas – Pioneering New Technology

- Bio-methane from biomass through gasification
- Injected into the interregional grid
- Industrial-scale demonstration
- 20 MW (2200 Nm3/hr) Bio-methane
- 5 MW District heating
- Can supply 16,000 cars

GoBiGas – Step by Step Development

Chalmers
Lab-reactor

"The Chalmers gasifier"
Chalmers 2-4 MW
Pilot plant

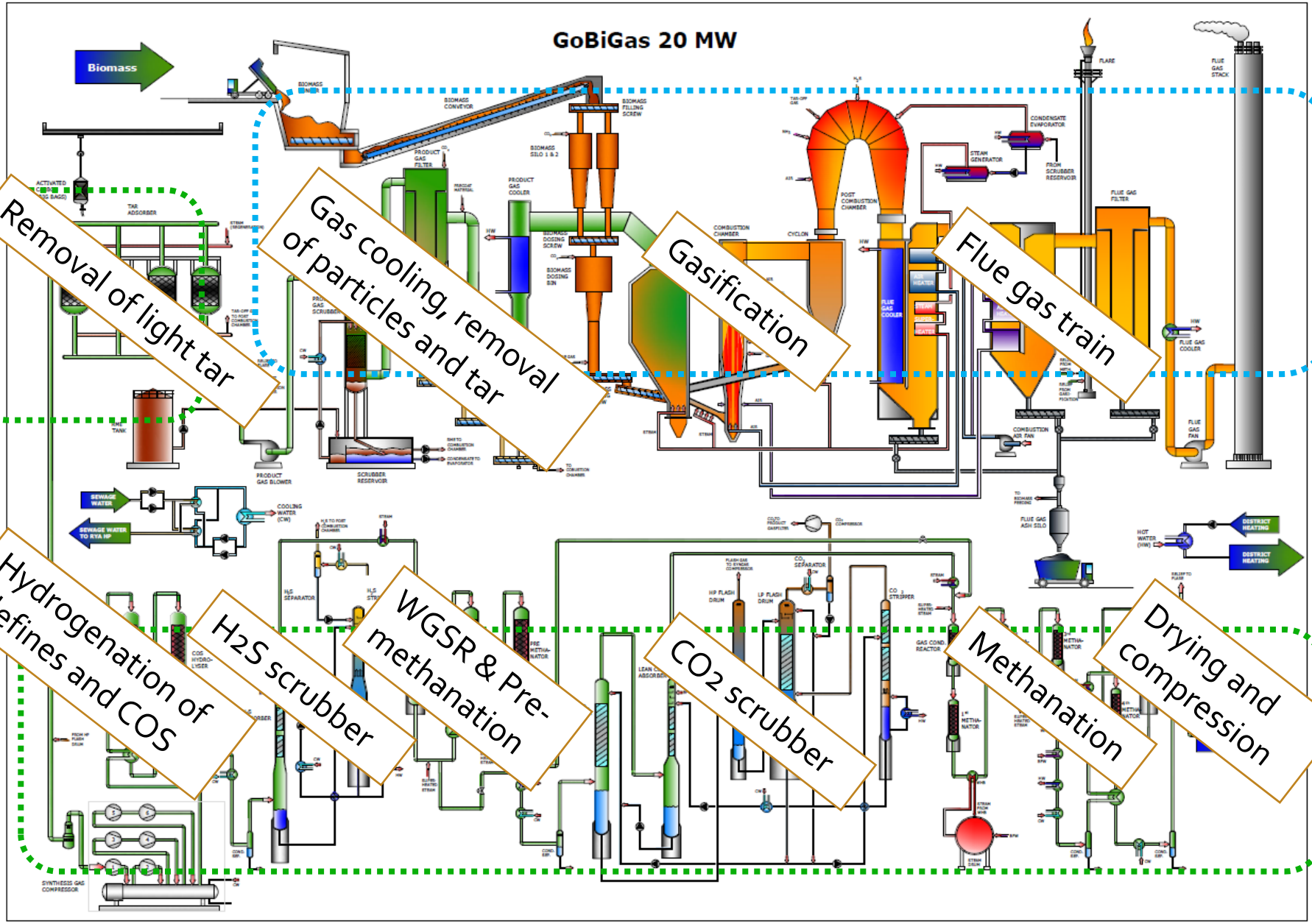


GoBiGas Phase 1
20 MW bio-methane
Demonstration Plant

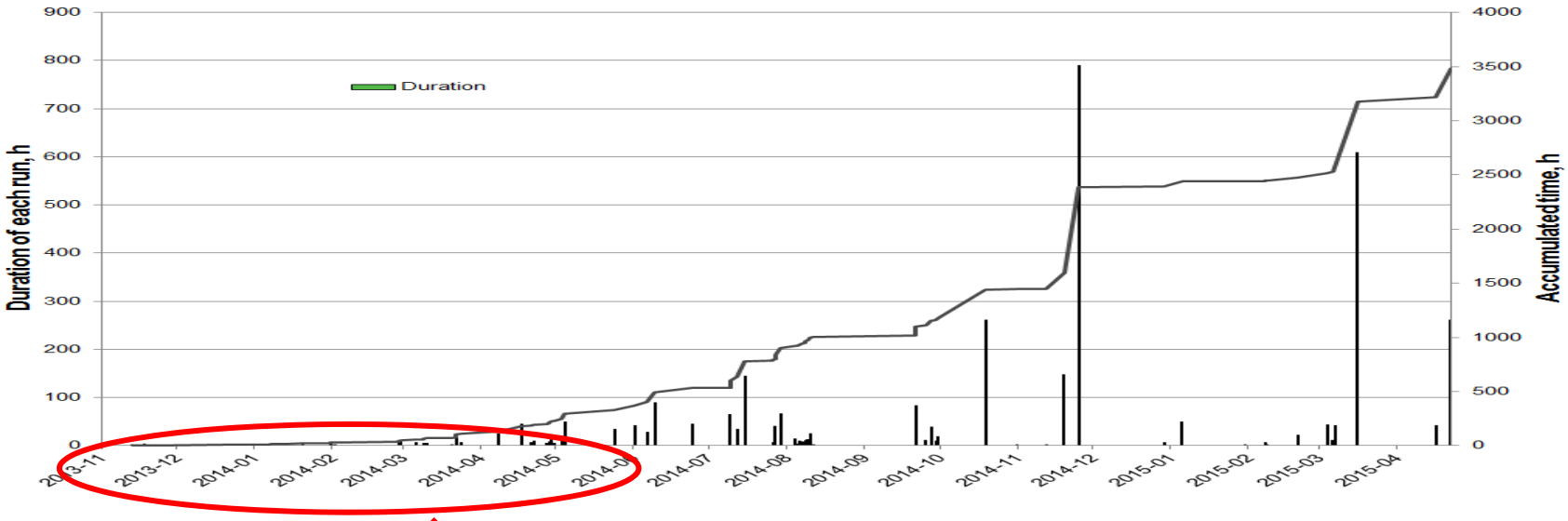
GoBiGas Phase 2
80-100 MW bio-methane
Commercial Plant

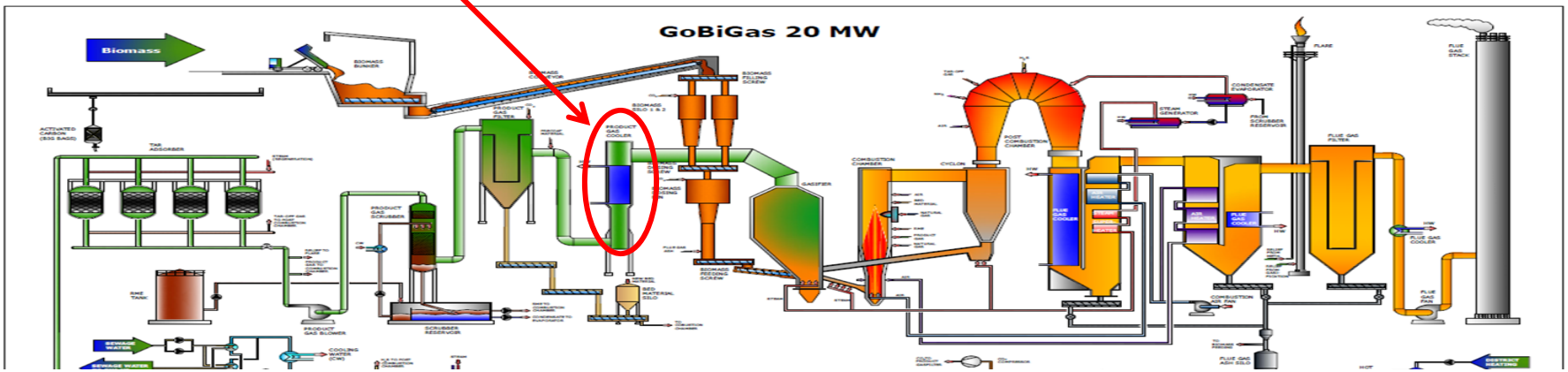
2008

2013


GoBiGas 20 MW
Biomass
Removal of light tar
Gas cooling, removal of particles and tar
Gasification
Flue gas train
Hydrogenation of olefines and COS
H2S scrubber
WGSR & Pre-methanation
CO2 scrubber
Methanation
Drying and compression

Intial Tar Problematics





Initial Tar Problematics

- Not able to activate the bed material (olivine)
  - Product gas cooler was clogged within hours
  - Cleaning required 2000 bar water and a stop of 8-10 days

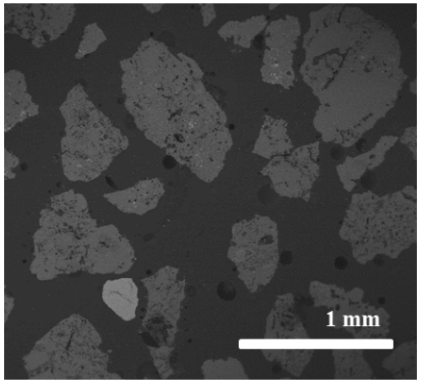
- An alternative method to activate olivine had to be developed
  - Two parallel initiative was initiated, which independently took forward two different suggestions on how to solve the problem
    - Göteborg Energi, Chalmers and Valmet (finally selected)
    - Göteborg Energi and ECN

Intial Tar Problematics

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

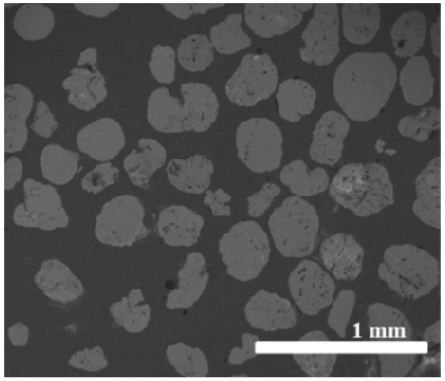
	Before K	After K
Total tar* (g/m3)	43,1	13,1
Total tar, excl. BTX (g/m3)**	21,8	4,4

Fresh olivine



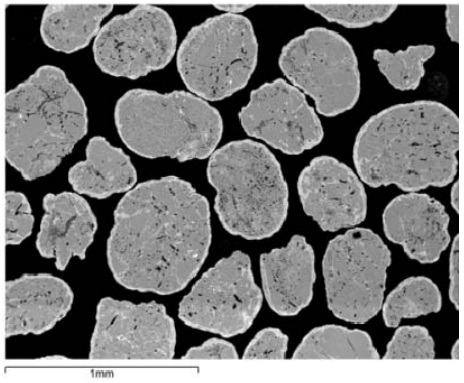
Analysis: Dr. Pavleta Knutsson

Used olivine



Analysis: Dr. Pavleta Knutsson

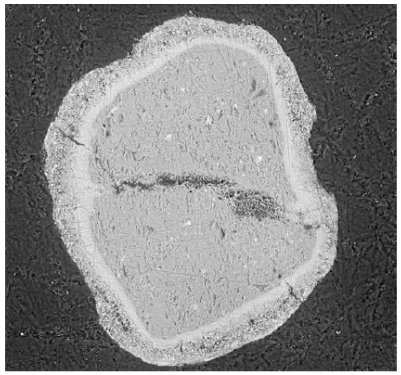
Used olivine after K_2CO_3

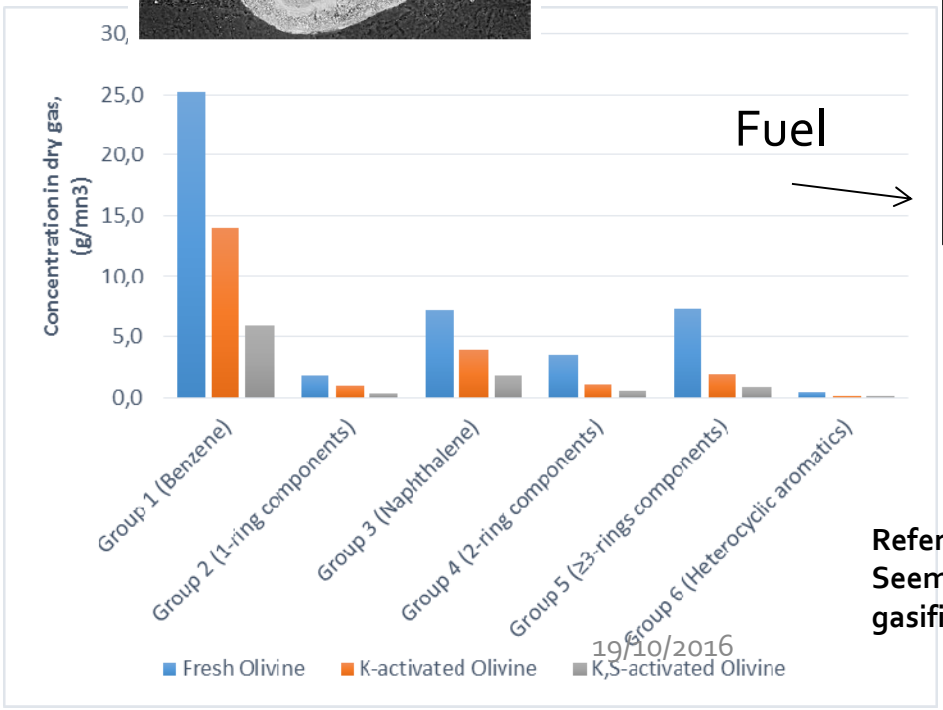


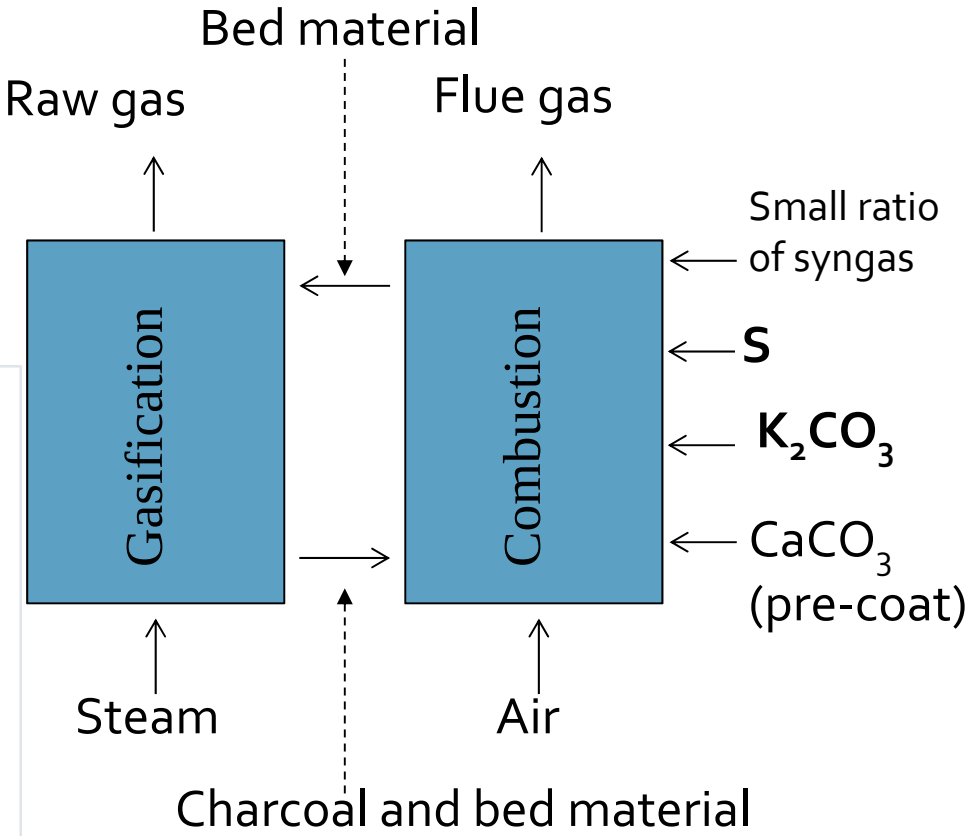
Analysis: TOP ANALYTIC, BSE-image

How To Control Tars

Olivine particle from GoBiGas

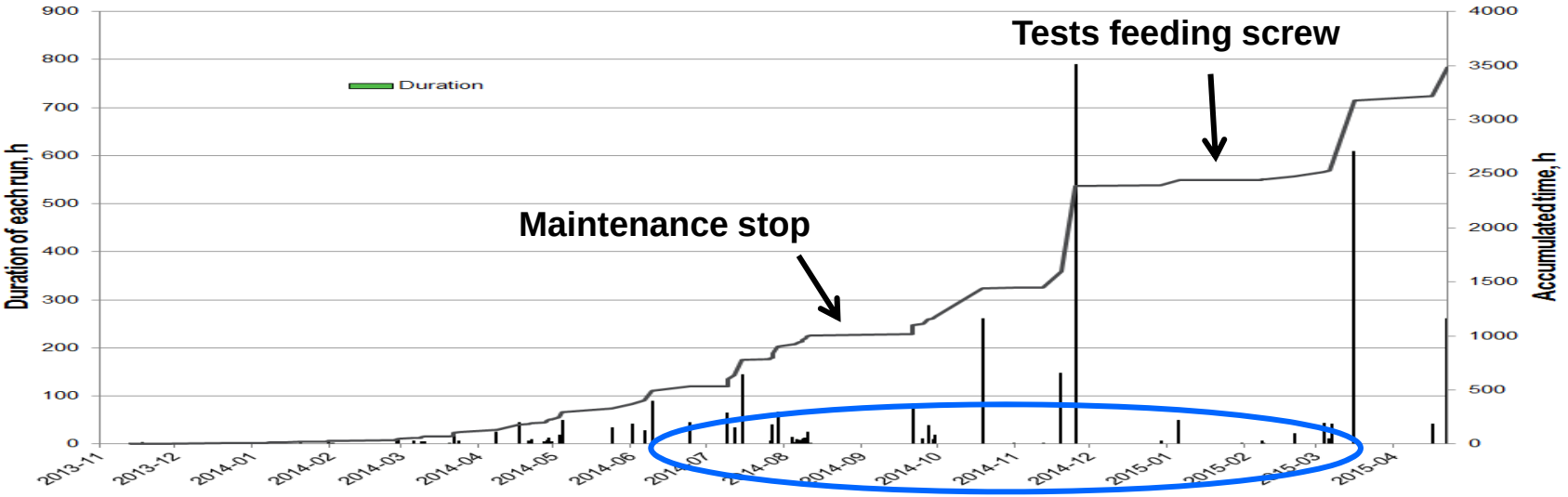


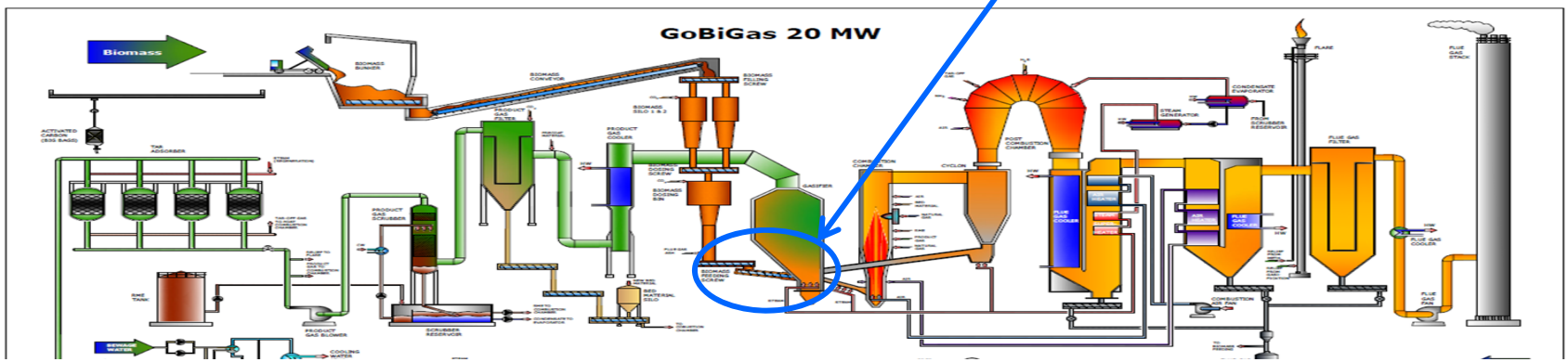




Referens: Jelena Marinkovic, Henrik Thunman, Pavleta Knutsson, Martin Seemann, Characteristics of olivine as a bed material in an indirect biomass gasifier Chemical Engineering Journal (1385-8947). Vol. 279 (2015), p. 555-566.

Fuel Feeding



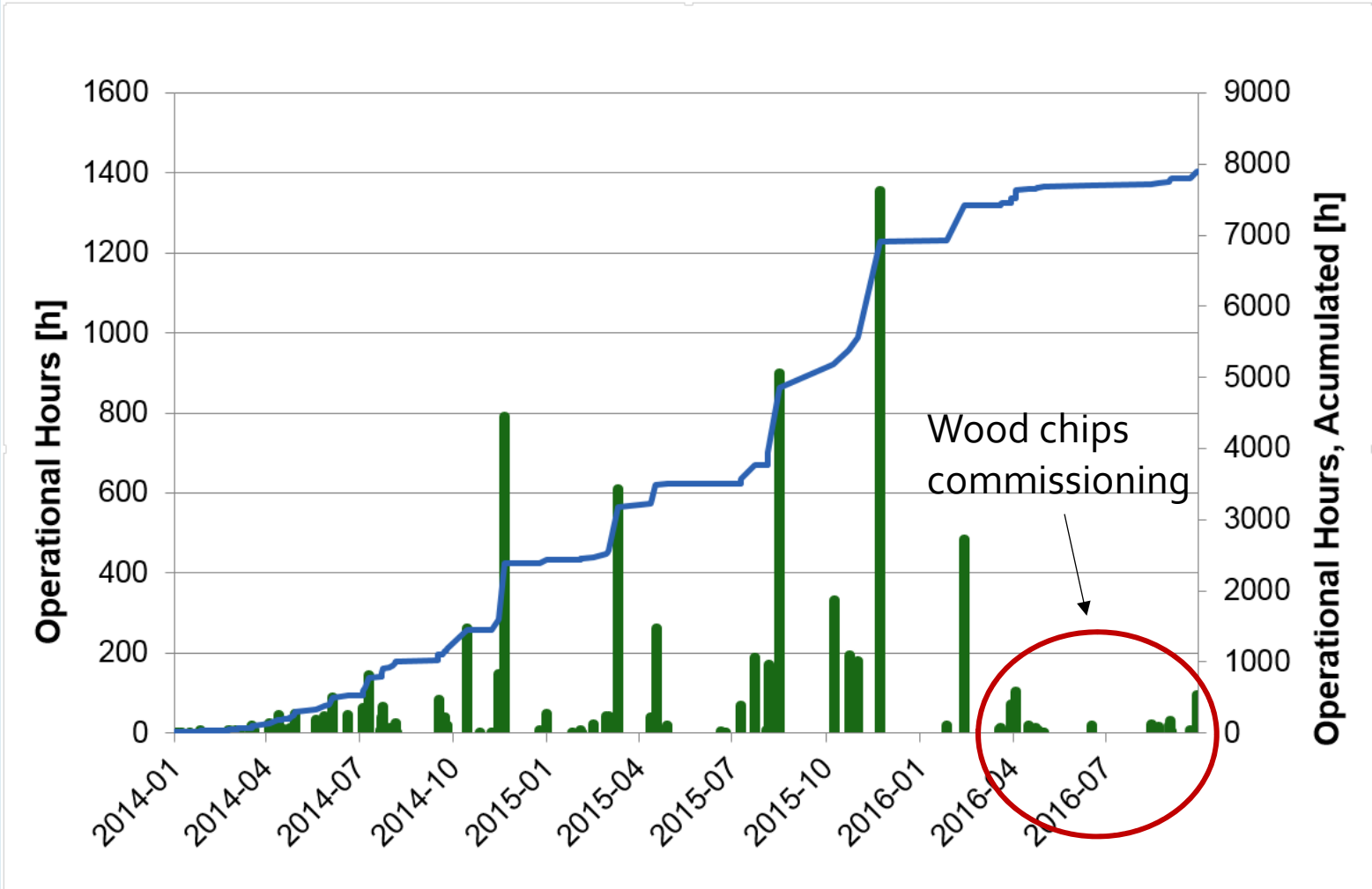


Fuel Feeding Solution

- Large number of strategies tested
- Present solution - the bed height is lowered, limiting heat transport by bed material.
- > 1300 hrs. of continuous operation without stops related to clogging (so far)

Picture by Dr. Claes Breitholtz at Valmet Power AB

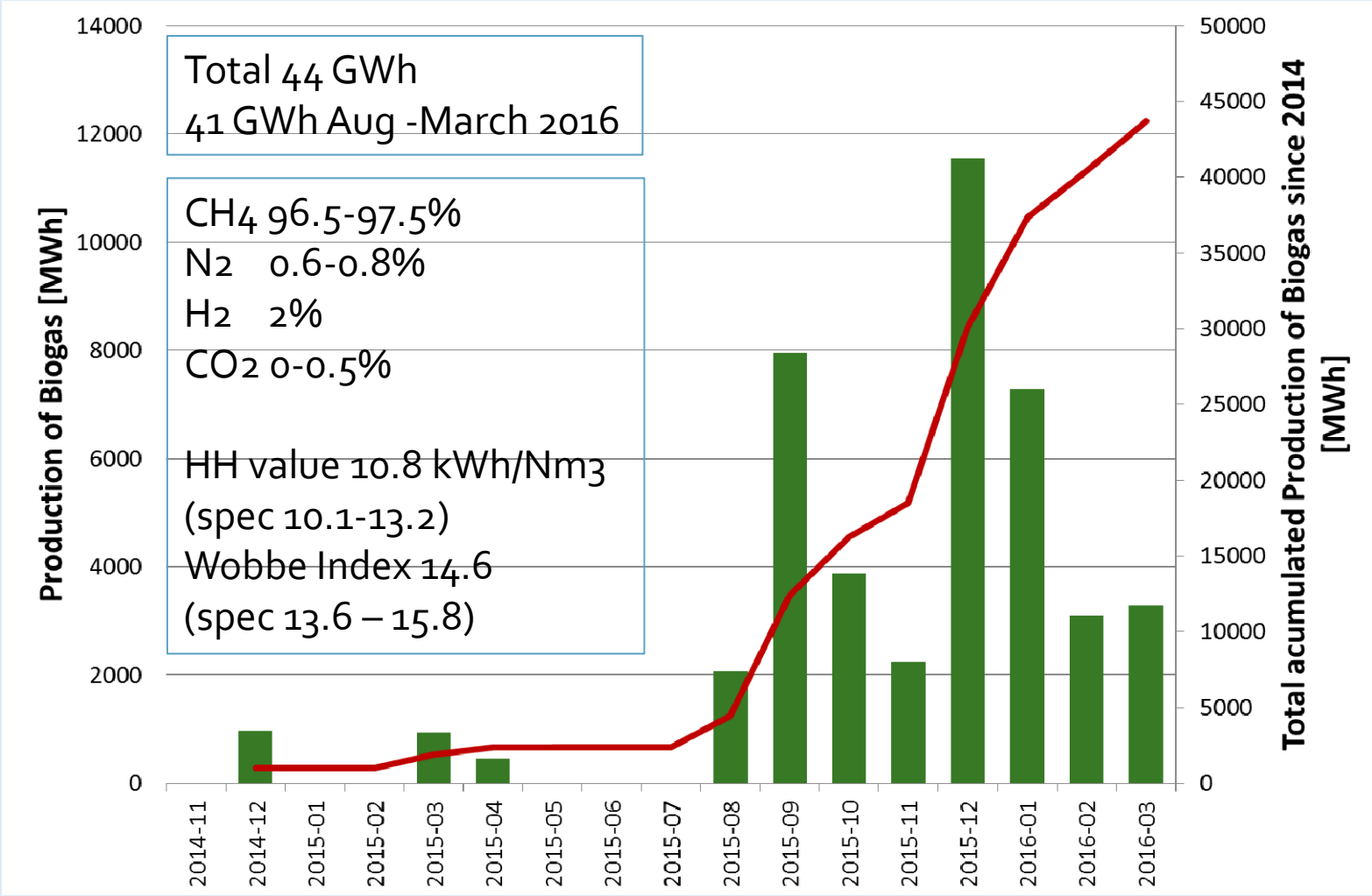
Gasification Availability ~ 8000 hours



Gasification - Performance Test (Wood Pellets)

Flue gas emissions	Guarantee	Measured	
Dust (24 hr average)	10	< 1.4	mg/Nm^3 @ 6% O2
CO (24 hr average)	500	109	mg/Nm^3 @ 6% O2
NOx as NO2 (1 year average)	95	96	mg/Nm^3 @ 6% O2
N2O (24 hr average)	20	3.2	mg/Nm^3 @ 11% O2
NH3 (24 hr average)	10	4	mg/Nm^3 @ 11% O2
Product gas	**Guarantee**	**Measured**	**Unit**
Capacity	24.3	23.5	MW
Flow	6890	6900	Nm^3/h
CH_4	8.3-11.4	8.6	Vol-%
O_2	<0.1	<0.01	Vol-%
C_6H_6	<15	14.4	g/Nm^3
N2	<0.85	0.3	Vol-%
Tar	<20	<10	mg/Nm^3

Bio-methane delivery



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 measurement facilities at GoBiGas 2015 -17

Conclusions

- GoBiGas is now online
- Major hurdles has been solved in gasification part and the gasifier operates at full load.
- Optimization of carbon beds for benzene removal now restrict the unit to go to full load
- Commissioning of gasification using wood chips, is ongoing.

Göteborg Energi

Thank you for your attention!

www.goteborgenergi.se
www.gobigas.se