

WoodRoll® ultraclean syngas to make a bio-energetic difference



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Malmö 2016-10-19
Rolf Ljunggren - Founder and CEO

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1. Cortus Energy

1.1 Cortus Energy

Provide cost effective renewable energy gas for power, industrial and transport applications based upon the patented WoodRoll® technology

- Founded 2006 to develop and commercialize the patented WoodRoll® technology
- Listed on Nasdaq OMX stock exchange since February 2013
- 10 employees, 6 consultants.

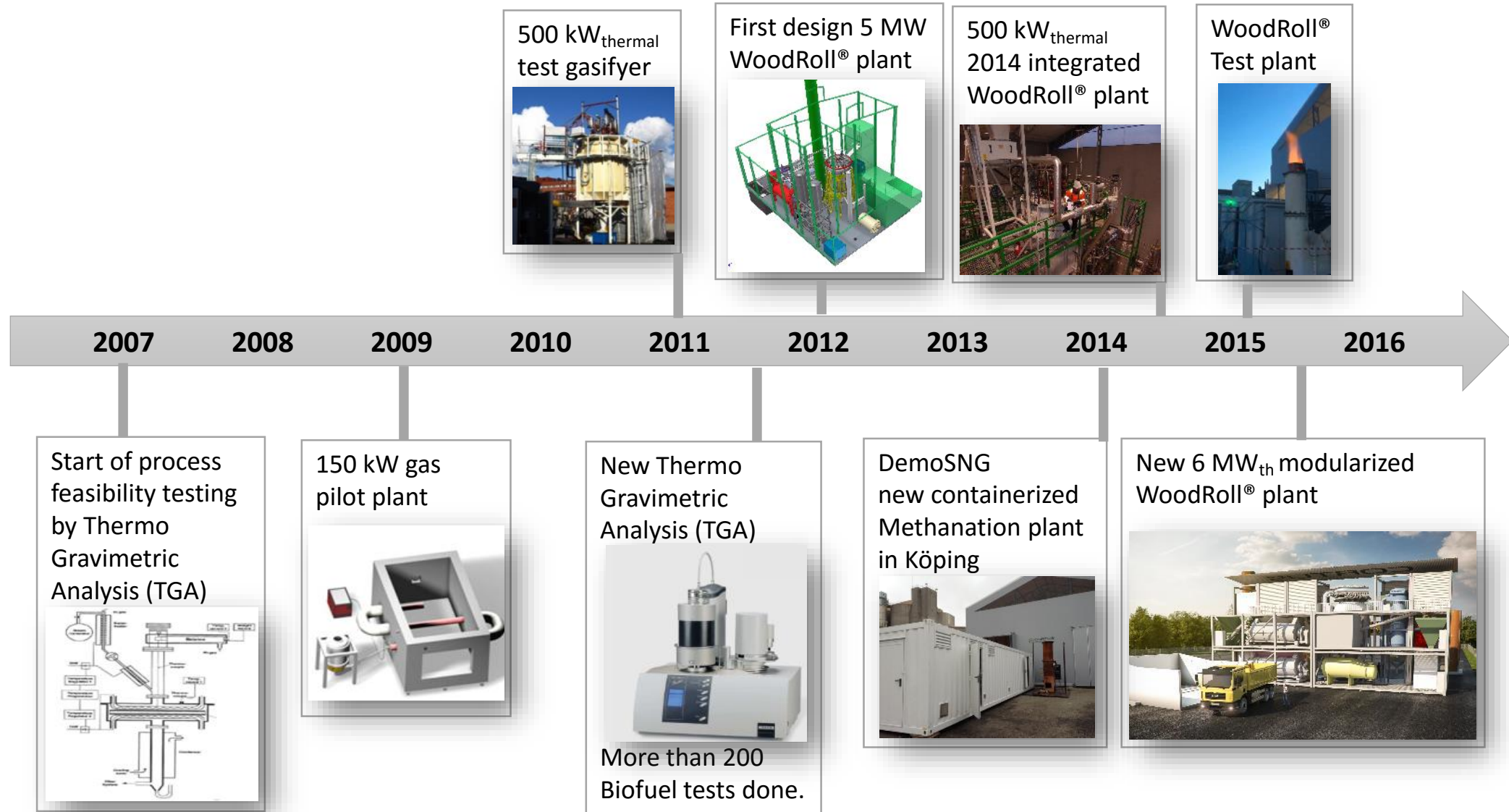


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- WWF climate solver (2009)
 - Top 25 Nordic Cleantech Open (2010)
 - Top 25 Cleantech summit Geneva (2011)
 - Classified as "Beyond state of the art" by German consulting company (2010) and Chicago Gas Technology Institute (2011)
 - Stockholm Cleantech hotlist (2013-)

1.2 WoodRoll® test & demonstration site



1.3 WoodRoll® – development until today





2. WoodRoll® technology

WoodRoll® – Versatile green Energy gas

WoodRoll® is a unique technology that replaces fossil energy by efficient gasification of biomass that produces green energy for vehicles, industry and power generation.

Feedstock

Forest-based feedstock such as forest residues and energy crops.



Waste from industry such as fiber sludge and construction waste.



Agricultural waste such as animal manure and crop residues.

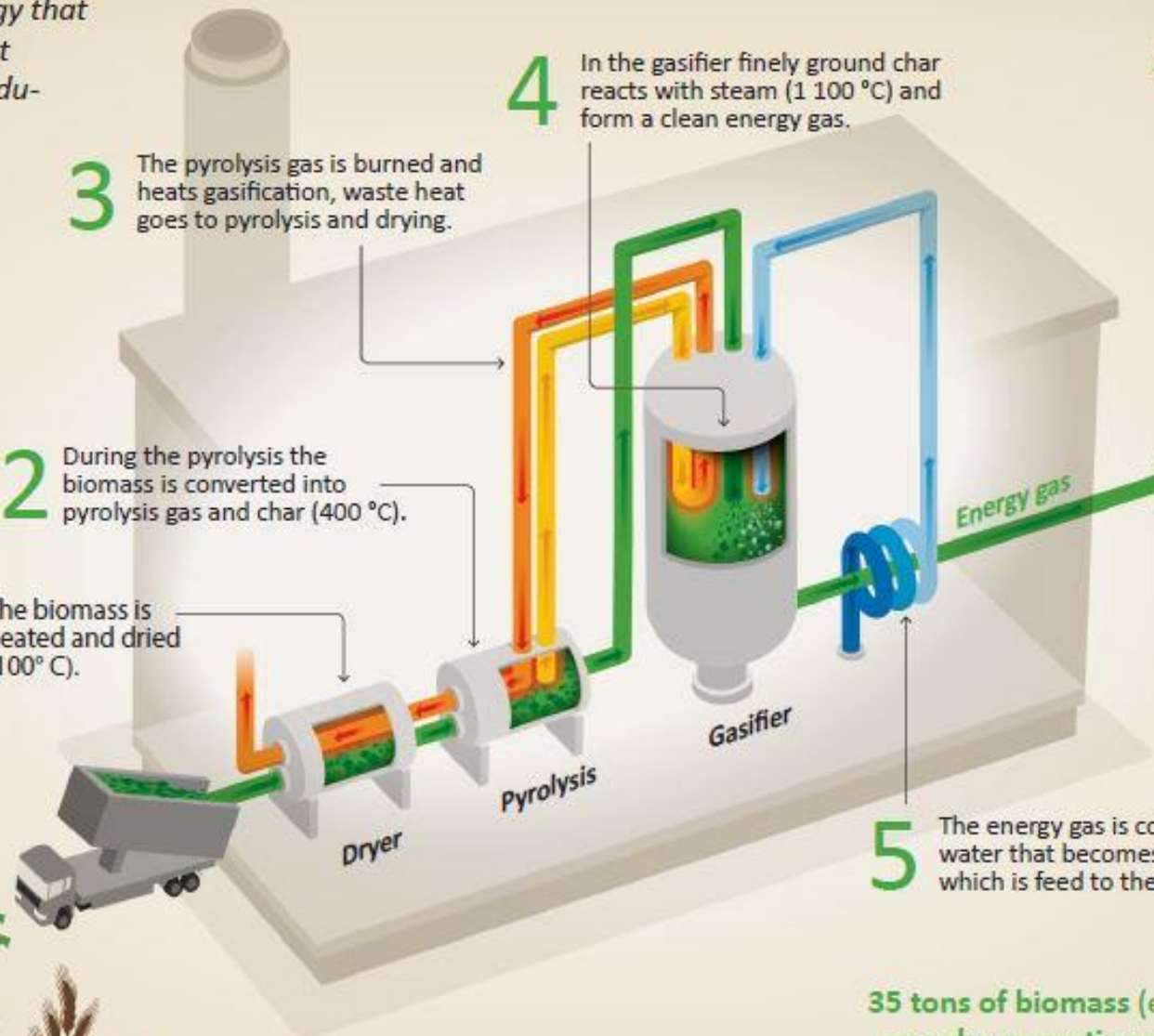
1 The biomass is heated and dried (100° C).

2 During the pyrolysis the biomass is converted into pyrolysis gas and char (400 °C).

3 The pyrolysis gas is burned and heats gasification, waste heat goes to pyrolysis and drying.

4 In the gasifier finely ground char reacts with steam (1 100 °C) and form a clean energy gas.

5 The energy gas is cooled with water that becomes steam, which is feed to the gasifier.



Applications

Biogas



Renewable power



Hydrogen



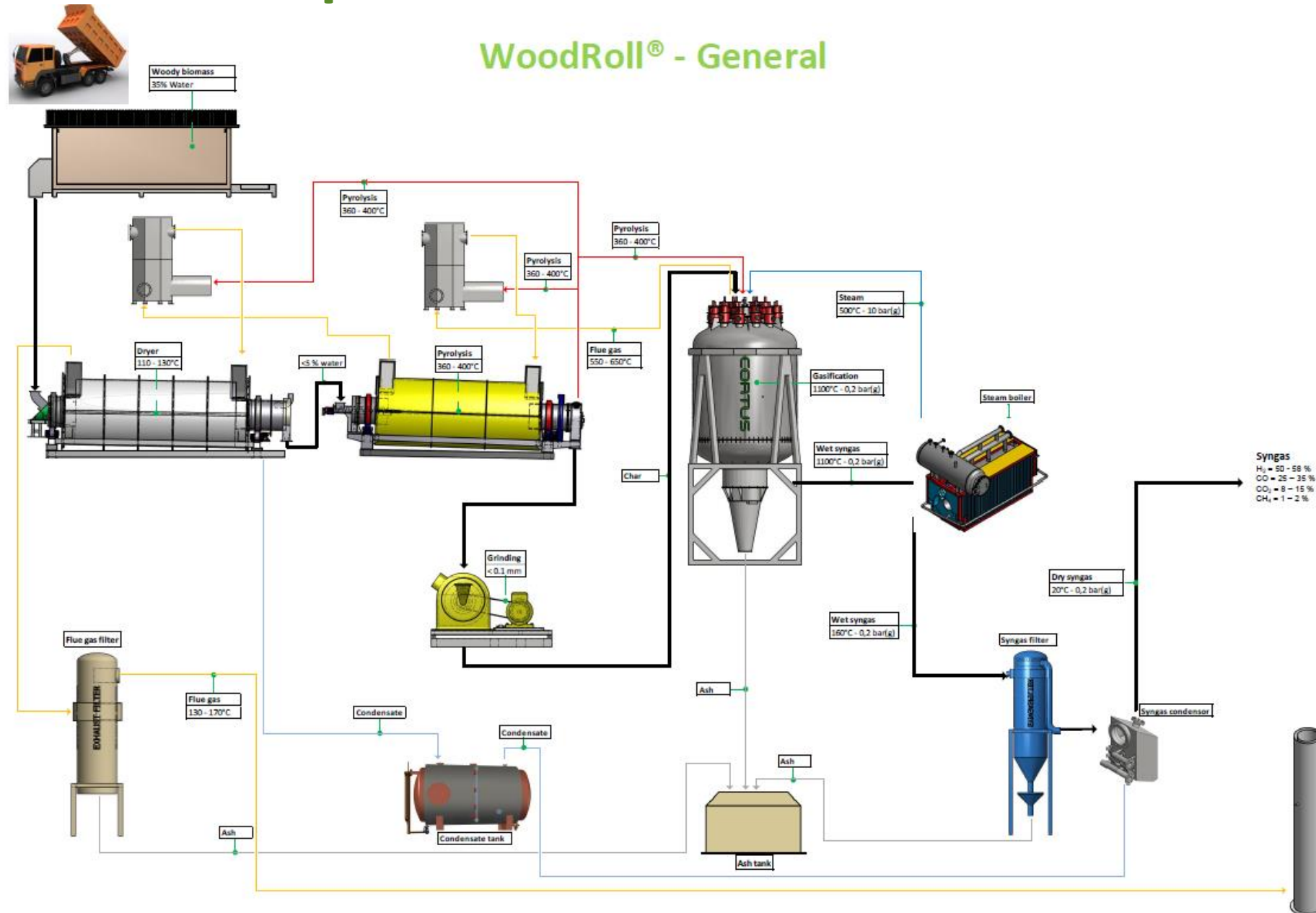
Industry



35 tons of biomass (equivalent to a lorry with trailer)
one-day operation of a WoodRoll® = 100 oil barrels



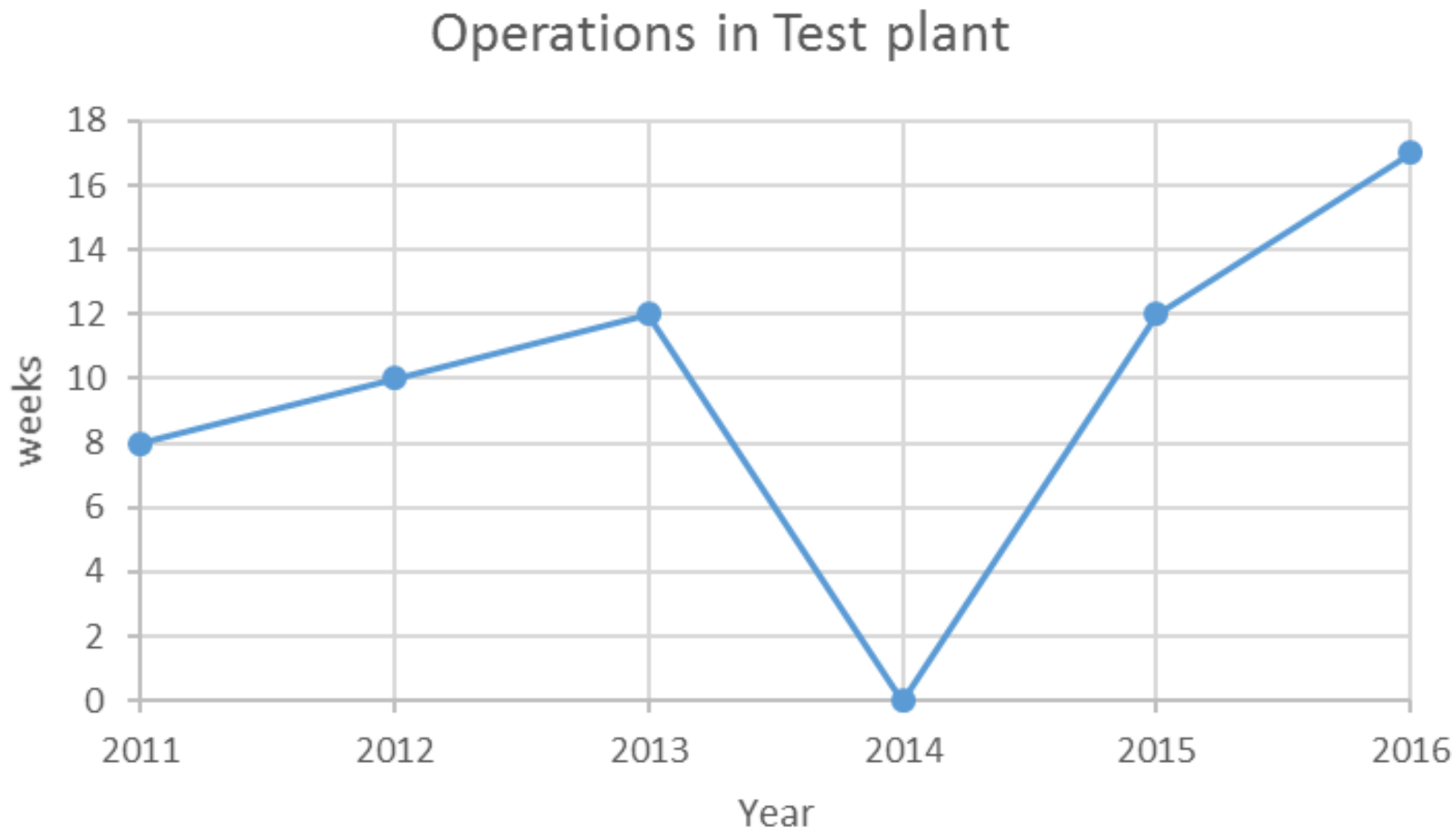
2.2 WoodRoll® – process scheme



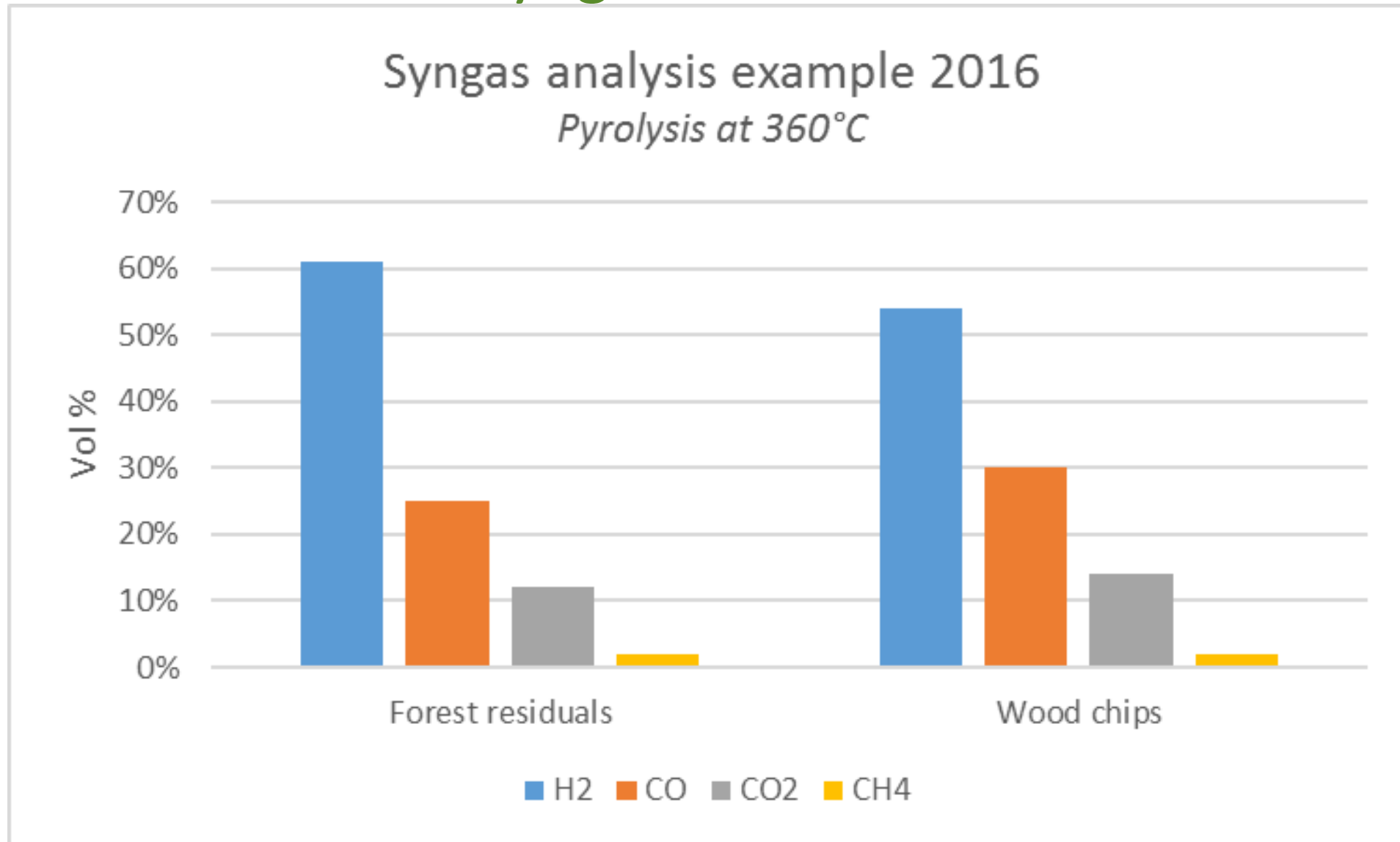


3. Operations in test plant

3.1 Test plant in Köping, SE

[illegible]

3.2 Versatile tar free syngas



3.3 Milsetones and challenges

Milestones reached

2011 - Indirectly heated char gasification

2013 - Remote monitoring during heating and complete conversion of char >99%

2015 - Single ended recuperative burners for pyrolysis gas in operation (two different models) and integrated operation (Nov)

2016 - 10 different biomasses gasified and syngas at catalytic quality (Oct)

Continuing challenges

- Instrumentation in pyrolysis and steam system
- Thermal yield at part load
- Cycle time for pre-heating and cooling
- Availability at 3- shift operation
- Material management for different biomasses



4. Ongoing development

4.1 Development

Ongoing

- Gas cleaning for catalytic process:
 - Green energy filling station
 - Biogas Expose
- Fuel feasibility:
 - Steel plant project in Sweden
 - Low cost rest products for Biogas Expose
- Availability/Capacity/Yield

Coming

- Methanation
 - Green energy filling station
 - Biogas Expose
- Hydrogen
 - Green energy filling station
 - Fuel cells for CHP
- Fuel feasibility:
 - CHP plant project in Japan
- Availability/Capacity/Yield

4.2 Green Energy Filling station



Swedish Energy Agency

Supporting a 500 T€ project in 2016

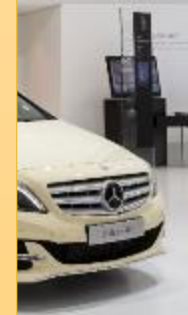
Objective 2016

To qualify syngas cleaning and conditioning for SNG/H₂/Fuel cells.

Plan 2017-18

Production of SNG/H₂

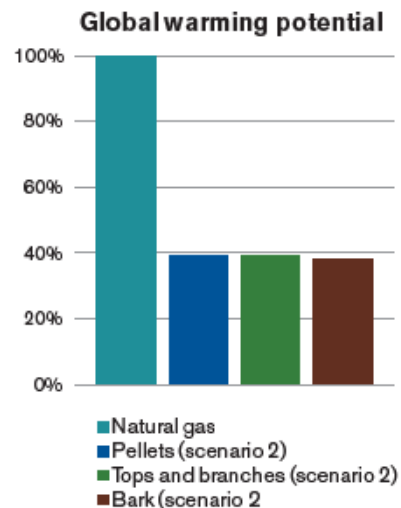
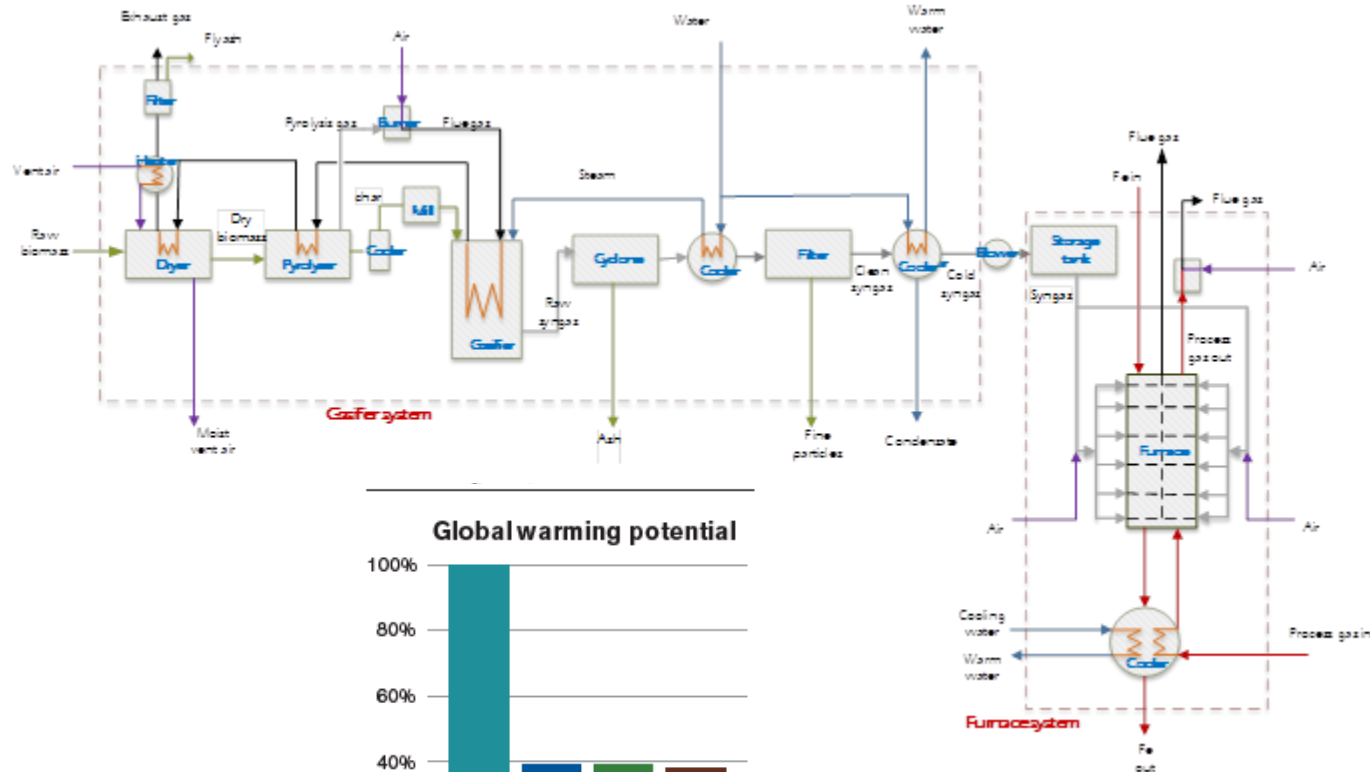
SYNGAS



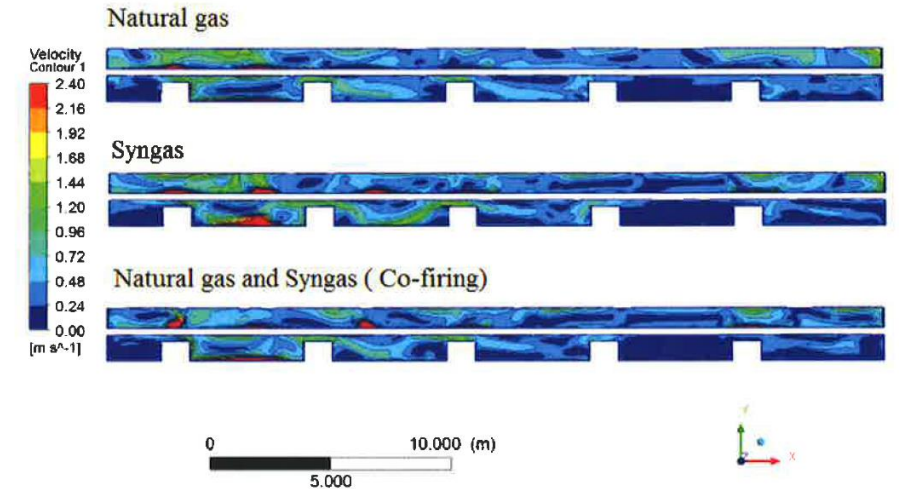
4.3.1 WoodRoll® for reheating furnaces at Höganäs

- The project is initiated within the Swedish Iron and Steel Society and funded by industry and Swedish Energy Agency.
- The aim is to investigate the gasification of biomass can be used to replace fossil fuels, thereby reducing emissions of greenhouse gases, in the steel industry in general and in the production of iron powder in particular.
- The project has for two years conducted a number of studies:
 - Gasification technology,
 - Impact on furnace technology,
 - Combustion technology,
 - Raw materials
 - Environmental impacts.
- The studies have shown the solution to be feasible from a technical, economical and environmental point of view.

4.3.2 WoodRoll® for reheating furnaces at Höganäs



Relative total results for global warming potential for different types of biofuel.



4.3.3 Project partners WoodRoll® at Höganäs



Höganäs 

ABB

 calderys®

OUTO
KUMPU

SSAB


SVEASKOG

 SÖDRA

 CORTUS
ENERGY

4.4.1 Biogas EXPOSE - Biofuel analysis

Biomass	Wood chips (Södra)	Sedimentation fiber (S1)	Precipitation (F1)	Chemical (K1)
Carbon (C) [% db]	50	43,6	25,3	32,2
Hydrogen (H) [% db]	6,2	8,9	2,8	4,2
Nitrogen (N) [% db]	0,1	0,1	0,1	2,2
Oxygen (O) [% db]	43,2	48,8	8,8	26,9
Chlorine (Cl) [% db]	<0,02	0,08	<0,02	0,62
Sulphur (S) [% db]	<0,013	0,037	0,02	3,16
Moisture content [%]	40	54	57	83

4.4.2 Biogas EXPOSE - Ash analysis

Method: Ash content according to standard SS-EN 14775:2009/15403:2011
Ash melting temperature according to standard SIS-CEN TS 15370/TR 15404

Performed by: Belab Bränsle och Energilaboratoriet

Analysis no: 160564 – Precipitation sludge (F1)
160565 – Sedimentation fiber sludge (S1)
160563 – Chemical sludge (K1)

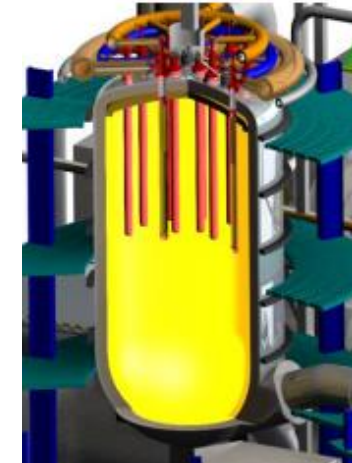
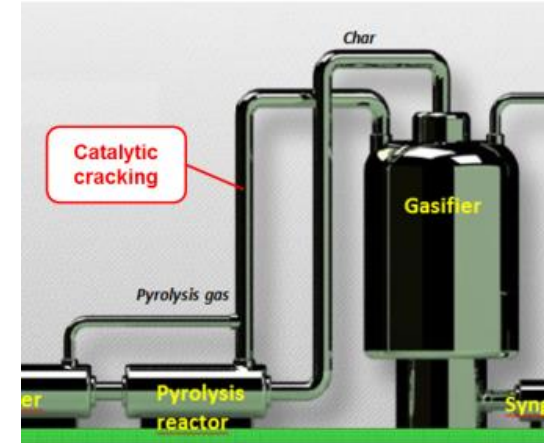
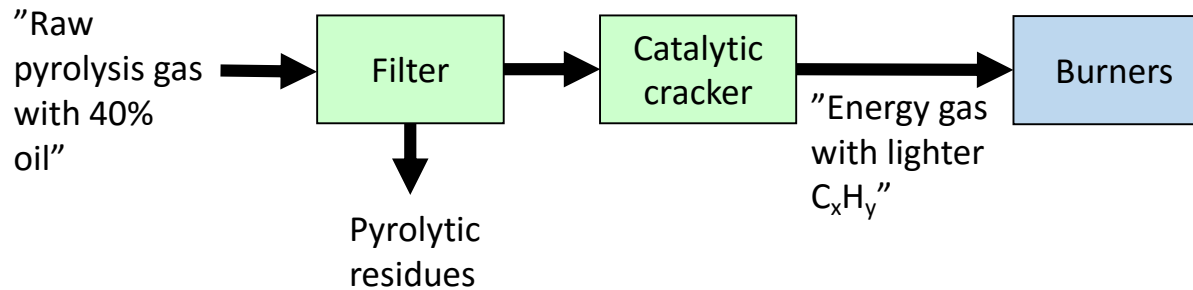
Biomass	Wood chips (Södra)	Sedimentation fiber (S1)	Precipitation (F1)	Chemical (K1)
Ash content [% db]	0,6	1,1	63,0	30,7
Shrinkage temperature [°C]	1210	710	880	1070
Deformation temperature [°C]	1470	1190	1460	1500
Hemisphere temperature [°C]	1480	1220	1470	>1500
Flow temperature [°C]	1490	1310	1480	>1500

4.5.1 Catalytic conversion of pyrolysis gas in WoodRoll®

Cracking and filtering of pyrolysis gas

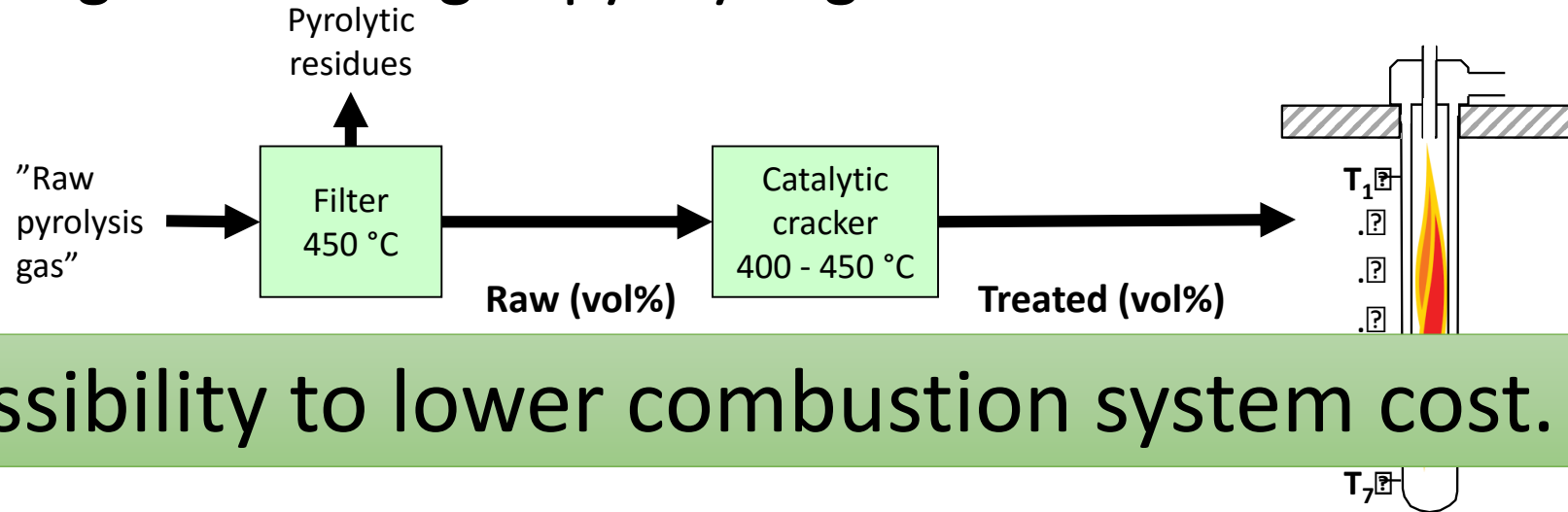
Energiforsk project aims:

- Experiments on-site
- Catalytic conversion of heavy organic compounds to lighter
- Filtering of pyrolytic biomass residues
- Improved process robustness



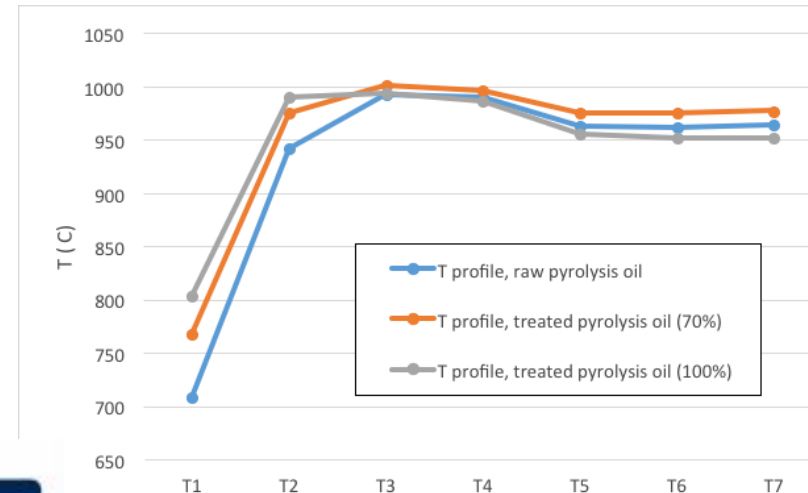
4.5.2 Catalytic conversion of pyrolysis gas in WoodRoll®

Cracking and filtering of pyrolysis gas



Possibility to lower combustion system cost.

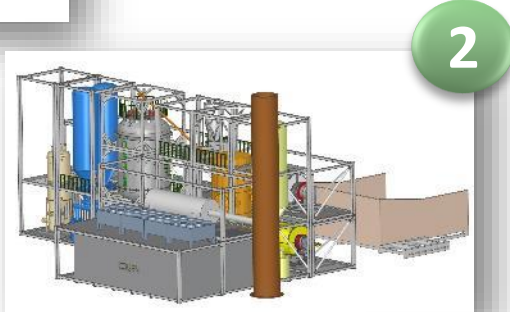
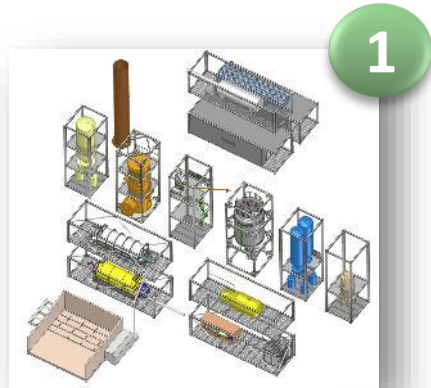
- Treated pyrolysis gas flow has 53 % less oil than the raw pyrolysis gas.
- Combustion zone for treated oil is longer than raw oil.
- "Treated oil easier to burn"





5. Engineering Development

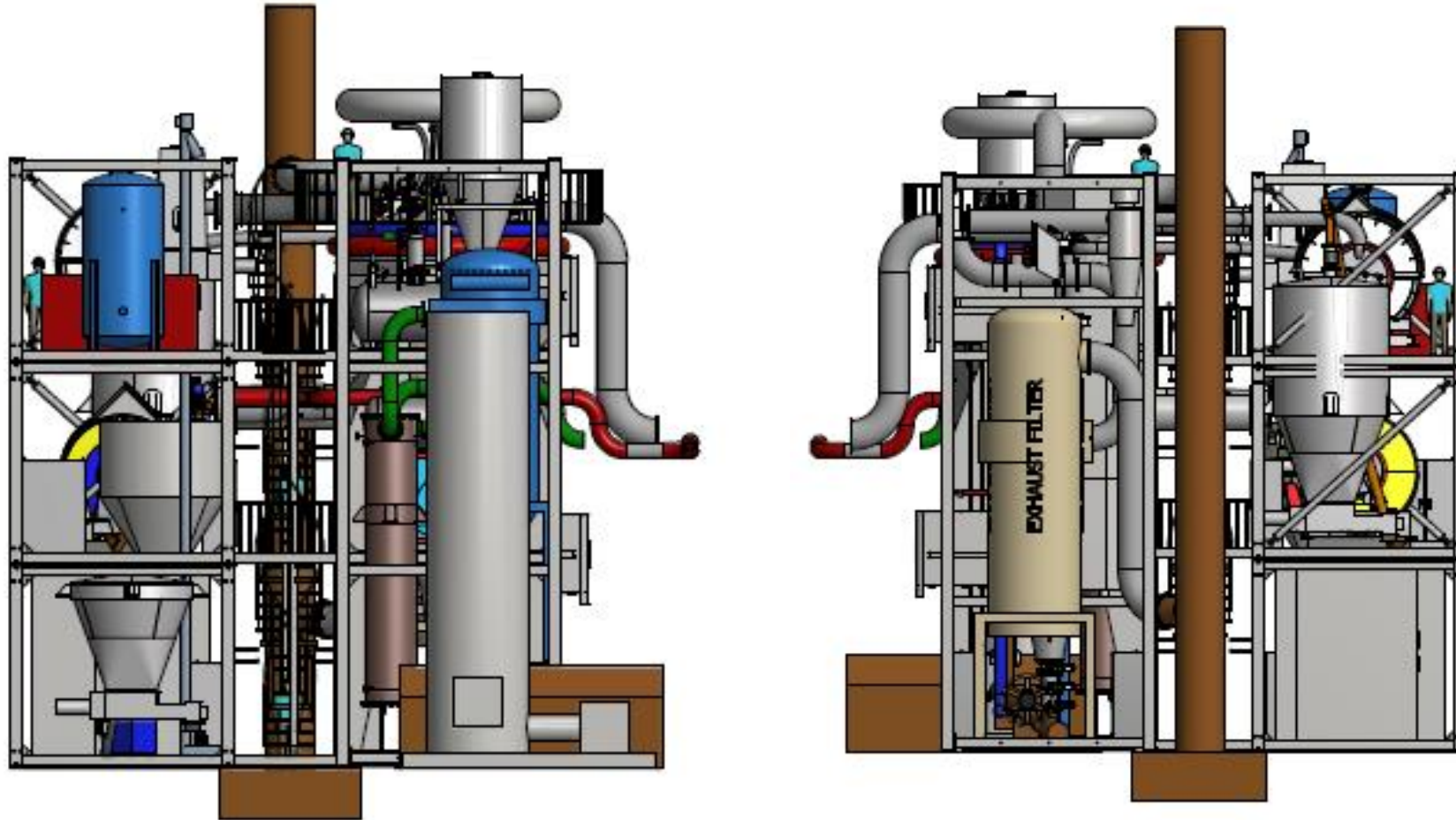
5.1 Modular delivery concept



Modular plants means:

- Engineering recycle from plant to plant
- Quality assurance in the plant delivery
- Rational construction module by module
- Minimize the erection period
- Service and maintenance made easy
- Plant can be moved – minimize risk and keep value over its full technical lifetime

5.2 6 MW WoodRoll®



Foot print: 27 x 11 x 12 meters (excl chimney)

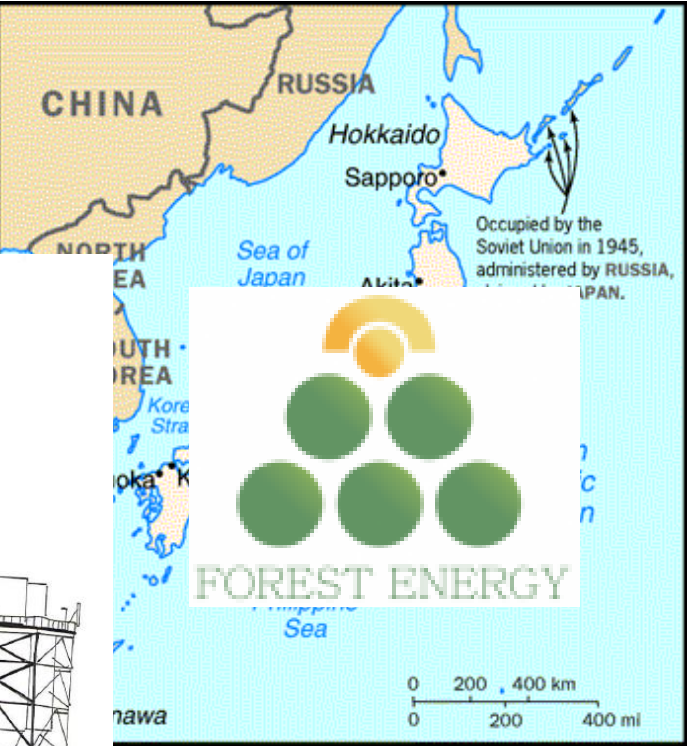
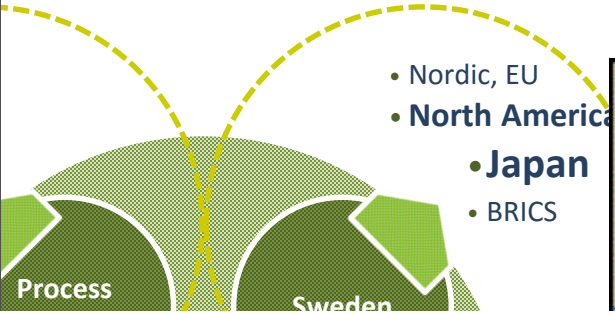
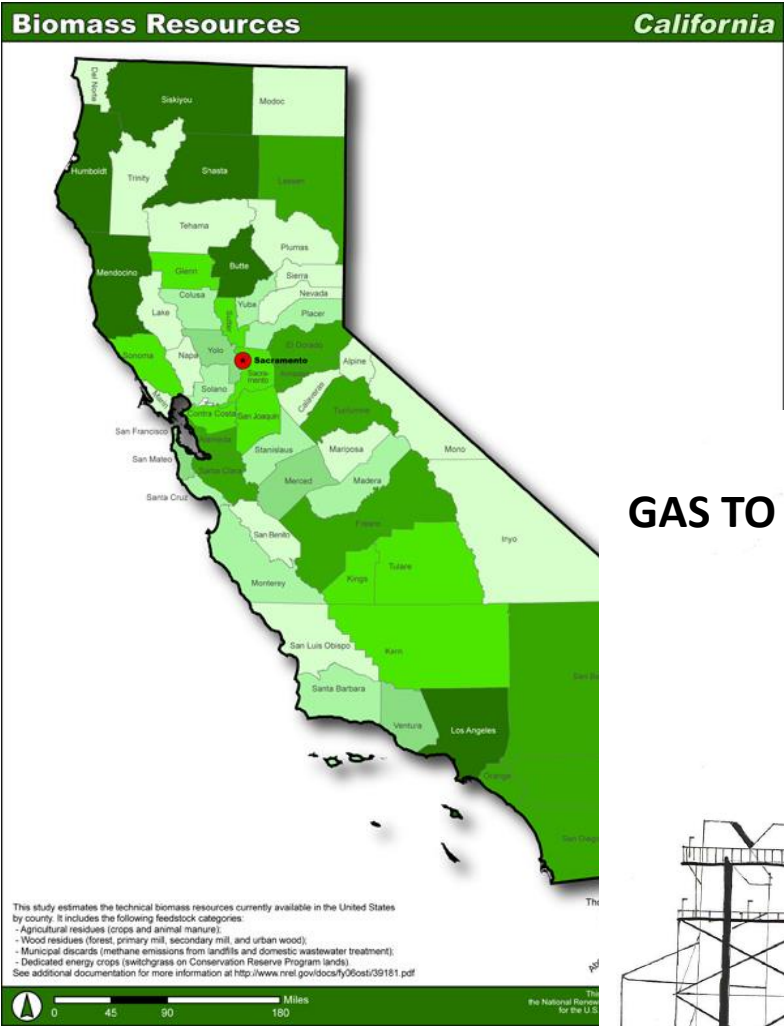
5.3 WoodRoll® at Höganäs





6. Next step

6.1 Next step



GAS TO LIQUID

