

Biomass gasification for CHP applications

C.M. van der Meijden

July 2014


ECN-L--14-038



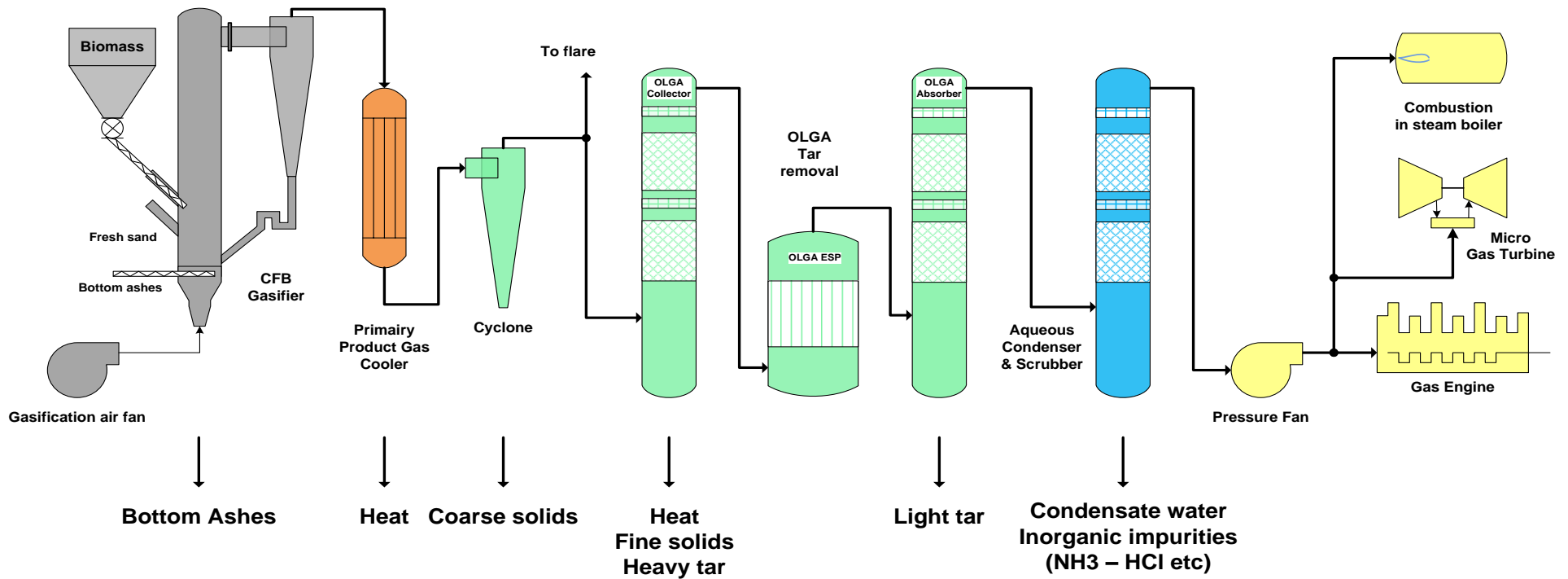
Biomass gasification for CHP applications

CHP & RENEWABLE ENERGY CONFERENCE
London, May 22nd 2014

Christiaan van der Meijden
vandermeijden@ecn.nl

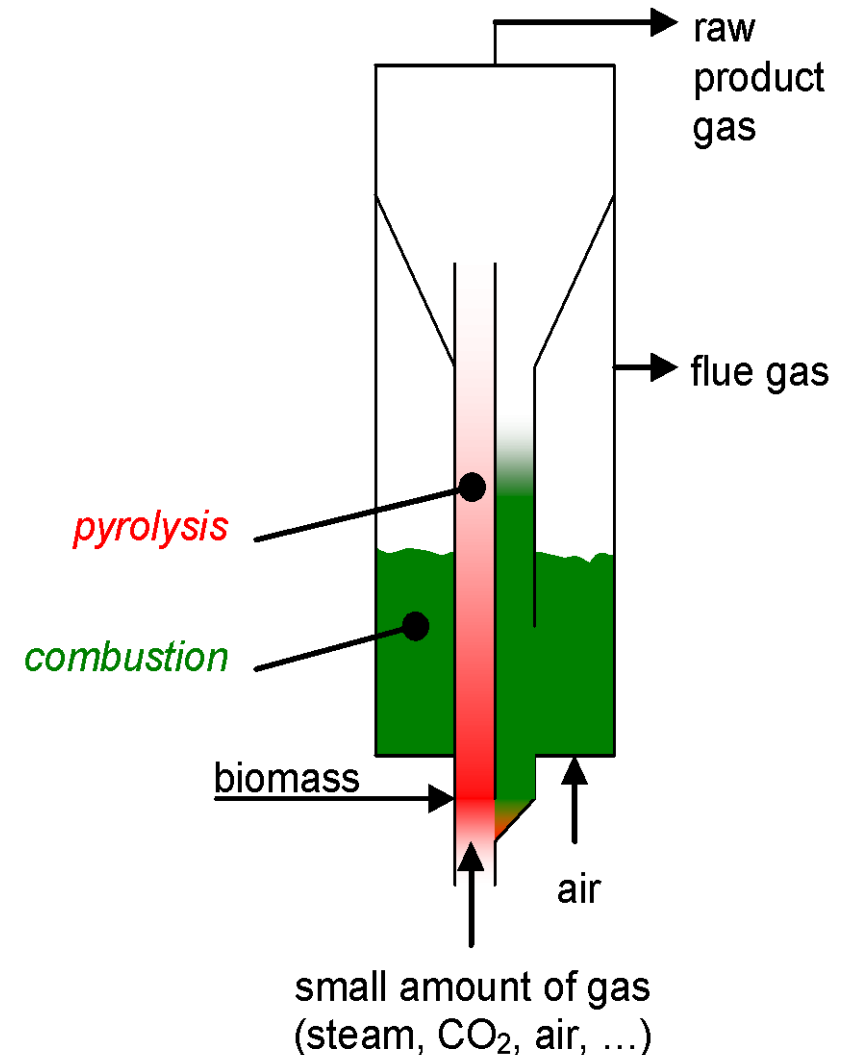
 +31 653 292 766

Overall Bio-CHP system based on fluidized bed gasification



MILENA Indirect Gasification

- Fluidized bed gasification
- Temperature level: 850°C
- Product gas contains methane, ethylene, benzene and tars. Heating value > 12 MJ/nm³.
- Very little nitrogen in producer gas
- Complete conversion of the fuel
- No carbon in the ash
- High efficiency
- Heat transfer through bed material
- One single vessel: compact design
- Fuel flexible



Comparison

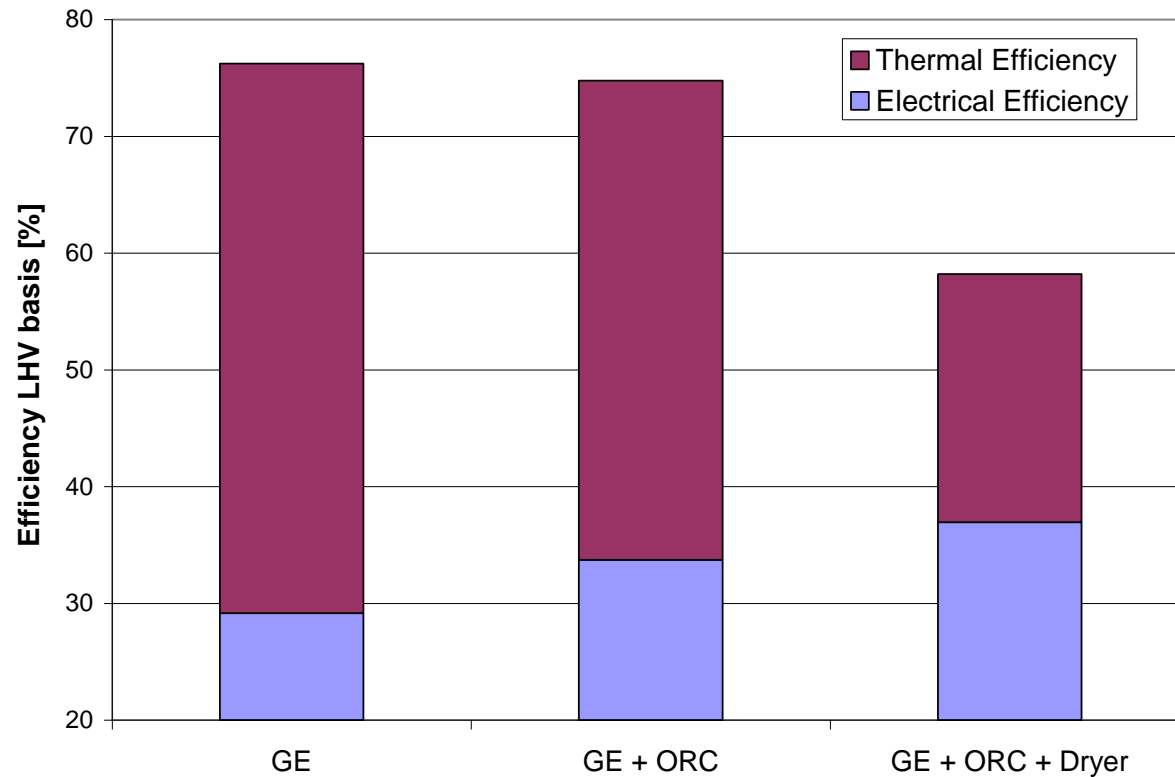


	MILENA	CFB/BFB	Downdraft
Conversion	100% / white ash	~90% / black ash	~90% / black ash
Cold Gas Efficiency	~80%	~70%	~70%
Temperature control	Good control, no char accumulation	Lower control ability due to char hold-up	Very heterogeneous
Temperature versus Efficiency	lower temperature = higher efficiency	lower temperature = lower conversion	lower temperature = lower conversion
Fuel flexibility	waste, agricultural residues any size	less freedom any size	woody only large chunks
Gas	12-15 MJ/Nm ³ essentially N ₂ -free	5-6 MJ/Nm ³ ~50% N ₂	5-6 MJ/Nm ³ ~50% N ₂
Scale	Scalable (>100 MW)	Scalable (>100 MW)	Max. 1 MW

Markets for MILENA gasifier

- **Co-firing in coal boilers or gas turbines**
 - Clean gas feeding to boiler or turbine
 - With Milena lower grade biomass or waste can be used, rather than the clean wood pellets needed for direct co-firing in boilers
- **Combined heat and power**
 - On-site conversion of waste to energy
 - In combination with gas engine or small gas turbine
 - Milena produces medium calorific gas, not diluted with nitrogen
- **Substitute Natural Gas production**
 - High methane content of producer gas makes Milena very suitable for SNG production (Bio-Methane / Bio-LNG)
- **(Co-)Production of fuels or chemicals**
 - FT, Ethylene, BTX

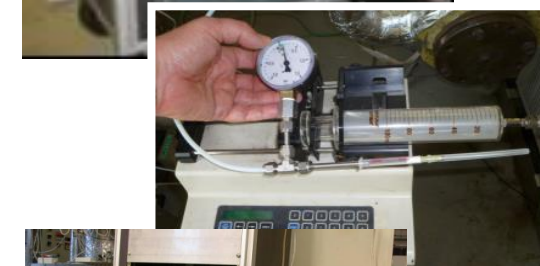
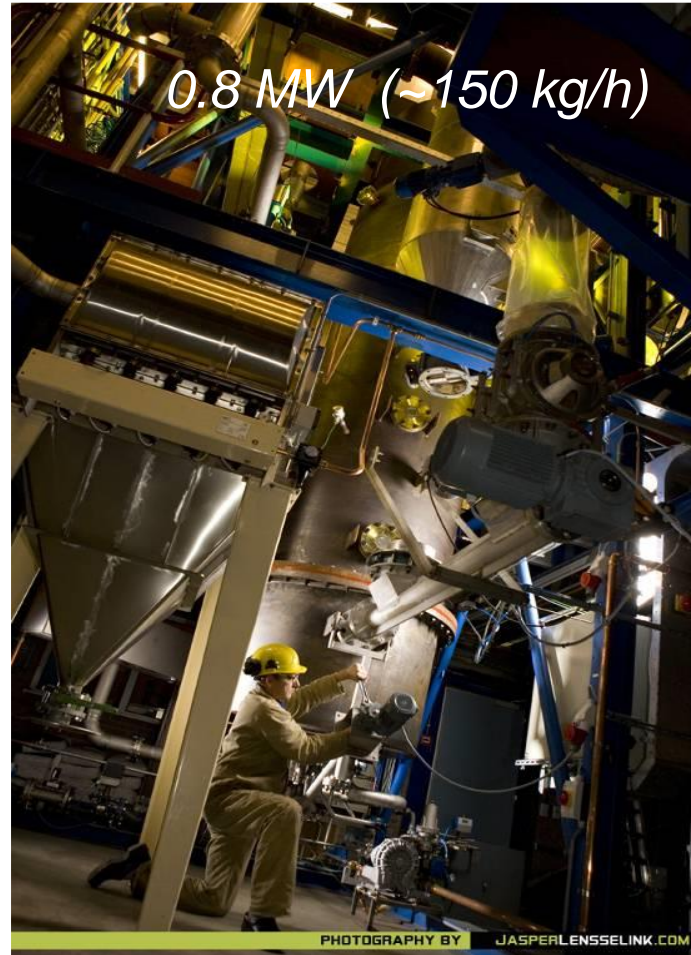
Gas Engine system efficiency MILENA CHP configuration



Typical scale: several MWe.

ECN Experience with MILENA gasification technology

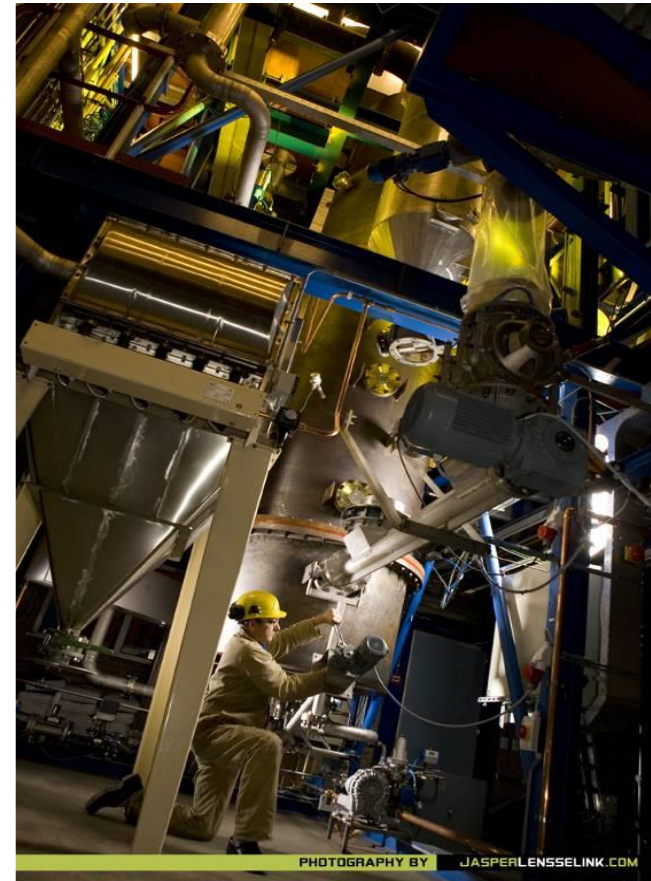
Milena Technology test facilities at ECN



800 kW_{th} MILENA + OLGA pilot plant

- MILENA gasifier in operation since 2008
- Typical input 150 kg/h
- Realistic fuel particles sizes.
- Refractory lined vessel.
- Runs in campaigns
- Connected to OLGA tar removal system

- OLGA pilot plant also tested in combination with CFB gasifier, gas engine and small gas turbine.



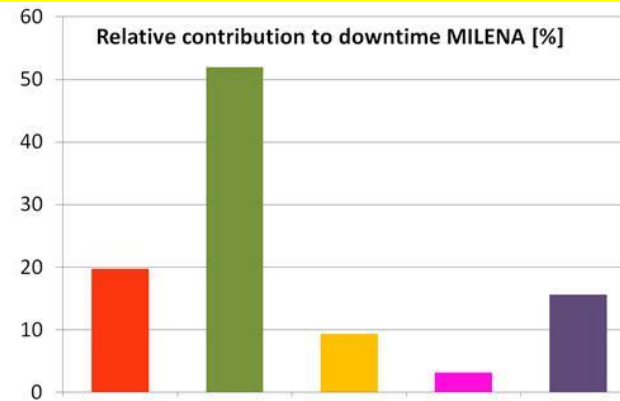
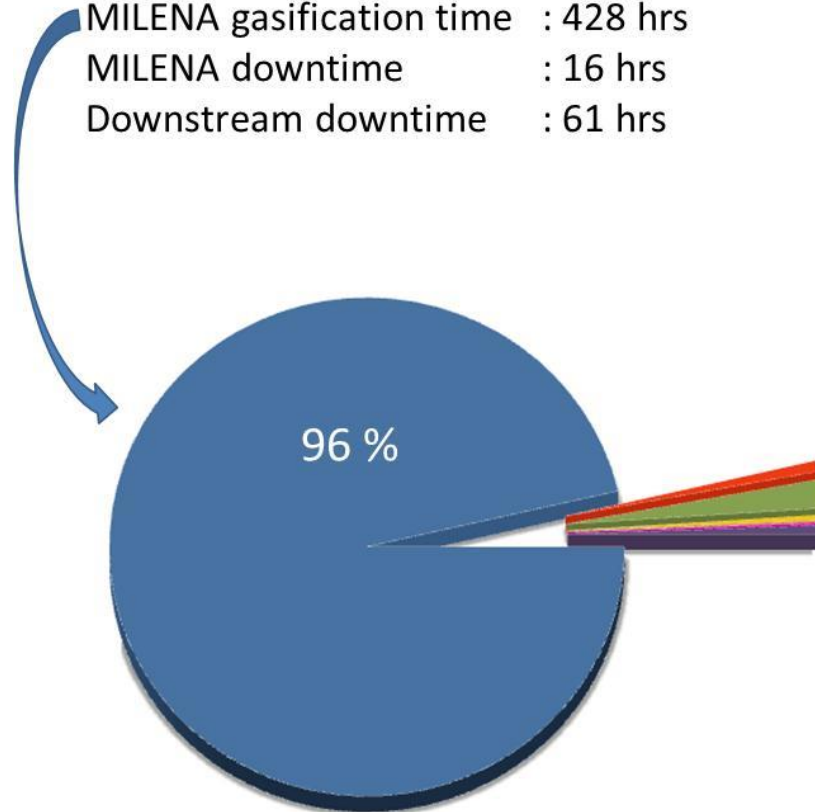
Tested feedstocks

- Clean Wood
- Demolition Wood
- Straw
- Soya stalk
- High-ash coals (> 50 wt% ash)
- Lignite
- RDF
- Sunflower husks



Results 500 hour test of 1 MW Milena + OLGA tar removal system

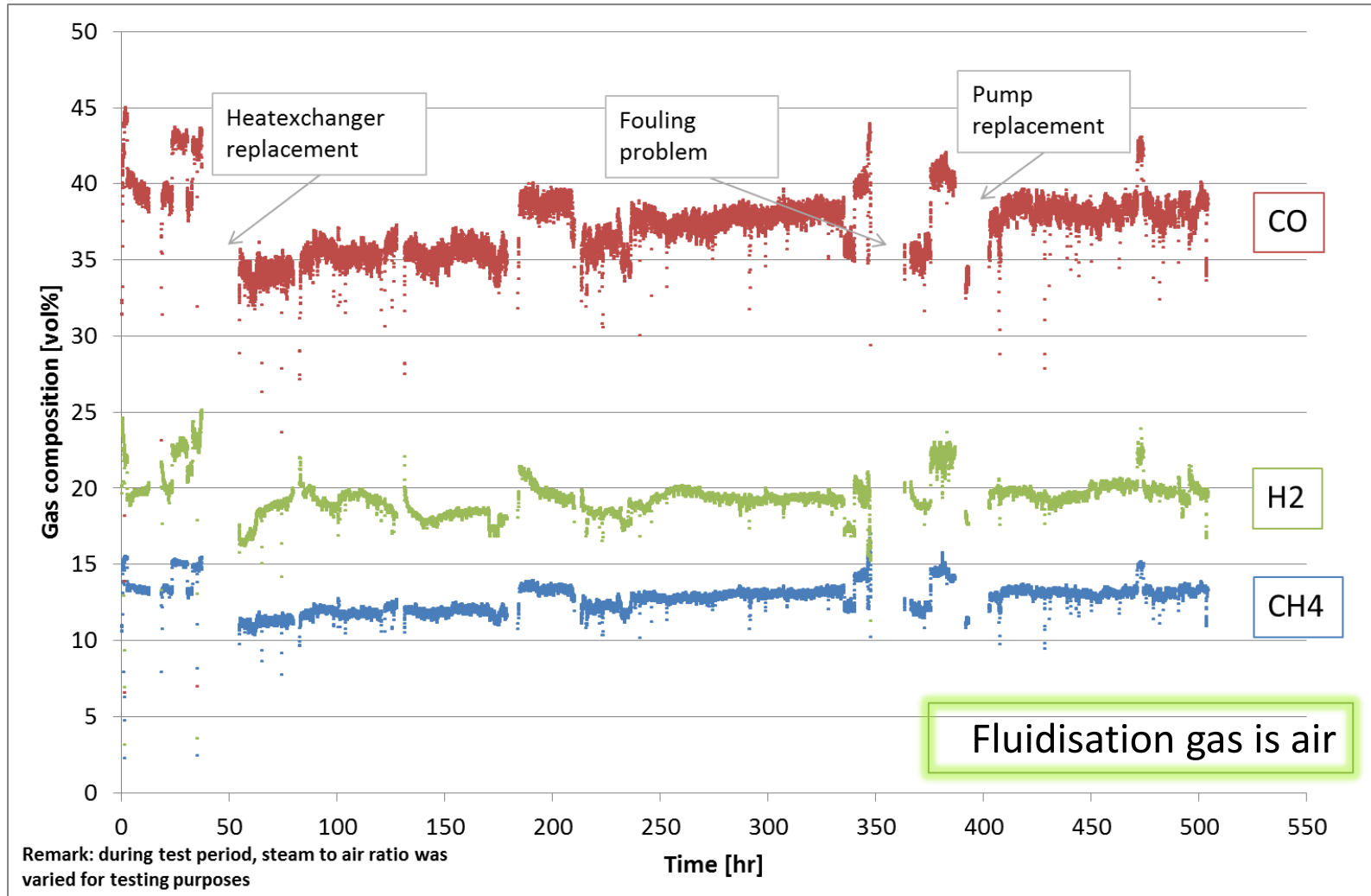
Duration experiment : 505 hrs
MILENA gasification time : 428 hrs
MILENA downtime : 16 hrs
Downstream downtime : 61 hrs



- Availability Milena 96%
- “Downstream downtime”: in OLGA tar removal system

■ In operation ■ Screw conveyor blockage ■ Repair dosing system
■ Forced stop ■ Rotary airlock valve blockage ■ HSE

Gas composition 2012 duration test



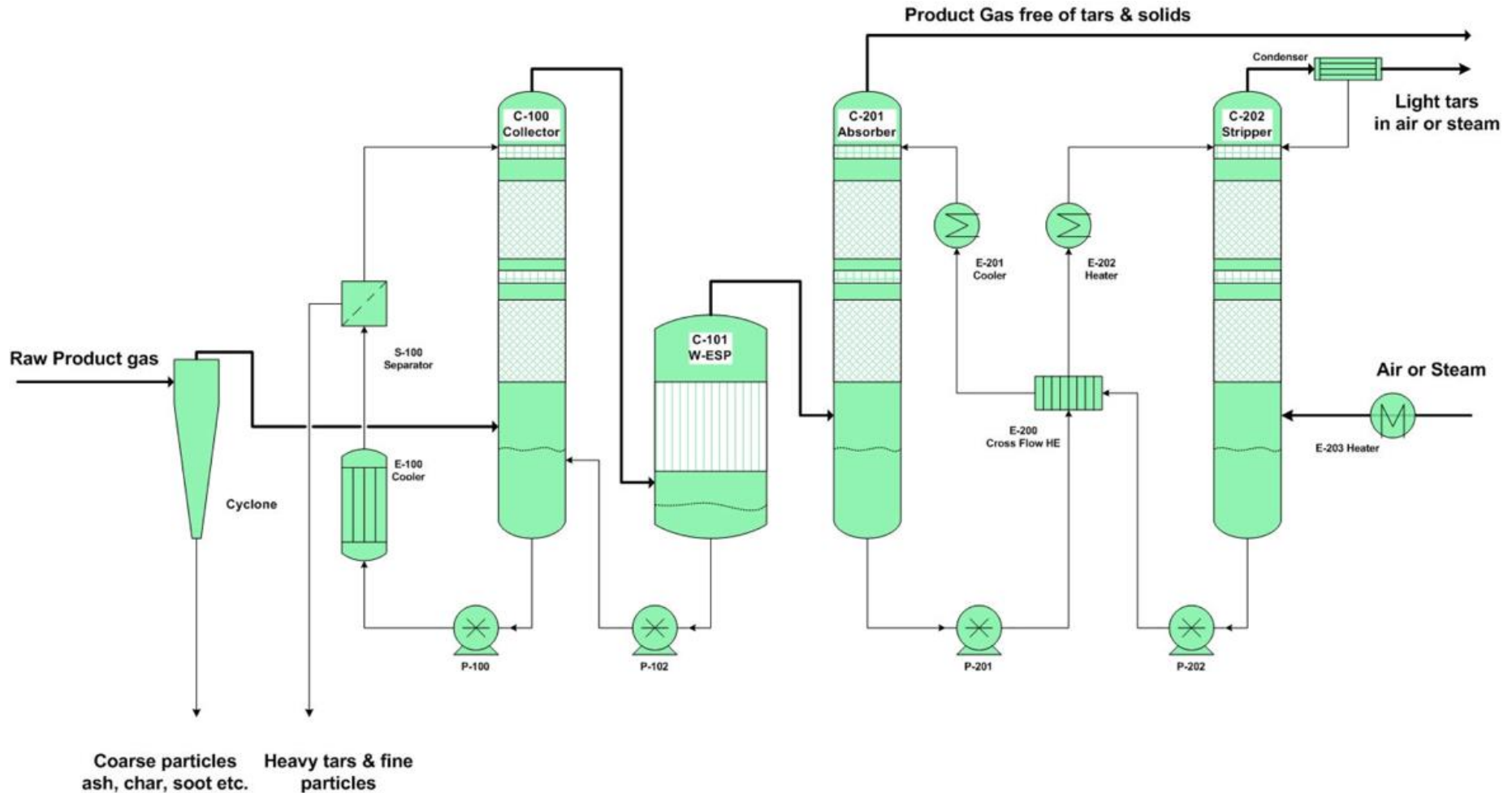
Gas cleaning

The tar problem

- Tar starts to condense $<400^{\circ}\text{C}$
 - Fouling coolers, blowers, inlet gas engines
- Water pollution
- Catalyst deactivation



ECN OLGA gas cleaning



Tar dew point < 10°C
No water pollution with tars!



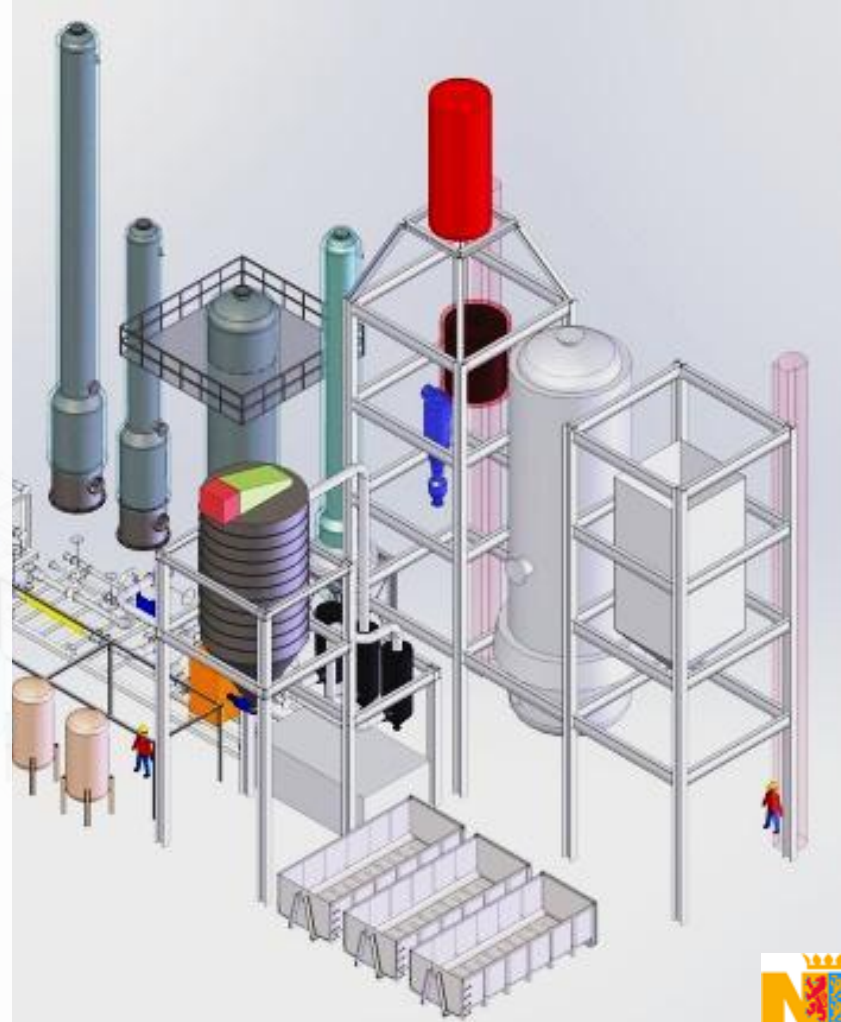


MILENA and OLGA commercialisation with Royal Dahlman

Project in Development in Alkmaar, The Netherlands



- Project has changed several times over past years.
- 4 MW MILENA - OLGA – Methanation producing Bio-Methane
- Royal Dahlman will build the plant
- Main subsidy granted, waits for final investment decision by Province of North Holland.



RDF gasification demo-project by ETI in UK



- 7 MW_e combined cycle using gas turbine
- MILENA – OLGA technology
- Dahlman leads consortium
- Phase 1 commissioned and funded by the Energy Technologies Institute (ETI).
- Three technologies / consortia compete in phase 1.
- Phase 1: Pilot scale testing + engineering in 2013
- After execution of phase 1 ETI will select one of the three competitors for the waste gasification demonstration.



Thermax Soya Residue

- 1 MWe Soya residue gasification demo.
- Construction ongoing
- Commissioning starts after summer 2014



Thank you for your attention!

Questions?

For more information:

www.milenatechnology.com

Contact:

Christiaan van der Meijden

+31 224 564582

vandermeijden@ecn.nl

ECN

Westerduinweg 3
1755 LE Petten
The Netherlands

P.O. Box 1
1755 LG Petten
The Netherlands

T +31 88 515 4949
F +31 88 515 8338
info@ecn.nl
www.ecn.nl