Waste wood gasification demonstration project

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Waste wood gasification demonstration project

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The Energy research Centre of the Netherlands (ECN)

- Independent R&D centre for renewable energy.
- Partly financed by the Dutch government and EU government grants, and partly by contract R&D.
- Main products: technology licenses and contract R&D
- 600 staff

R&D fields

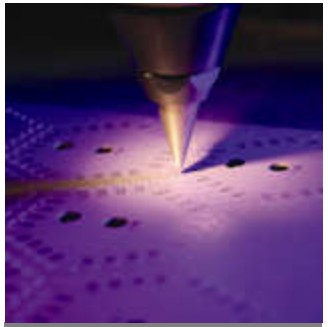
Policy Studies

Biomass

Solar Energy

Wind Energy

Energy Efficiency



Energy Engineering

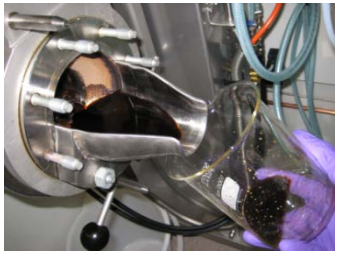
Environment

Biomass R&D areas

- Upgrading: Biomass to commodity fuel
  - Torrefaction: ECN technology available on full scale
  - New technology for torrefaction of wet biomass: TORWASH

- Combustion: Biomass boilers and Co-firing
  - Fuel behaviour during combustion
  - Ashes, slags, agglomeration behaviour

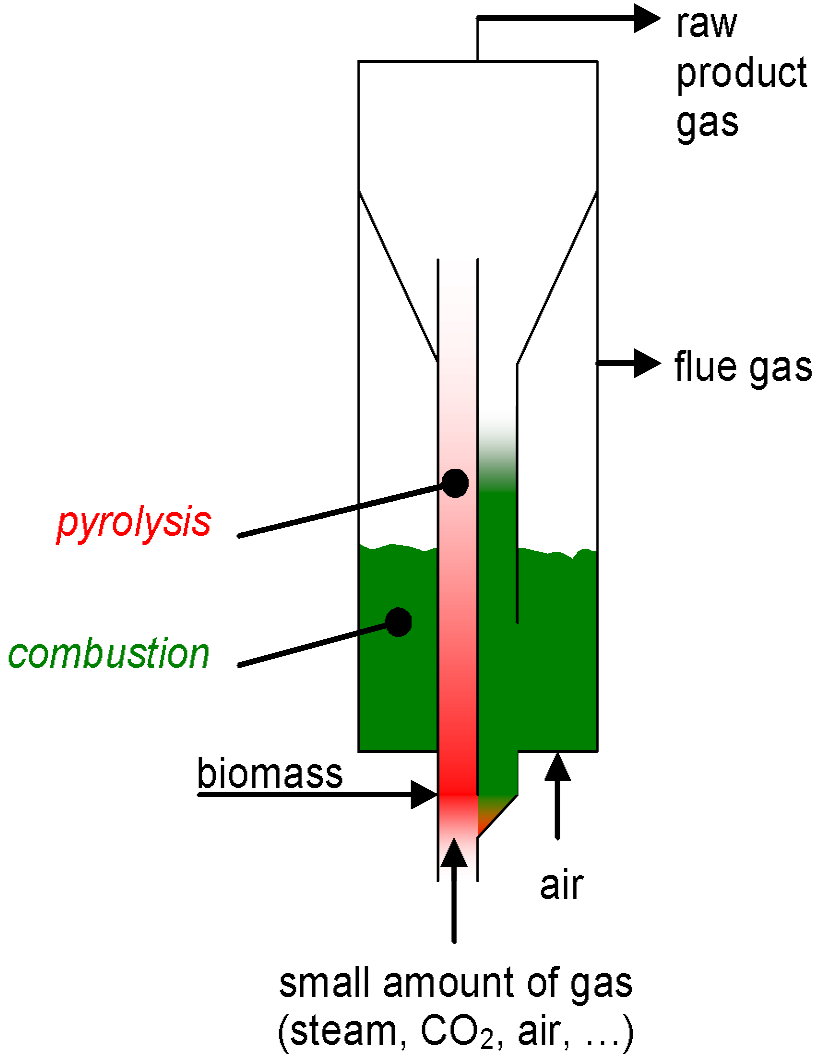
- Gasification: Production of power or fuels
  - Development of gasification technology, MILENA
  - Tar removal and product synthesis, OLGA
  - Test equipment and expertise to provide services
- Biorefinery: Technology for a biobased economy
  - Organosolv fractionation: conversion into cellulose, hemicellulose, and lignin
  - Conversion of fractions into marketable products



MILENA waste gasification technology

MILENA Indirect Gasification

- Fluidized bed gasification
- Temperature level: 850°C
- Product gas contains methane, ethylene, benzene and tars
- Complete conversion of the fuel
- No carbon in the ash
- High efficiency
- Very little nitrogen in producer gas
- Heat transfer through bed material
- One single vessel: compact design
- Fuel flexible: wood, RDF, lignite, sunflower husks, etc.



Comparison

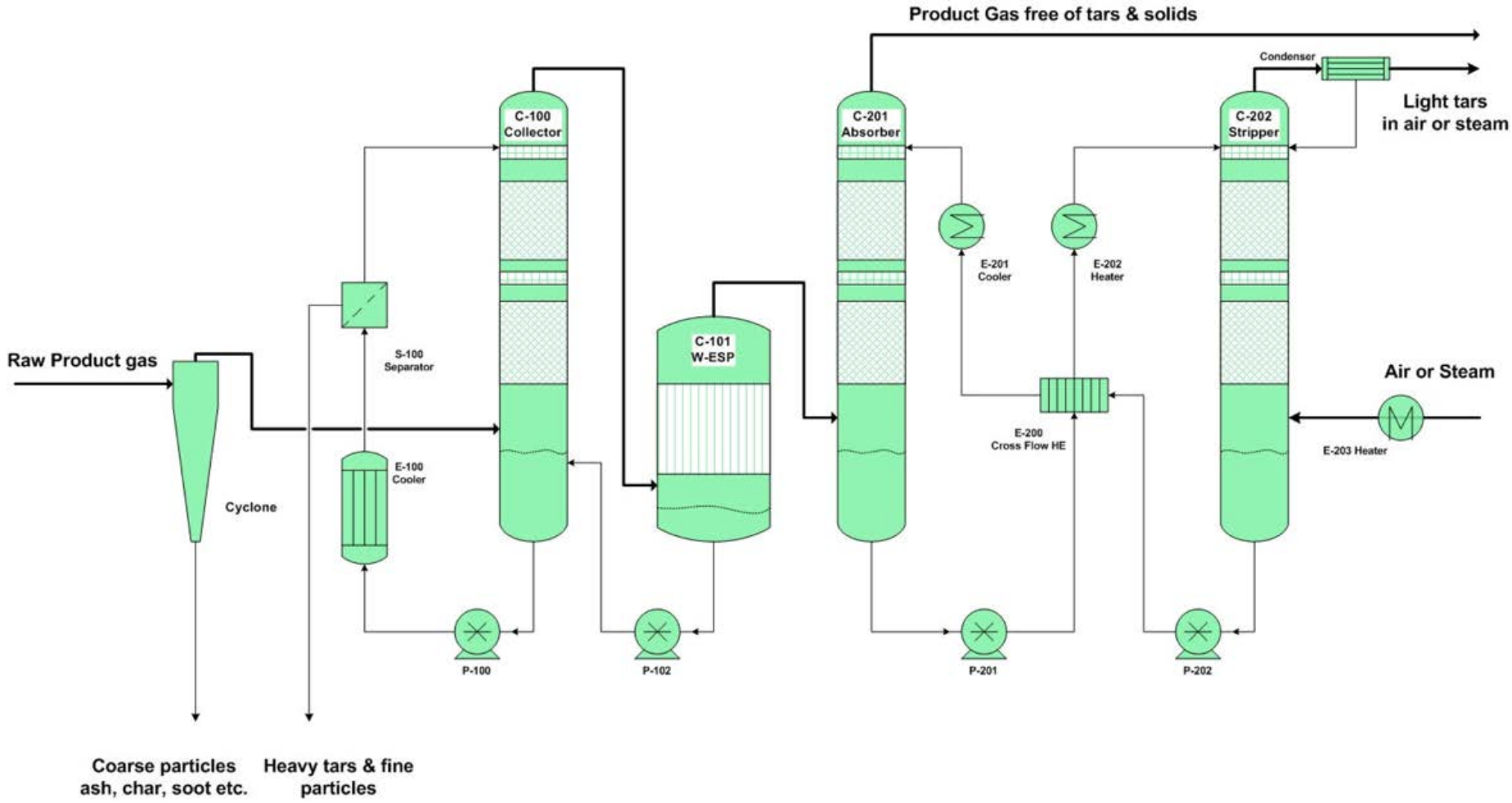
	MILENA	CFB/BFB	Downdraft
Conversion	100% / white ash	~90% / black ash	~90% / black ash
Cold Gas Efficiency	~80%	~70%	~70%
Temperature control	Good control, no char accumulation	Lower control ability due to char hold-up	Very heterogeneous
Temperature versus Efficiency	lower temperature = higher efficiency	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
- Production of fuels or chemicals

OLGA Tar Removal System

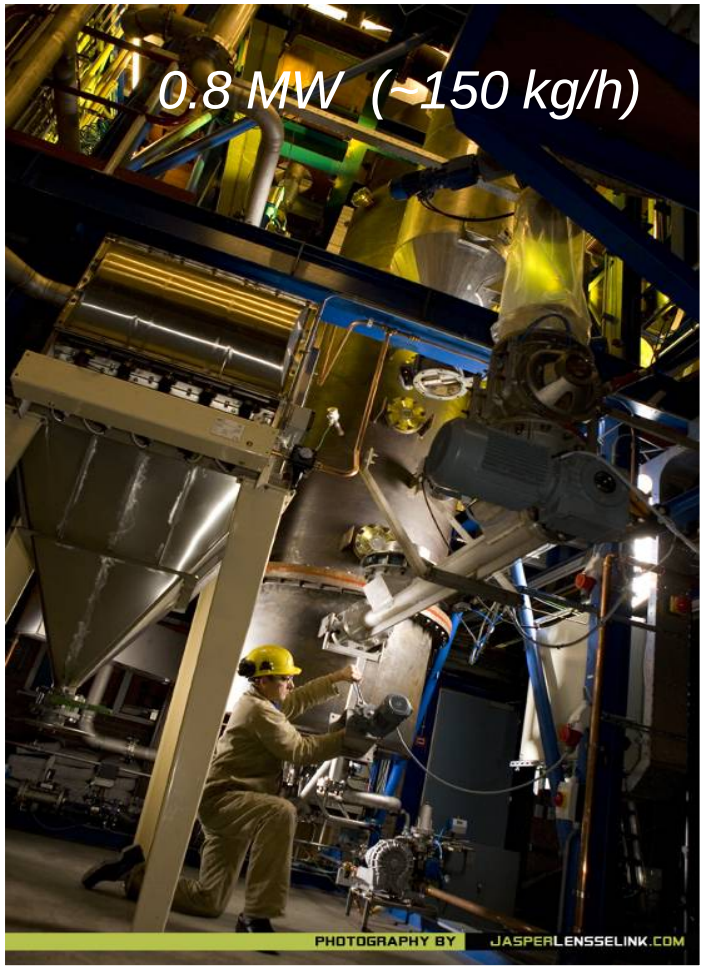
ECN OLGA gas cleaning




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

ECN Experience with MILENA gasification technology

Milena Technology test facilities at ECN

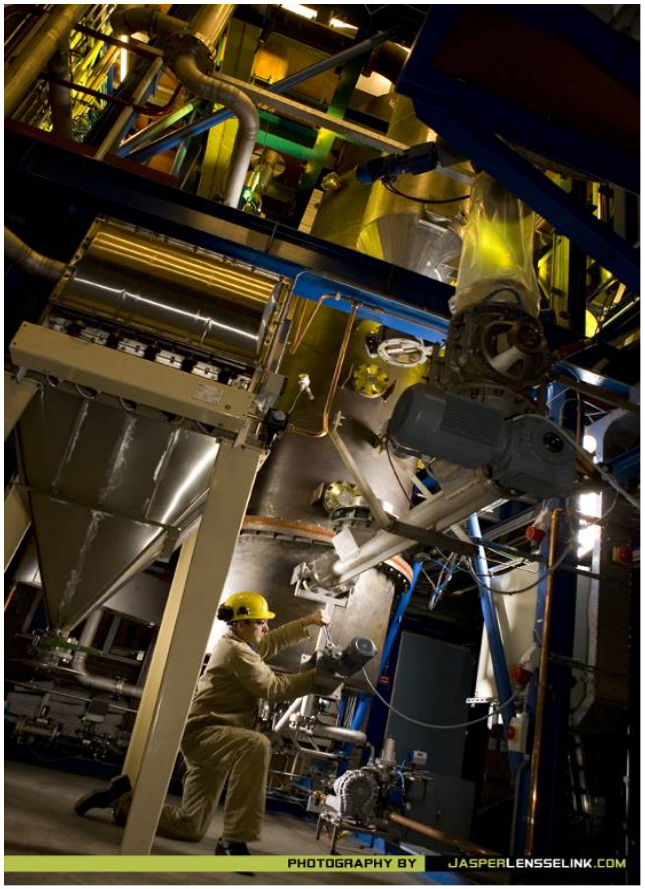


Tested feedstocks

- Clean Wood
- Demolition Wood
- Straw
- Soya stalk
- High-ash coal
- Lignite
- RDF
- Sunflower husks

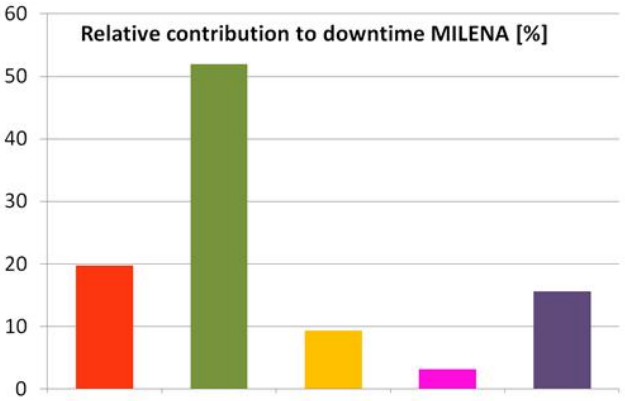
1 MW_{th} MILENA pilot plant

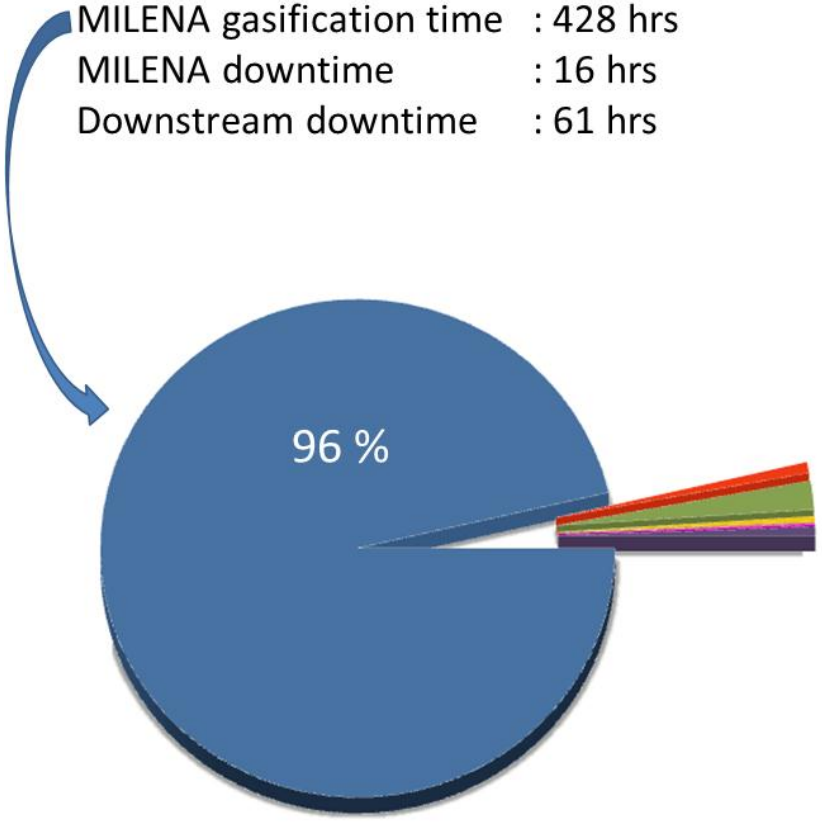
- In operation since 2008
- Fuels tested:
  - Clean Wood
  - Demolition Wood
  - RDF tests planned this year
- Runs in campaigns
- Connected to OLGA tar removal system



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

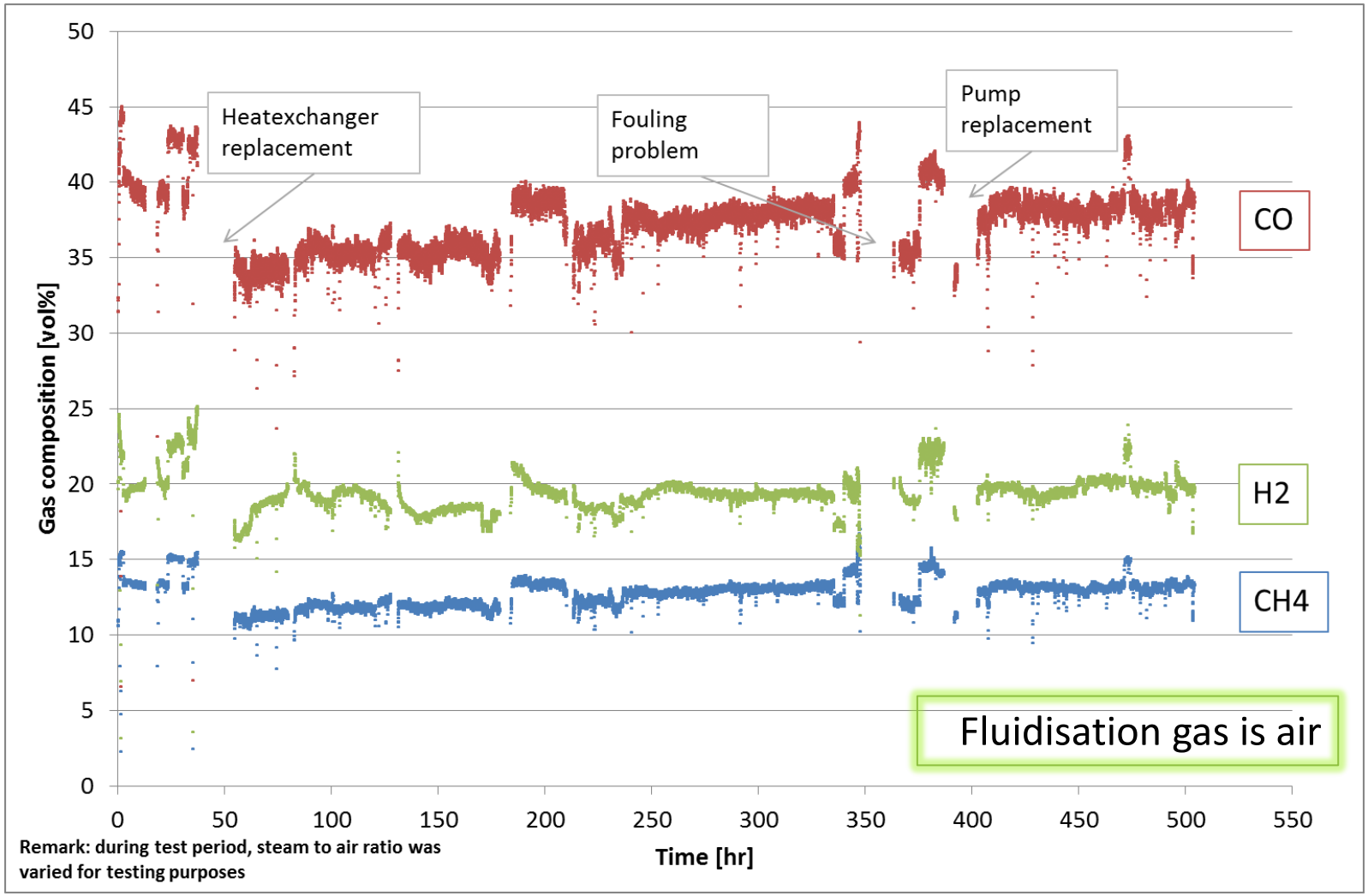
Duration experiment : 505 hrs
MILENA gasification time : 428 hrs
MILENA downtime : 16 hrs
Downstream downtime : 61 hrs





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

Gas composition duration test



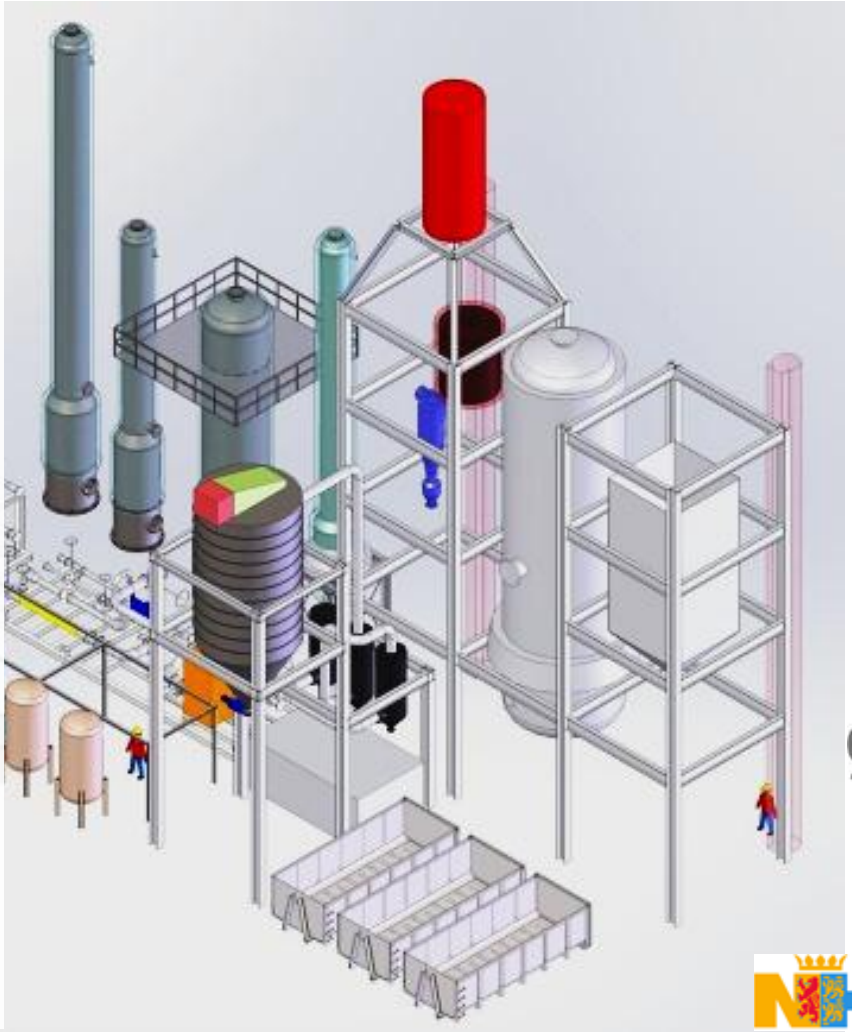
MILENA and OLGA commercialisation with Royal Dahlman

Royal Dahlman

- Royal Dahlman is a Dutch company with approx. 100 staff
- Longstanding experience in filter technology, e.g. gas turbine inlet filters for GE.
- OLGA license from ECN in 2007
- First 4 MW_{th} OLGA system build in France in 2008
- Second 4 MW_{th} OLGA system build in 2010 in Portugal
- MILENA license from ECN in 2013
- Visit them at booth No 4

Project in Development in Alkmaar, The Netherlands

- 12 MW_{th} MILENA and OLGA producing green power
- Side stream SNG production installation
- Royal Dahlman will build the plant
- Currently detailed engineering
- Final investment decision in mid 2013
- Construction 2013/2014
- Start-up 2015



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.

Conclusions MILENA gasification & OLGA tar removal

- Technology distinguishes itself in high efficiency and knowhow of the development team
- Lab & pilot facilities available
  - Tested on wood and waste wood on pilot scale
  - Residues, coal, RDF on lab scale
  - No long duration experience
- OLGA tar removal system reduces tars to very low levels
- Gas contains valuable chemicals
- Application in CHP, co-firing, SNG, chemical production
- Ready for first commercial demonstration projects
  - 2 projects in construction phase (CHP plant on soya stalk in India and waste wood demonstration in the Netherlands)
  - Others close to FID

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