



Energy research Centre of the Netherlands

COUNTRY REPORT the NETHERLANDS

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Breda, The Netherlands*

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Bram van der Drift

Breda, 2 November 2009



HOST

the Netherlands (Tzum)

- 3 MW_{th} CFB gasifier, cooler, cyclones, boiler, steam turbine, flue gas cleaning: bag house filter
- chicken manure
- now only used for test campaigns for future customers

Portugal

- 3 MW_{th} CFB gasifier, cooler, cyclones, OLGAs by Dahlman, NH₃-scrubber, gas engine
- chicken manure (now generally dumped)
- April 2010: ready

DAHLMAN

Portugal

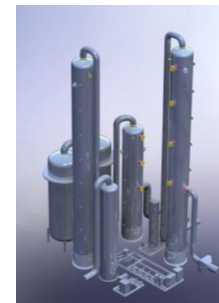
- 3 MW_{th} CFB gasifier by HoSt, cooler, cyclones, OLGA, NH₃-scrubber, gas engine
- chicken manure (now generally dumped)
- April 2010: ready



DAHLMAN

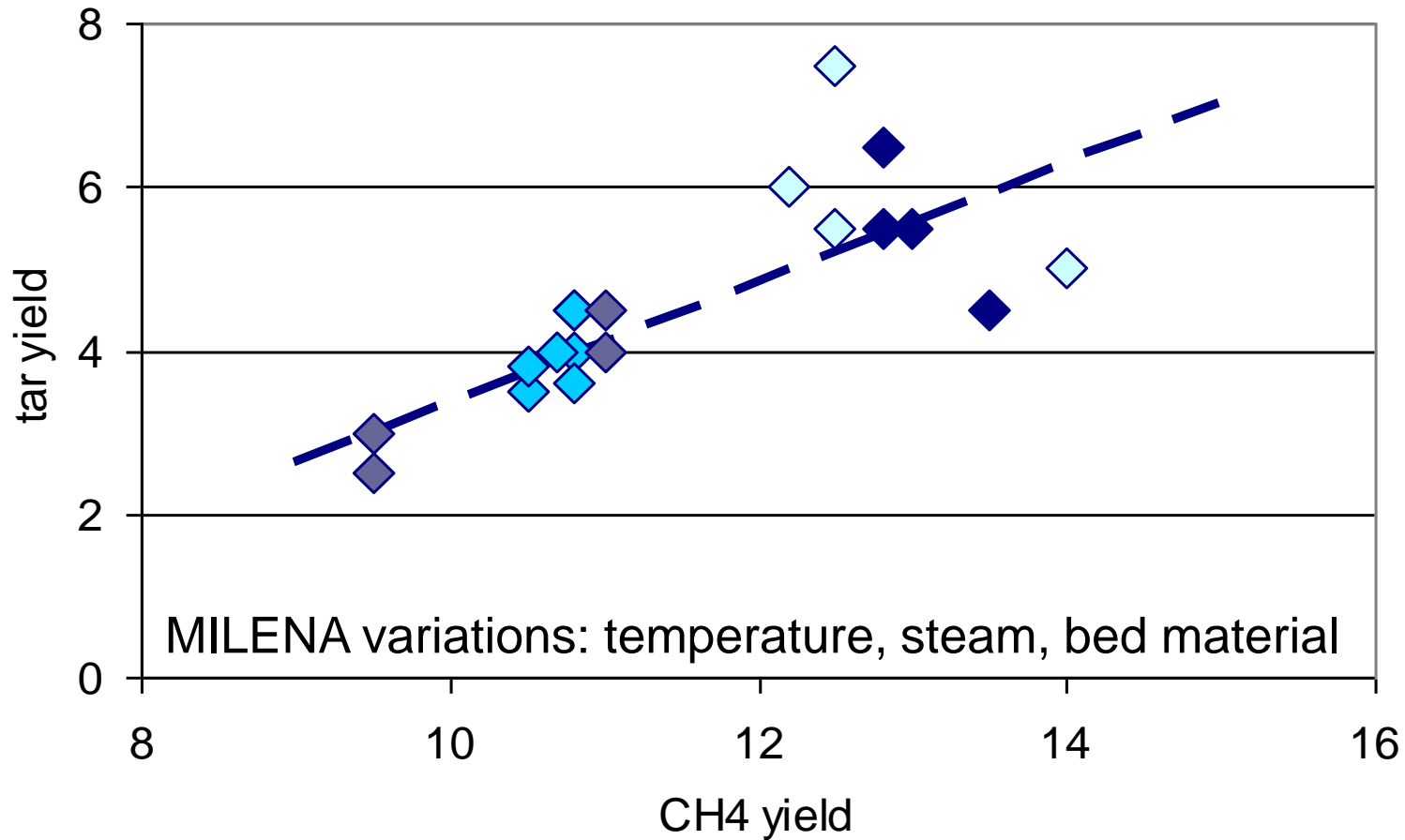
OLGA flexibility

- gasifier: BFB, CFB, indirect (MILENA), PRMe
- fuel: wood, chicken manure, RDF, ...
- tar IN: tested up to 40 g/Nm³
- tar OUT: tar dew point below 0°C
- removal of: tar, particles, dioxins, ... but no methane
- size: 2 Nm³/h ... 20 000 Nm³/h



DAHLMAN

OLGA creates freedom



BIO-MCN

- trials with 5% glycerin in natural gas, co-reforming with natural gas, 20 kton/y bio-methanol
- full-scale glycerin distillation purification, 50% glycerin in natural gas, 200 kton/y bio-methanol started summer 2009: limited capacity
- now modify bottle neck, expected to operate full capacity December 2009
- 2nd generation biofuel plant: 180 MW_{MeOH} or 5 PJ/y !

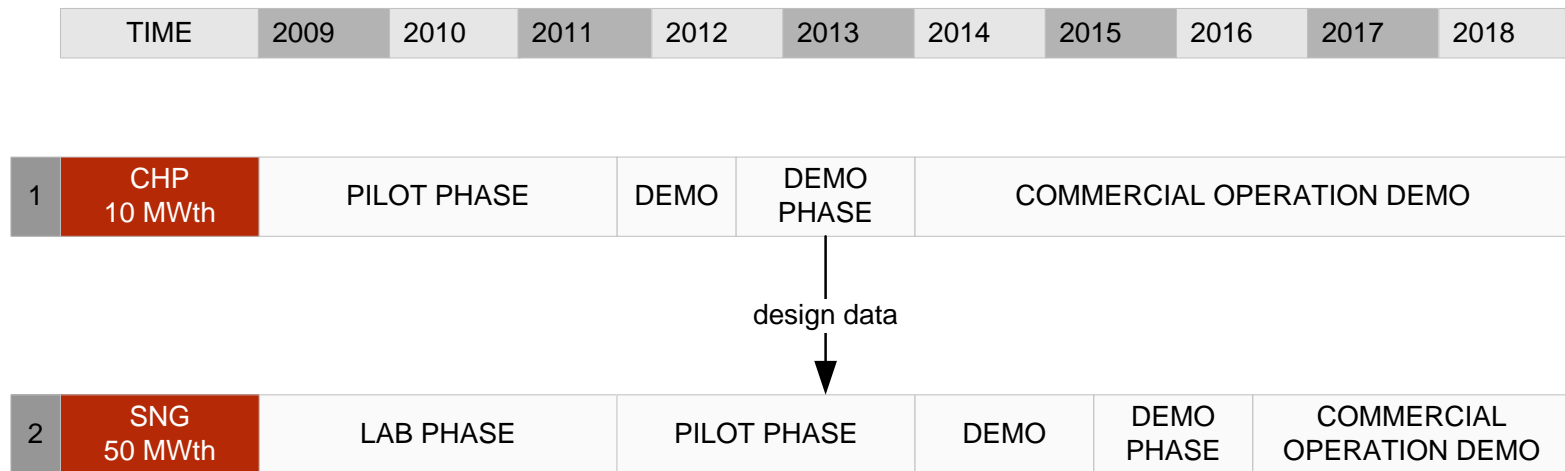


NUON and ESSENT

- NUON: Wednesday
- Essent: Thursday

HVC

- MSW incineration for power/heat (existing)
- demolition wood CFB boiler for power/heat (existing)
- digestion for power/heat (existing)
- digestion for SNG 40 bar (ready mid 2010)
- gasification for SNG (MILENA and OLGA based):

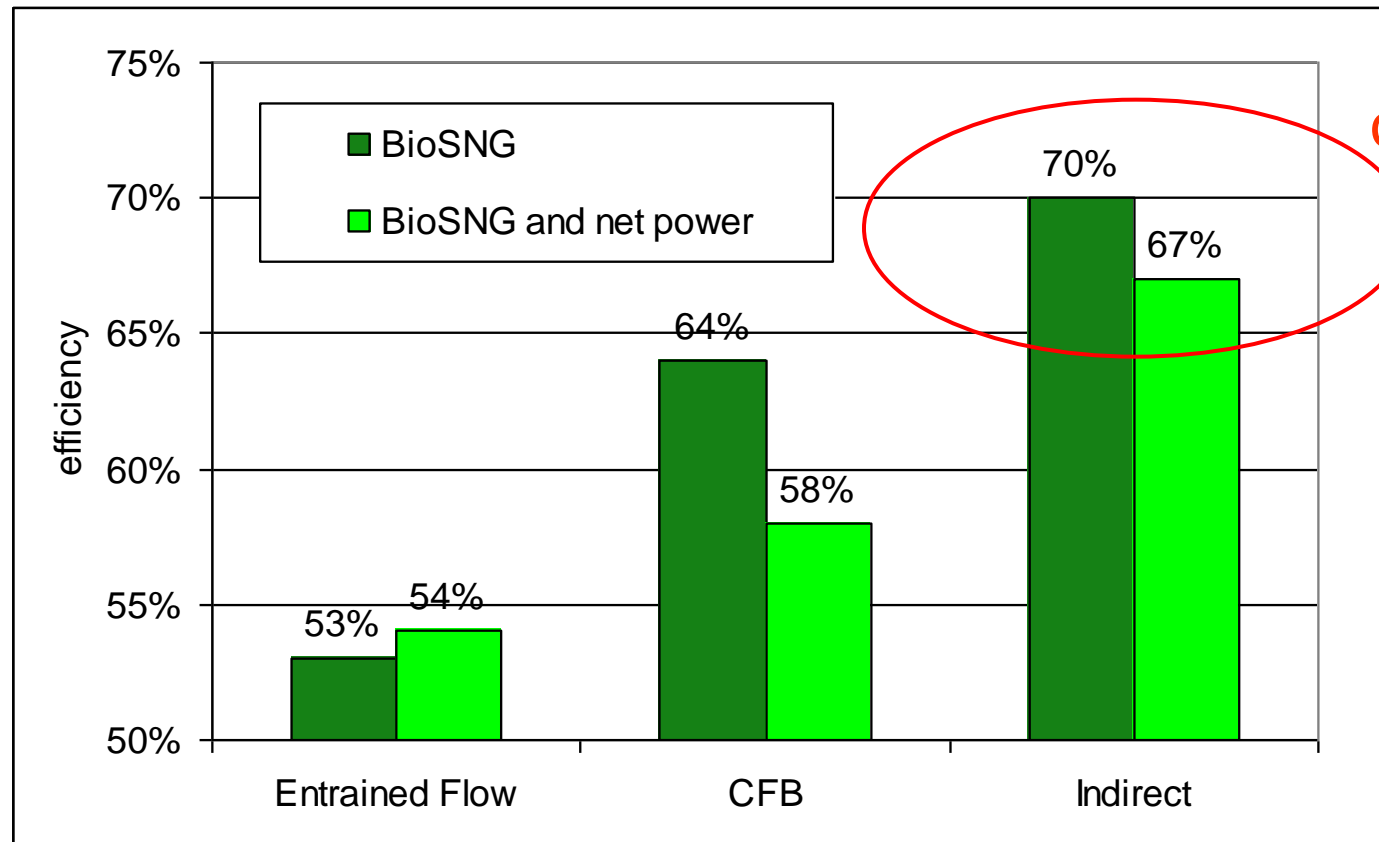


ECN

- *MILENA-OLGA*:
 - successfully tested at pilot scale (200 Nm³/h) in August 2009
 - next test with demolition wood in December 2009
 - basic engineering 10 MW demo at HVC started
- *SNG*:
 - lab-scale facility available
 - next test (200 h) now
 - system for 70% efficiency...

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System biomass-to-SNG:



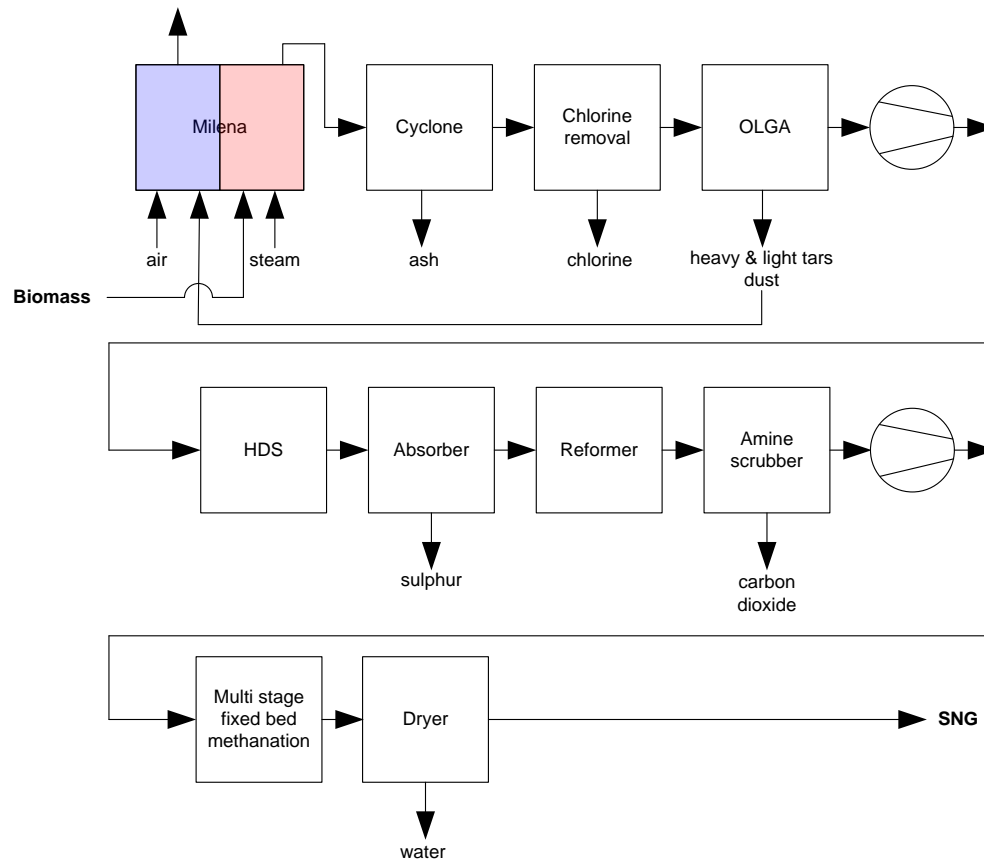
our choice

ECN

System biomass-to-SNG:

1. MILENA: full conversion, fuel flexible, high methane
2. OLGA: removes high tar load, no methane removal
3. other gas cleaning: no water condensation, no removal of valuable (energy-containing) components
4. methanation: “commercial”
5. upgrading: commercial

System biomass-to-SNG:



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MILENA for biomass and lignite:

- lab-scale MILENA gasifier, air blown, ~5 kg/h
- can be CO₂-neutral in BioSNG system with up to 35% lignite
- composition:

| | wood | lignite |
|---------------------|-------|---------|
| C [wt% daf] | 49% | 66% |
| S [wt% daf] | 0.02% | 0.31% |
| ash [wt% dry] | 1% | 4% |
| volatiles [wt% daf] | 84% | 59% |

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MILENA for biomass and lignite:

| Lignite in mix | [wt-%] | 0% | 28% | 55% |
|-------------------------------|------------------------|------|------|------|
| CO | [vol-% dr.] | 37 | 31 | 23 |
| H ₂ | [vol-% dr.] | 21 | 29 | 36 |
| CO ₂ | [vol-% dr.] | 19 | 21 | 23 |
| CH ₄ | [vol-% dr.] | 12 | 11 | 8 |
| C ₂ H ₂ | [vol-% dr.] | 0.43 | 0.37 | 0.21 |
| C ₂ H ₄ | [vol-% dr.] | 4.6 | 3.8 | 2.9 |
| Tar | [g/m ³ dr.] | 30 | 26 | 16 |
| H ₂ S | [ppmV dr.] | 49 | 360 | 330 |
| COS | [ppmV dr.] | 3 | 24 | 35 |
| Thiophene | [ppmV dr.] | 10 | 39 | 47 |

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two interesting publications:

- R.W.R. Zwart, Gas Cleaning Downstream Biomass Gasification – status report 2009, :
<http://www.ecn.nl/docs/library/report/2008/e08078.pdf>
- L.P.L.M. Rabou *et al*, Tar In Biomass Producer Gas: An Enduring Challenge, Energy and Fuels, 2009

MORE INFORMATION

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publications: www.ecn.nl/publications

composition database: www.phyllis.nl

tar dew point calculator: www.thersites.nl

IEA bioenergy/gasification: www.ieatask33.org

Milena indirect gasifier: www.milenatechnology.com

OLGA: www.olgatechnology.com / www.renewableenergy.nl

SNG: www.bioSNG.com and www.bioCNG.com