Status of biomass gasification

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STATUS OF BIOMASS GASIFICATION

Bram van der Drift

IEA BIOENERGY

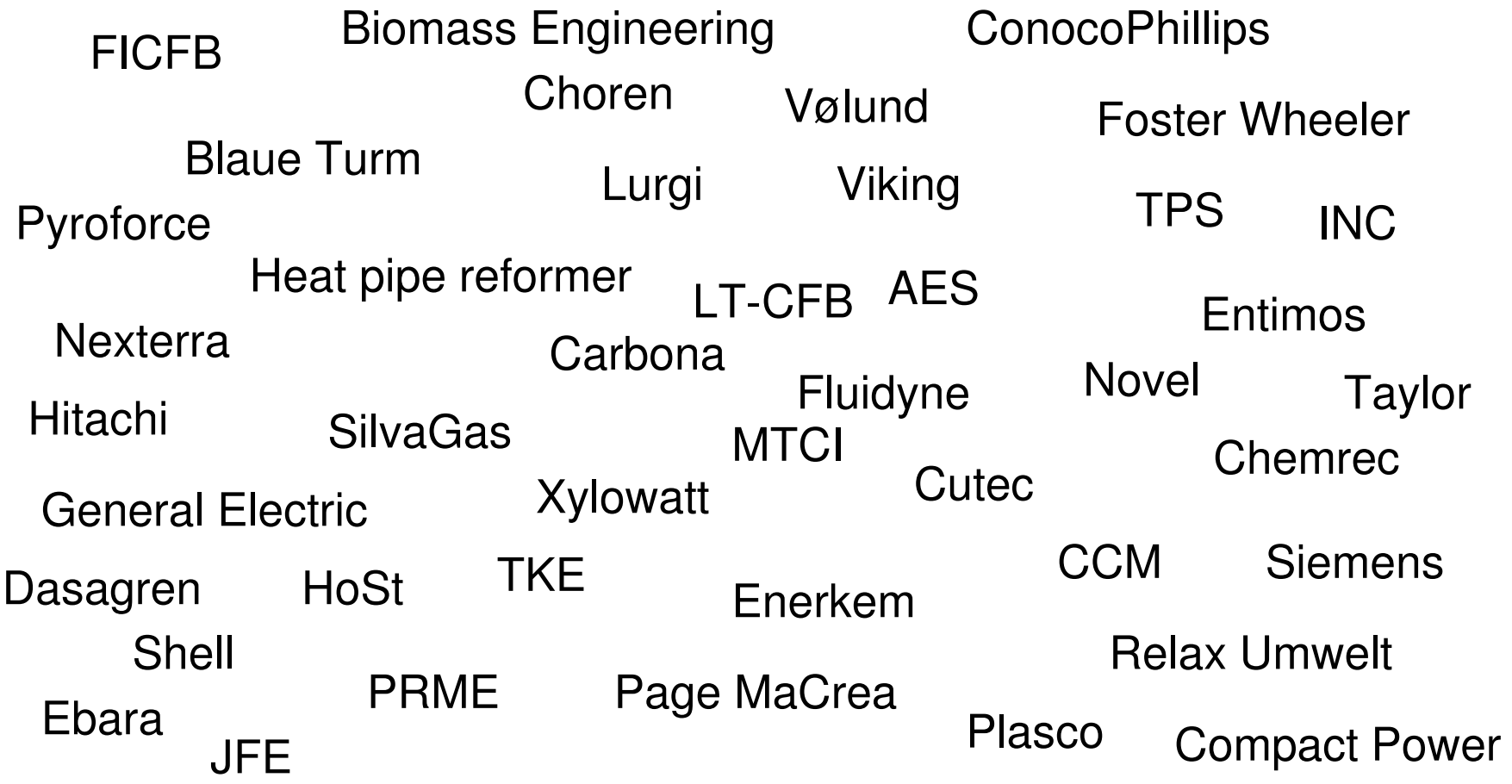
task 33: biomass gasification

- 11 member countries
- USA, Switzerland, Finland, Sweden, Denmark, Austria, Germany, New-Zealand, Canada, EU, the Netherlands
- meeting every 6 months, next: April 2009 Stuttgart

- www.ieatask33.org

MANY … BIOMASS GASIFIER CONCEPTS

illustrating the status of biomass gasification



ONLY GASIFICATION
successes (1)

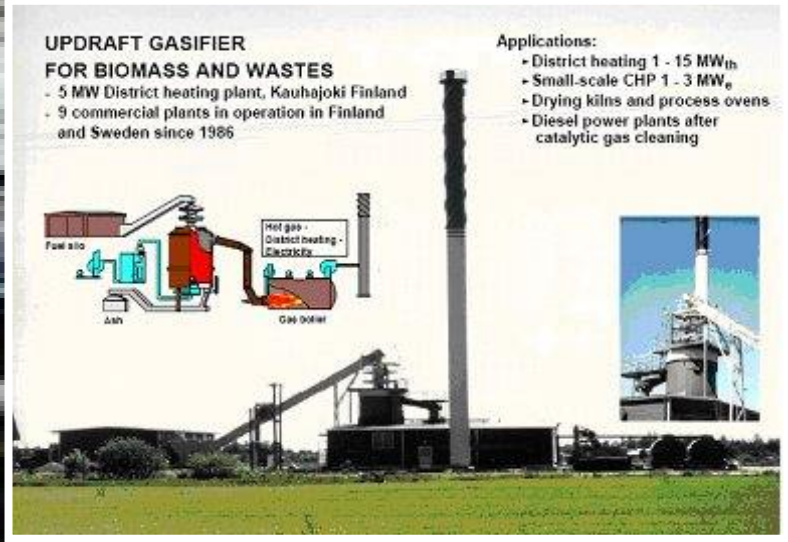
CFB FW, Lahti (Fin), co-firing PF boiler
45 $MW_{th\_biomass}$

CFB Metso, Varo (Swe), co-firing lime kiln
35 $MW_{th\_biomass}$

Updraft Nexterra, Tolko (Can), boiler
12 $MW_{th\_biomass}$

ONLY GASIFICATION
successes (2)

PRME, # plants with boiler 1-30 $MW_{th\_biomass}$



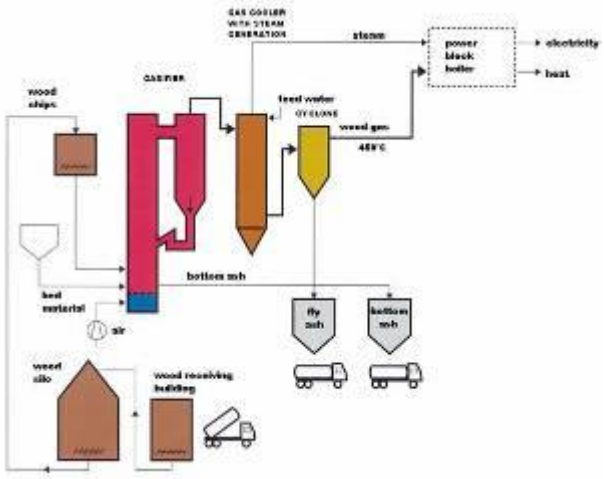
fluidized bed FERCO, Burlington (US), boiler 40 $MW_{th\_biomass}$

Updraft Bioneer, 8 plants with boiler 4-5 $MW_{th\_biomass}$

CHALLENGE 1: DOWNSTREAM UNITS

Amer 85 MW_{th} CFB gasifier co-firing

- 2000: planned start-up with cooler (200°C), filter, wet scrubbers
- 200x: reconstruction, only cooler (450°C) and cyclones remain
- 2005: plant officially becomes production unit
- 2007: 3000 h
- 2008: cooler fouling still is main problem



CHALLENGE 2: ECONOMICS

ARBRE 8 MW_e CFB gasifier IGCC

- 2001: ARBRE was realised, Yorkshire (UK): CFB gasifier, dolomite tar removal, cooler, cyclone, filters, scrubbers, gas turbine
- 2002: bankruptcy
- 448 hours gasification, 220 hours steam turbine,5 hours gas turbine

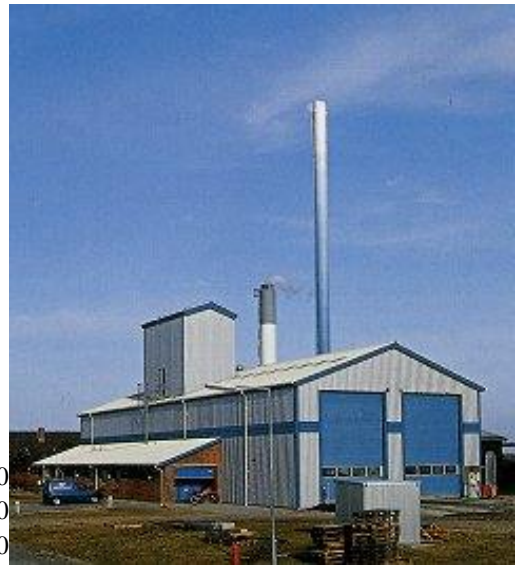
CHALLENGE 3: FUEL

3 MW_{th} HoSt CFB gasifier Tzum (NL)

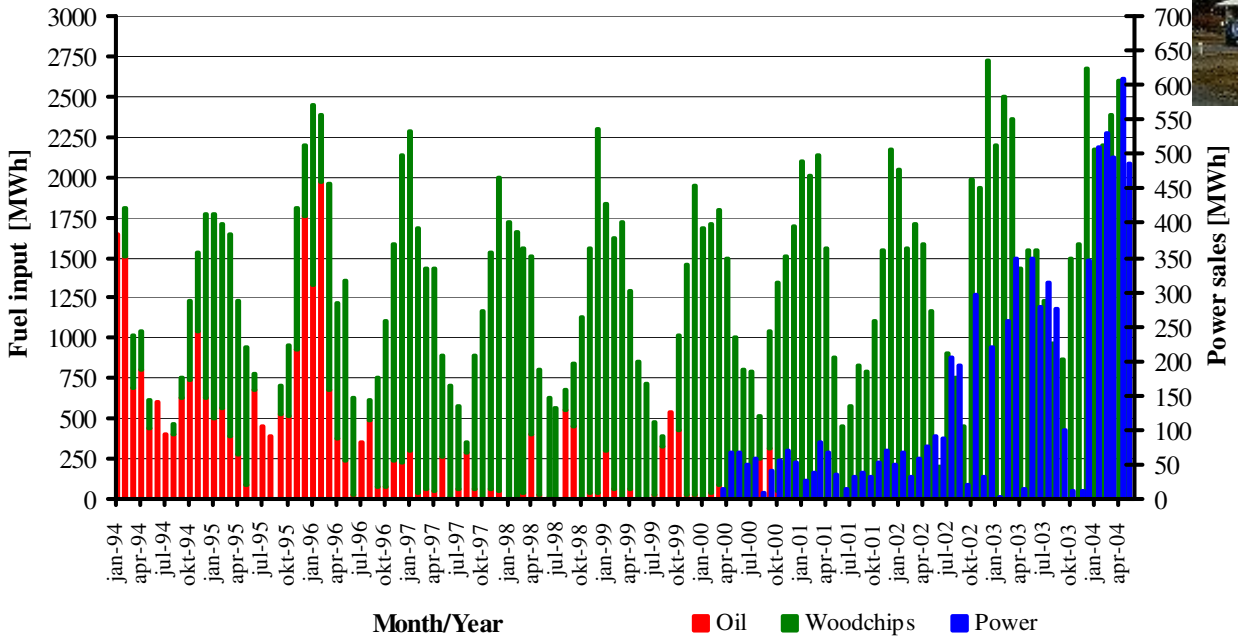
- 2005: CFB gasifier, cooler, cyclones, boiler, steam turbine on chicken manure
- 2007: 3500 h
- dry chicken manure +5 €/ton instead of -30 €/ton
- insufficient heat demand

SUCCESS STORY (1)

Vølund 1.5 MW_e CHP updraft



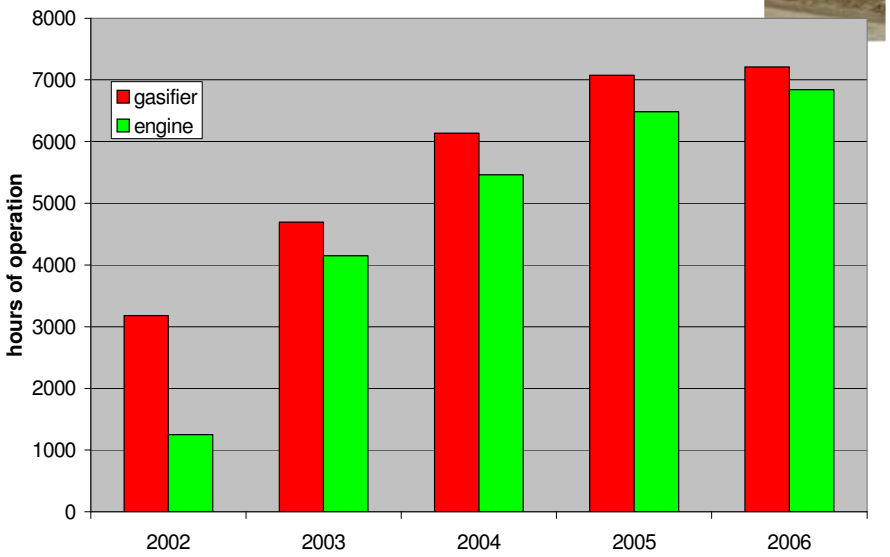
- 1994: plant started in Harboøre (DK)
- tar/water waste problem
- 2006: 8000 hours/year of operation



SUCCESS STORY (2)

FICFB 2 MW_e CHP Güssing

- 2002: started
- 2005: 6500 hours
- several slip-stream “plants”
- second one (Oberwart) ready



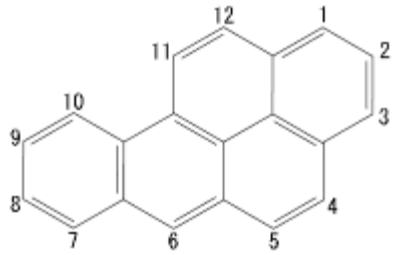
SUCCESS STORY (3)

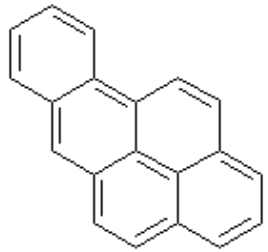
~60 MW_{th} co-gasification IGCC Buggenum

- 2002: start co-gasification trials
- 2006: biomass facilities ready for 30wt% wood
- 2008: ~15wt% is normal

DEVELOPMENTS (1)

tar cleaning

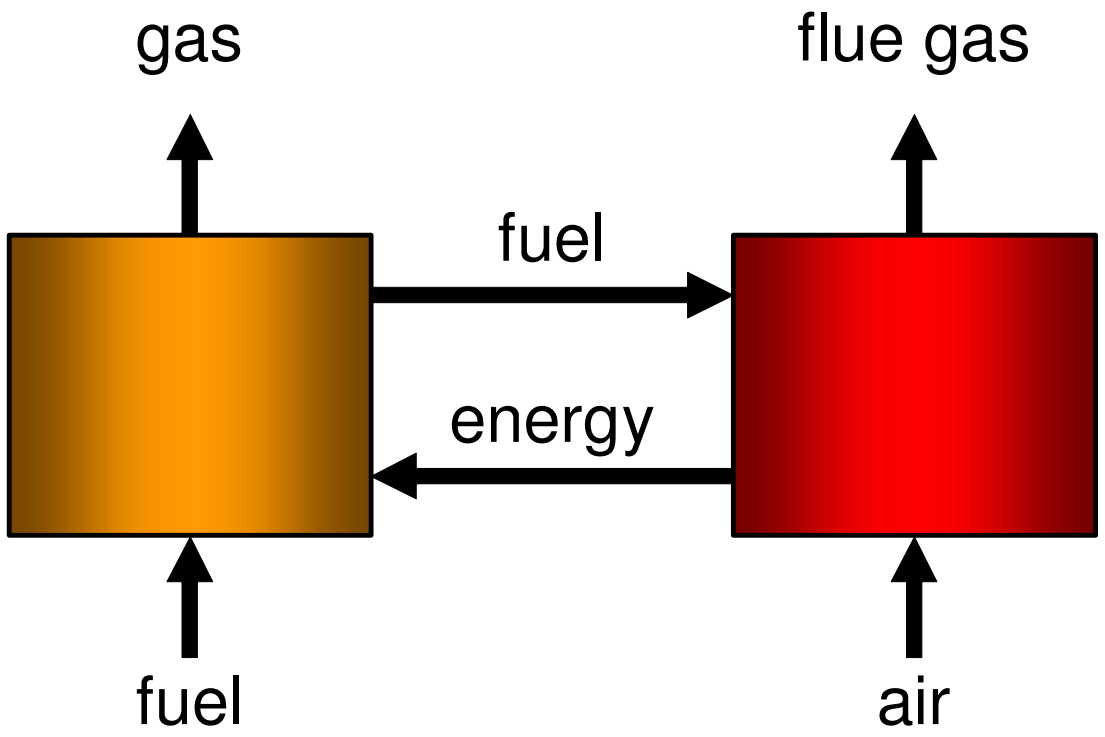




- No tar production (DTU Viking, entrained flow/Buggenum, …)
- No gas cooling (Värnamo)
- Condensation (Vølund, Schwarze Pumpe, ..)
- Dolomite CFB (TPS)
- Catalytic reforming (Carbona/Skive, Novel/Kokemäki, VTT/Varkaus, NREL, …)
- RME scrubber (FICFB/Güssing, Wiener Neustadt, Pyroforce, …)
- OLGA oil scrubber (Moissannes, …)
- Partial oxidation (DTU, Tue, …)
- Plasma torches (Plasco, …)

DEVELOPMENTS (2)

indirect gasification



complete conversion, N_2-free gas, no ASU, tar combustion

DEVELOPMENTS (2)

indirect gasification

- Battelle – FERCO – SilvaGas: Burlington (US), …
- Taylor Biomass Energy (US)
- FICFB (Austrian Energy / TUV):
  - "the original": Güssing (A), Oberwart (A), …
  - copied: EU Joint Research Centre (NL)
  - copied: University of Canterburry (NZ)
  - copied: Mid Sweden University (S)
- Chalmers: Göteborg (S)
- MTCI: Trenton (Can)
- MILENA: Petten (NL), HVC (NL)
- Heat Pipe Reformer: Munich (D)

DEVELOPMENTS (3)

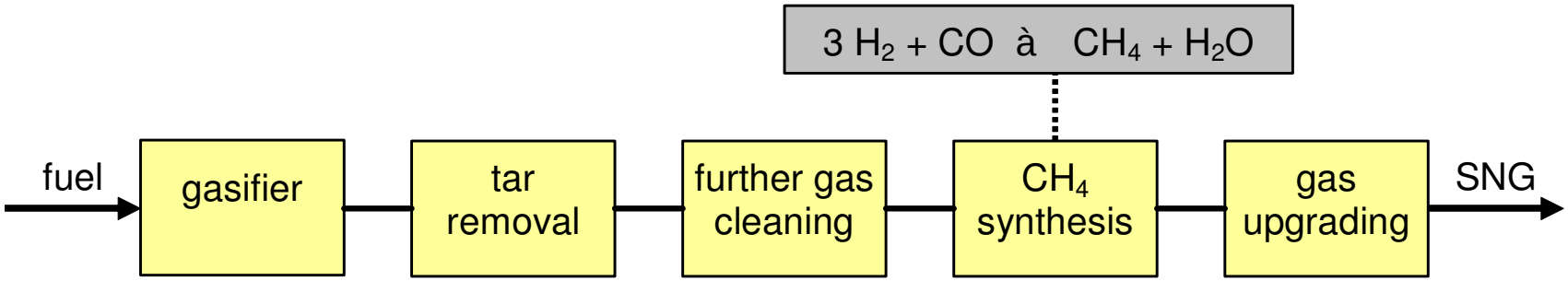
biofuels

- Ethanol: Enerkem, Taylor, …
- Methanol: BioMCN, Enerkem
- DME: Chemrec, Värnamo
- Fischer Tropsch: Choren, Cutec, TUV, Neste/VTT/Stora, UPM/Kymmene, …
- SNG: ECN, TUV, PSI/CTU, Göteborg, E.On, HVC, …

DEVELOPMENTS (4)
bioSNG

SNG: Substitute Natural Gas

- SNG can be transported and used as natural gas
- up to 70% energy efficiency
- up to ~150% CO_2-reduction
- as low as 5 €/GJ production costs (excl. feedstock costs)



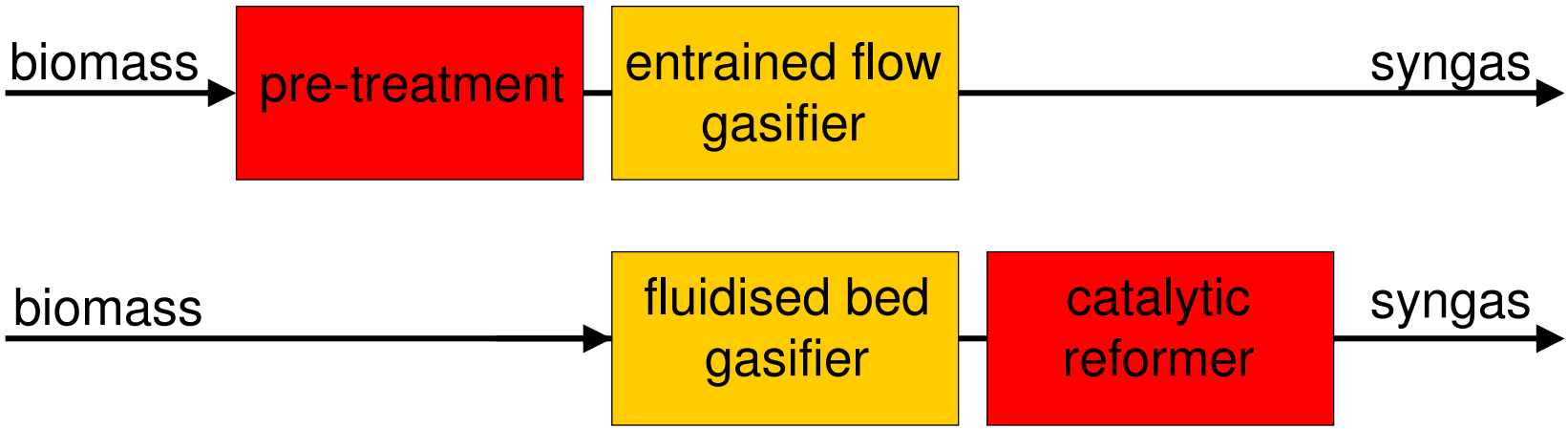
DEVELOPMENTS (4)
bioSNG

- ECN development based on MILENA gasification (high methane yield) and OLGA tar removal (no methane removal)
- HVC: 10 MW CHP demonstration plant ready 2012: MILENA, OLGA, engine
- HVC: 50 MW SNG demonstration plant ready 2015: 70% SNG/wood efficiency



DEVELOPMENTS (5)

syngas: H_2 and CO



DEVELOPMENTS (5)
syngas: H_2 and CO

entrained flow pre-treatment options:

- torrefaction
- flash pyrolysis
- mix with coal

torrefaction 50 kg/h pilot plant at ECN (NL)

Dynamotive 100 tpd demo plant (Canada)

250 MW_e EF gasifier up to 30wt% wood, Buggenum (NL)

DEVELOPMENTS (6)

Plasco Canada

- demonstration unit in commissioning phase (Ottawa, Canada)
- ~20 MW_{th} MSW input
- plasma tar removal
- plasma ash melting
- filter, water scrubber, biological sulphur removal, activated carbon Hg removal, 7 Jenbacher engines

DEVELOPMENTS (7)
power instead of only heat

concepts originally designed for close coupled combustion, now develop to complete systems including gas cleaning:

- Bioneer à catalytic reforming, engine (Novel-concept)
- PRME à OLGA, engine (Moissannes)
- Nexterra à gas cleaning, engine

CONCLUSIONS

- Gasification is “hot” and gaining interest (again)
- Many, many gasification concepts exist
- Biomass gasification is rather well-developed, but…
- Only few successful examples concerning:
  - gas cooling
  - gas cleaning
  - economics
- Success stories are characterized by:
  - enough time and money
  - scientific support
  - fuel contracts

CONCLUSIONS

- New developments:
  - indirect gasification
  - new gas cleaning concepts
  - biofuels
  - bioSNG
  - syngas

MORE INFORMATION

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