ECN

Energy research Centre of the Netherlands

Biomass gasification and biomethanation technology

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Energy research Centre of the Netherlands

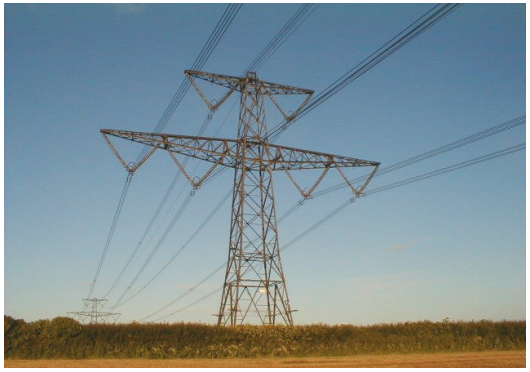
ECN mission: development of high-quality knowledge and technology for the transition to a sustainable energy supply, and bringing this to the market

~70 M€/y turnover
~530 employees

Organization in 7 Program units: solar – wind – biomass/coal – efficiency – policy – clean fossil – hydrogen

Program unit Biomass/Coal

Heat and Power



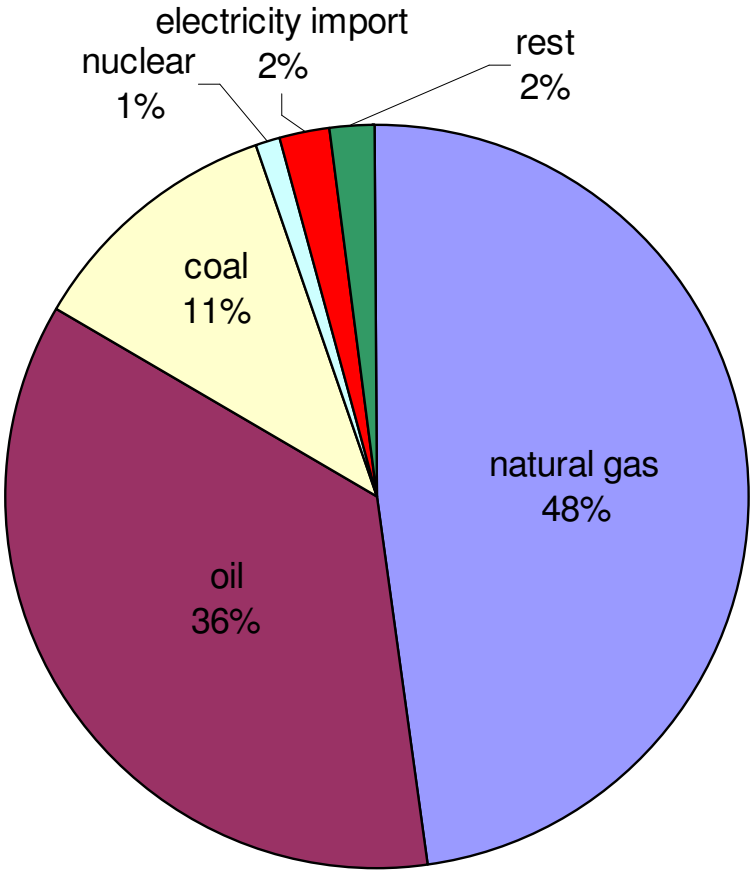
SNG (Green Natural Gas)

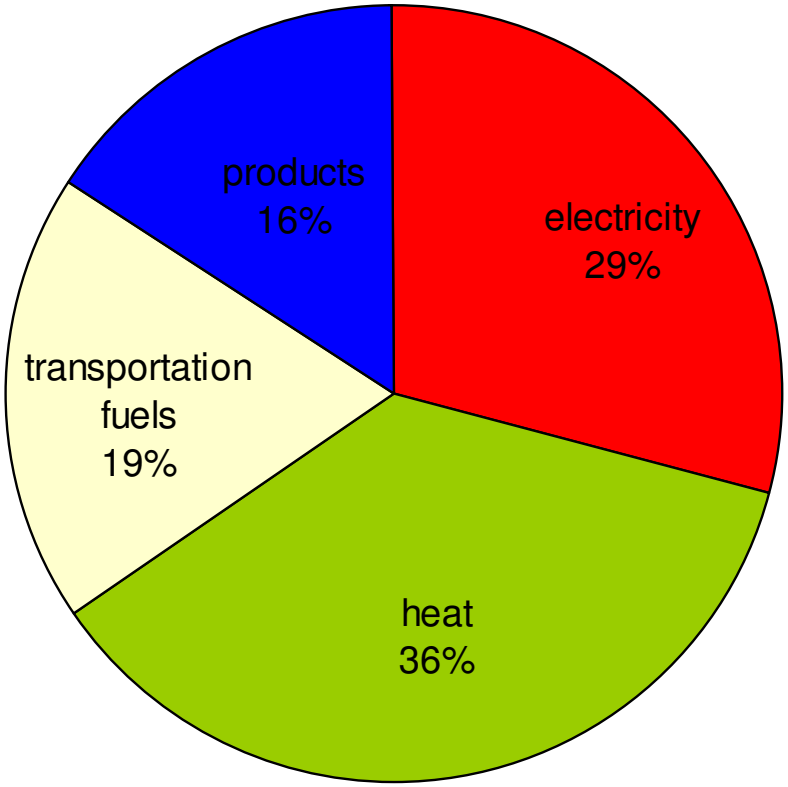
Transportation Fuels and chemicals

Content

- ECN reasoning for Bio-SNG production
- Implementation plan for Bio-SNG
- Duration test results with lab scale facility

ENERGY in NL


electricity import
2%
nuclear
1%
rest
2%
coal
11%
natural gas
48%
oil
36%

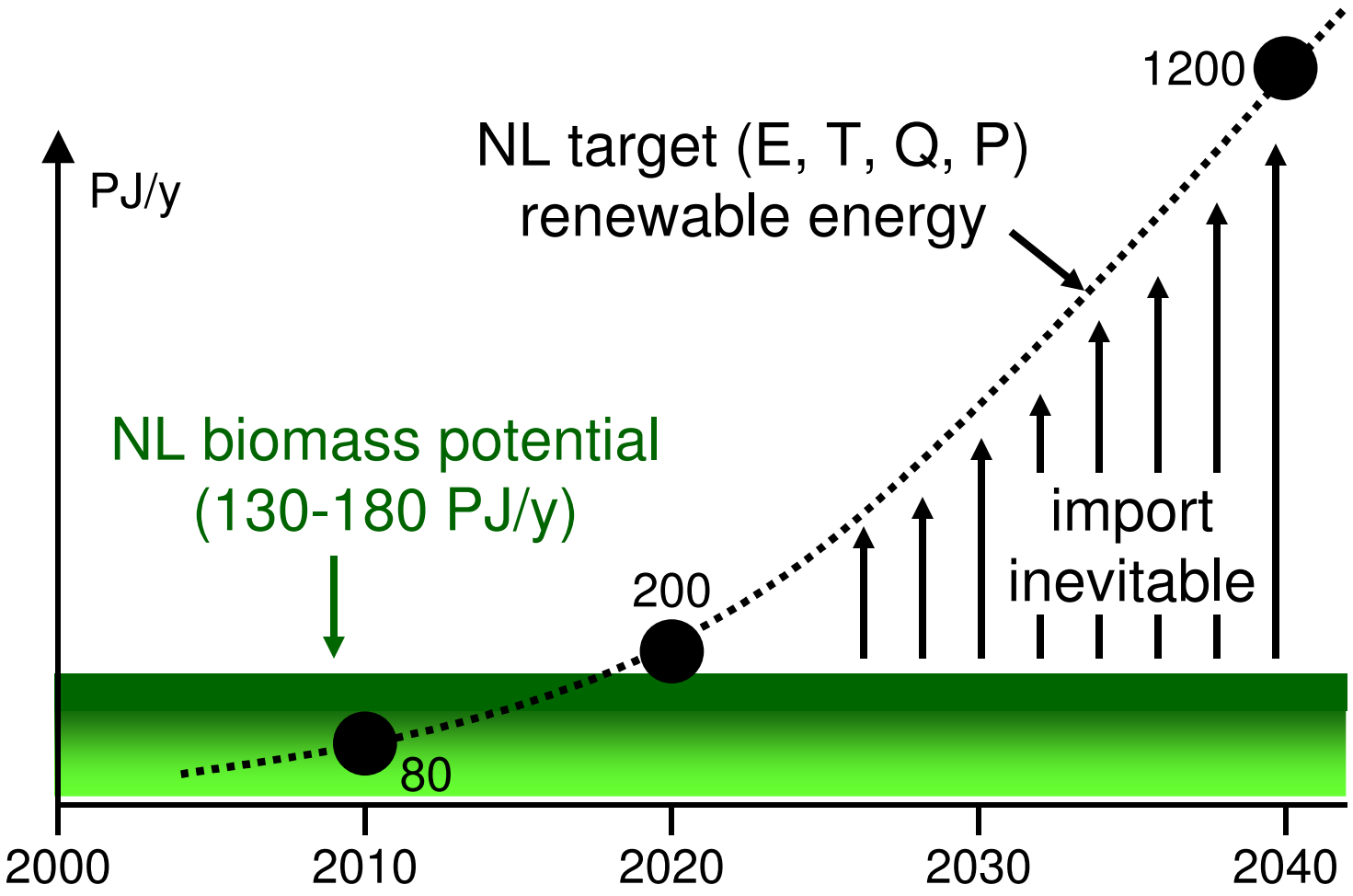

products
16%
electricity
29%
transportation
fuels
19%
heat
36%

Definition of "Green Natural Gas"

Biogas and SNG

Biogas	- Produced by digestion, contains mainly CH_4 and CO_2
Landfill gas	- Product of landfills, composition similar to biogas
SNG	- Synthetic Natural Gas, contains mainly CH_4 - Produced via gasification followed by methanation - Main sources: coal and biomass
bio-SNG	- Synthetic Natural Gas from biomass
"***green natural gas***"	- Comprising both bio-SNG and upgraded biogas/landfill gas - Complies with specifications for injection to natural gas grid - Has same properties as natural gas - Can be used in all existing equipment

Biomass availability and targets in NL

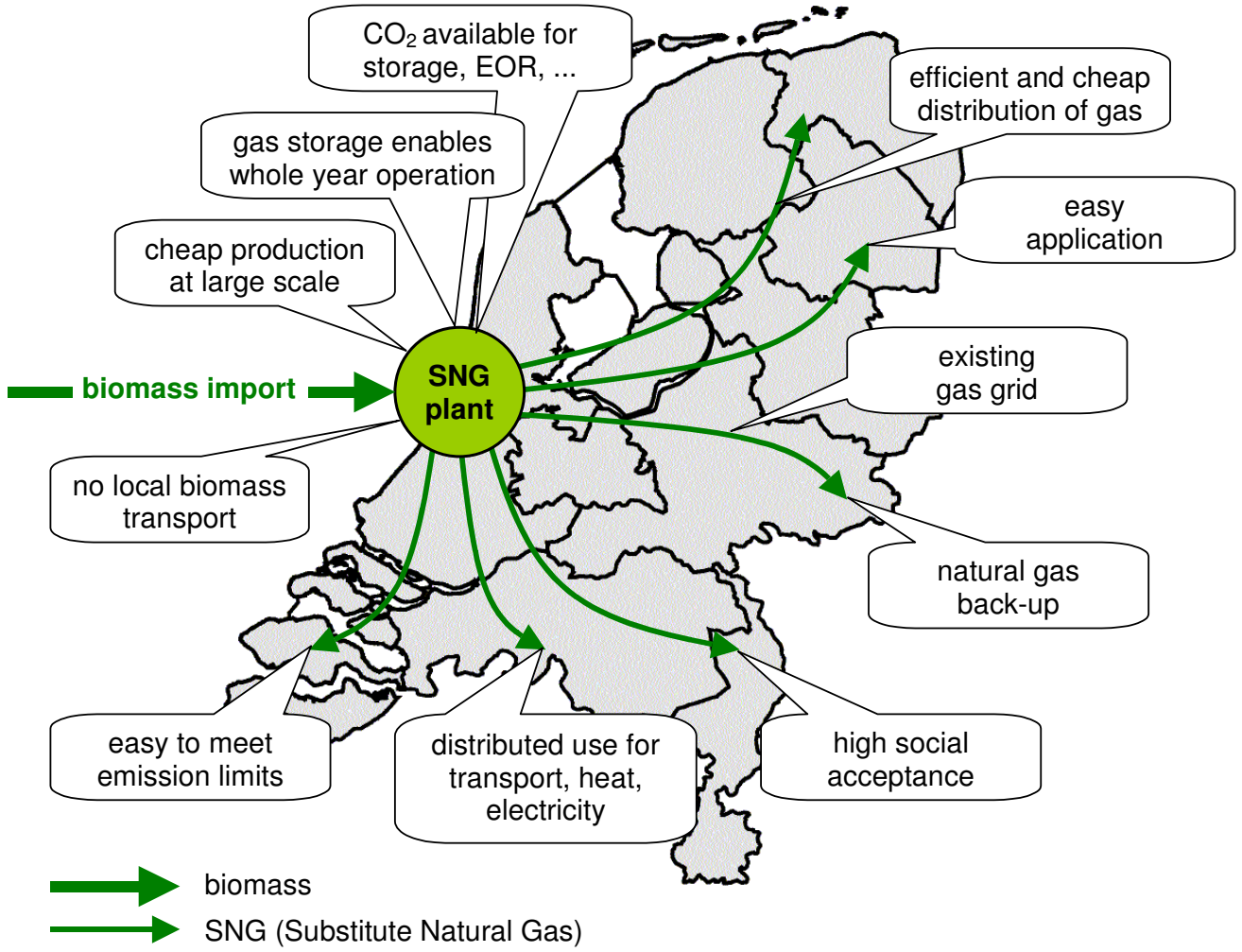


Consequences

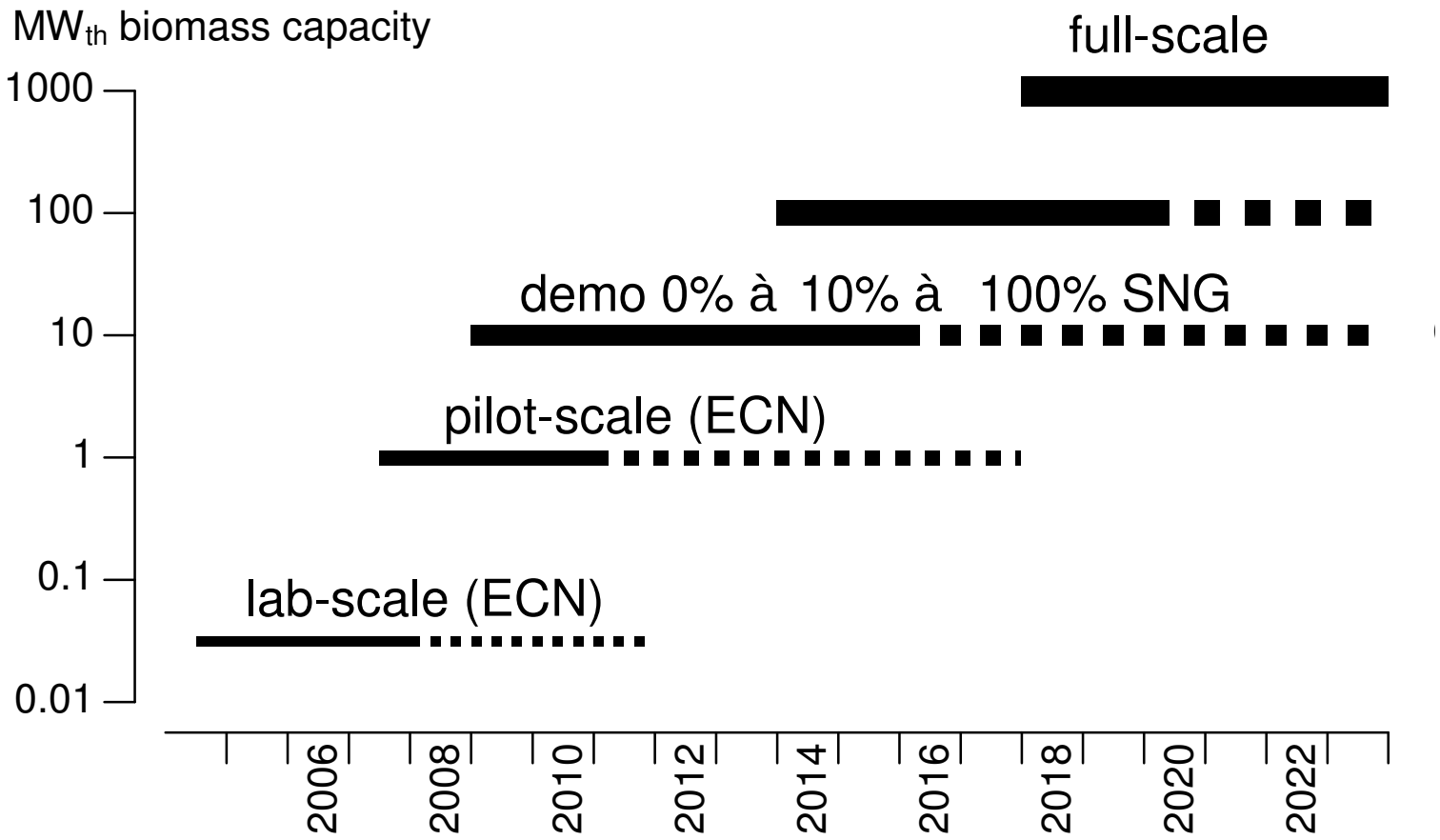
- biomass import inevitable in NL
- biomass will be expensive (plus ~3 €/GJ)
- biomass will probably be wood
- biomass will be available at only few locations (harbours)

- consequence: large-scale and high efficient

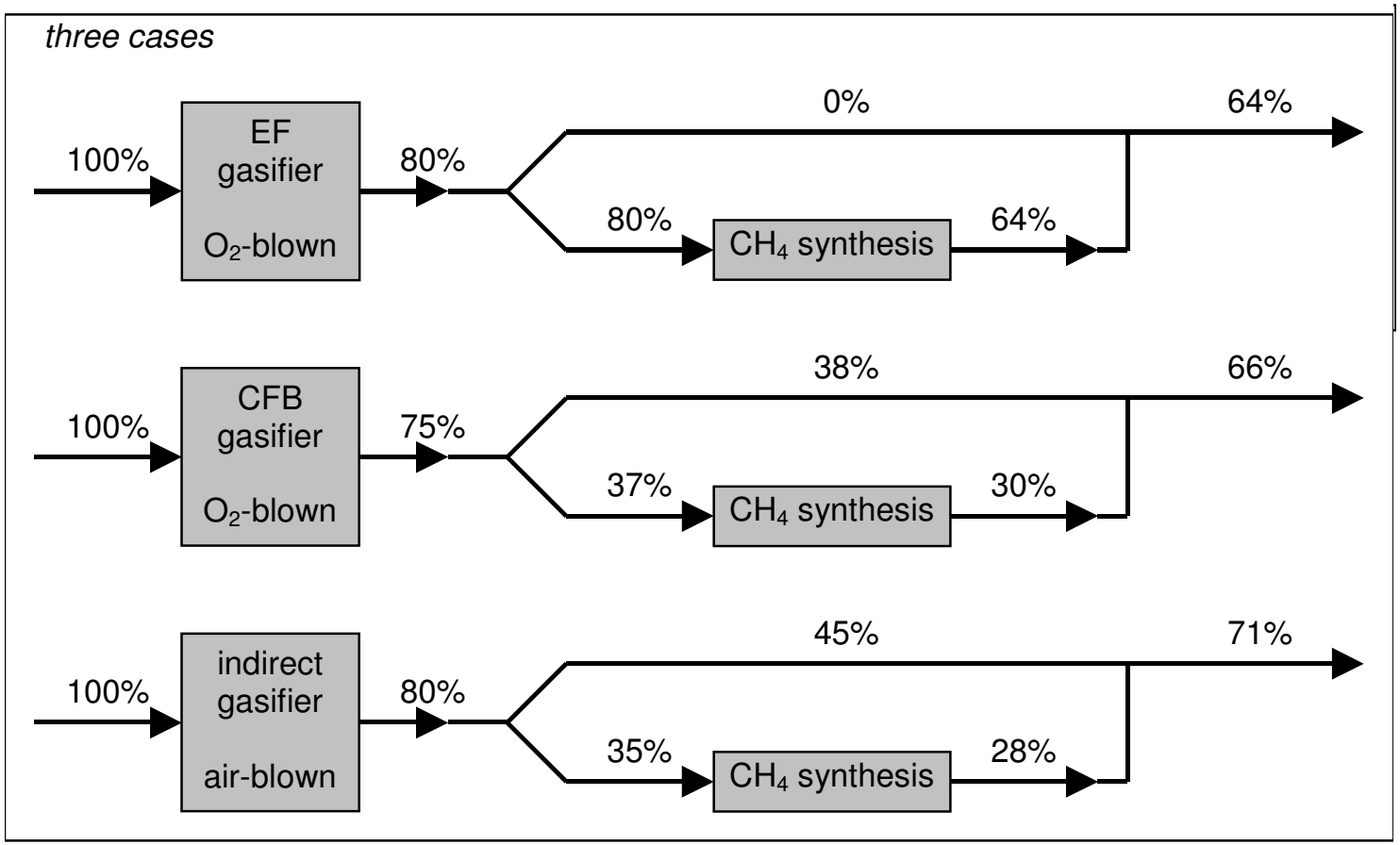
SNG: Substitute Natural Gas



Implementation plan



Choice of gasifier
efficiency



EF: entrained flow, CFB: circulating fluidised bed

Indirect gasification for Bio-SNG

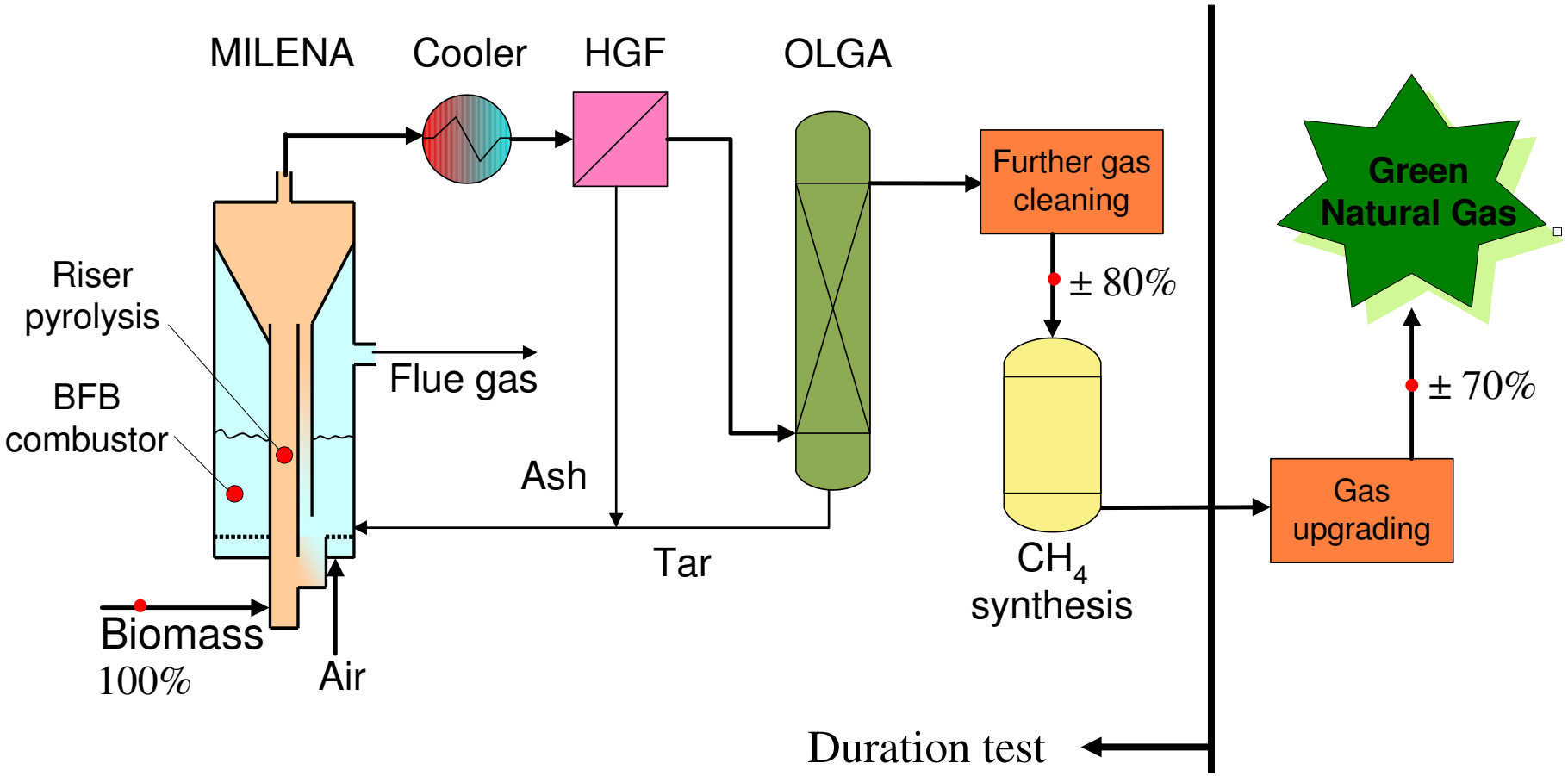
$C_6(H_2O)_6$ (20% moisture)

Upgraded product gas

$3\ CH_4 + 3\ CO_2$

$3\ CH_4$ (Bio-SNG)

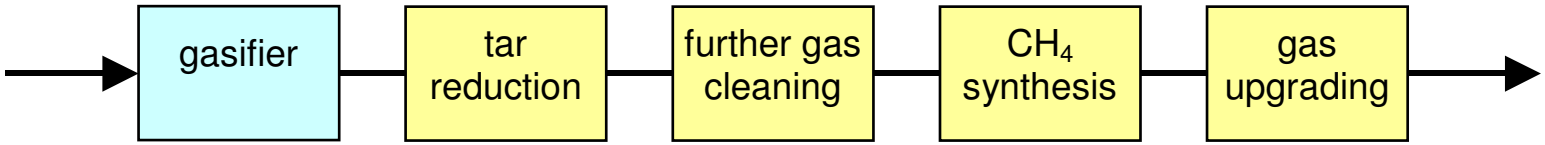
Process diagram for Bio-SNG production



Duration test with lab scale facility

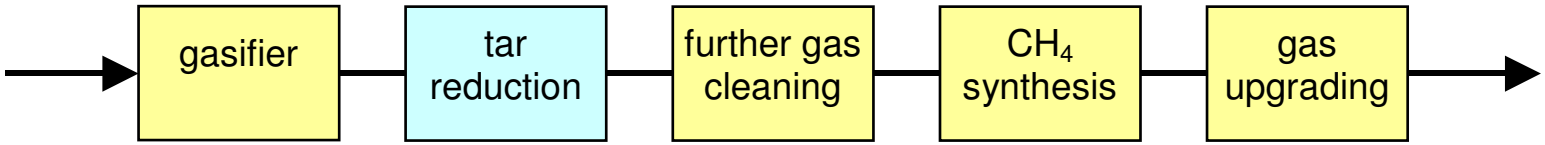
- 75 hours of continuous operation
- 2 operators per shift
- Dust, Tar, S and Cl removal
- No further upgrading

ECN equipment MILENA



- Indirect gasifier (5 kg/h)
- Developed for high efficient SNG-production
- 7 m_n^3/h wet product gas
- Pilot MILENA construction in 2007 (200 kg/h)

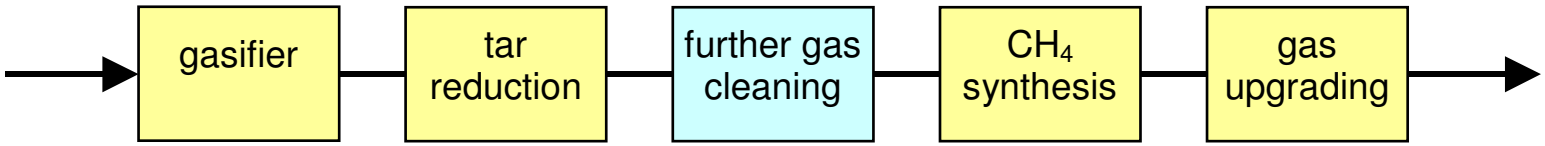
ECN equipment: OLGA



Tar absorption Tar condensation

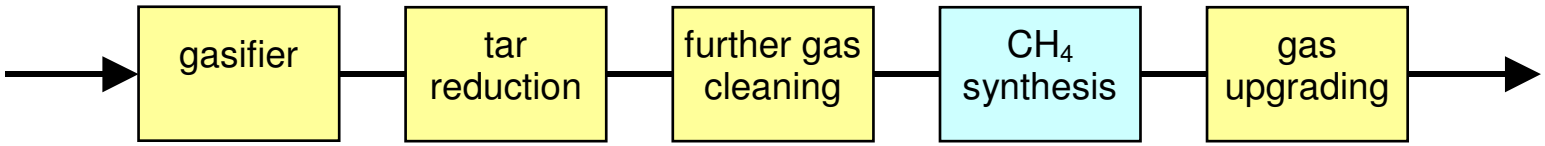
- OLGA tar removal with oil
- tar dew point << 10 ℃
- www.ecn.nl
  www.dahlman.nl
- 2 and 200 m_n^3/h unit available
- 2000 m_n^3/h operated for 100 hours in France, duration test planned.

ECN equipment : SACHA



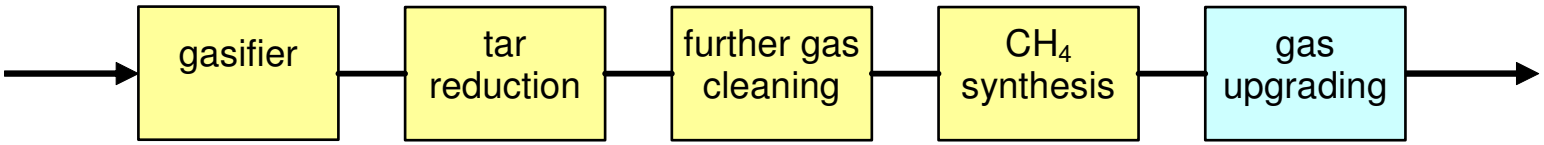
- SACHA dry gas cleaning
- H_2S, COS, HCl removal with Sorbent materials
- S and Cl = 1 ppm_v OUT

ECN equipment: CH_4 synthesis



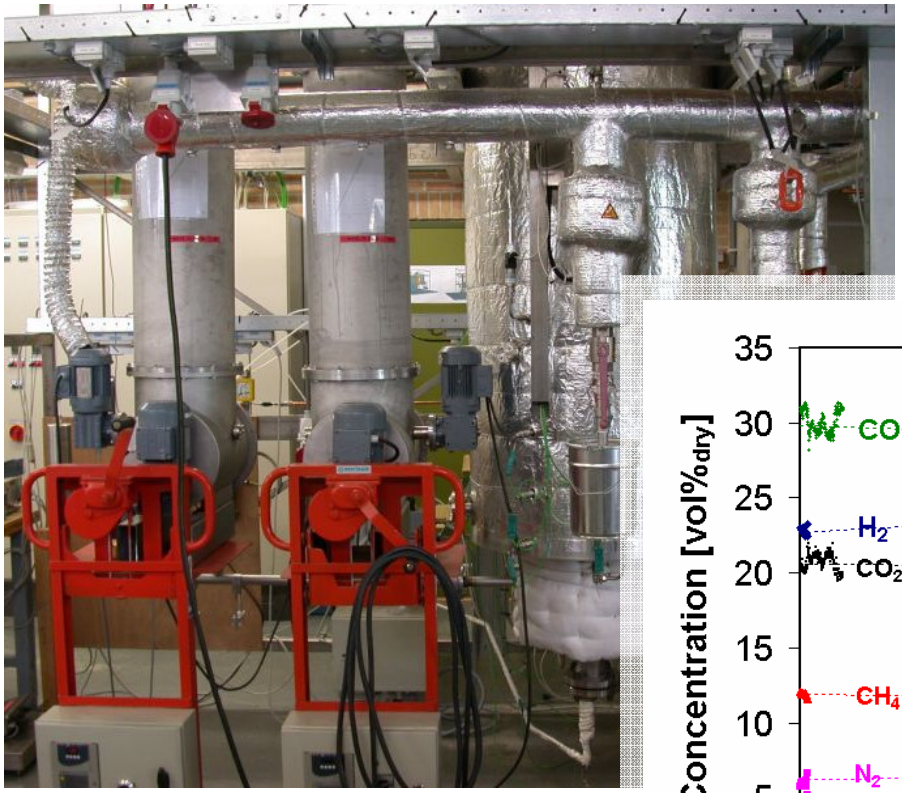
- Packed beds of catalyst
- 2 m_n^3/h product gas

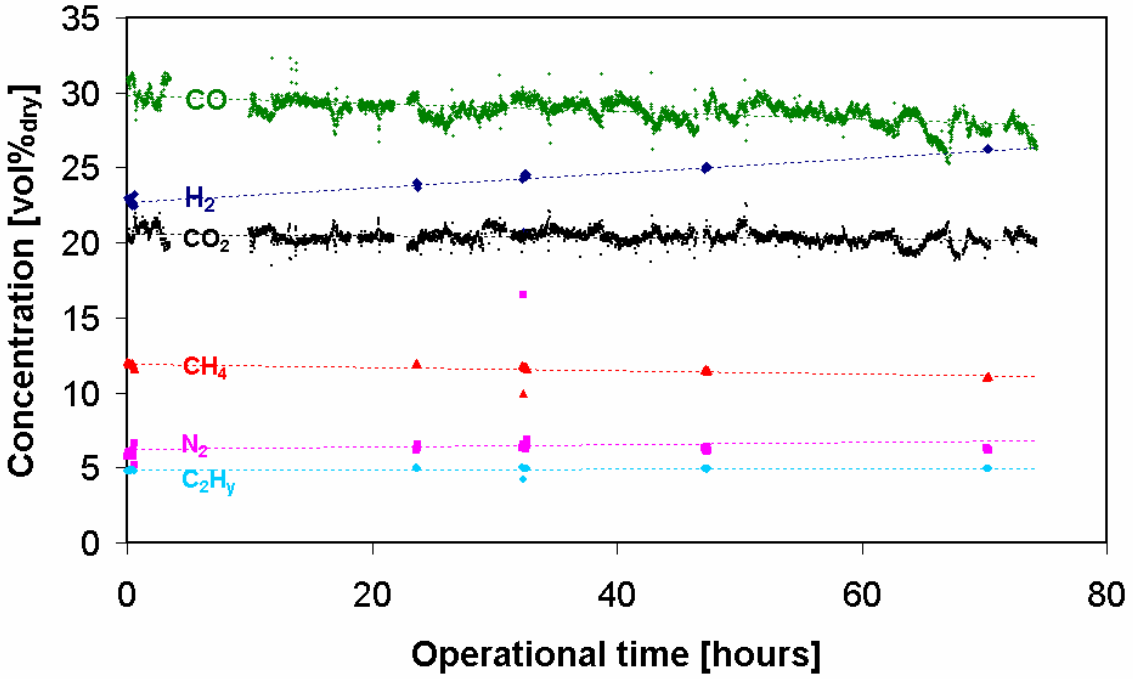
ECN equipment: gas upgrading



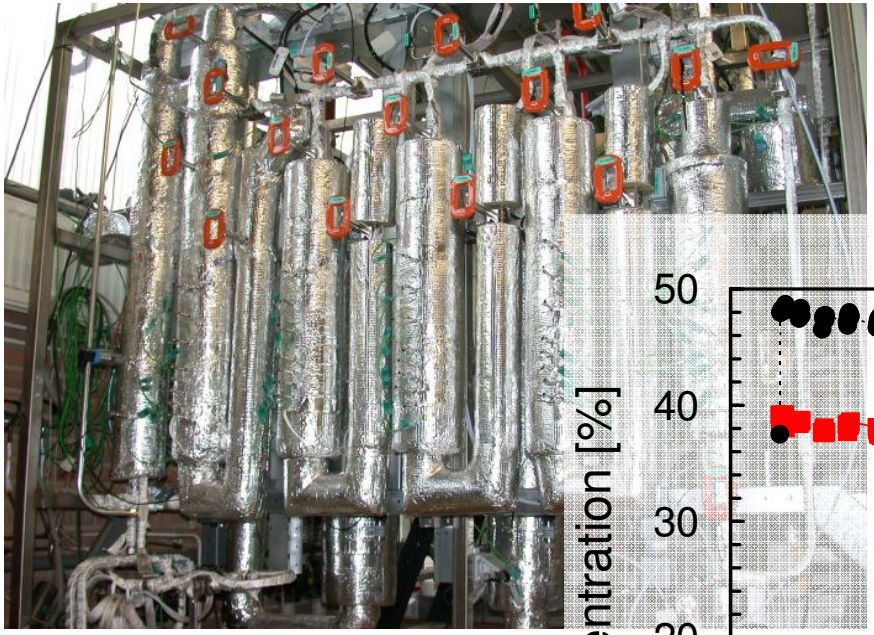
No gas upgrading performed

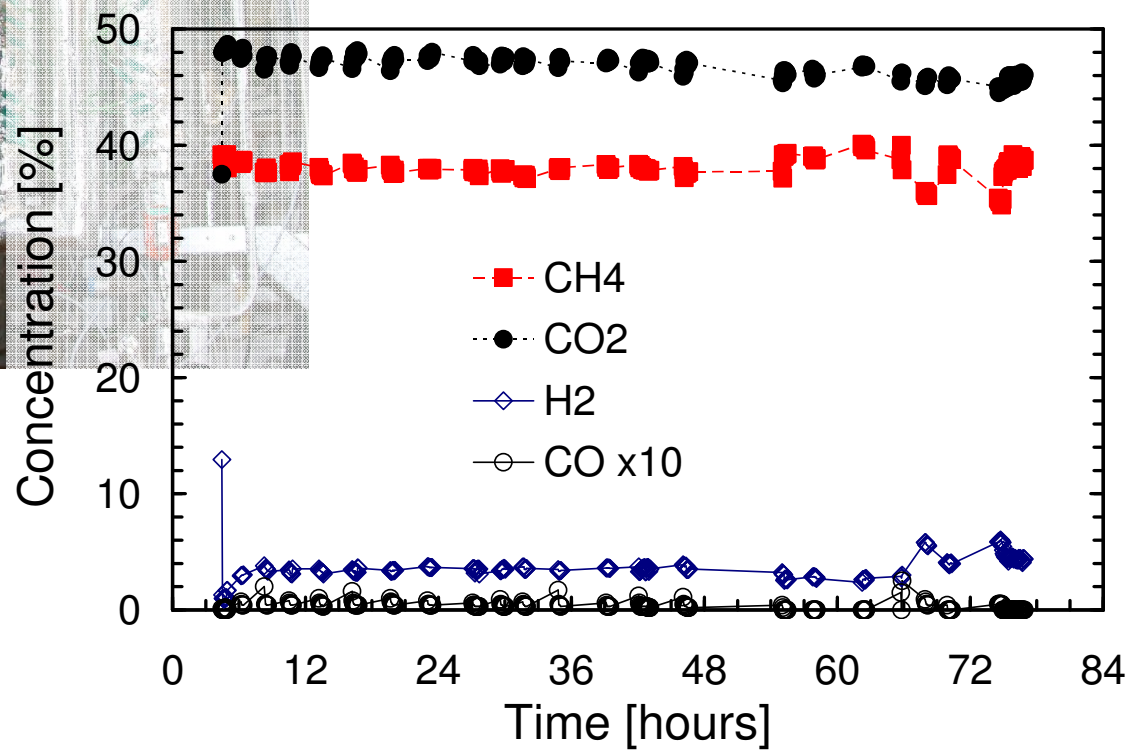
MILENA gas composition





CH_4 synthesis gas composition





Conclusion

- Efficiency of Biomass to Bio-SNG is crucial in SNG production
- Large scale plants are needed for SNG production
- Functional test with laboratory scale SNG installation successful

Further research

- Optimization Milena
- Optimization gas cleaning
- Optimization CH_4 synthesis
- Construction of Pilot plant
- Formation of consortium for the Demo installation ($10MW_{th}$)

Further Information

Information

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Other

General information: www.ecn.nl/bkm

Phyllis biomass database: www.phylis.nl

Tar Dewpoint calculator: www.thersites.nl