ECN

Energy research Centre of the Netherlands

BIOMASS RESEARCH at ECN

Bram van der Drift

ECN-BIOMASS

~50 persons, ~8 M€/y, organized in three groups:

- power and heat
  - biomass upgrading (torrefaction)
  - waste to energy
  - co-firing
  - CHP (combustion, gasification)
- syngas and SNG
  - syngas (feeding, slag/ash issues, …)
  - SNG (indirect gasification, OLGA tar removal, …)
- transportation fuels and chemicals
  - Fischer Tropsch
  - ethanol (lignocellulose)
  - chemicals and materials (biorefinery)

TORREFACTION …

TORREFACTION (1)

why?

fact: coal is conventional

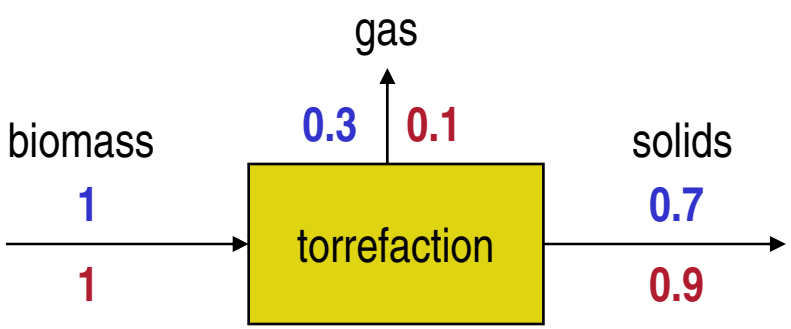
so: turn biomass into “coal” to make things easy

250 MW_e coal IGCC, Buggenum (NL)

2x600 MW_e coal boiler, Geertruidenberg (NL)

TORREFACTION (2)

what is it?



energy densification (E/kg): $\frac{0.9}{0.7}$ = 1.3

mass energy

- temperature: 200-300 °C
- pressure: near atmospheric
- absence of oxygen
- product: solid phase (energy)
- particle size < 4 cm thickness
- residence time 10 to 60 min
- heating rate: <50 °C/min

TORREFACTION (3)

the conversion

green biomass **waste**

demolition wood

tough and fibrous
heterogeneous
15 to 18 MJ/kg (LHV, ar)
< 5 GJ/m^3

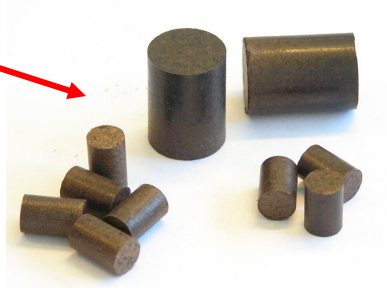
torrefaction and pulverisation

friable and less fibrous
hydrophobic
preserved
homogeneous
19 to 22 MJ/kg (LHV, ar)
< 5 GJ/m^3

TOP fuel powder

750-850 kg/m^3
15-20 GJ/m^3

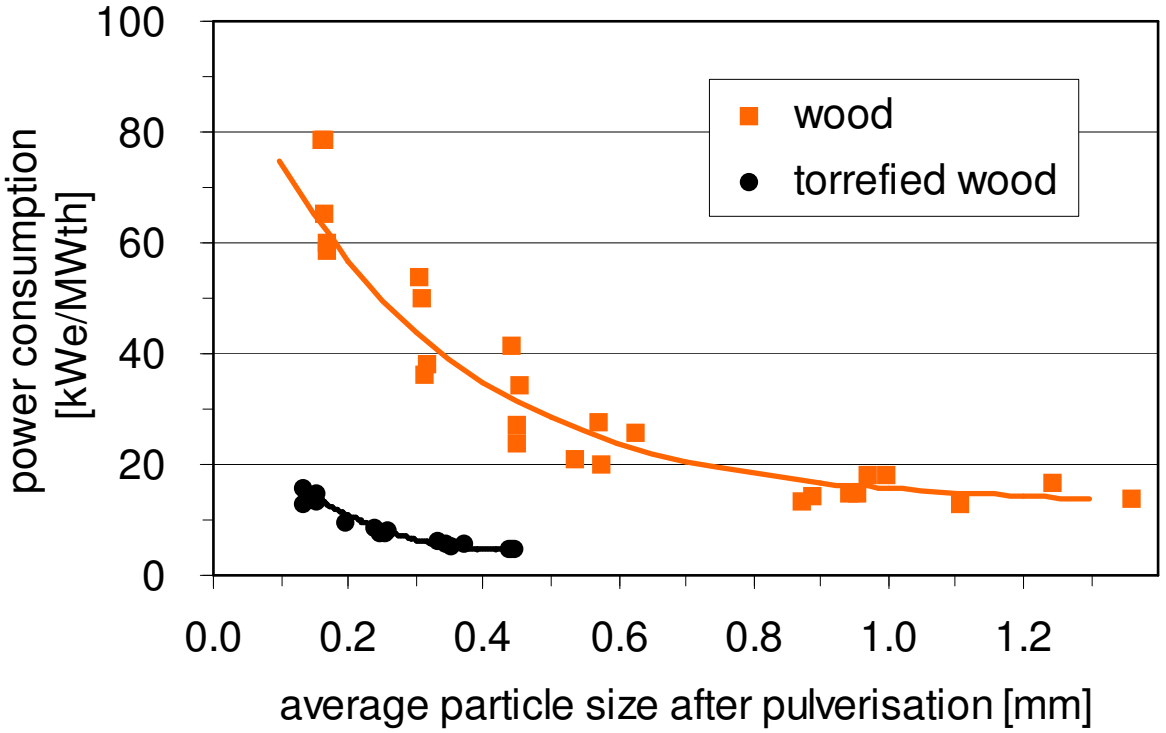
pelletisation



TOP fuel pellets

TORREFACTION (4)

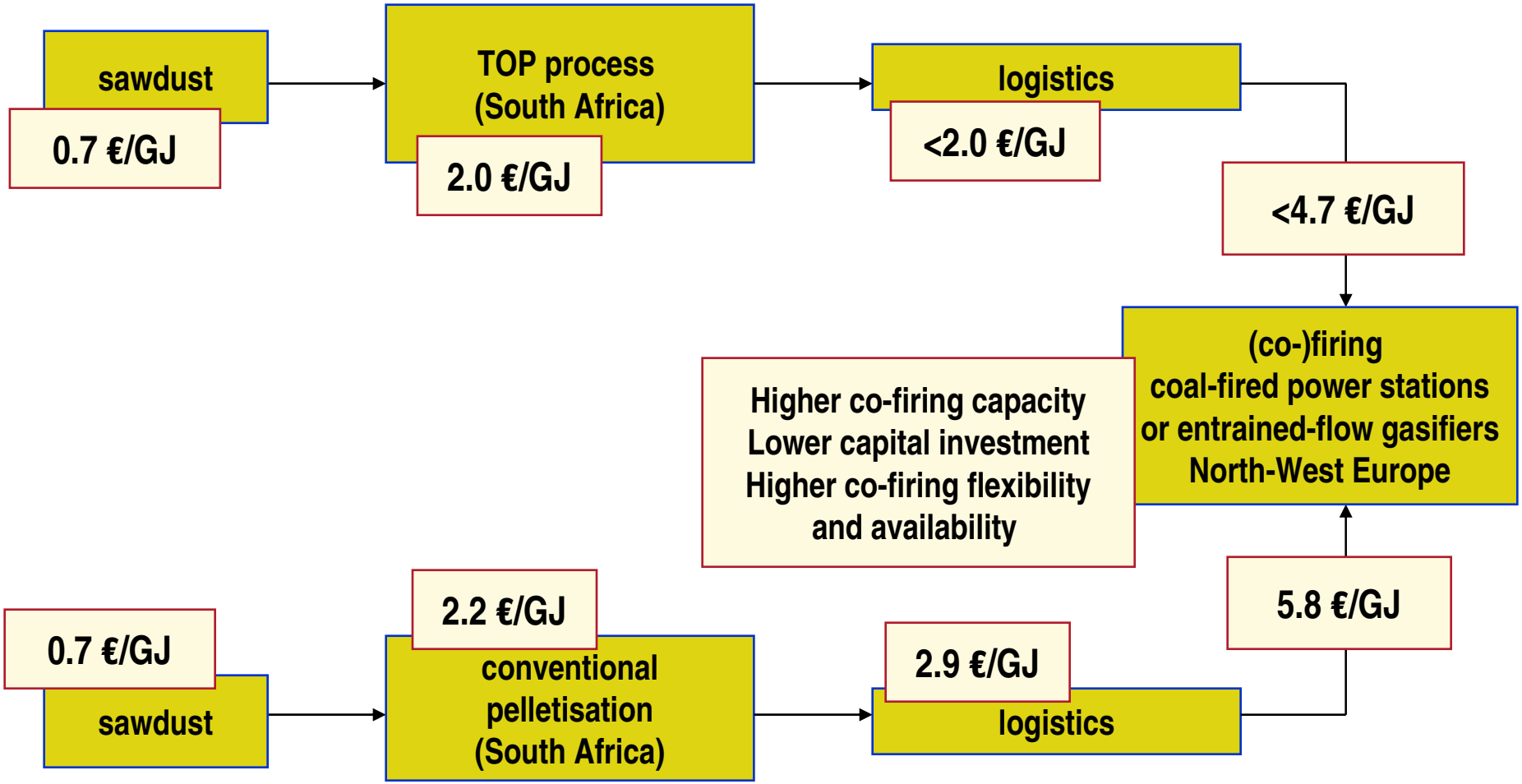
easy grinding



[ECN-reports: ECN-C-05-013, ECN-05-067, ECN-05-073]

TORREFACTION (5)

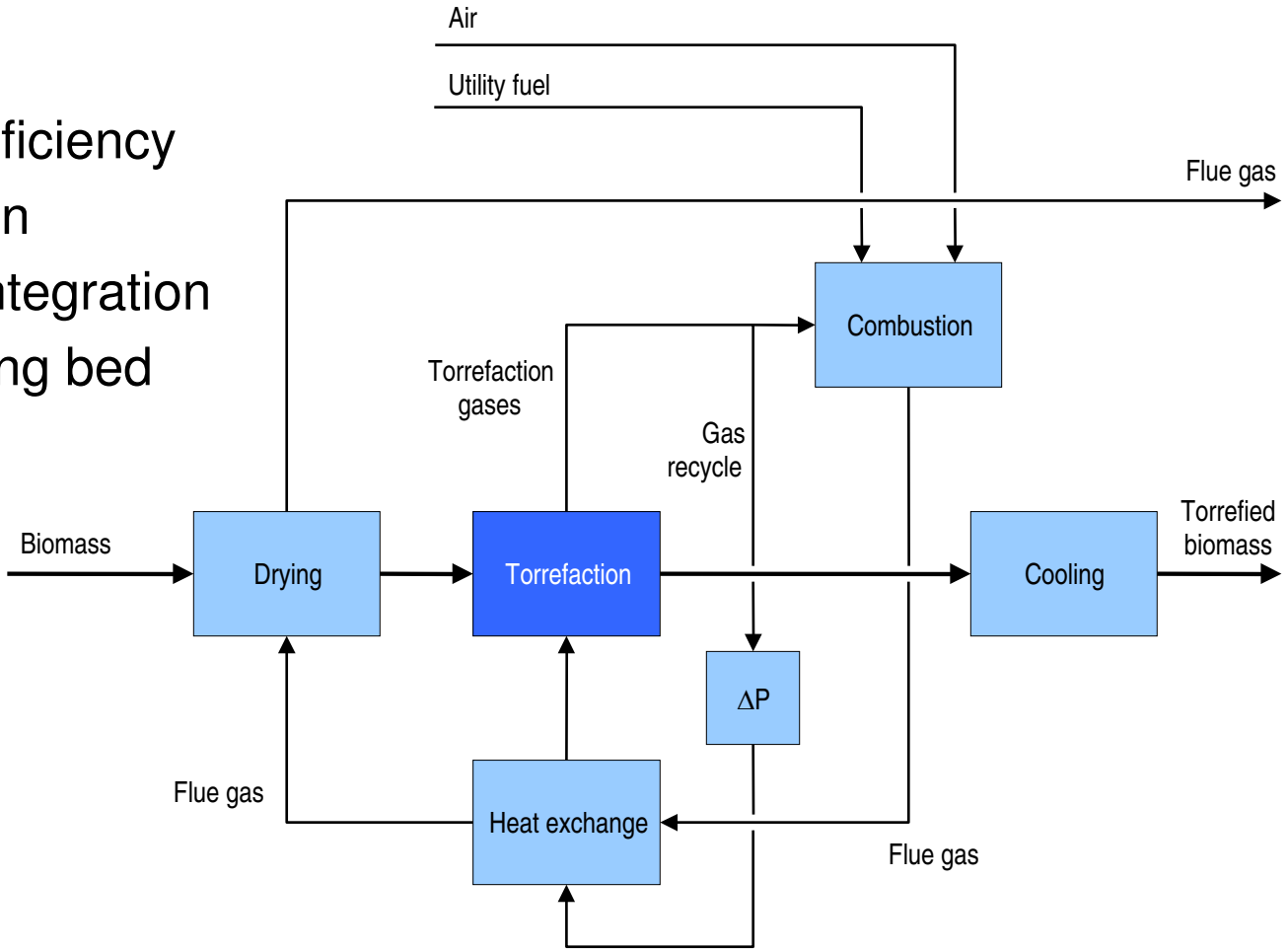
economics



TORREFACTION (6)
at ECN

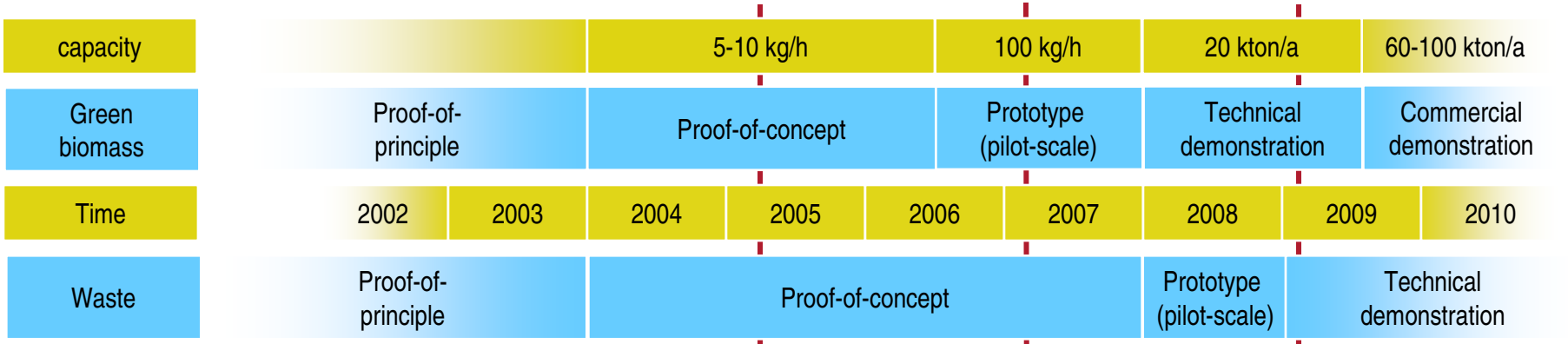
ECN focus:

- high energy efficiency
- heat integration
- pellet (TOP) integration
- compact moving bed technology



TORREFACTION (7)

"roadmap"



Proof-of-concept
- Experimentally based process design
- Technology identification
- Knowledge base torrefaction
- Experimental infrastructure torrefaction
- Economic evaluation full-scale (+/- 30%)
- Set-up pilot phase of development

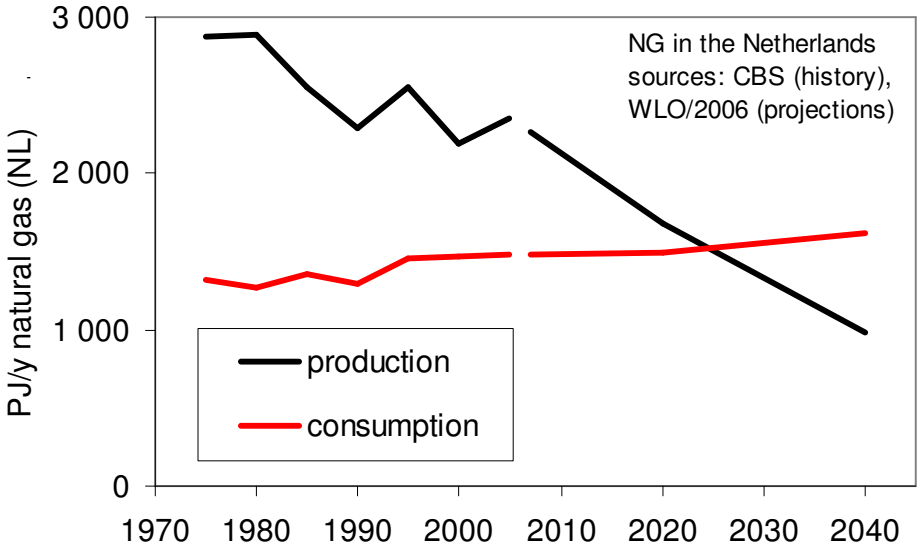
Prototype (pilot-scale evaluation)
- Pilot plant / prototype technology
- Demonstration technical feasibility
- Process and product characterisation
- Economic evaluation full-scale (+/- 20%)
- Business plan(s)

Technical demonstration
- Demonstration plant (semi-commercial)
- Technical feasibility (refined design)
- Product applications (large scale)
- Economic evaluation full-scale (+/-10%)
- Business plan(s)

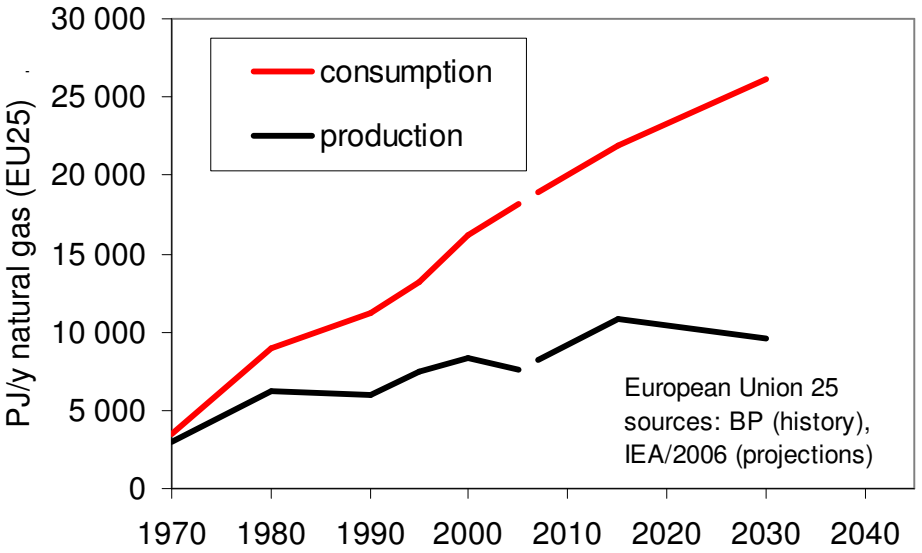
SNG: SUBSTITUTE NATURAL GAS

SNG FROM BIOMASS (1)

why?

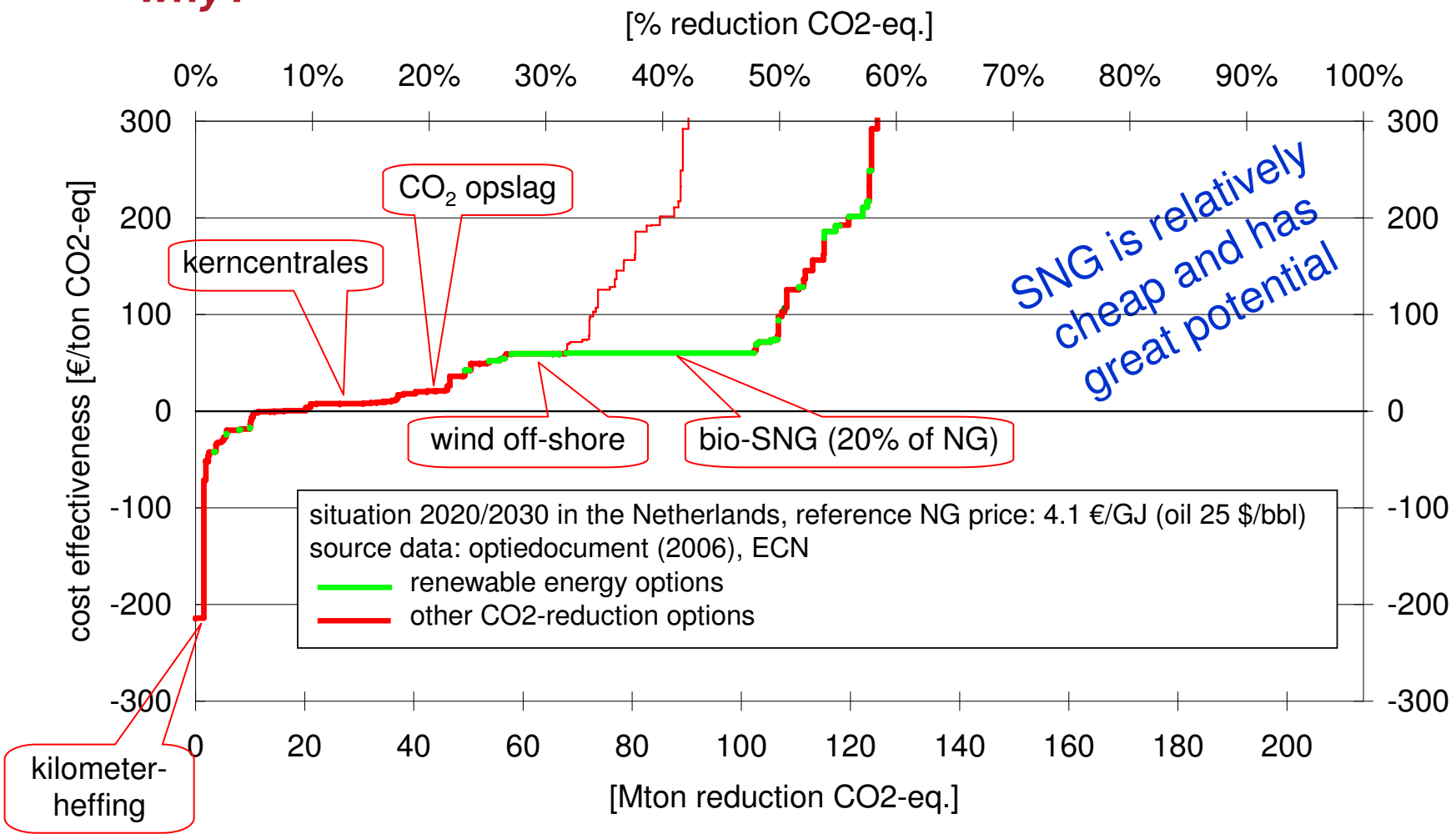


gas is popular,
but not available



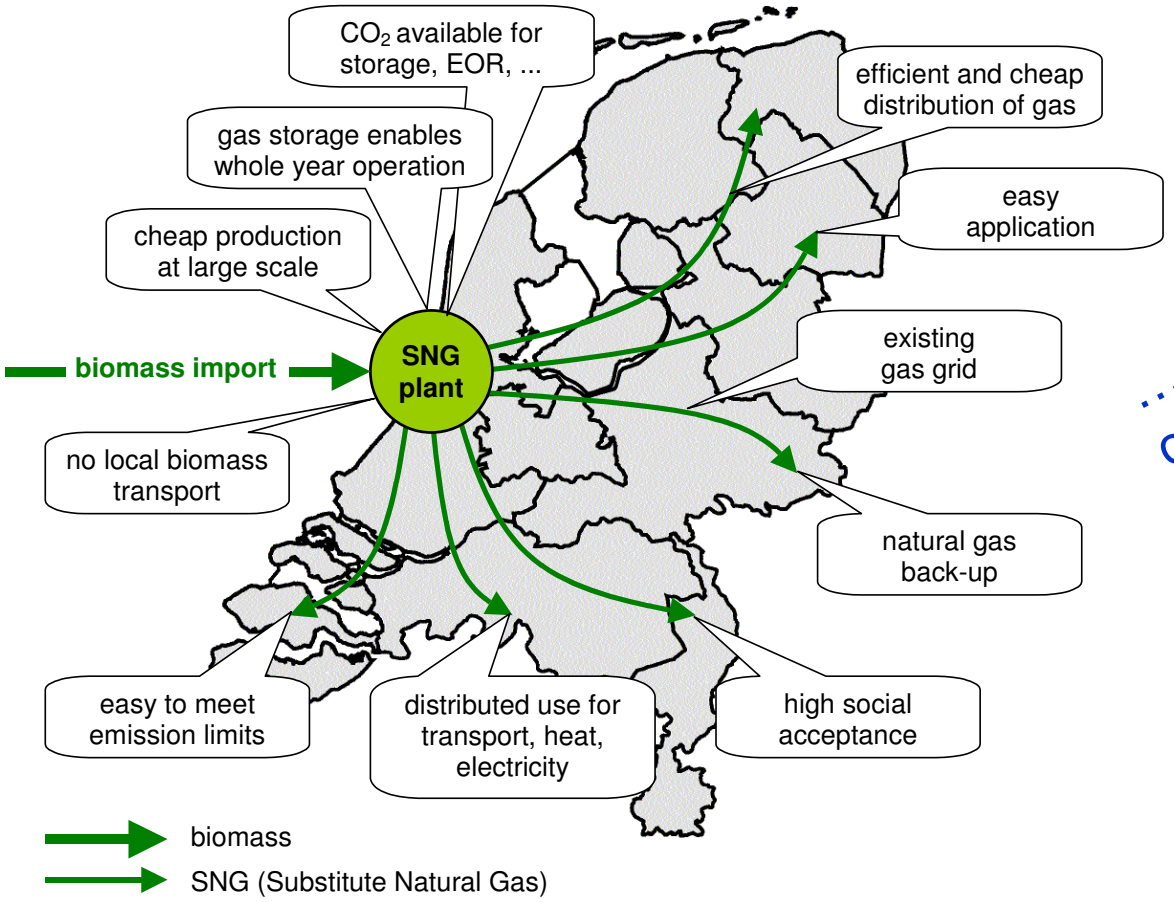
SNG FROM BIOMASS (2)

why?



SNG FROM BIOMASS (3)

why?

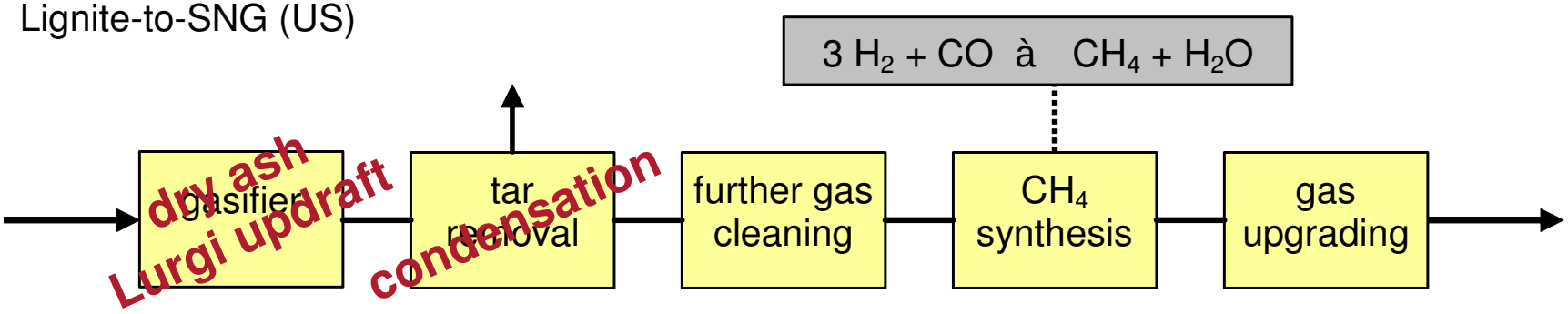


…and many other reasons

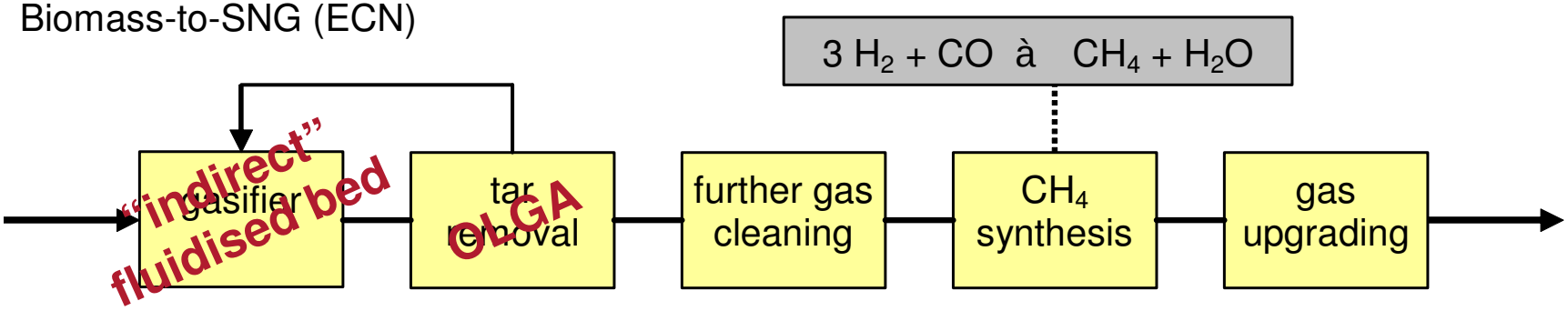
SNG FROM BIOMASS (4)
system

3 GW lignite-to-SNG plant, Beulah, ND, USA

Lignite-to-SNG (US)

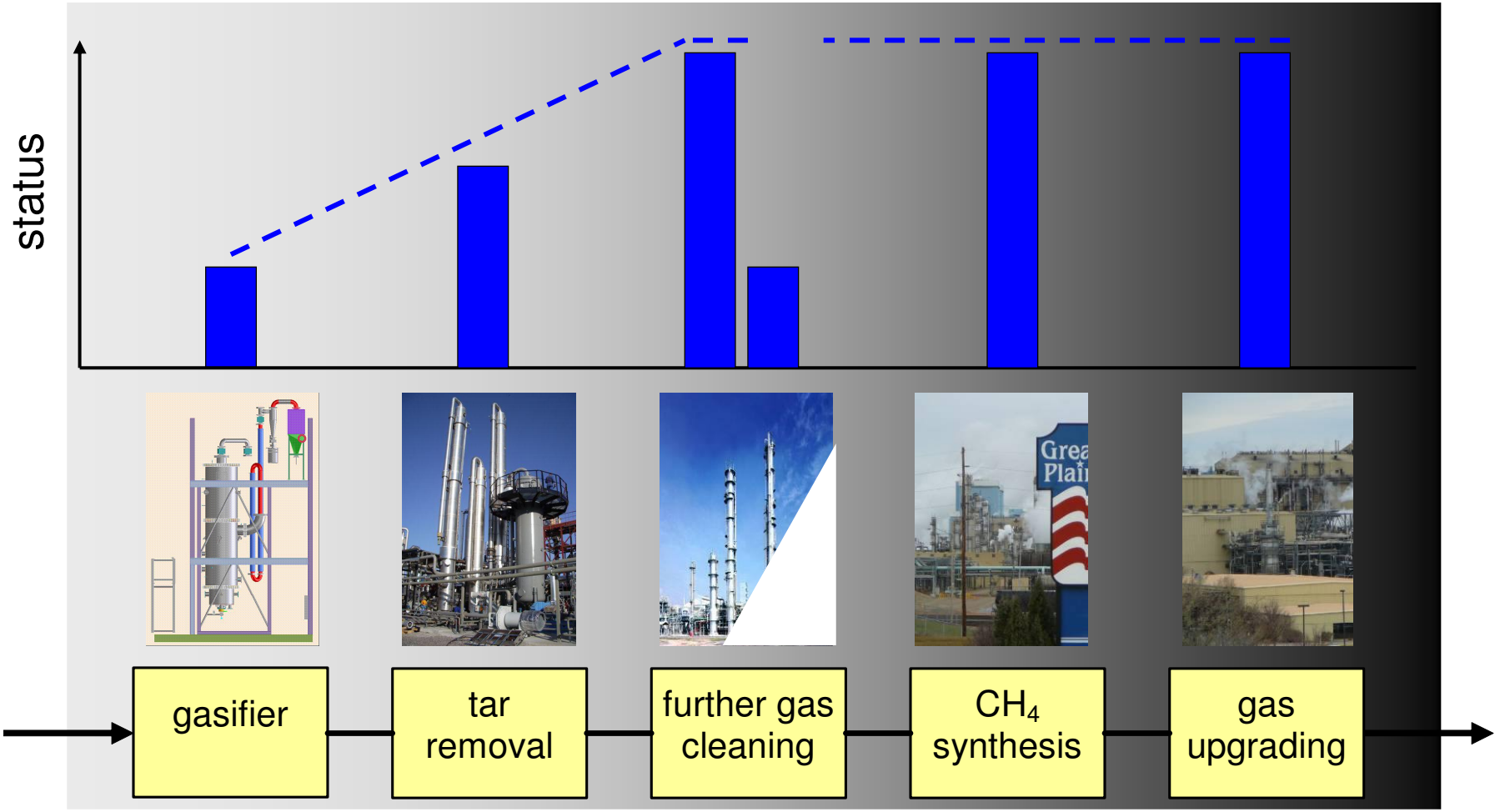


Biomass-to-SNG (ECN)



SNG FROM BIOMASS (5)

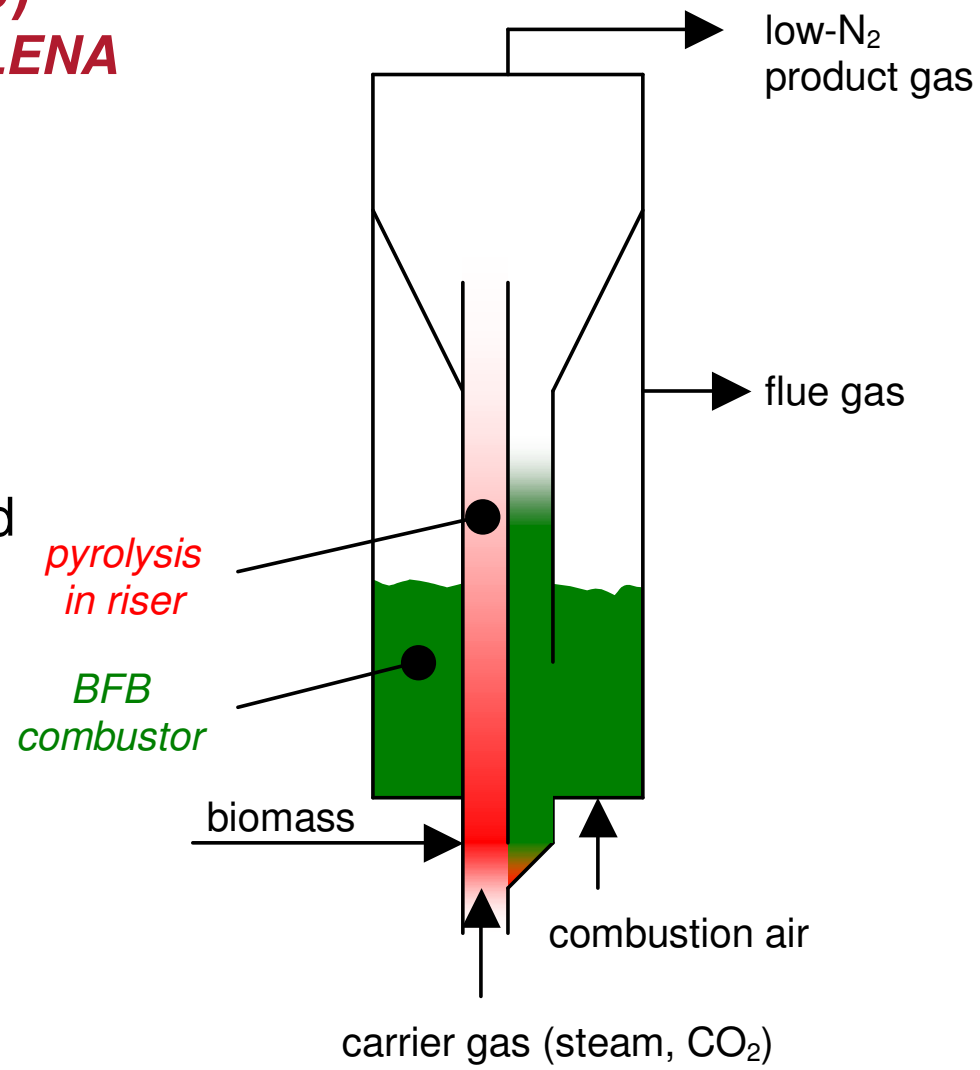
development status



SNG FROM BIOMASS (6)

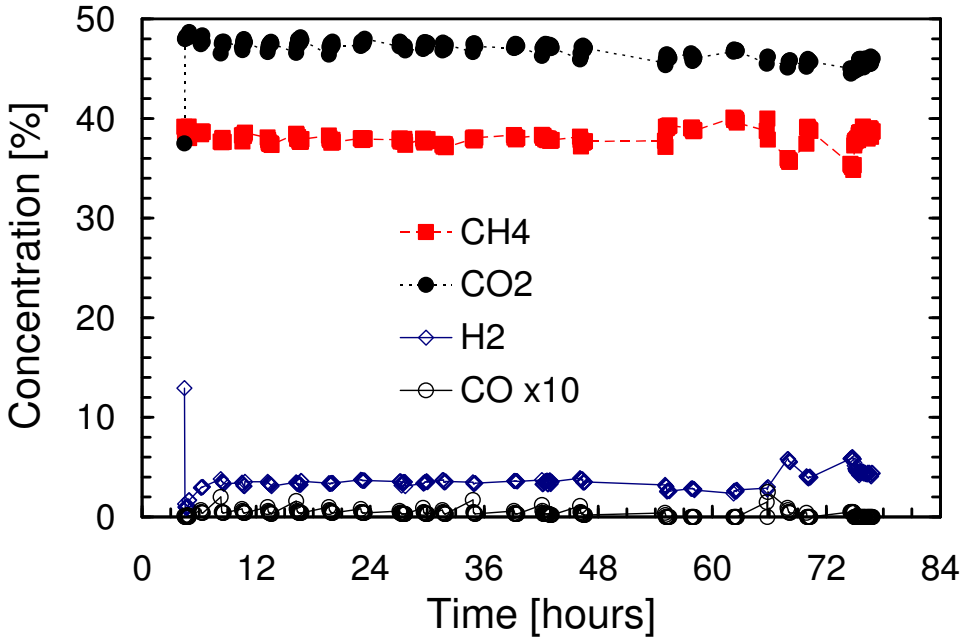
indirect gasification with MILENA

- indirect gasifier
- developed for high efficient SNG-production
- can be operated as "SilvaGas" and "Güssing" and BFB
- 25 kW available, 800 kW under construction



SNG FROM BIOMASS (7)

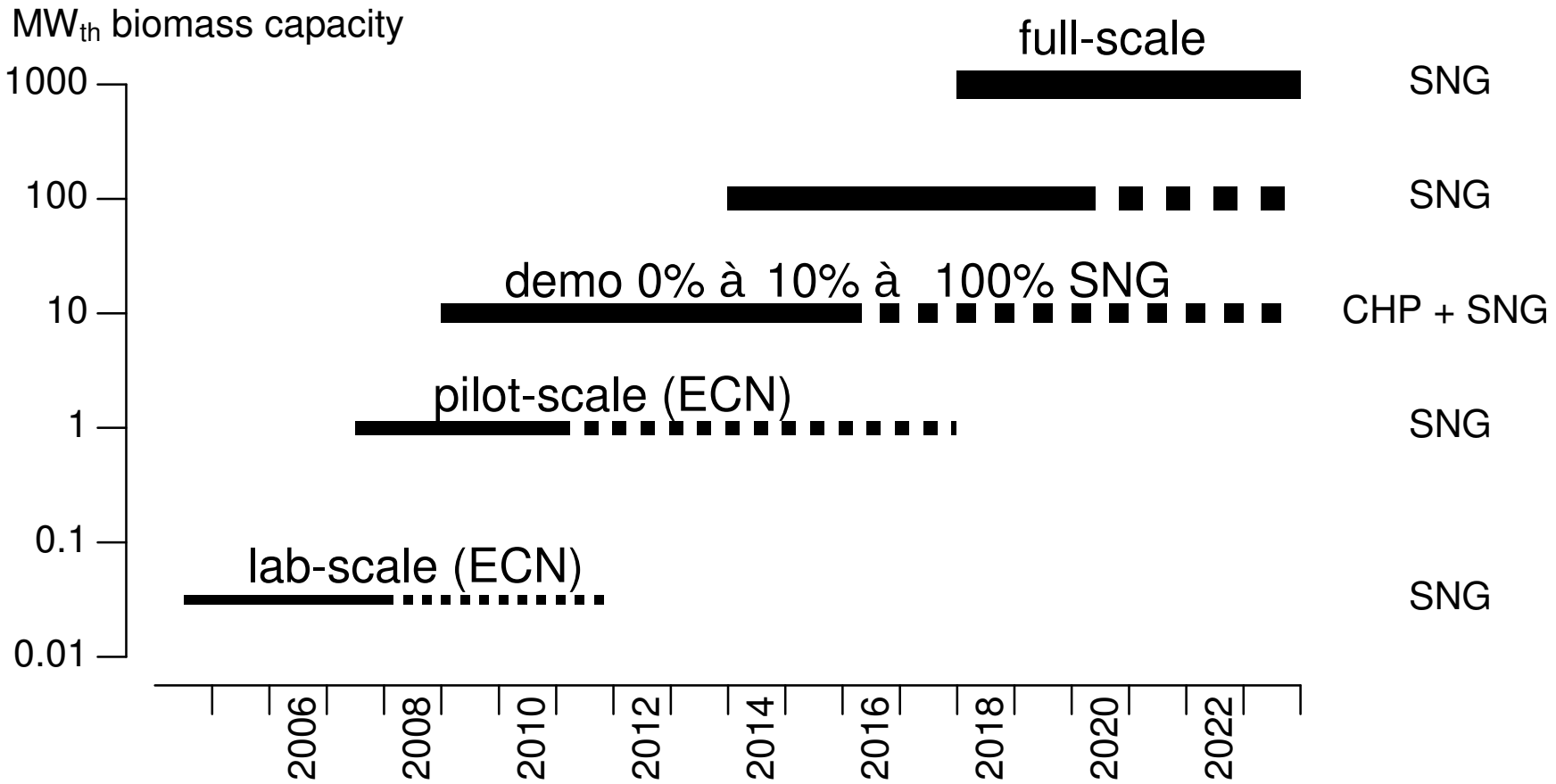
at ECN



wood | MILENA gasifier | OLGA tar removal | gas cleaning | methanation

SNG FROM BIOMASS (8)

"roadmap"



OLGA TAR REMOVAL

DAHLMAN
FILTER TECHNOLOGY

OLGA TAR REMOVAL (1)

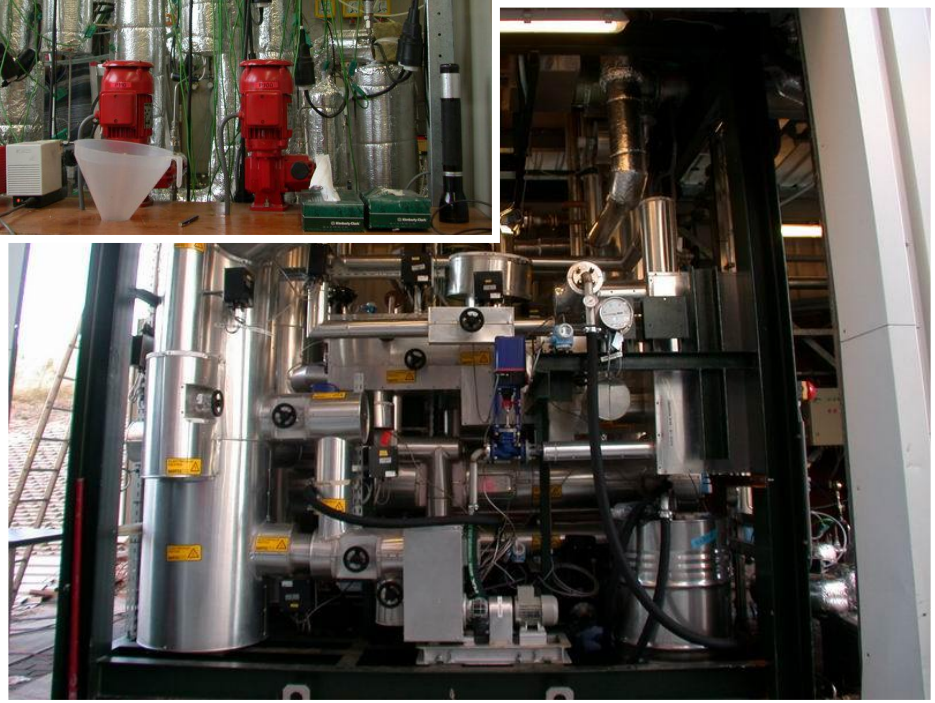
the tar problem

- fouling
- waste water problem
- catalyst deactivation

OLGA TAR REMOVAL (2)

development

2 nm3/h lab-scale facility at ECN, 2002, >1400 hours



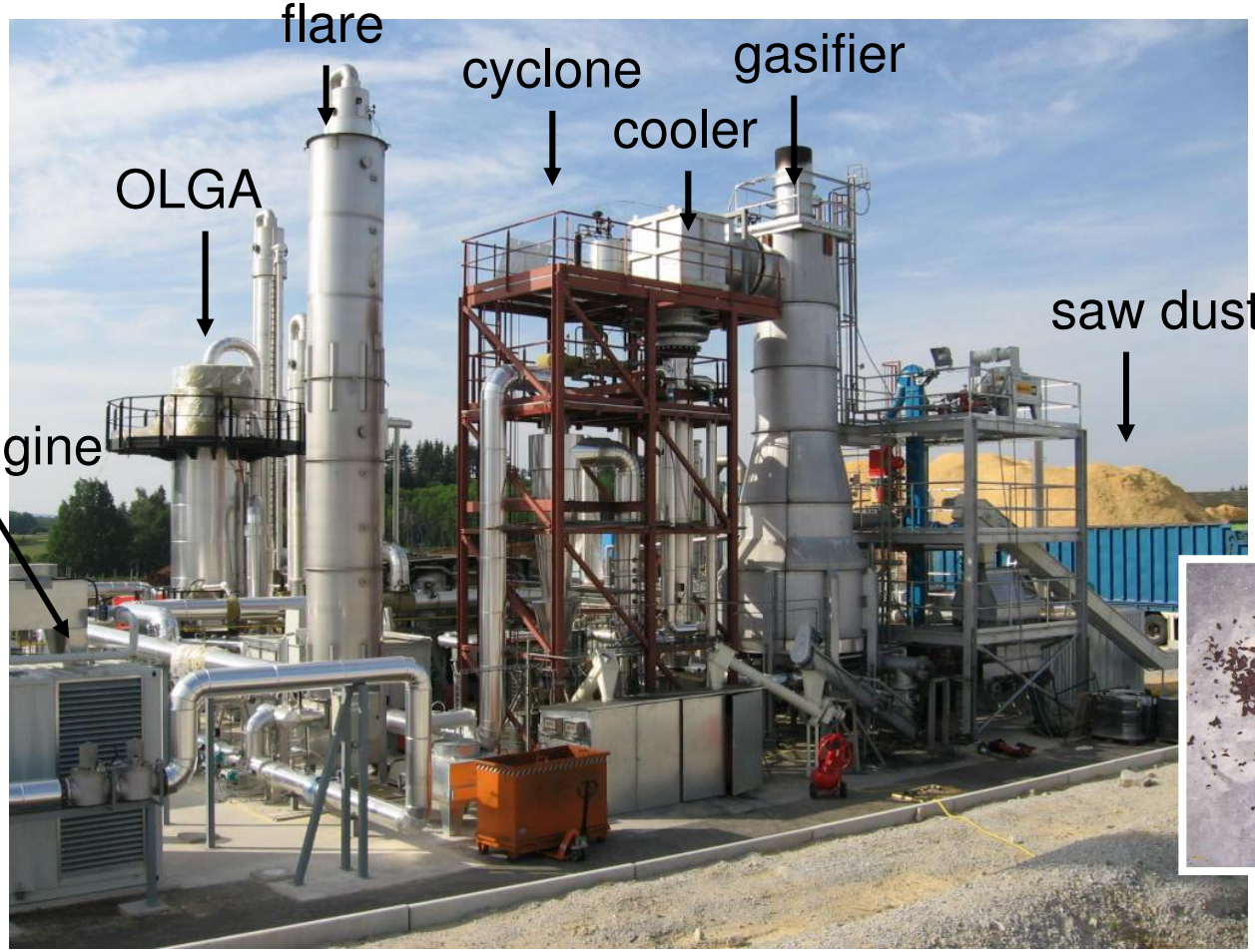
200 nm3/h pilot facility at ECN, 2003, 900 hours

2000 nm3/h plant in France, 2006, 100 hours

DAHLMAN FILTER TECHNOLOGY

OLGA TAR REMOVAL (3)

the 4 MW_{th} installation in France



wine residue

OLGA TAR REMOVAL (4)

the 4 MW_{th} installation in France

Project details

- Moissannes in France
- Eneria is plant operator
- Dahlman is OLGA supplier
- ECN assisted design, start-up, and operation

Key process data

- Saw dust and Wine residue
- 4 MW_{th} fixed bed gasifier,
- 1.1 MW_e gas engine
- OLGA removes fine dust + tar
- 100 hours of OLGA operation
- Performance according design
- Duration tests planned in 2007

MORE INFORMATION

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publications: www.ecn.nl/library
composition database: www.phyllis.nl
tar dew point calculator: www.thersites.nl
IEA (task 33: biomass gasification): www.gastechnology.org/iea