

GREEN GAS by gasification: a unique opportunity for the gas industry

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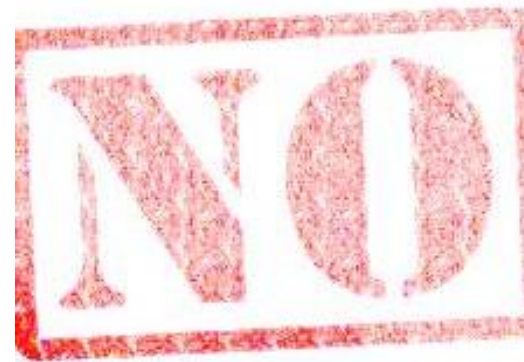
GREEN GAS by gasification: a unique opportunity for the gas industry

Bram van der Drift

ECN

EDGaR Closing Conference, 18-19 March 2015, Amsterdam

- Will Green Gas always be more expensive than Natural Gas?
- No
- Green Gas has the potential to become competitive with Natural Gas
- Should we wait for that to happen?
- No
- Technology development is required to get there, start now



TWO PROCESSES to make Green Gas



Digestion
of wet biomass

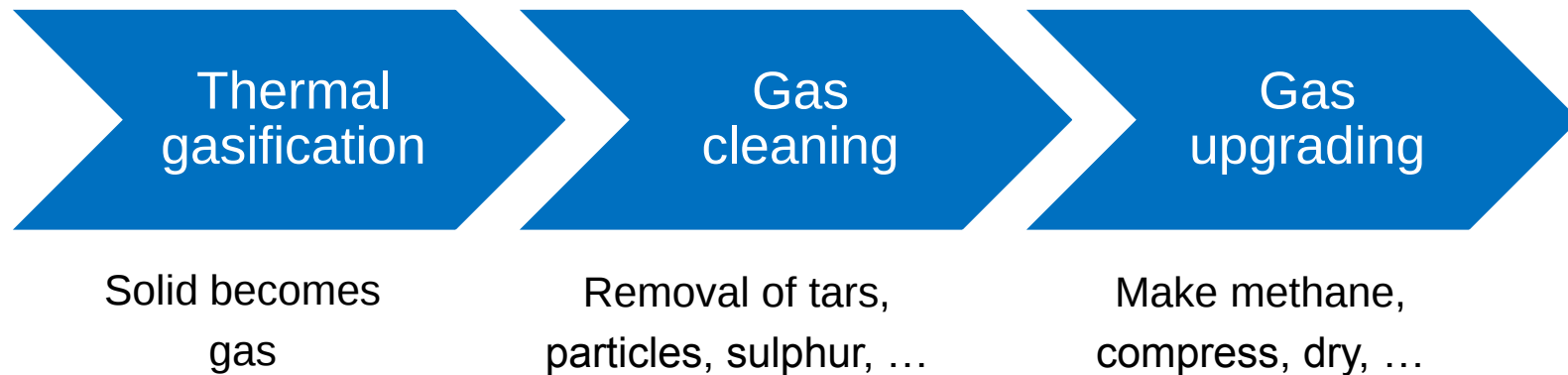
Gasification
of dry biomass





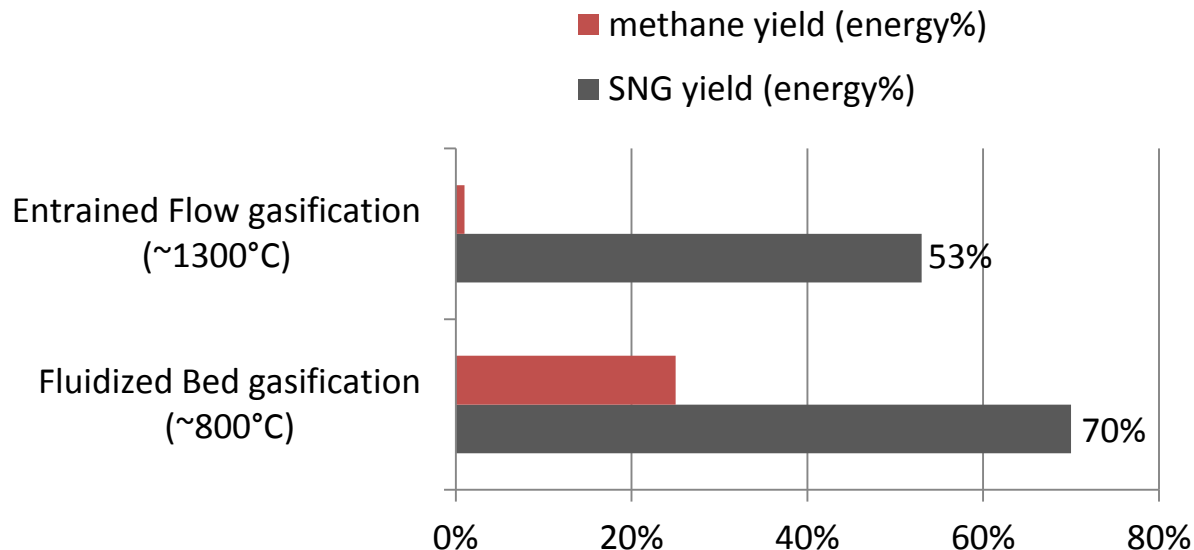
GASIFICATION for GREEN GAS

3 step process



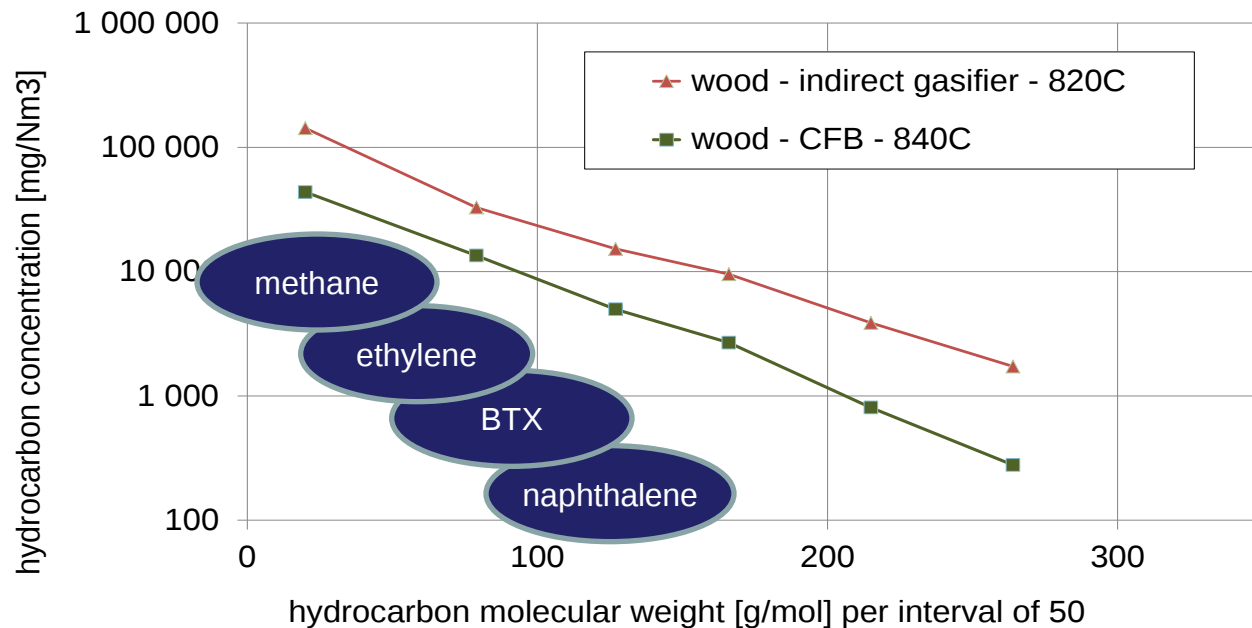
GASIFICATION: NOT TOO HOT PLEASE

instant methane is good for efficiency



Source: C. M. van der Meijden et.al., Biomass and Bioenergy 34, pp 302-311, 2010

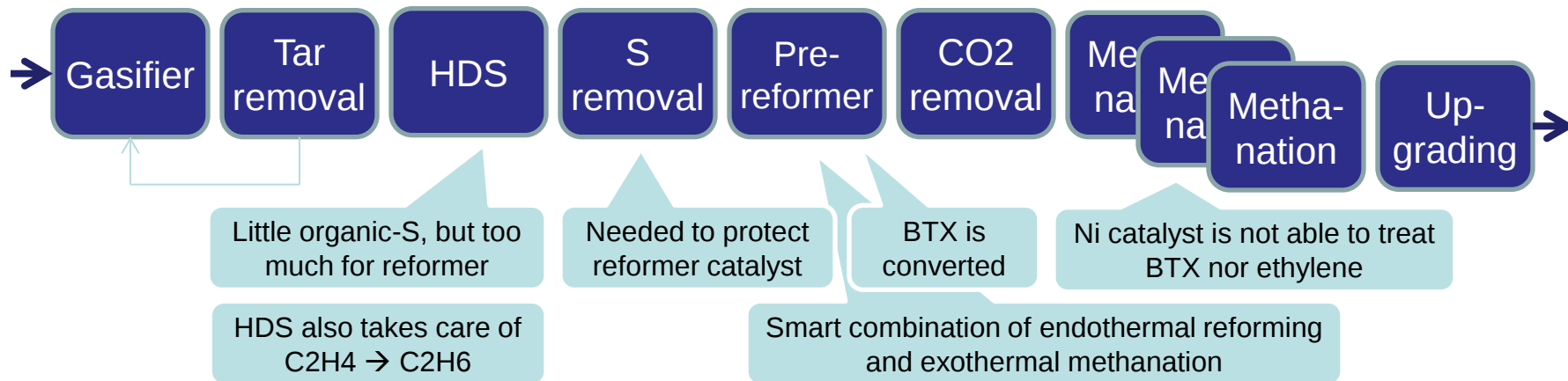
METHANE NEVER WALKS ALONE



BTX: Benzene,
Toluene, Xylenes

ECN BASE CASE

everything is converted to methane



Gasifier: Fluidized Bed Gasifier operating at $\sim 800^\circ\text{C}$

HDS: HydroDeSulphurization (converting organic S molecules into H_2S)

BTX: Benzene, Toluene, Xylene ($\sim 90\%/9\%/1\%$ in case of fluidized bed gasification at $\sim 800^\circ\text{C}$)

OPERATING FACILITY at ECN

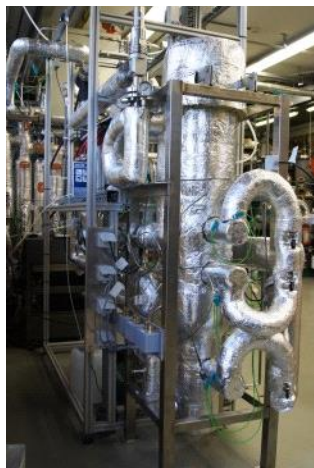
70% efficiency from biomass to Green Gas



MILENA gasifier



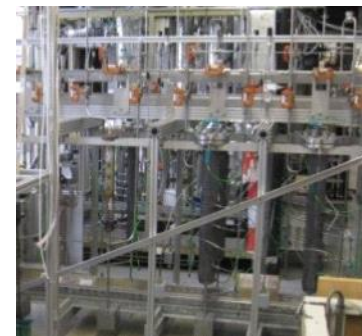
OLGA tar removal



HDS reactor



*Further gas
cleaning*



*Methanation
reactors*

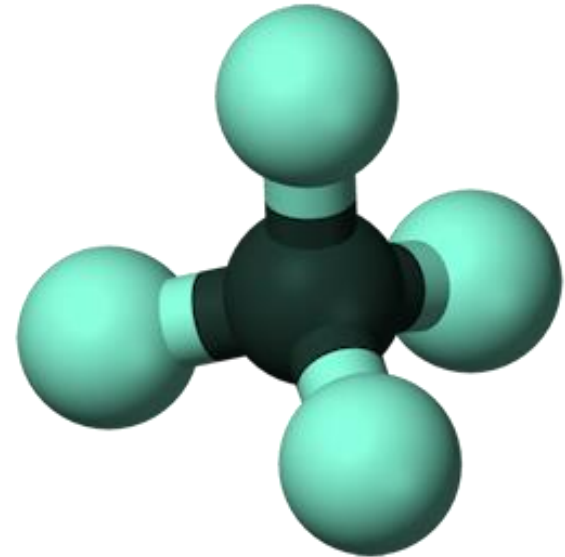
COST OF GREEN GAS

long-term perspective (say 2030)

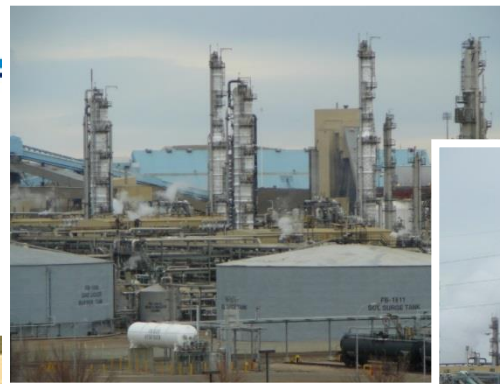
	Biomass at 2 \$/GJ	Biomass at 9 \$/GJ
Biomass	2.9 \$/GJ	12.9 \$/GJ
Capex	7.5 \$/GJ	
Opex	1.7 \$/GJ	
Other	1.2 \$/GJ	
Power	0.7 \$/GJ	
Total [\$/GJ]	14 \$/GJ	24 \$/GJ
Total [\$ct/m³ NG-eq]	45 \$ct/m³	77 \$ct/m³

HOW TO GET THE COSTS DOWN

- Scaling up
- Cheaper biomass
- And the other ones...



THE DAKOTA EXAMPLE



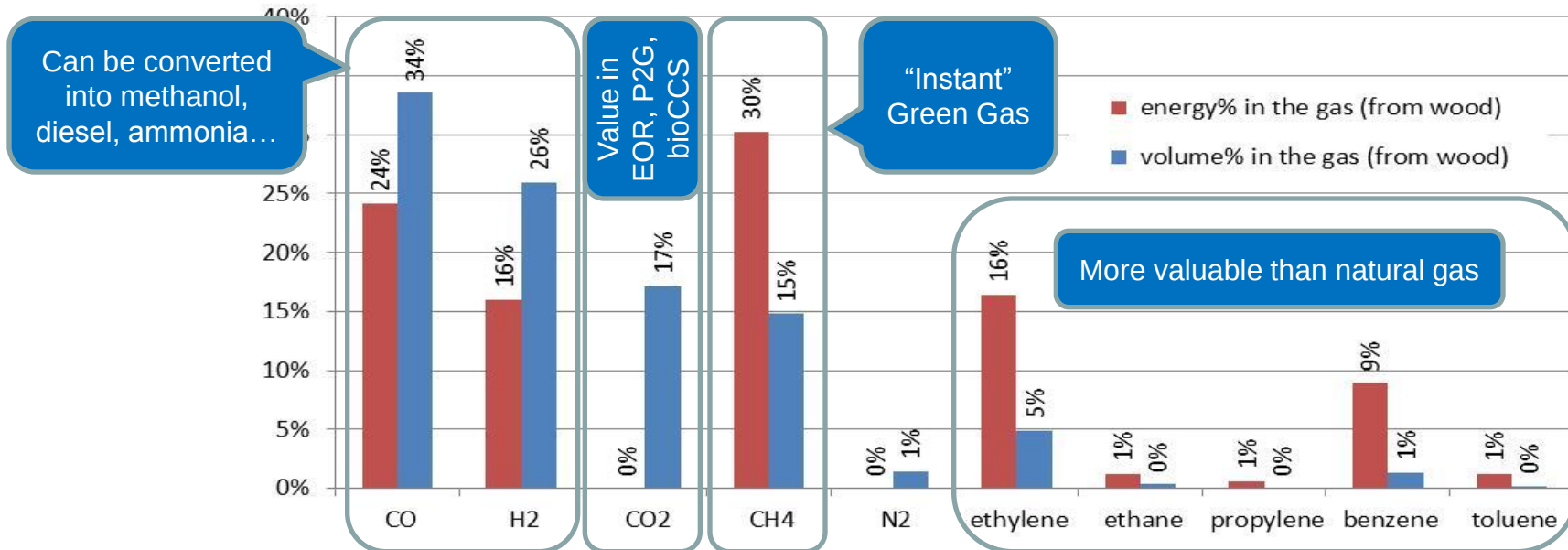
THE DAKOTA EXAMPLE

- Lignite to SNG in North Dakota
- 1.1 bcm SNG/year
- And several co-products: naphtha, phenols, oil, CO₂
- The co-products pay the process



	Energy output [%]	Revenue [%]
SNG	79%	41%
Naphtha, phenol, oil, CO ₂	21%	59%

GASIFICATION OF BIOMASS: GAS COMPOSITION



GREEN GAS COST REDUCTION

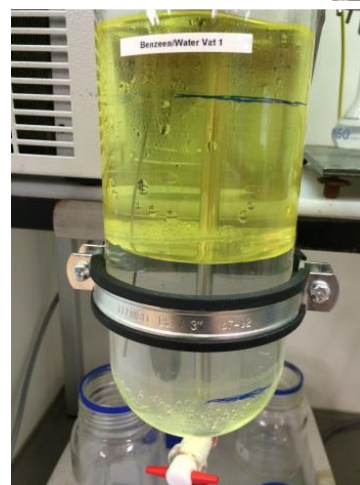
- -3 \$/GJ by bio-BTX
- -5 \$/GJ by bio-ethylene (either separated or converted into aromatics)
- -5 \$/GJ by bio-CO₂
- And more:
 - H₂/CO for bio-chemicals
 - Increasing bio-BTX yield
 - Increasing bio-ethylene yield
 - Accommodate huge amounts of H₂ to make methane
 - Solving the renewable power intermittency



BTX SEPARATION

benzene, toluene, xylenes

- First step after OLGA tar removal
- Liquid BTX product: first liter in 2014
- >95% separation
- BTX = 90/9/1
- Simplifies downstream process to Green Gas



CONCLUSION

- Green Gas by gasification of biomass can have 70% efficiency
- Estimated production costs 14-24 \$/GJ Green Gas
- Chemical co-products can reduce this with up to 13 \$/GJ, or even more...
- Co-production of bio-chemicals and bio-SNG (Green Gas) is a good prospect
- Not original though (DakotaGas, shale gas, ...)
- Bio-chemicals will boost social acceptance
- “Better is the enemy of good”
- Let us not wait and start producing Green Gas by gasification now
- Which is what we do with Gasunie and Royal Dahlman

OPPORTUNITY for GAS INDUSTRY: BIOBASED ECONOMY



Future:

Gas industry is number 10 in a bio-based economy

Now:

Gas industry is in defense position

Number 10 (playmaker): a player who controls the flow of the team's offensive play, and is often involved in passing moves which lead to goals, thanks to their vision, technique, biomass control, creativity, and passing ability

MORE INFORMATION

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SNG: www.bioSNG.com / www.bioCNG.com
BTX: www.bioBTX.com



Ministerie van Economische Zaken



Nederlands

Hier wordt geïnvesteerd in uw toekomst. Het onderzoeksprogramma EDGaR is erkentelijk voor de bijdrage van de financieringsinstellingen: Samenwerkingsverband Noord Nederland. Dit project wordt medegefinancierd door het Europees Fonds voor Regionale Ontwikkeling en door het ministerie van Economische Zaken. Cofinanciering vindt eveneens plaats door de Provincie Groningen.

English

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