

Towards the commercialization of the ESME technology for bio-SNG production – The AMBIGO project

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MILENA + OLGA + ESME
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Natural gas in The Netherlands

- Groningen gas field (since 1963).
- Existing infrastructure: > 12000 km gas transmission network.
- 93% of buildings connected to gas grid.
- “Gas roundabout of North-West Europe”.



Natural gas concessions of the NAM in The Netherlands

<https://commons.wikimedia.org/w/index.php?curid=4254271>

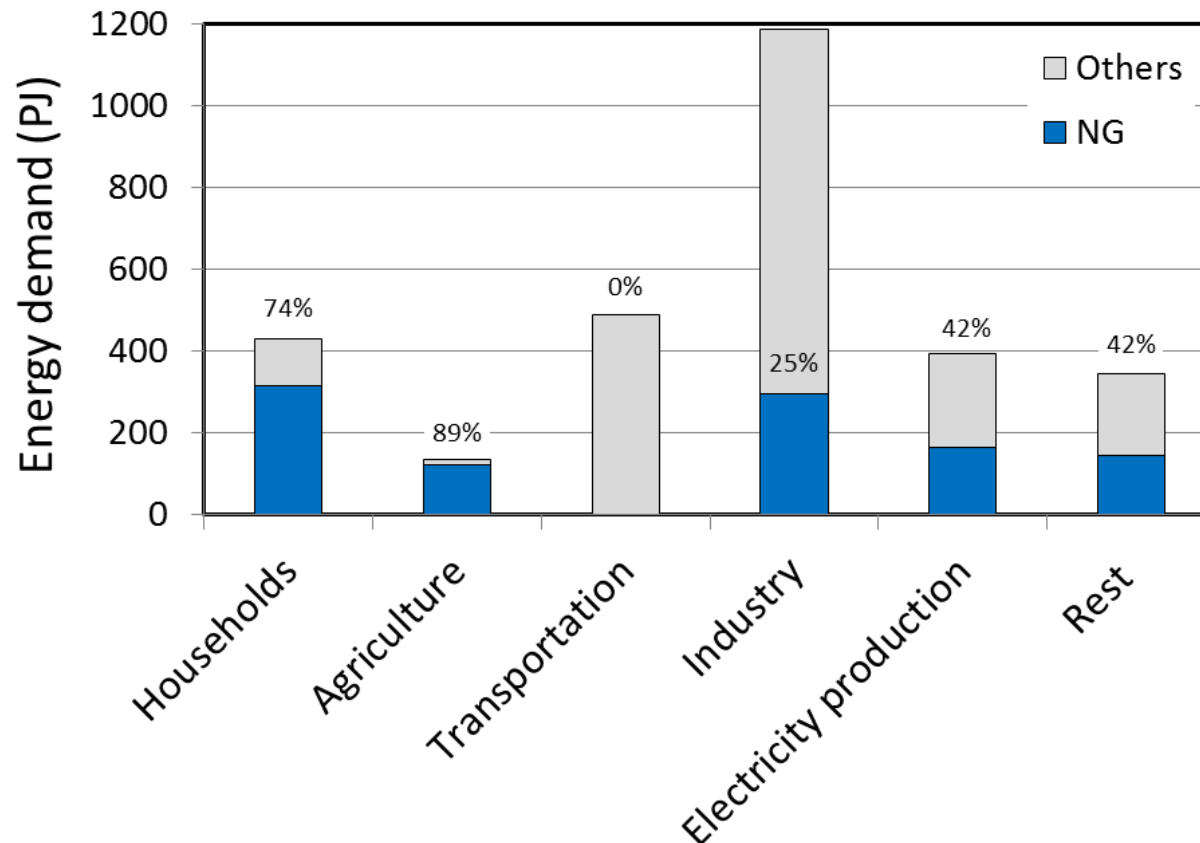
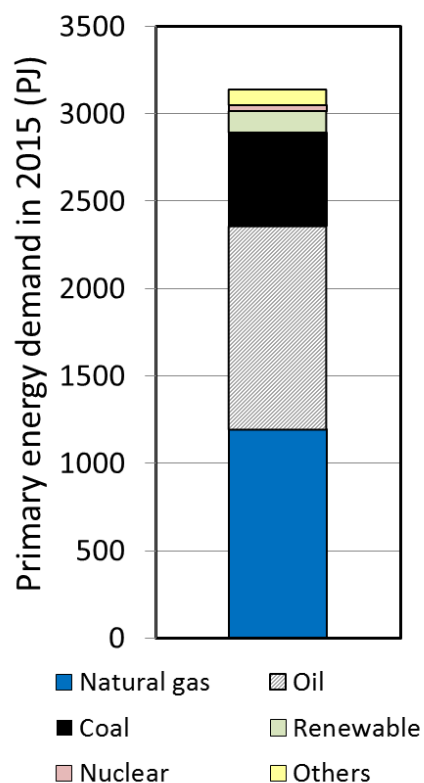


Gasunie's Dutch Natural Gas transport network

<http://www.devieskartografie.nl/thematische-kaarten/gasleiding-netwerkaart-nederland>

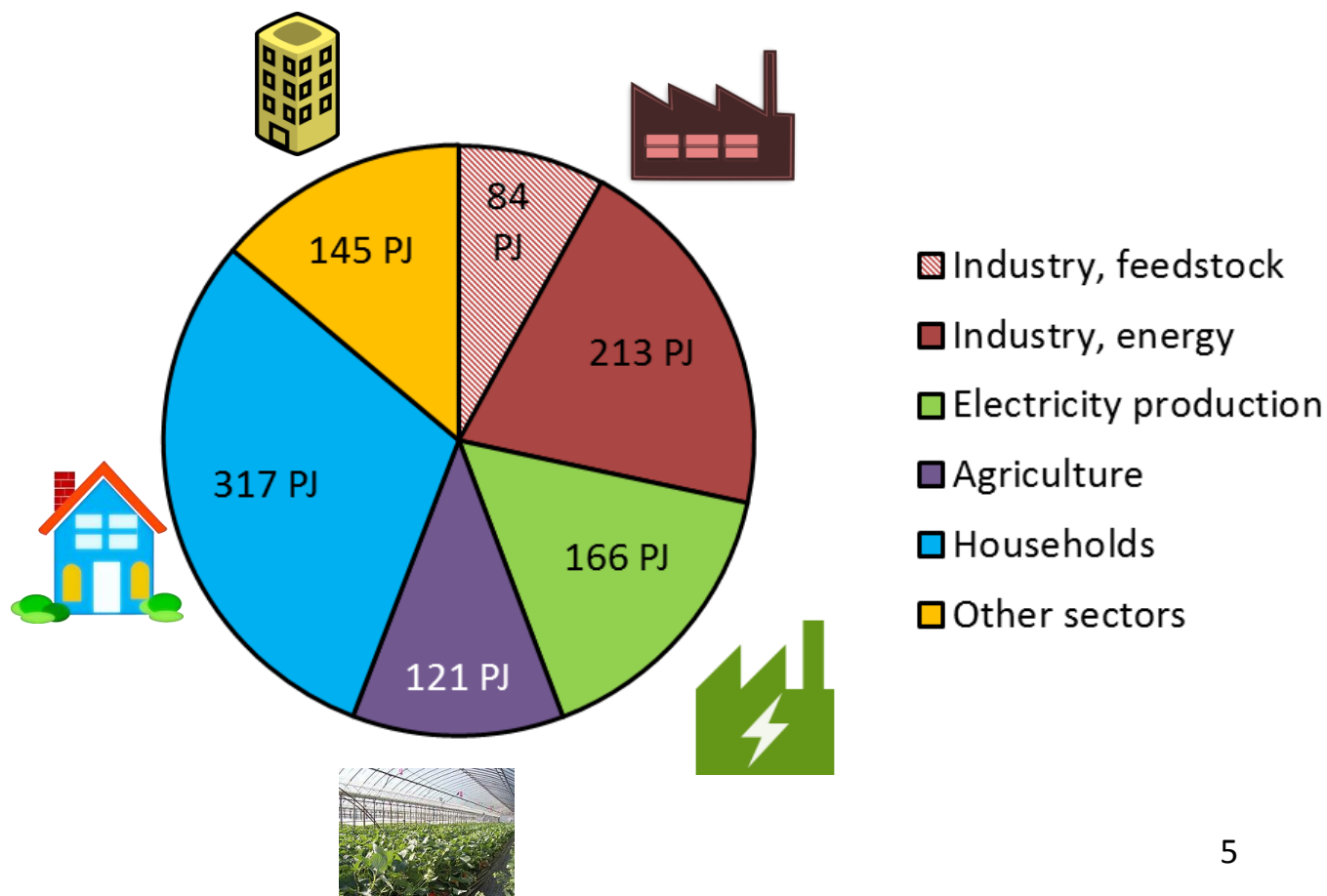
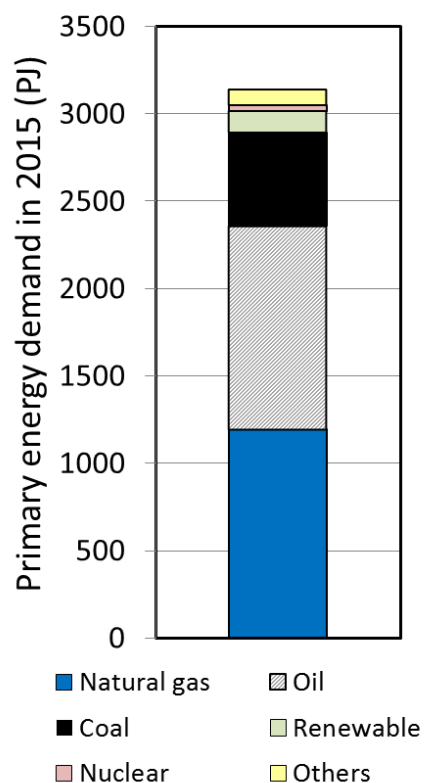
Natural gas in The Netherlands

Natural gas distribution per sector



Natural gas in The Netherlands

Natural gas distribution per sector



But there are challenges...

- Depleting reserves (800 bcm out of the initial 2800 bcm).
- Increasing gas imports.
- Gas drilling-derived earthquakes → production cap (21.6 bcm/y from October 2017).



<http://www.theenergycollective.com/energy-post/2395247/groningen-gas-production-and-earthquakes-safety-at-all-cost>



<http://aardgas-in-nederland.nl/de-toekomst-van-aardgas/aardgasreserves-en-verbruik/>



<http://www.dutchnews.nl/features/2016/06/91027/>

To make it even more challenging...

Paris agreement: need for substantial reduction of CO₂ emissions in 2050 (80-95% compared to 1990).



[http://www.un.org/apps/news/
story.asp?NewsID=53749#.WRX](http://www.un.org/apps/news/story.asp?NewsID=53749#.WRX)
YEmc0Pml

NL still far from 2020 objectives:
≥14% total energy from
renewables in 2020 (target) vs.
~6% in 2015 (actual).

Green gas – part of the solution

Need for alternative NG sources → GREEN GAS

- Replacement of NG in sectors difficult to be replaced with electricity (e.g. high-T industrial heat, chemicals feedstock, built environment, transport).
- Storage possible → balancing of the electricity grid.
- Use of existing gas infrastructure.
- Gasification: possibility of large-scale green gas production (+ other fuels and chemicals).

**Important role of green gas in a CO₂-free energy system
→ faster, less costly energy transition**

- Signed in 2011 by the Dutch Ministry of Economic Affairs and 25 partners of the Green Gas Forum.
- Development of green gas market in the mid-term: biogas (digestion), bio-SNG (gasification), P2G.
- Ambition: 3 bcm NG equivalent in 2030.
- Biogas can potentially supply $\frac{3}{4}$ of the 2030 target → need for supplementary large-scale technologies.
- Biomass gasification → expected significant contribution (10-20%) to gas supply in 2030.



The commitment is there!



Joint Declaration

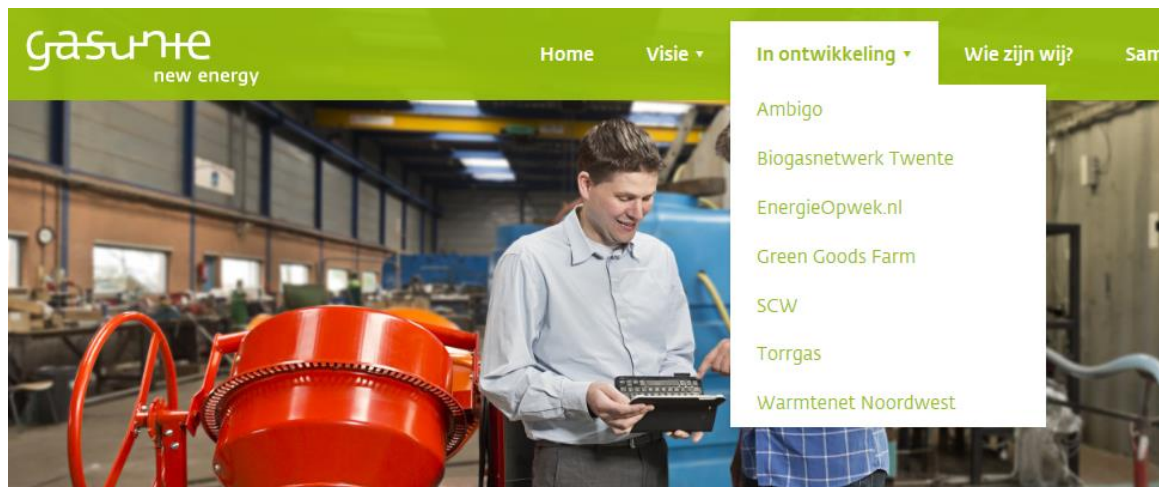
Dublin, 23 April 2015

Green Gas Initiative of European gas transmission operators
Energinet.dk, Fluxys Belgium, Gasunie, GRTgaz, Swedegas, Gaznat and ONTRAS

“We aim to establish a 100% CO₂-neutral gas supply by 2050”

- Facilitate the growth of green gas, including certification.
- Promote cross-border cooperation.
- **Stimulate innovation for large-scale production (biomass gasification).**
- Development of P2G.
- Unlock the potential of LNG for small/mid-sized ships and heavy duty trucks.

The commitment is there!



<https://www.gasunienergy.nl/in-ontwikkeling>

- Biogas network in Twente: central upgrading of biogas to green gas.
- Green Goods Farm: valorization of grass to chemicals and biogas.
- SCW: supercritical gasification.
- Torrgas: torrefaction + high-T gasification.
- **AMBIGO: bio-SNG from biomass gasification.**

The ECN approach for bio-SNG: MILENA/OLGA/ESME



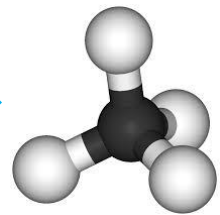
Gasification
MILENA



Gas cleaning
OLGA

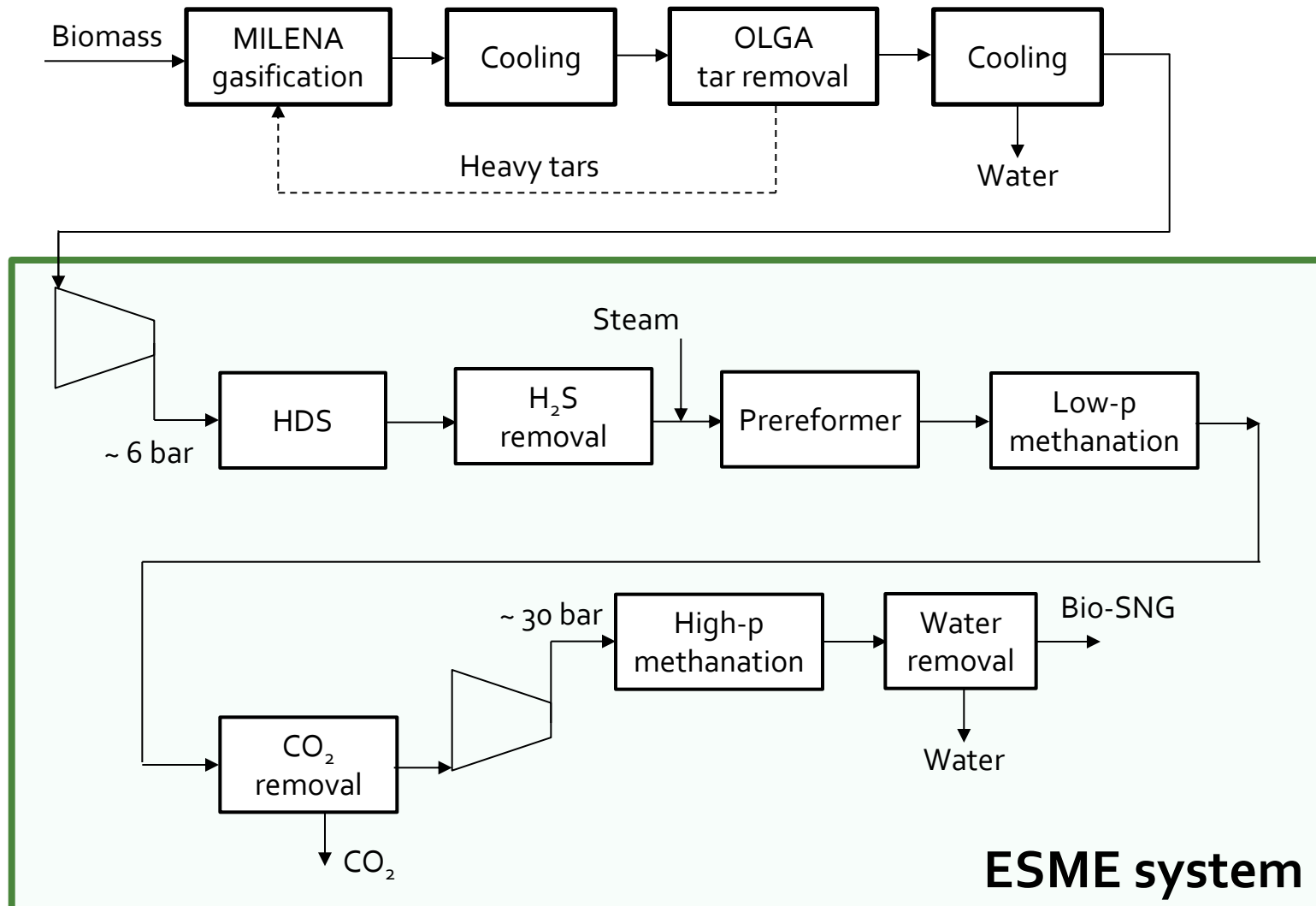


Methanation
ESME

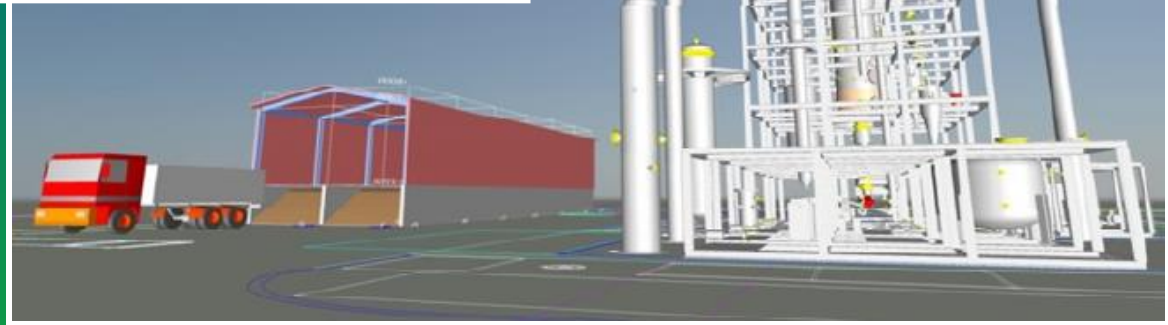


MILENA/OLGA + ESME: optimal use of biomass properties
→ high overall efficiency (6% higher than other SNG processes)

The ECN approach for bio-SNG: MILENA/OLGA/ESME



The AMBIGO project



The AMBIGO project

- 4 MWth bio-SNG demo plant in Alkmaar, NL.
- Objective: demonstration of efficient bio-SNG production from biomass gasification.
- MILENA, OLGA and ESME technologies combined for the first time at semi-industrial scale.
- Project consortium formed by public and private entities.



<https://www.ambigo.nl/assets/files/factsheet-ambigo-new.pdf>



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The AMBIGO project

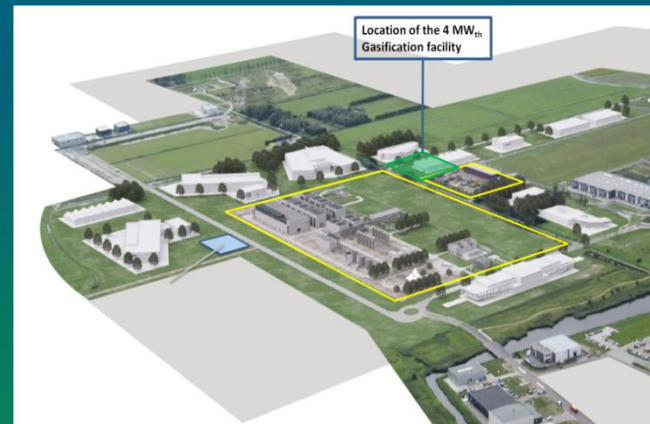
Alkmaar



Barnsteenstraat 8

The AMBIGO project

The pathway of technology deployment



Q3 2017:
FID

2017-2018:
Construction

2019-2023:
Demonstration

2020-2040:
Commercialization

The AMBIGO project

Project status

- 6.5 M € grant awarded by the government.
- 2016: environmental permits granted.
- Basic engineering stage completed.
- Final investment decision expected by Q3 2017.
- Start of operation planned in 2019.



2017 Q3:
FID

2017-2018:
Construction

2018-2023:
Demonstration

2020-2040:
Commercialization

The AMBIGO consortium



**Participatiefonds
Duurzame Economie
Noord-Holland**

PDENH: investment fund for companies and projects contributing to sustainable economy in the North Holland province.



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The AMBIGO consortium



- Ambition: replacement of 5-10 bcm fossil NG with renewable gas (H₂ and bio-SNG) in 2050.
- Independent role on infrastructure.



- Ambition: shifting towards 2nd-gen bio-SNG.



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The AMBIGO consortium



- Largest energy research institute in NL.
- Development of MILENA, OLGA and ESME technologies.



- DRT: development and commercialization of MILENA and OLGA technologies.



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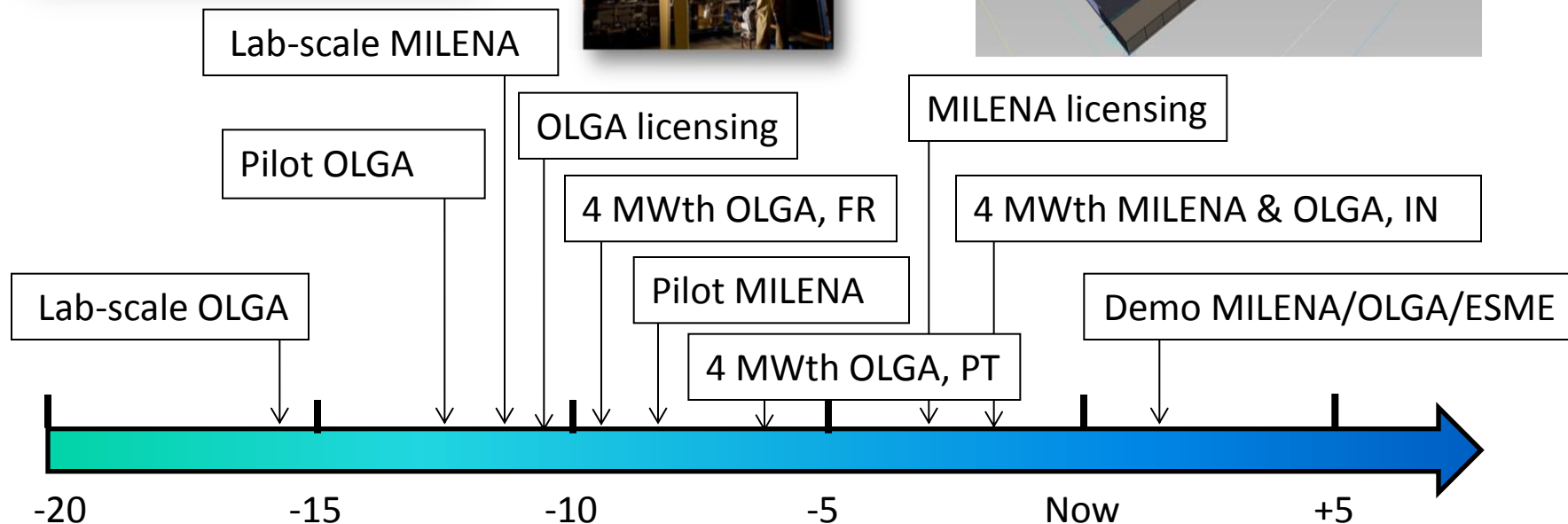
InVesta and AMBIGO

- Institute for Valorization and Expertise in Thermochemistry Alkmaar.
- Support organizations and companies in practical R&D and scale-up of biomass/waste gasification and production of biofuels and chemicals.
- Cost-effective innovation and demonstration by shared research and facilities.



- Co-financed by the Dutch Ministry of Economic Affairs and the North Holland province.
- Start operation expected in September 2017.

Upscaling of the technology



Towards the commercialization of bio-SNG technologies

Reduction of cost of bio-SNG production:

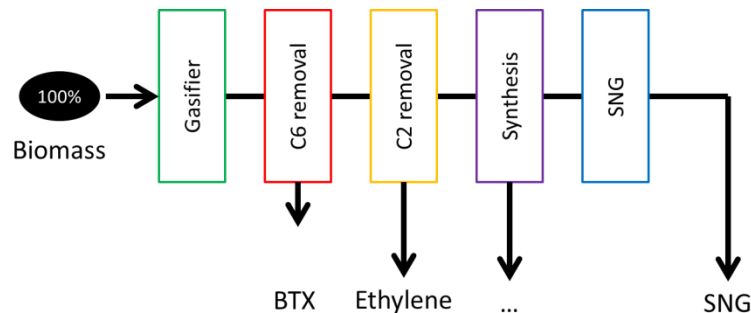
- Use of low-value biomass.
- Application of **co-production schemes** → maximize chain value.

Waste-to-energy plant in Thailand based on MILENA/OLGA supplied by DRT.

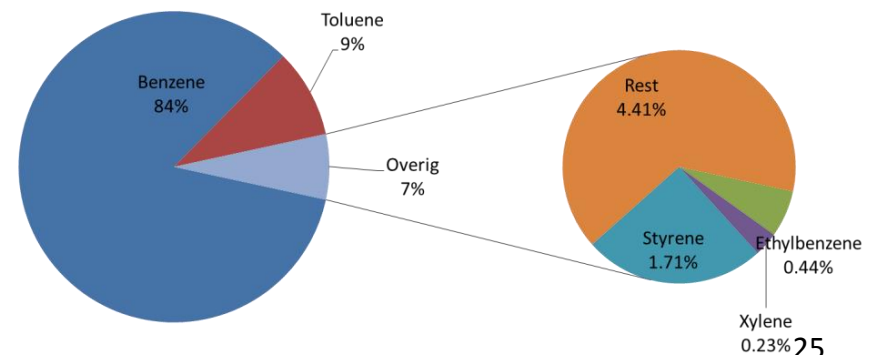


Co-production: bio-BTX recovery

- Ethylene, BTX: can be converted to methane by ESME, but high economic value as separate product.



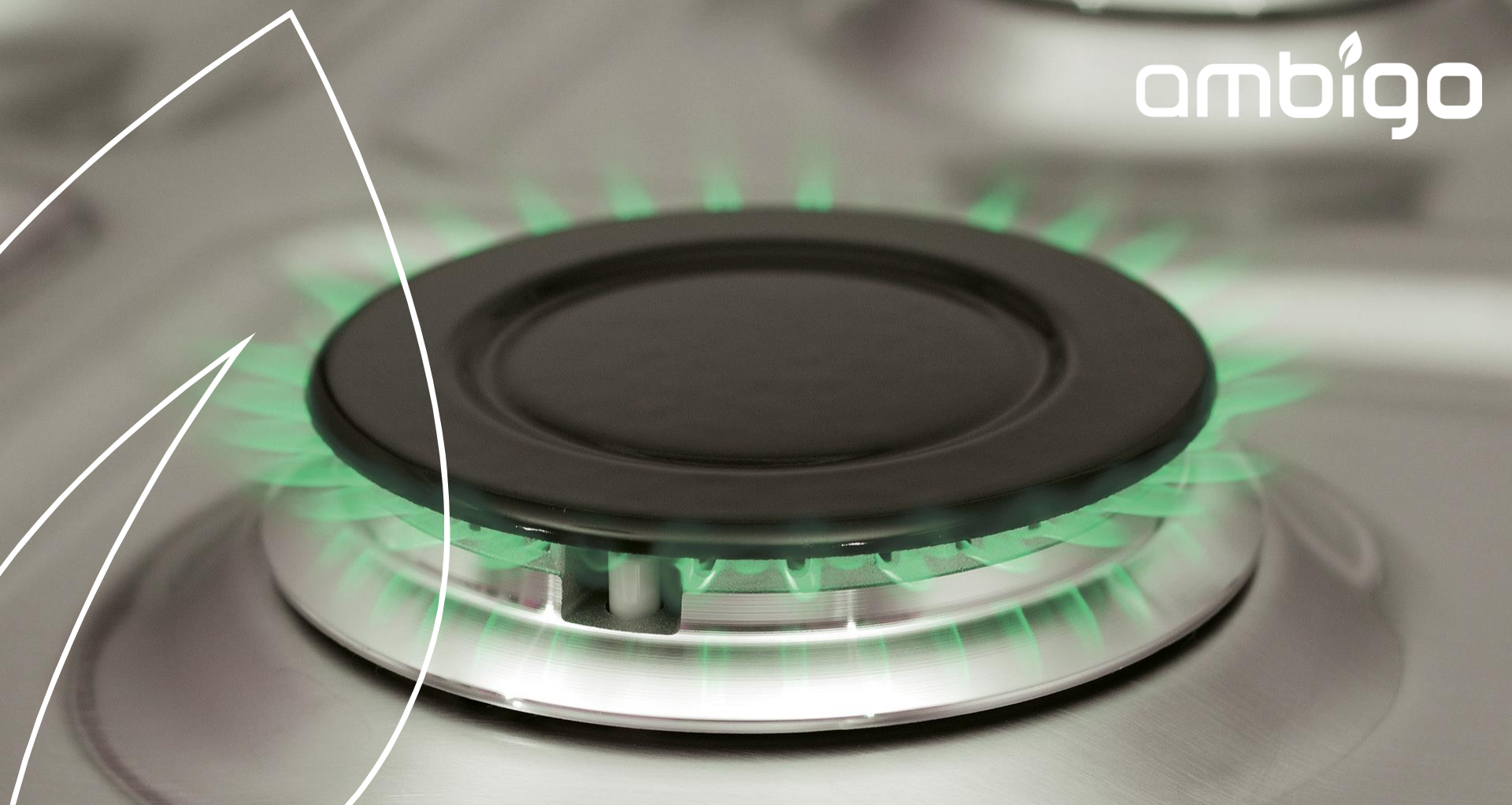
- Recovery of valuable compounds from producer gas in co-production schemes.
- Bio-BTX scrubbing. Efficiency > 95%.



Composition of bio-BTX from beech wood (wt.%)

Key messages

- Important role of green gas in the Dutch future energy system → key stakeholders are committed.
- Considerable progress in SNG from biomass gasification, but still need for demonstration of innovative technologies at industrial scale.
- MILENA + OLGA + ESME = improved overall SNG efficiency.
- AMBIGO: milestone in commercialization of bio-SNG in NL. FID expected in Q3 2017.
- Opportunities for reduction of production cost: waste fuel and co-production schemes.



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Thanks for your attention!

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Acknowledgment



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Ministerie van Economische Zaken

