

# Country report The Netherlands

## Gasification of biomass and waste

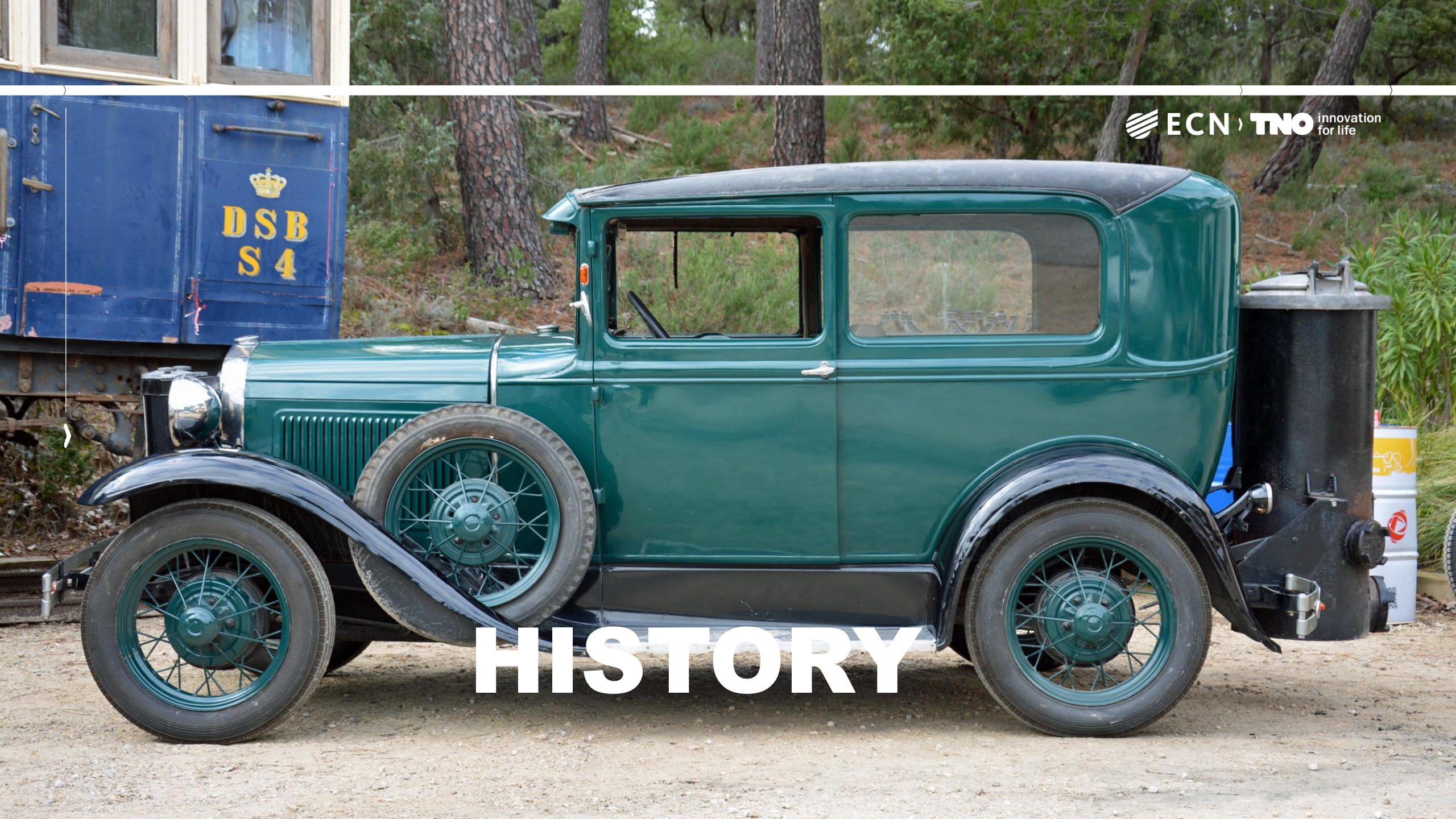


**Berend Vreugdenhil (ECN.TNO)**

## OUTLINE

- › History
- › Commercial installations
- › Demonstrations
- › Experimental setup
- › Developments
- › Netherlands based suppliers
- › Observations

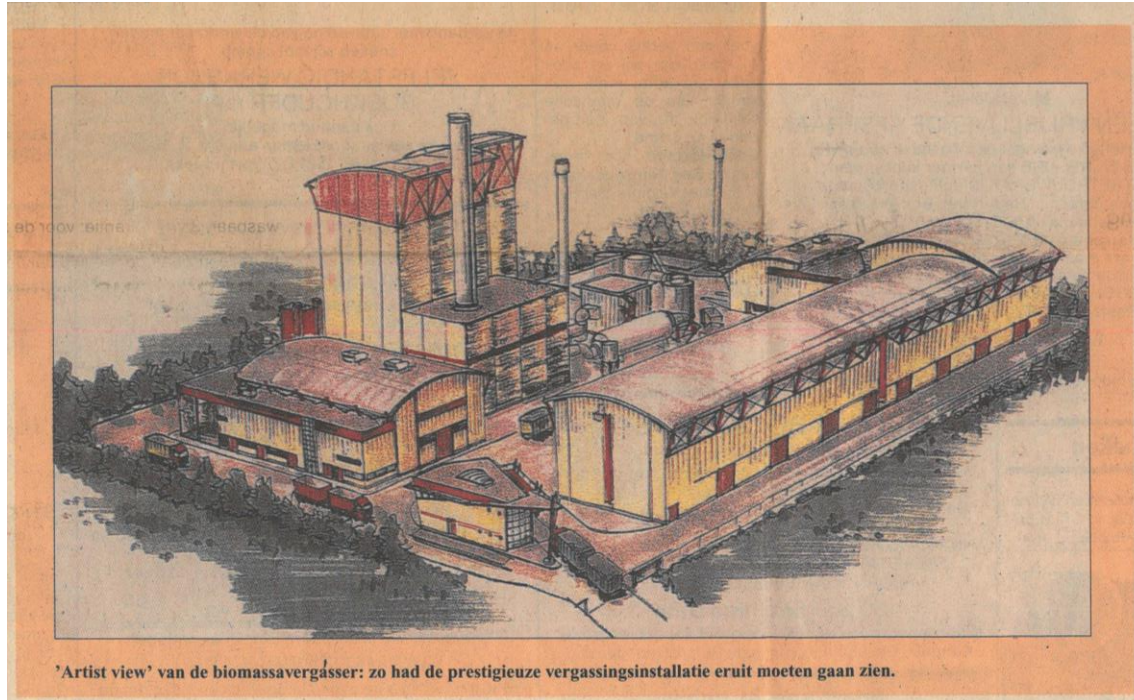




# HISTORY



# NOORD-HOLLAND PROJECT



Biomass gasifier for power production

- Feedstock locally sourced biomass residues
- Annual production of 250.000 MWh
- Est. construction costs 215 Mfl. In 1998 (roughly 100 M€)

Two reasons for not being build

- Feedstock was assumed to be delivered at the gate for no fee
- Power prices were assumed to be 20 fl. cents per kWh

## WOODSPIRIT

- › Gasification based biomethanol production
- › Total investments est. 500M€, with 200 M€ from the NER300 fund.
- › Torrefaction as pretreatment
- › EF gasification for production of synthesis gas
  
- › It was considered a demonstration (FOAK) and therefore the investment was too large.
- › NER300 funds only became available after successful operation of the plant



BioMCN started the Woodspirit project and is a large producer of bio-methanol to date.

## BUGGENUM

- › IGCC from Nuon/Vattenfall
- › Coal gasifier producing 253 MW<sub>e</sub> (43% net eff.)
- › Shell gasifier operated at 28 bar (started 1993)
- › Since 2006 operated with 10% (energy) wood
- › Co-firing rate tested up to 70% (energy)
- › Closed in 2013
  
- › Low energy prices
- › High operating costs



Photo Dijkstra, taken from NRC



# COMMERCIAL PLANTS



## RWE AMER POWER STATION

- › Gasifier connected to a 600 MW<sub>e</sub> coal fired power station
- › 85 MW<sub>th</sub> CFB gasifier based on Lurgi technology
- › Operation was possible due to subsidy
  
- › Currently the gasifier is off-line
- › RWE is upgrading the site to 100% sustainable



The Amer-9 coal-fired power station with the waste wood



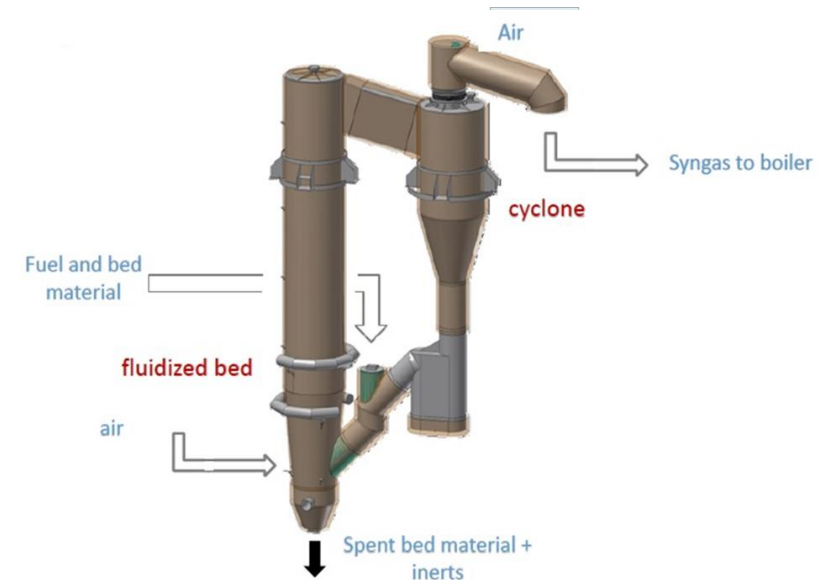
## ESKA PAPER REJECT GASIFICATION

- CFB technology supplied by Leroux & Lotz (TPS technology)
- 10 - 13 MWth input CFB gasifier, depending on LHV rejects
- Boiler produces 5 – 16 ton/h steam (196°C, 13,6 bar)
- Fully automatic operation
- Build in 2016, in operation since Oct-2016
- 5900 hrs uptime in 2017 (4500 h on reject)

Some 2018 facts

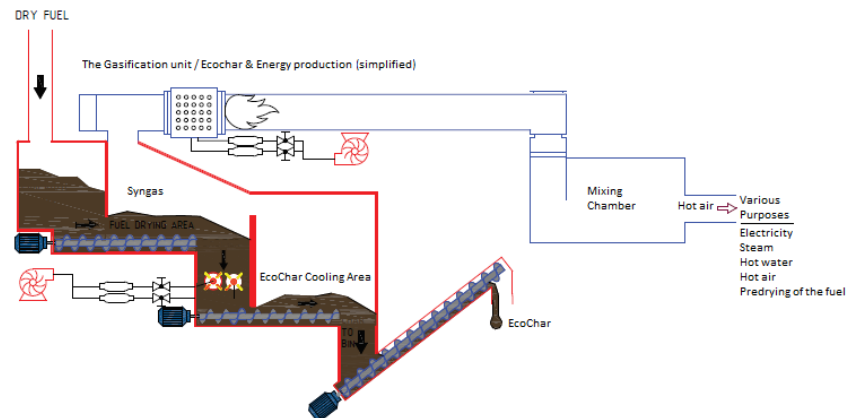
6400 hrs uptime (5300 on rejects)

132 TJ steam produced, saving 2600 ton CO<sub>2</sub>



# MAVITEC GREEN ENERGY

- › Down draft fixed bed gasifier is the heart of the process.
- › Products are a combustible gas and EcoChar
- › Modular system



Turkey manure gasifier



Poultry gasifier



Digestate (cow manure) gasifier

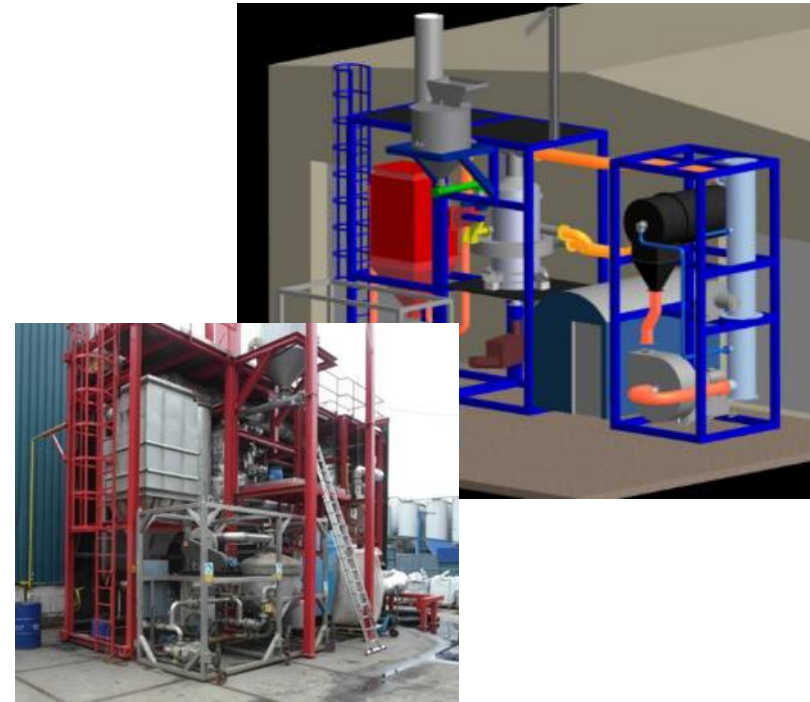
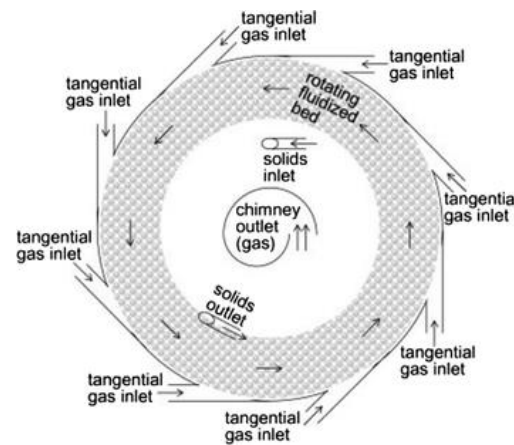


Swine manure gasifier



# SYNVALOR (START UP PHASE)

- › Multi Stage Vortex gasifier
- › Goal is to produce low tar gas from difficult feedstocks
- › Currently starting up a CHP unit at a Gerbera grower in Mijdrecht



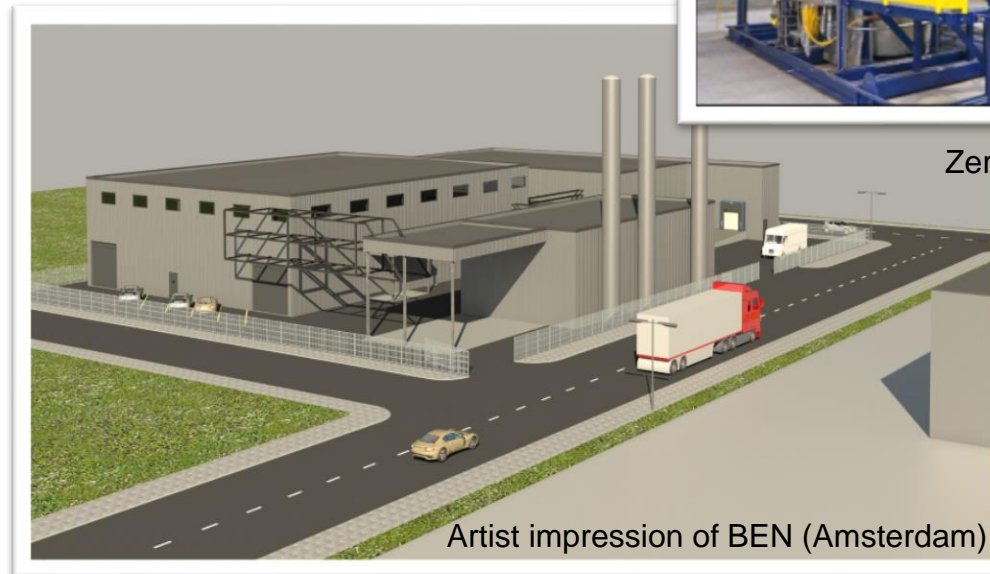
de Wilde J, de Broqueville A (2007) Rotating fluidized beds in static geometry: experimental proof of concept. AIChE J 53:793–810

## BIO ENERGY NETHERLANDS (START UP PHASE)

- › Based on Zero Point Clean Tech
- › Fixed bed down draft technology
- › 8 MW heat production
- › 2 MW power production
- › Started construction Nov-2017
  
- › Future plans include
  - › Hydrogen production
  - › Carbon utilization as biochar
  - › CO<sub>2</sub> utilization



ZeroPoint (Ireland)



Artist impression of BEN (Amsterdam)



# DEMONSTRATIONS AND EXPERIMENTAL SETUPS AND DEVELOPMENTS

## GASUNIE SUPPORTED INITIATIVES

### AMBIGO Green Gas

- 4 MW<sub>th</sub> indirect gasification
- Demolition wood
- T ~ 850°C
- P ~ 1 bar



### SCW Green Gas

- 2 MW<sub>th</sub> super critical
- Wet biomass
- T > 375°C
- P > 221 bar



### Torrgas Green Gas

- 0,7 MW<sub>th</sub> direct gasification
- Torrefied biomass
- T > 1050°C
- P ~ 1 bar





# TECHNICAL UNIVERSITY DELFT

## Research Topics at TUD

- Gasification combined to an SOFC
- Gasification in a vortex reactor
- Supercritical water gasification of wet biomass
- Fluidized gasification of torrefied biomass

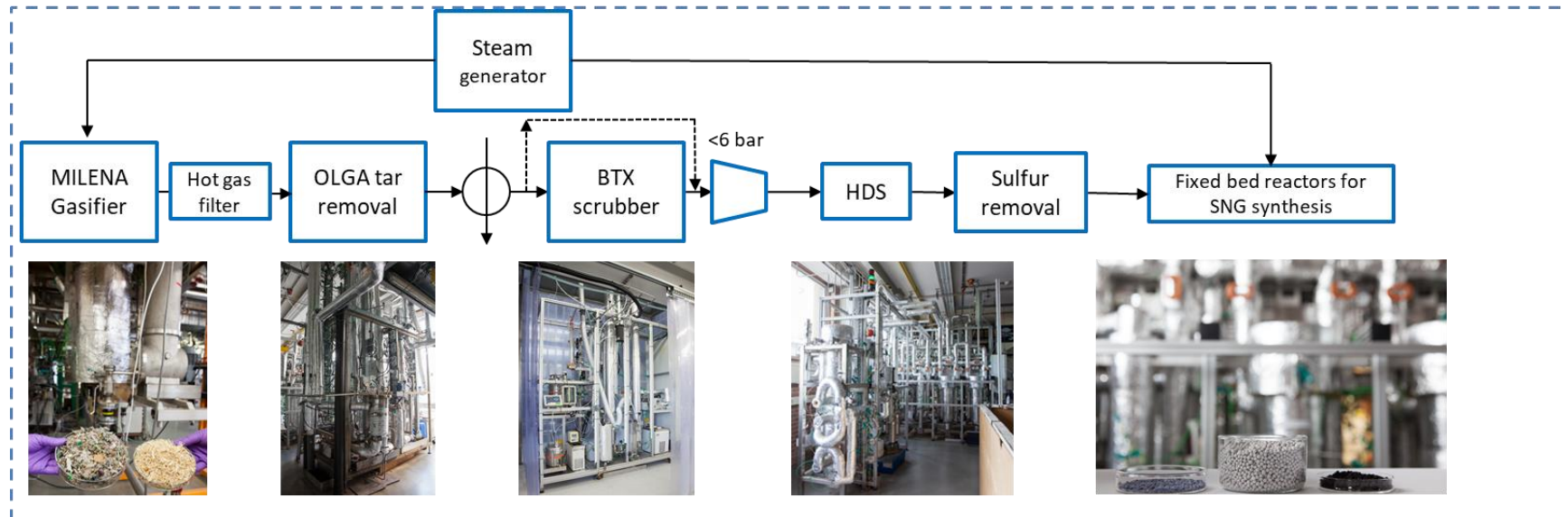


25 kWth BFB gasifier

<https://www.tudelft.nl/en/3me/>

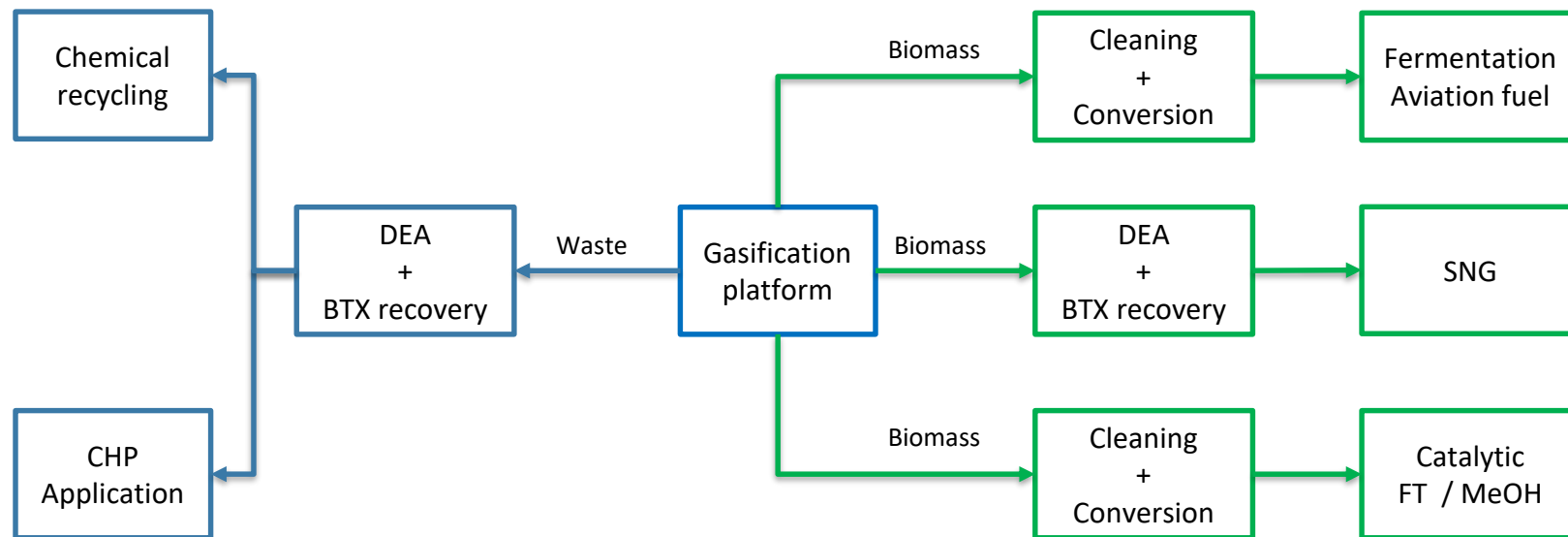
# ECN PART OF TNO

*Current lab installation*

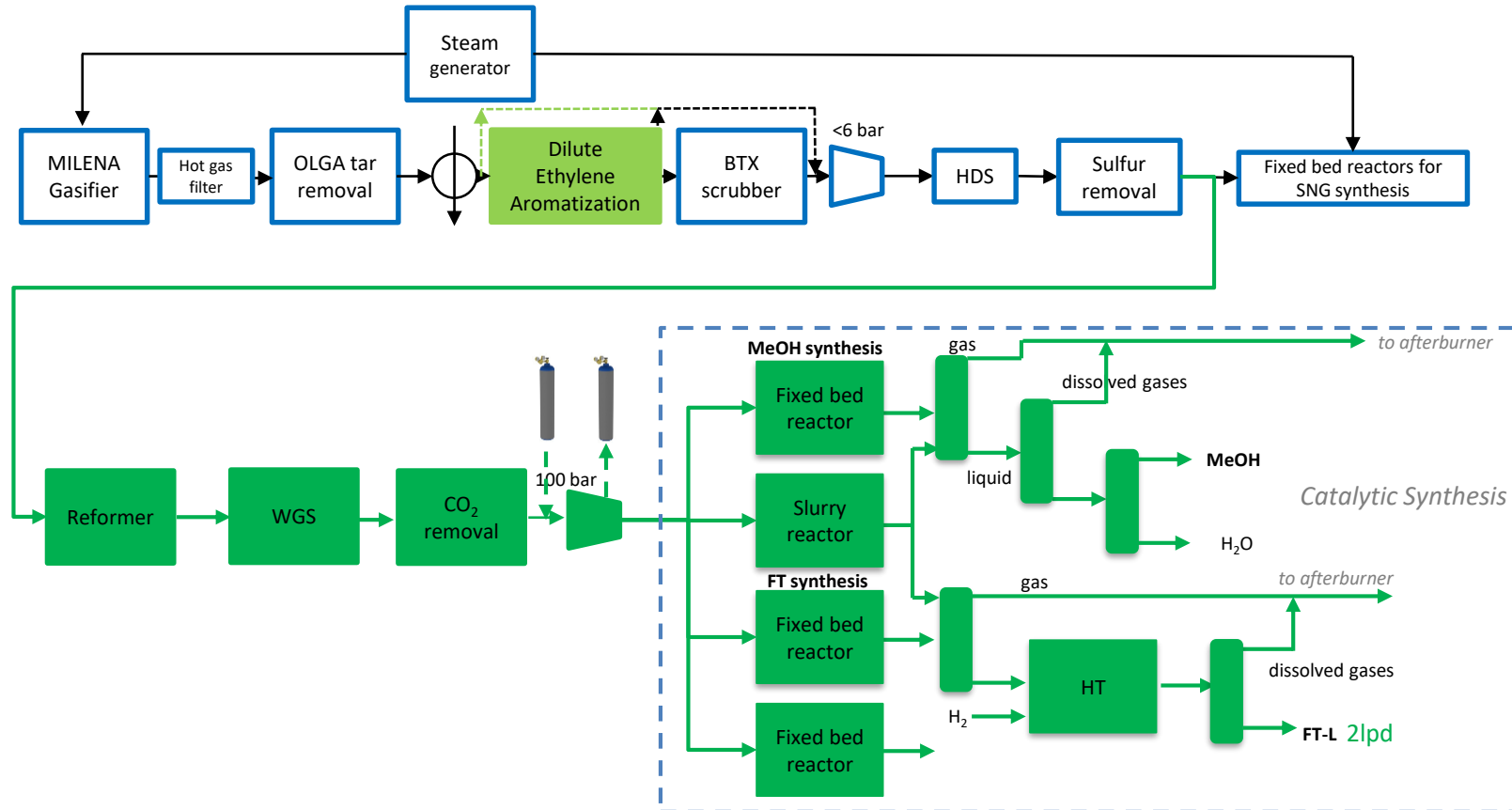




## R&D TOPICS AT ECN.TNO



# BIOFUELS LABORATORY AT ECN>TNO



## DEVELOPMENT WASTE TO METHANOL

### Waste to Methanol project Rotterdam

- Based on Enerkem technology
- O<sub>2</sub> blown BFB gasifier
- 360 kton/a waste → 220 kton/a MeOH

### Partners

- Port of Rotterdam
- Enerkem
- Nouryon
- Air Liquide
- Shell



Photo: Enerkem plant in Canada

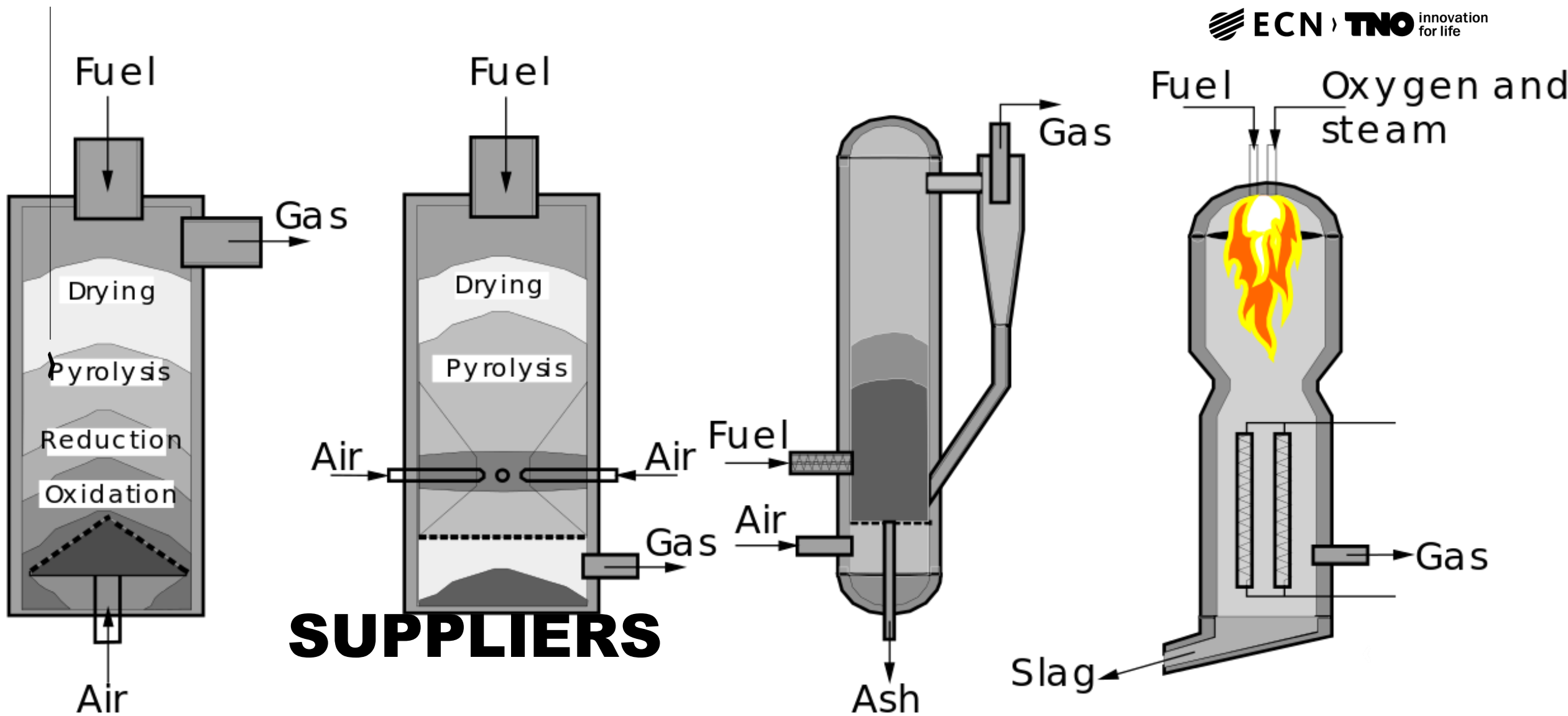


# UP DRAFT

# DOWNDRAFT

# FLUIDIZED BED

# ENTRAINED BED



## DUTCH GASIFICATION TECHNOLOGY SUPPLIERS

1. Mavitec → Down Draft Fixed Bed gasification as a solution to “manure waste stream”, focussing on heat and power production.
2. Synvalor → Vortex reactor concept as a CHP solution
3. HoSt → CFB gasification technology for low grade feedstock aiming on CHP application

## HOST

- › Turn key supplier of CHP technology
- › Examples in Tzum (NL) and Santiago de Besteiros (P)
- › Skid building for ease of transport
- › Circulating Fluidized Bed technology developed with ECN
- › Wood / Chicken manure





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4. Torrgas → Fast pyrolysis + high temperature gasification of torrefied biomass, syngas applications

# TORRGAS

- › Modular setup of syngas production
- › Operated on torrefied biomass to simplify feeding
- › First step is fast pyrolysis
- › Second step is gasification using oxygen
- › Products are syngas and biochar
  
- › Syngas gas be used for methane, methanol and other chemicals

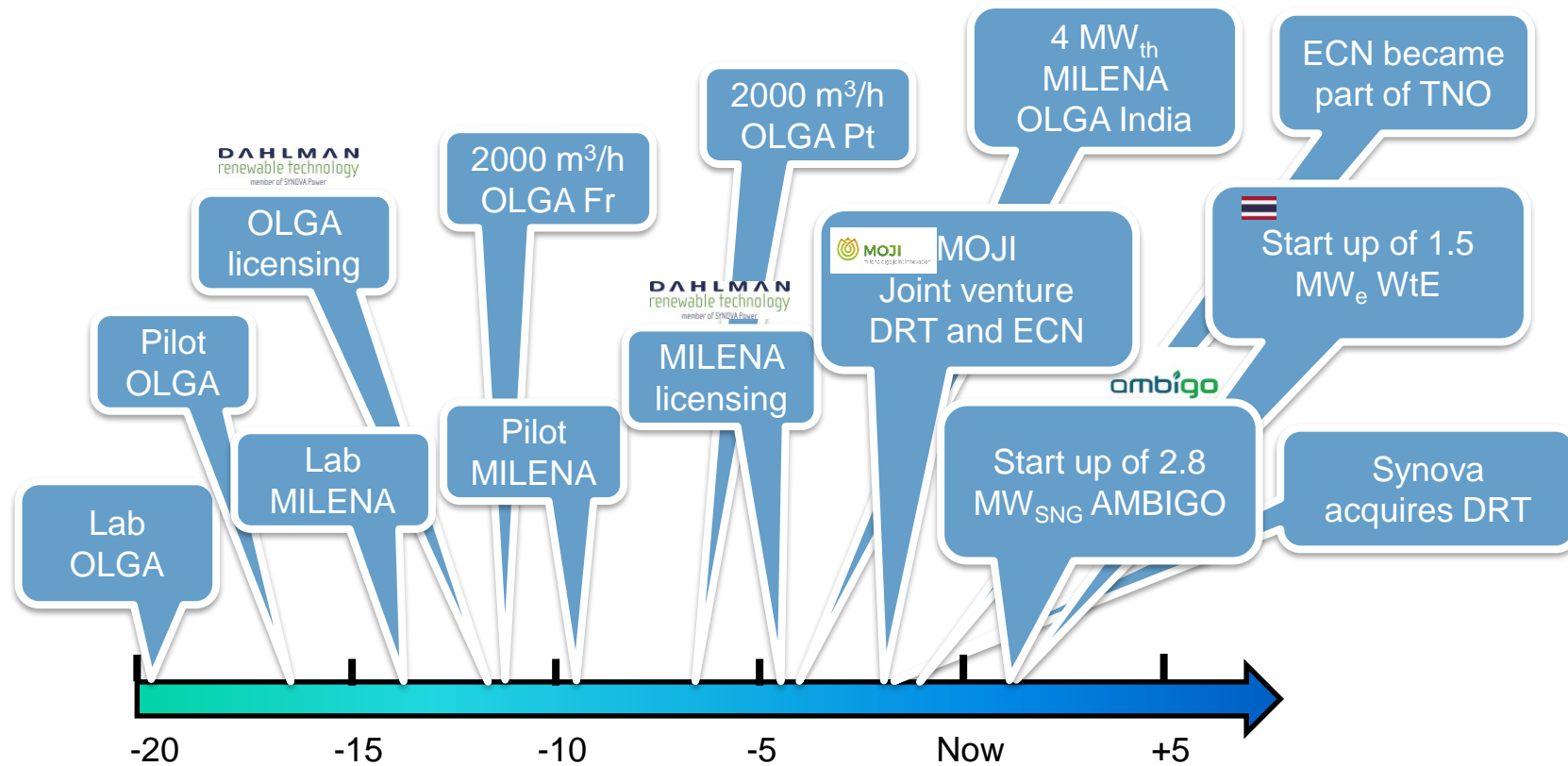


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5. Synova → Indirect gasification + tar removal, diverse applications CHP, SNG, chemicals



# SYNOVA



## SYNOVA

- › Turn key supplier of Waste to Energy systems.
- › Two standard design packages, based on MILENA OLGA technology (ECN developments)
  - M6 is a unit producing 1,5 MW<sub>e</sub> using an engine
  - M30 is a unit producing 8 MW<sub>e</sub> using a turbine (Caterpillar)
- › M6 is part of the AMBIGO plant to produce SNG in Alkmaar (2.8 MW<sub>SNG</sub>)
- › M6 is part of a project to produce electricity from waste in Thailand (1.5 MW<sub>e</sub>)
- › Synova also supplies technology for chemicals, SNG or biofuel production.

# THAILAND PROJECT





*Dank voor het luisteren*  
*Thank you for listening*

IEA Bioenergy



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