

# › MILENA GASIFICATION AS PLATFORM TOWARDS HEAT & POWER AND SUSTAINABLE FUELS & CHEMICALS

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# OUTLINE


- › ECN as part of the larger TNO organisation
- › MILENA OLGA platform technology
- › Green Gas and impurities
- › Heat and Power and impurities
- › New approaches towards impurities
- › Future role of gasification
- › Observations

# TNO OVERVIEW

WE WORK FOR MORE THAN  
**2400**  
companies



MORE THAN  
**2000.**  
fte research




**47**  
professors



**12**  
lecturers


MORE THAN  
**4500**  
projects per year



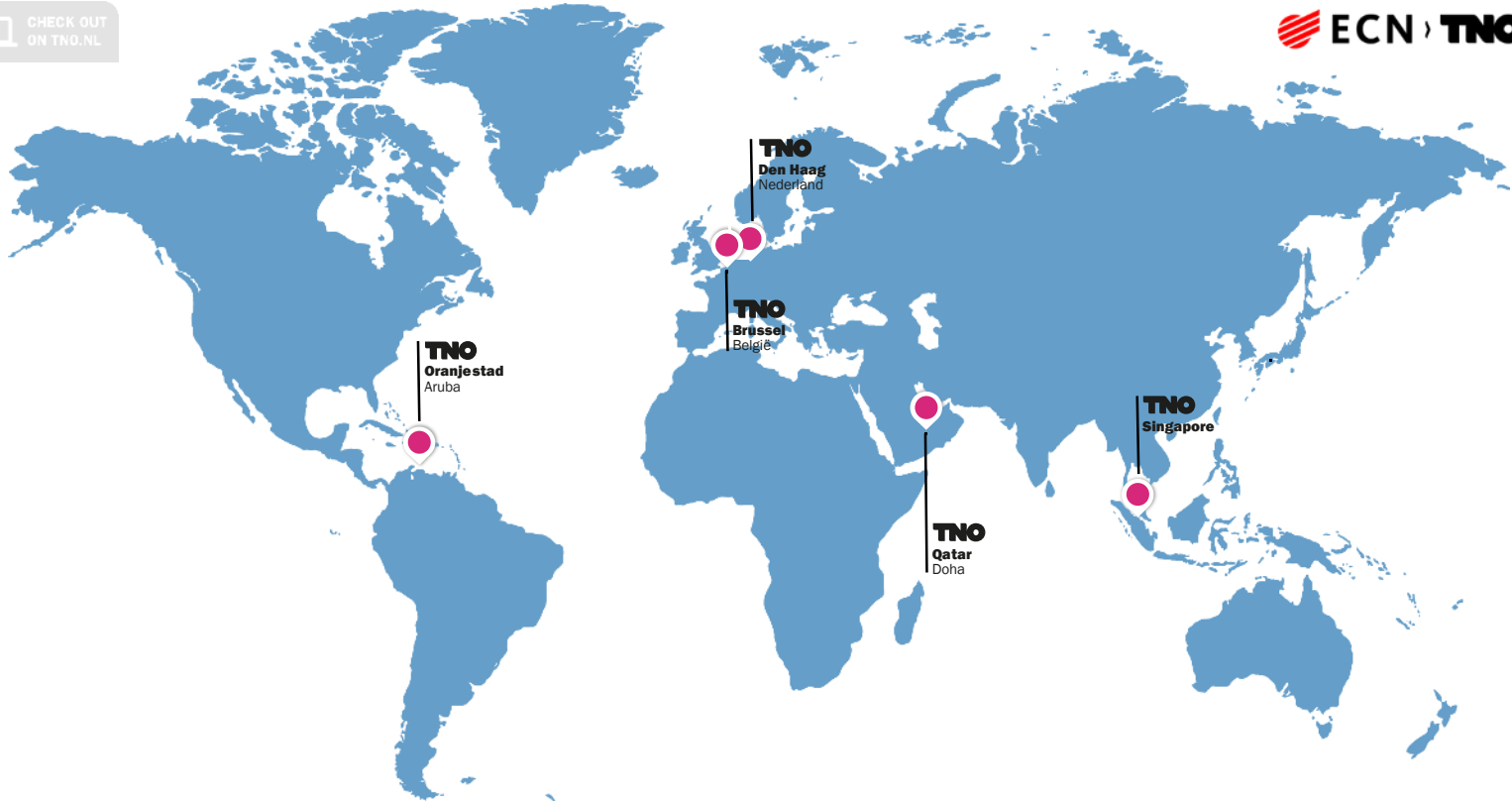
publications  
**2188**



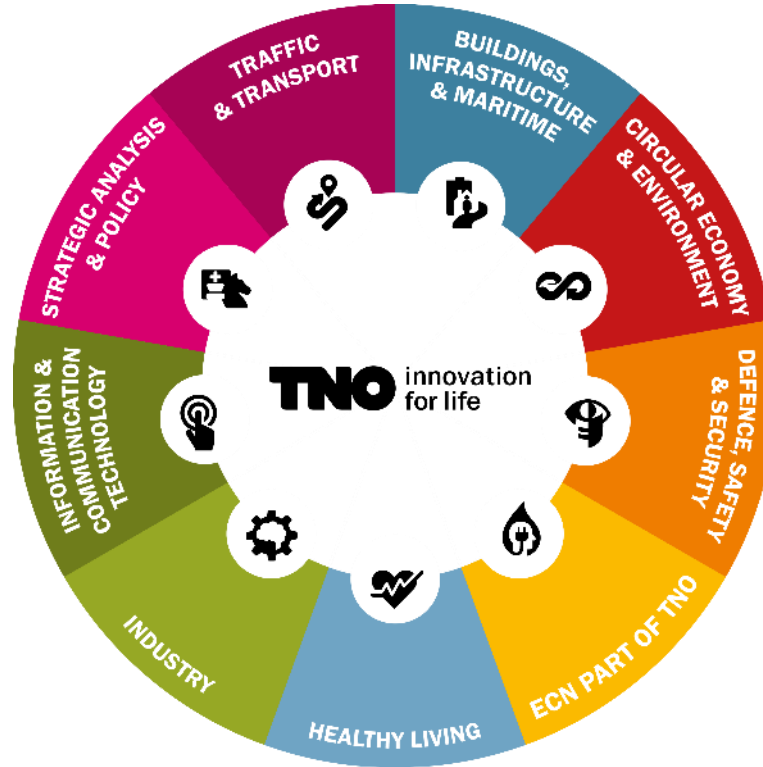
**856**  
patents



# LOCATIONS



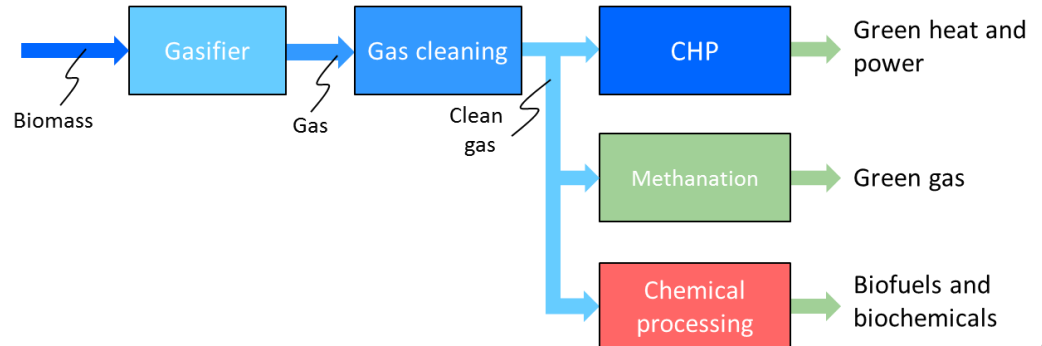
# TNO UNITS



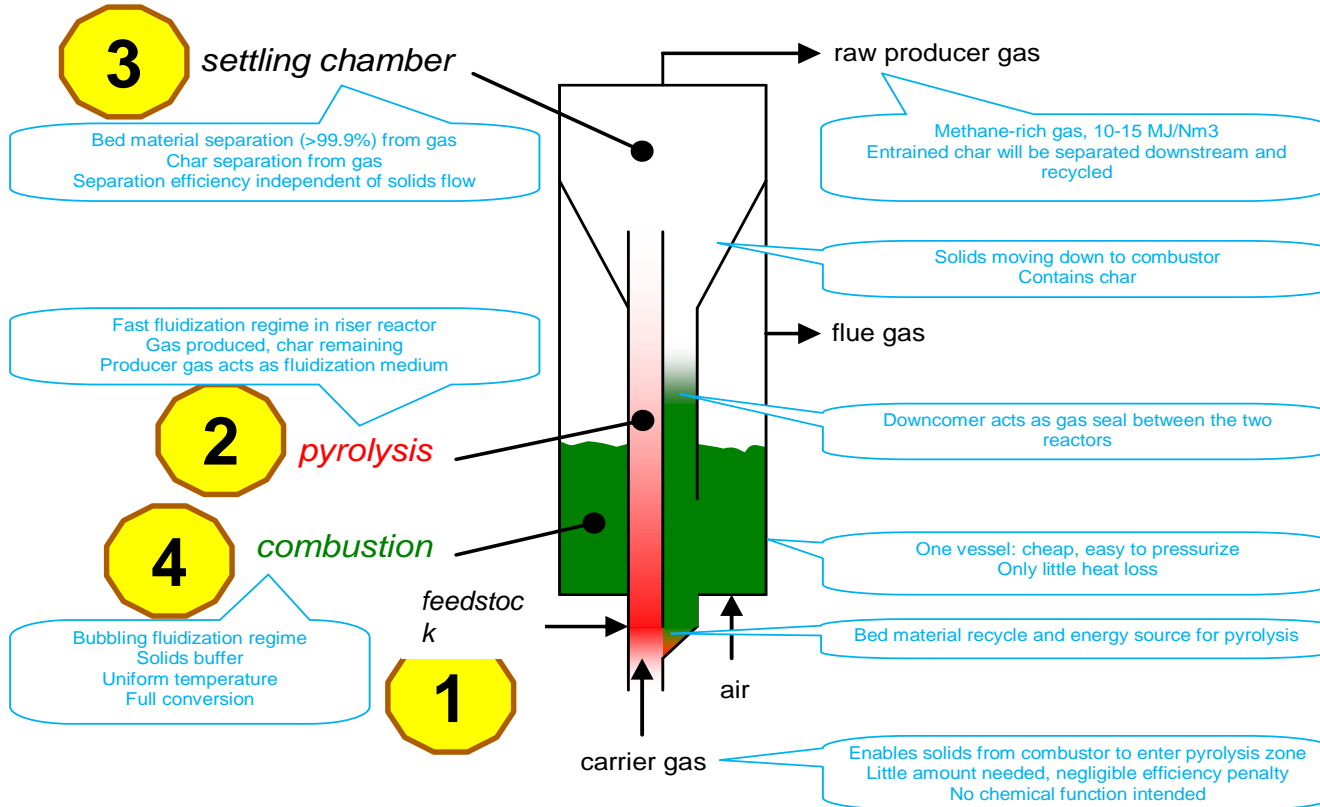
# MILENA OLGA

## A PLATFORM TECHNOLOGY FOR ENERGY AND CHEMICALS

- › Gasification converts biomass or solid waste into a combustible product gas
- › After cleaning, the product gas can be used for:
  - › Boiler firing to replace fuel oil or natural gas
  - › CHP generation using gas engines or gas turbines -> high electrical efficiency
- › Via deeper cleaning, separation and catalytic conversion of the product gas a broad range of biofuels and bio-chemicals can be produced
  - › BioSNG, BioLNG
  - › Fischer Tropsch liquids
  - › Methanol and higher alcohols
  - › Hydrogen
  - › BTX, Ethylene
  - › Etc.



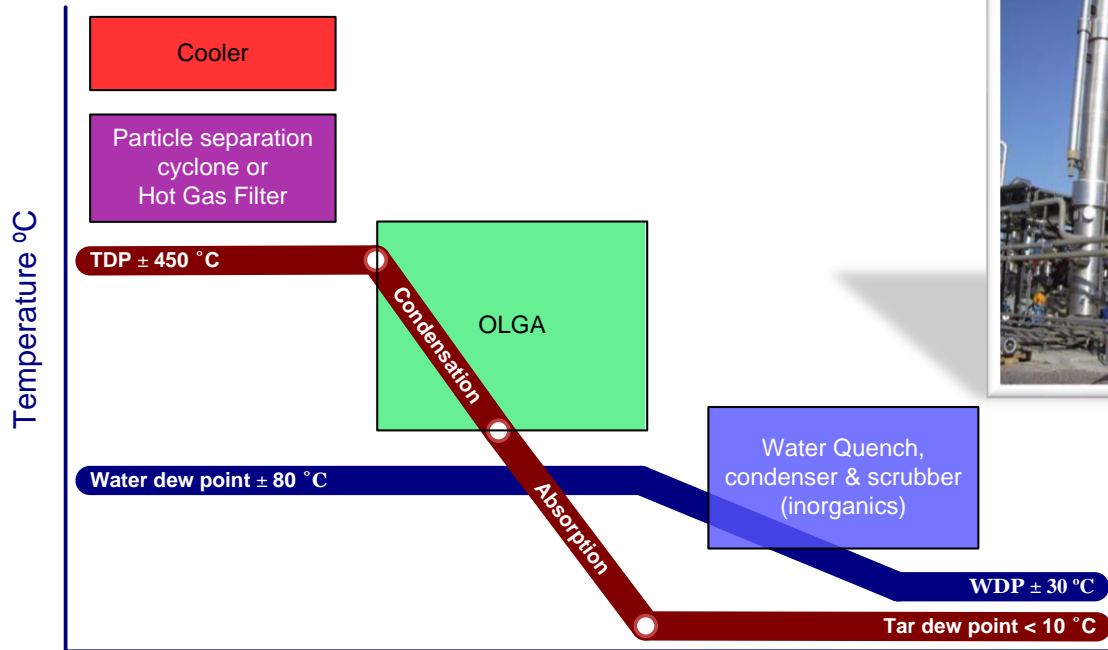
# MILENA TECHNOLOGY



1 ton/h 2014 (India)

# OLGA TECHNOLOGY

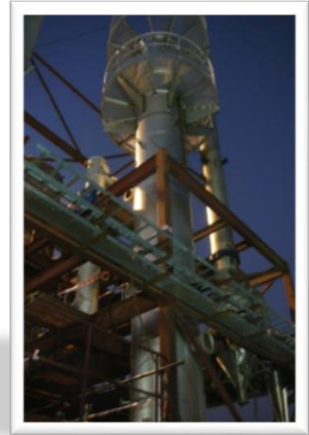
2 000 nm<sup>3</sup>/h plant  
in France, 2006



Dew points & process choices



**ECN** **TNO** innovation for life



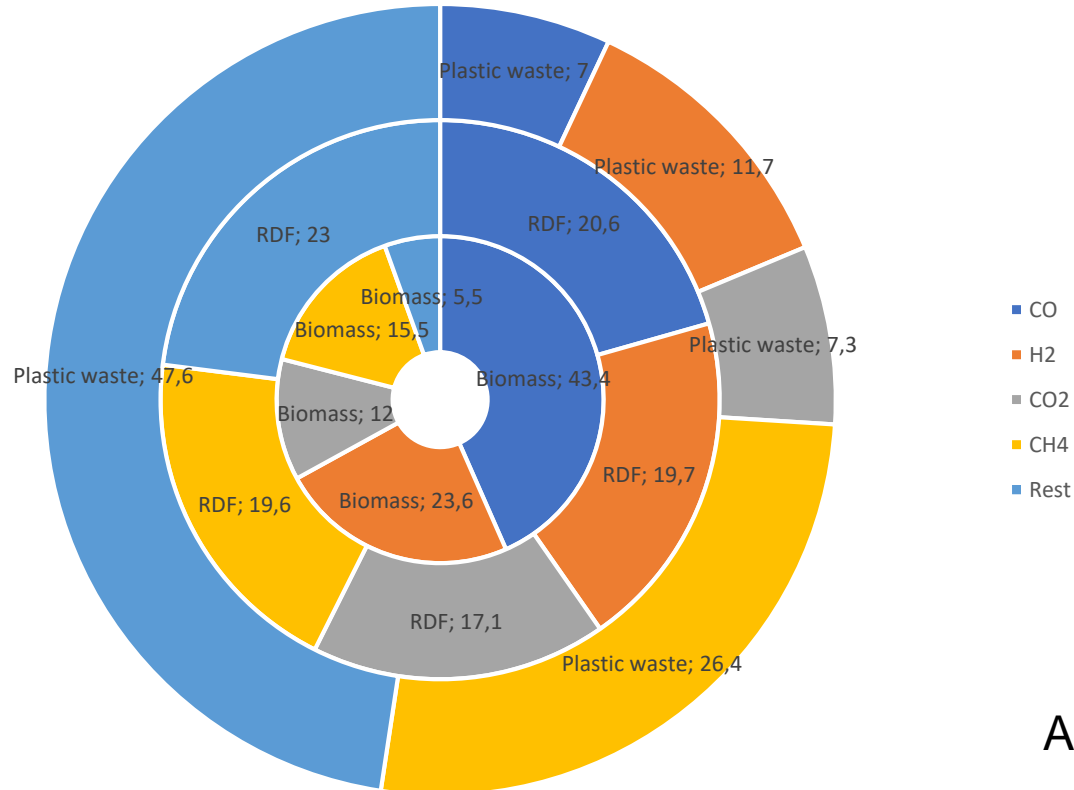
2 000 nm<sup>3</sup>/h plant in  
India



2000 nm<sup>3</sup>/h plant  
in Portugal, 2010

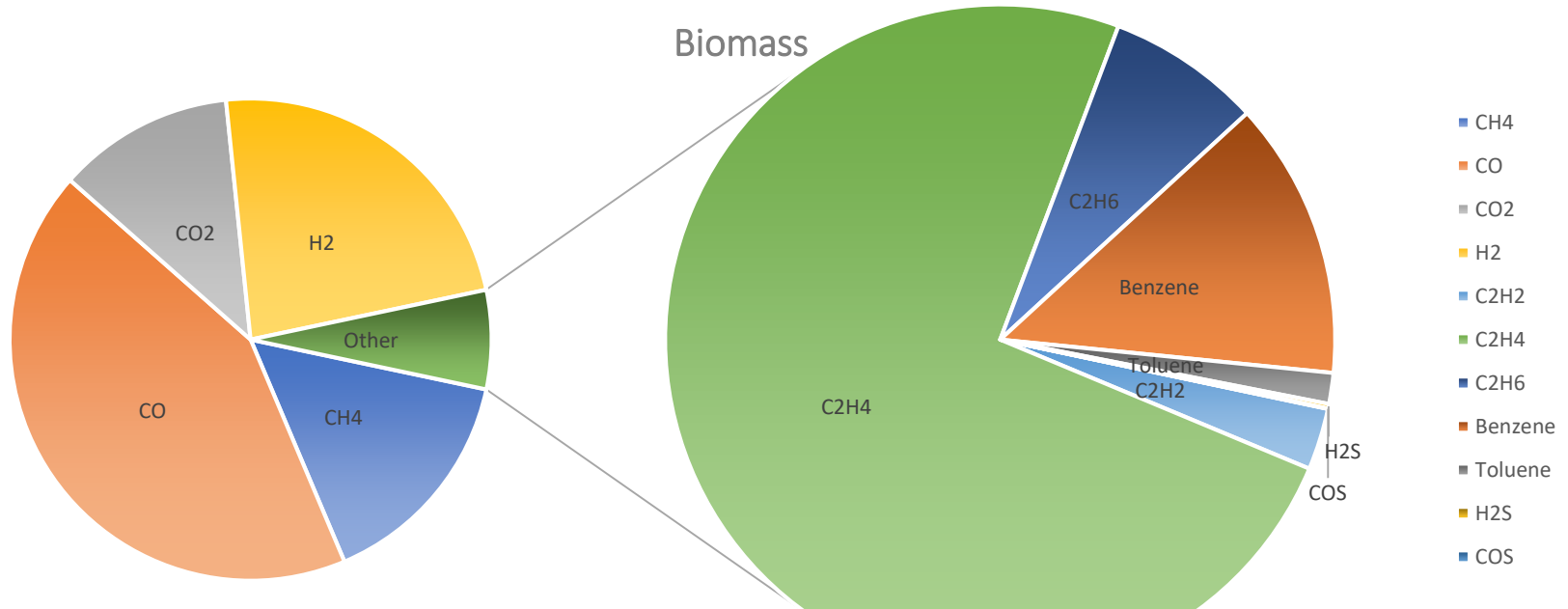


# FEEDSTOCK RANGE & IMPLICATION

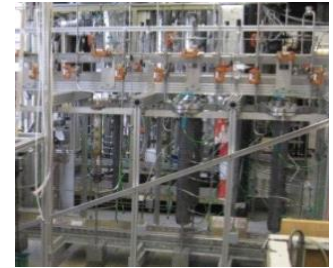
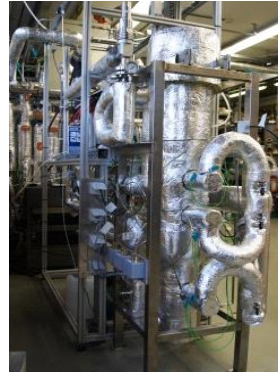


All values are in vol%

# BIOMASS USED IN GREEN GAS PRODUCTION



# MILENA-OLGA-ESME BENCH-SCALE DEVELOPMENT PLATFORM FOR BIOMASS-TO-SNG



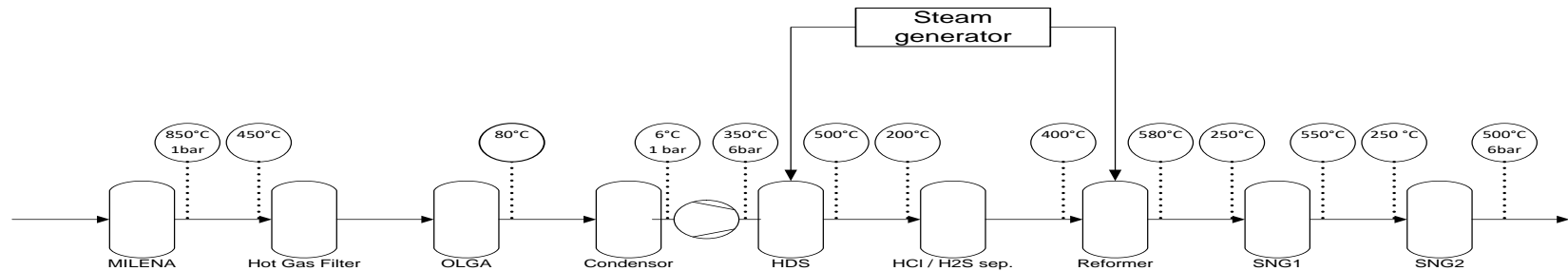
*MILENA gasifier*

*OLGA tar removal*

*HDS reactor*

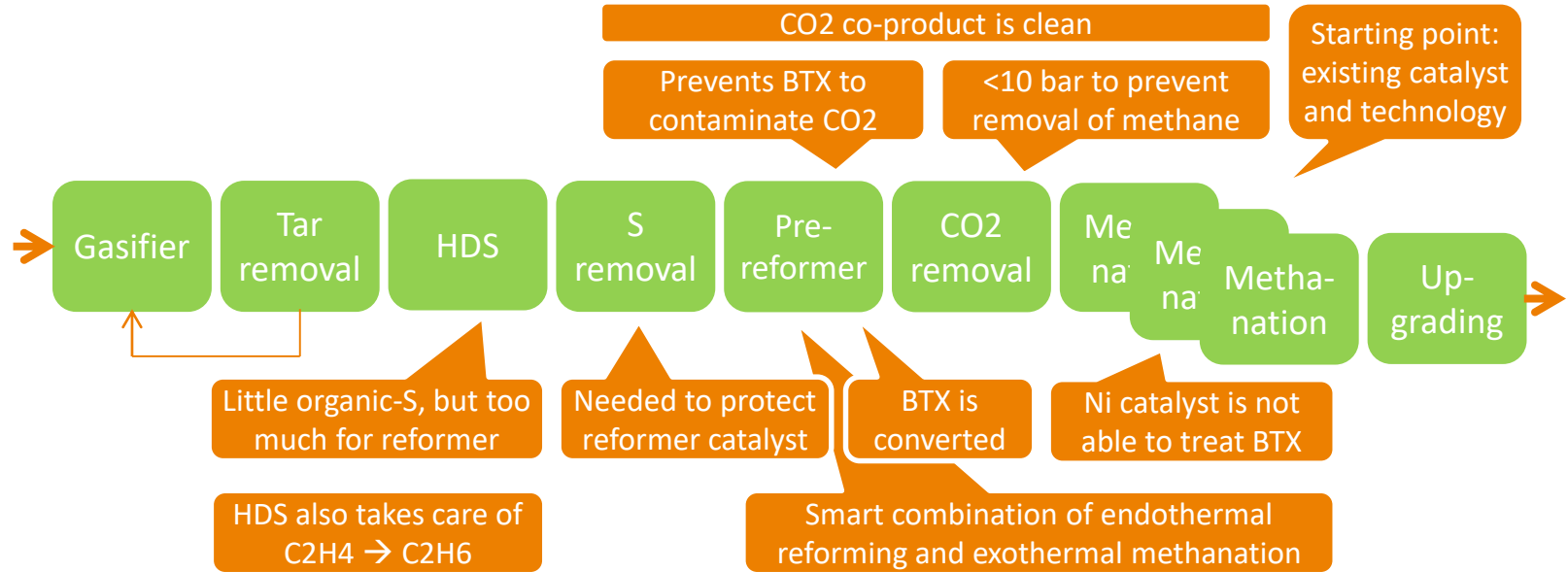
*Further gas cleaning*

*Methanation reactors*



# BIOSNG PROCESS

## THE ECN CHOICES AND IP

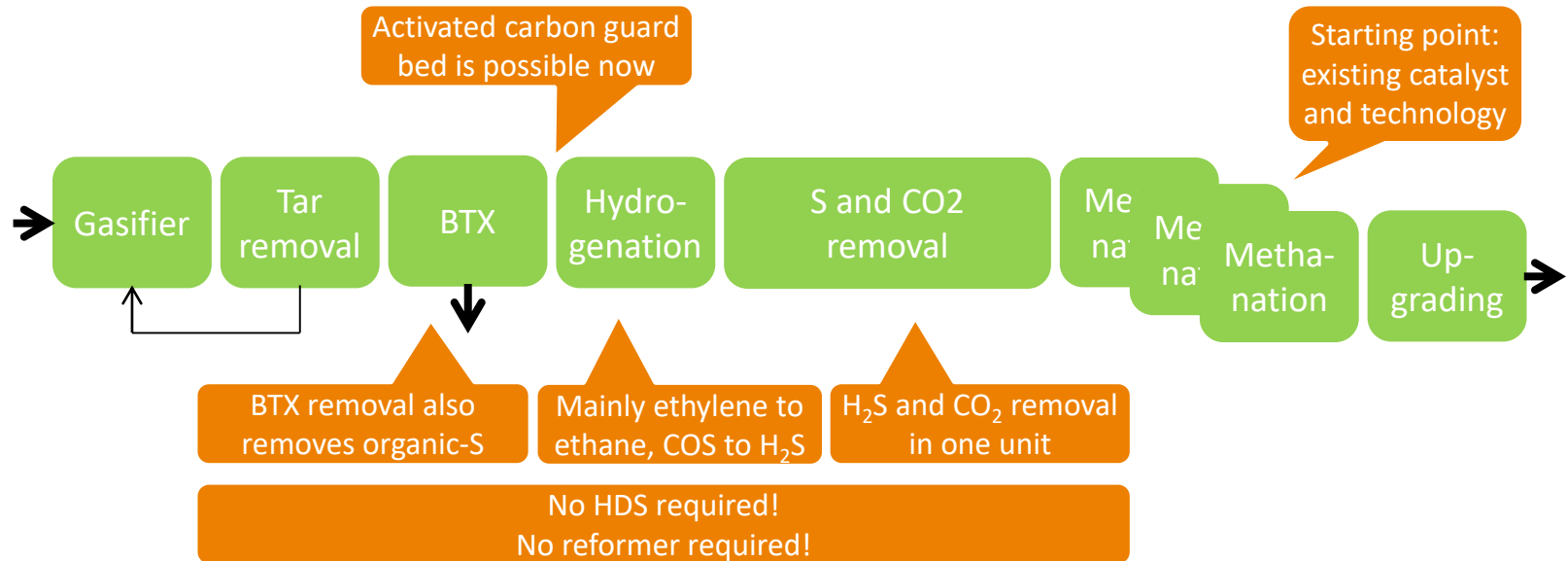


*Gasifier: Fluidized Bed Gasifier operating at temperature below 1000°C*

*HDS: HydroDeSulphurization (converting organic S molecules into H<sub>2</sub>S)*

*BTX: Benzene, Toluene, Xylene (~90%/9%/1% in case of fluidized bed gasification at ~800°C)*

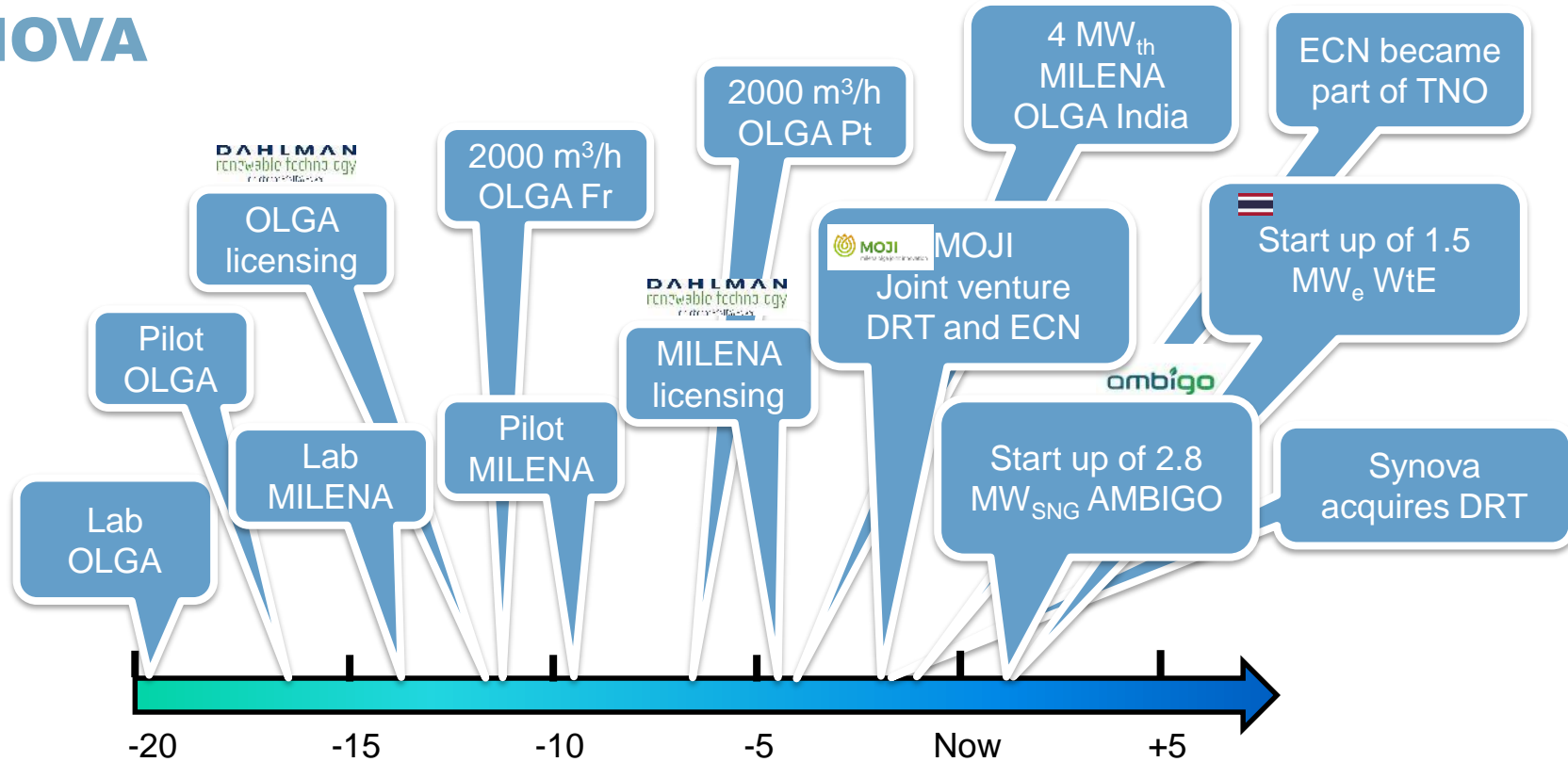
# BIOSNG PROCESS WITH BTX REMOVAL



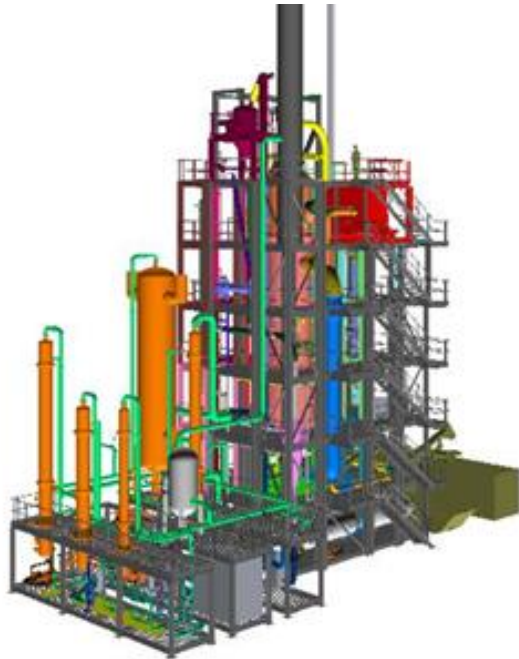
*Gasifier: Fluidized Bed Gasifier operating at temperature below 1000°C*

*BTX: Benzene, Toluene, Xylene (~90%/9%/1% in case of fluidized bed gasification at ~800°C)*

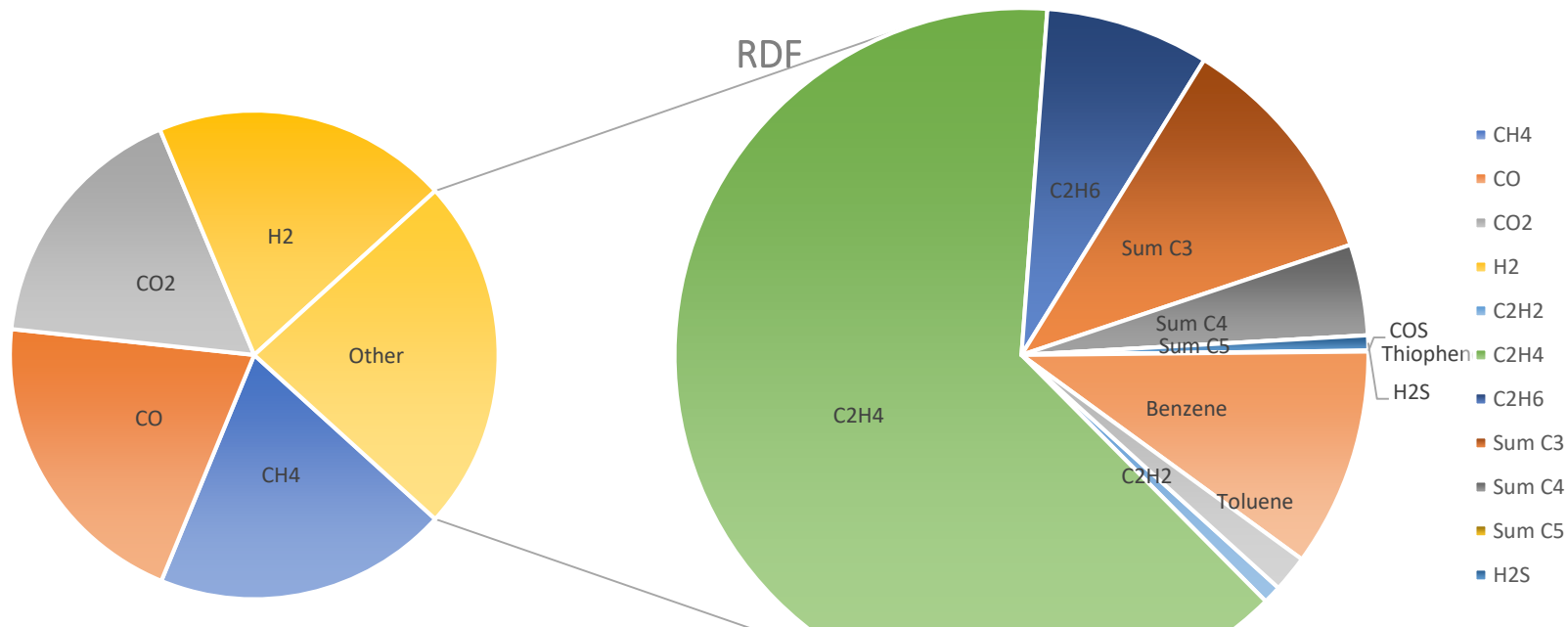
# WASTE TO ENERGY SYNOVA



# THAILAND PROJECT 6 MWTH → 1.5 MWE



# RDF USED IN W2E

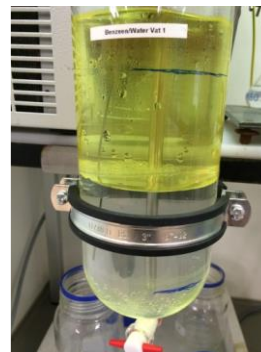
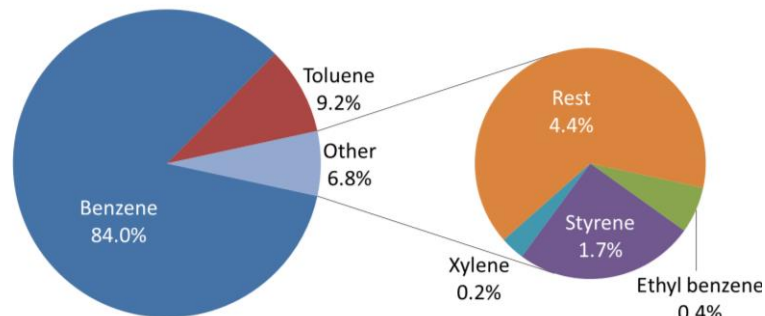




## BTX SEPARATION (AND ETHYLENE AROMATIZATION) (BTX = BENZENE, TOLUENE, XYLENES)

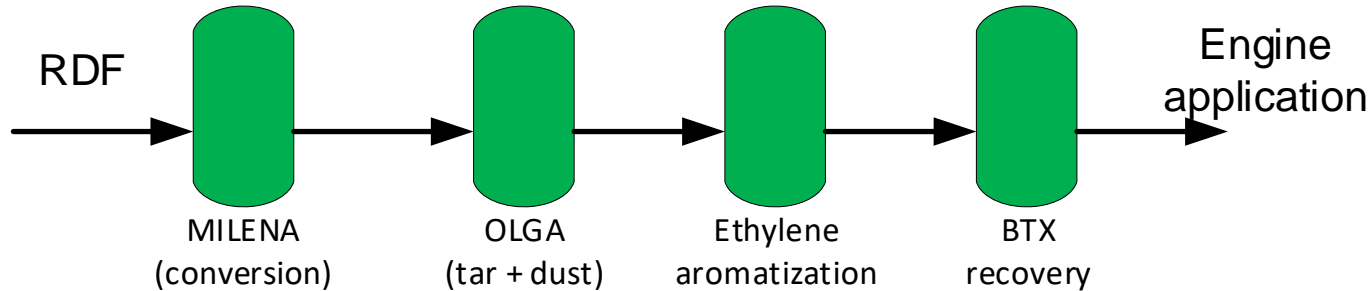
- › First step after (OLGA) tar removal
- › Simplifies downstream processing and improves business cases
- › Proof of Concept: >95% separation, B/T/X = typically 90/9/1
- › Next step: Process optimisation and piloting

**Biorizon**  
The way to aromatics  
[www.biorizon.eu](http://www.biorizon.eu)



BTX scrubber,  
2 Nm<sup>3</sup>/h 17

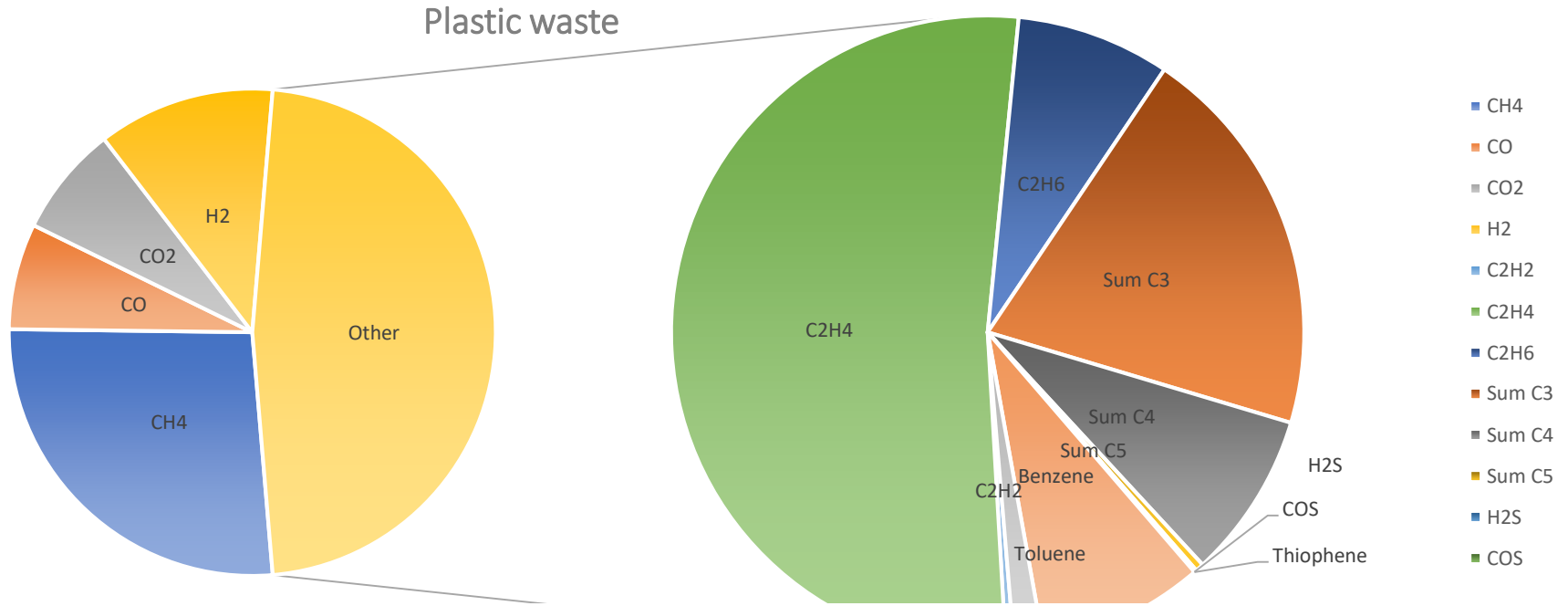
## FUTURE FOR W2E



- + Improved engine efficiency
- + CAPEX reduction on no. Engines
- + CAPEX reduction on flue gas cleaning
- + Additional income from BTX
- + BTX as storable energy to balance grid

- Additional CAPEX upfront
- BTX liquid as product / storage

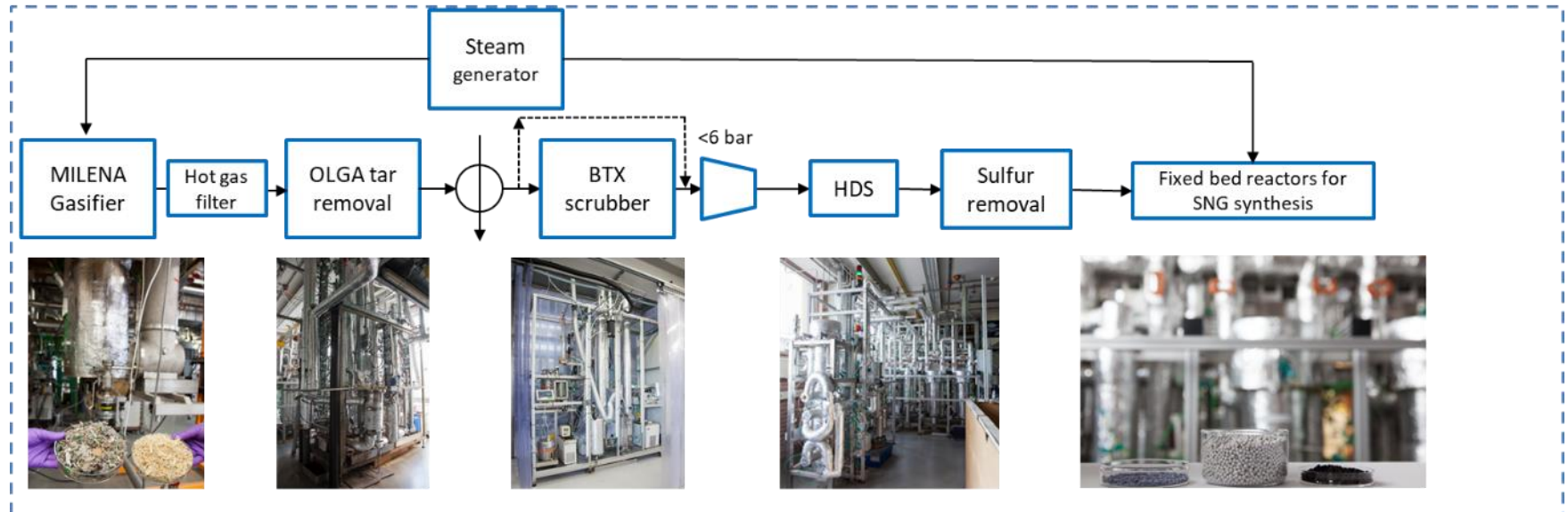
# FUTURE OF IMPURITIES



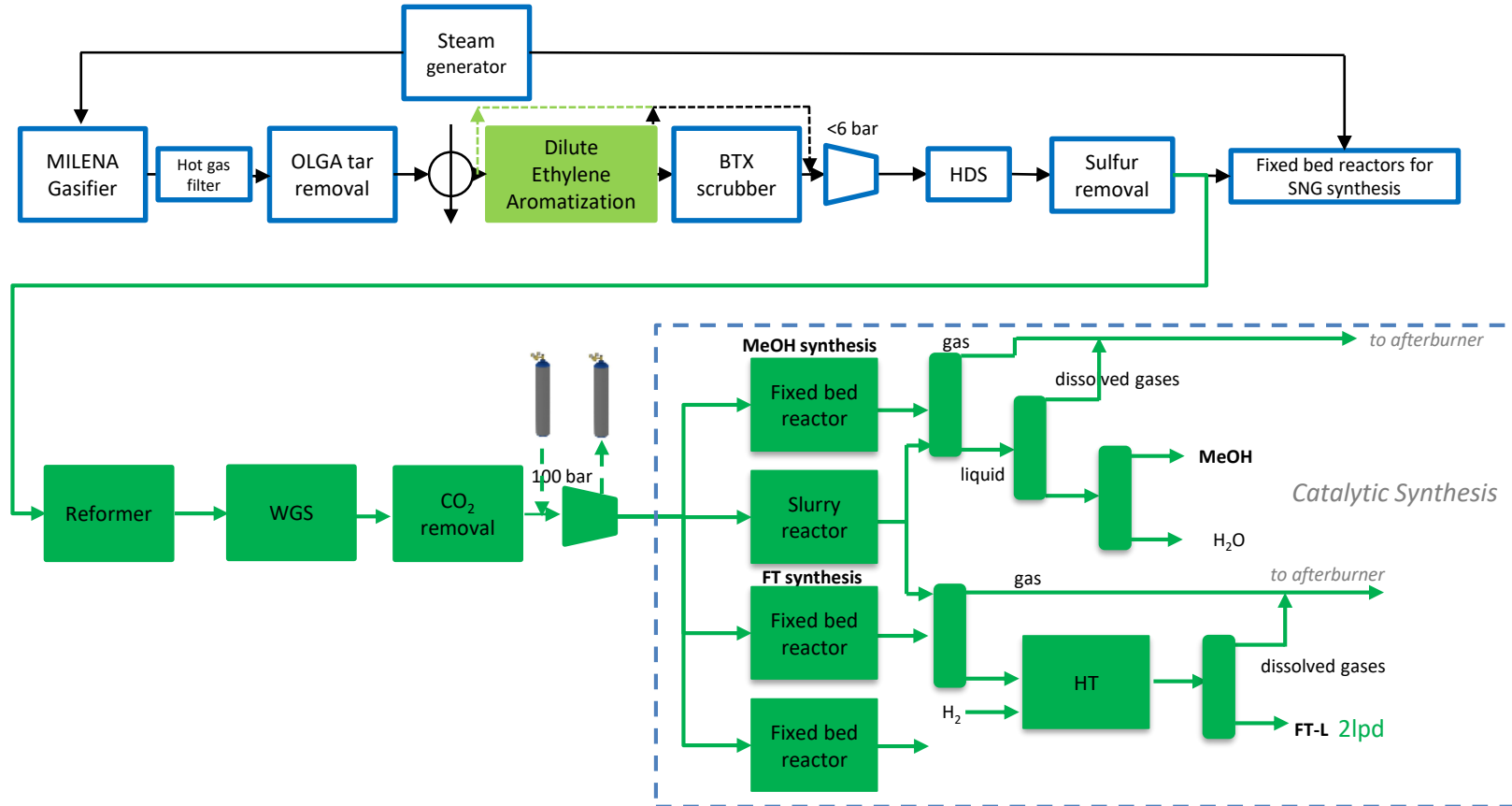
Waste is a feedstock without a purpose

# FUTURE ROLE OF GASIFICATION

*Current lab installation*



# BIOFUELS LABORATORY AT ECN>TNO



## CONCLUDING REMARKS

1. MILENA OLGA is commercial available technology (SYNOVA) for Green Gas production and for Waste to Energy applications
2. Indirect gasification is a versatile technology feedstock wise and outlet wise
3. Single products lead to sub-optimal value chains
4. Gasification offers the opportunity to valorize the molecular capital in the feedstock
5. The future for gasification is in co-producing energy, materials and chemicals
6. Rethinking boundary conditions helps to come to new processes

› **THANK YOU FOR YOUR  
ATTENTION**

**TNO.NL/ECNPARTOFTNO**



**ECN** ›

**TNO**

innovation  
for life