IEA Bioenergy
Technology Collaboration Programme

Task 33 Country report The Netherlands

December 2021

Berend

Online via Teams

Opportunities for gasification

- The Netherlands is steering away from use of biomass for heat and power, but has identified it as crucial for the production of fuels and chemicals
- Horizon Europe has a clear theme on biofuels and biochemicals
- Circularity will depend heavily on gasification based technologies
- Hydrogen is being pushed a lot, provides opportunitees for gasification as well

Gasification locations in the Netherlands

TNO, Petten
R&D center on gasification

Mavitec, Heerhugowaard
Technology provider

ESKA, Hoogezand
Active CFB Gasifier

Torrgas, Groningen
Technology provider
EF gasifier demo site

SCW, Alkmaar
Technology provider
Super critical gasifier demosite

BEN, Amsterdam
Active Fixed Bed Gasifier

G.I. Dynamics, Amsterdam
Waste to Chemicals project

Enerkem, Rotterdam
Waste to Methanol project

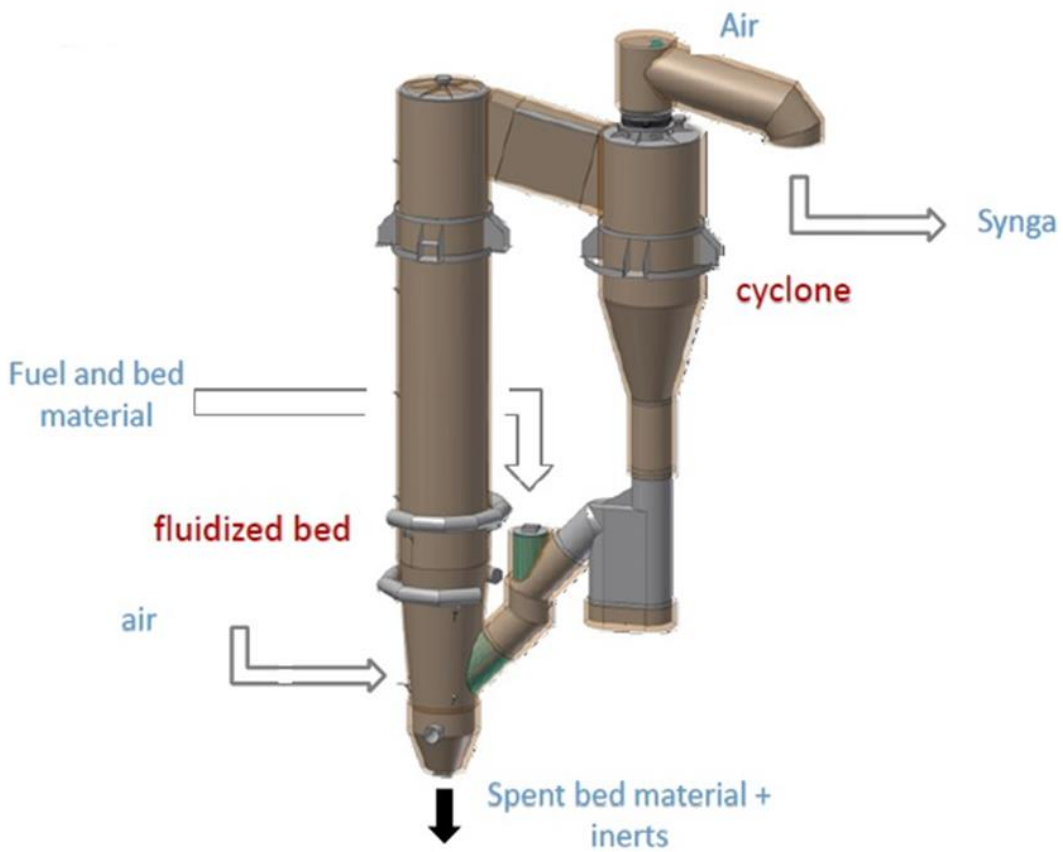
Synova, Maassluis
Technology provider

Stercore, Emmen
Manure gasification project

Amer, Geertruidenberg
Idle CFB Gasifier

Brightsite, Geleen
Gasification platform
Biomass to hydrogen (Torrgas)
Waste to chemicals (RWE)

ESKA – CFB gasifier on paper rejects



- 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 barg)
- Fully automatic operation
- Build in 2016, in operation since Oct-2016

Some 2021 facts

85% Uptime expected

12 kton of rejects (all from the site)

50 kton of reject processed since startup

Stercore

- Economic Due Dilligence finished (KplusV)
- Technical Due Dilligence finished (DNV)
- Technical detailed design and building design finished together with Emmtec Engineering as EPC
- Off take agreement for the Bio-LNG with a UK/NL oil major agreed upon as a fuel guarantee not depending on the SDE++ scheme
- In compliance with first court ruling, expecting final verdict in December
- Start building expected Q2-2022
- First stage investment approx.32Meuro

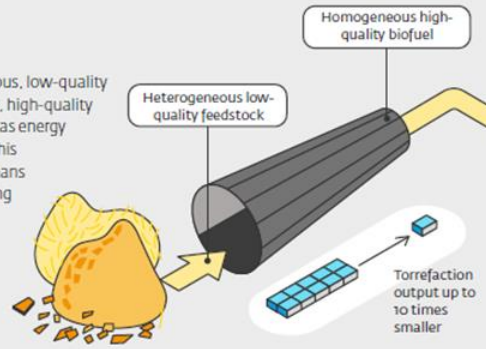
Torrgas - the process

Waste streams as feedstock

Torrefaction processes use a wide range of waste streams that would otherwise be burned or left to perish. This greatly increases the amount of waste that can be reused.

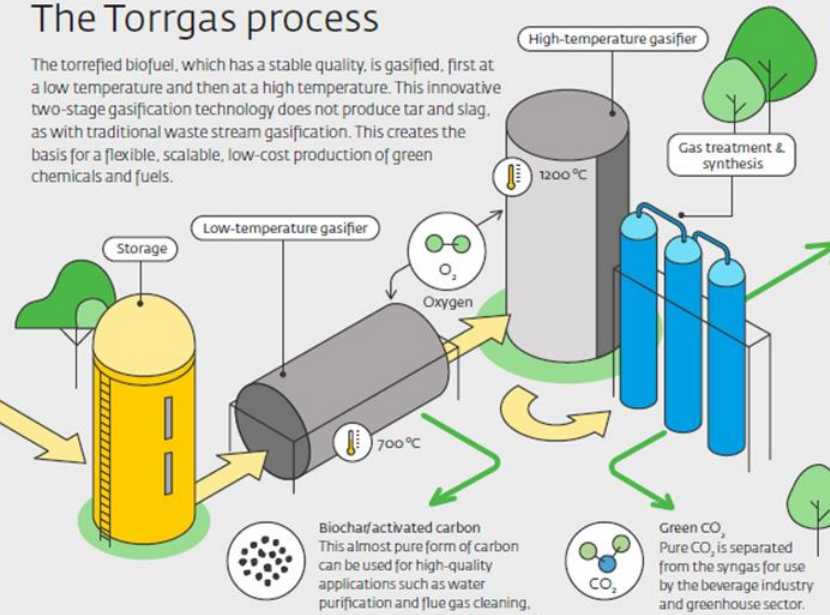
Torrefaction

Torrefaction converts heterogeneous, low-quality waste streams into homogeneous, high-quality biofuels that are around ten times as energy dense as the original feedstocks. This enables efficient transport and means torrefaction is a vital link in enabling large-scale reuse of problematic waste streams.

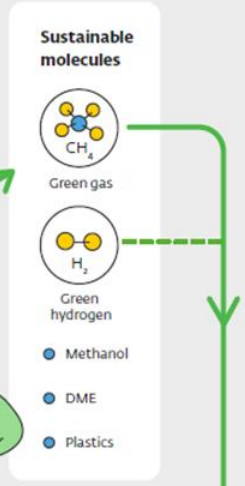


The Torrgas process

The torrefied biofuel, which has a stable quality, is gasified, first at a low temperature and then at a high temperature. This innovative two-stage gasification technology does not produce tar and slag, as with traditional waste stream gasification. This creates the basis for a flexible, scalable, low-cost production of green chemicals and fuels.



Product



Uses of green gas

The Torrgas process produces green gas from syngas. This gas is transported through gas infrastructure to users in the industrial domain (for use as a feedstock and for process heating) and to the built environment.

Benefits of the Torrgas process

Scalable
A Torrgas plant can be scaled up to 100 MW.

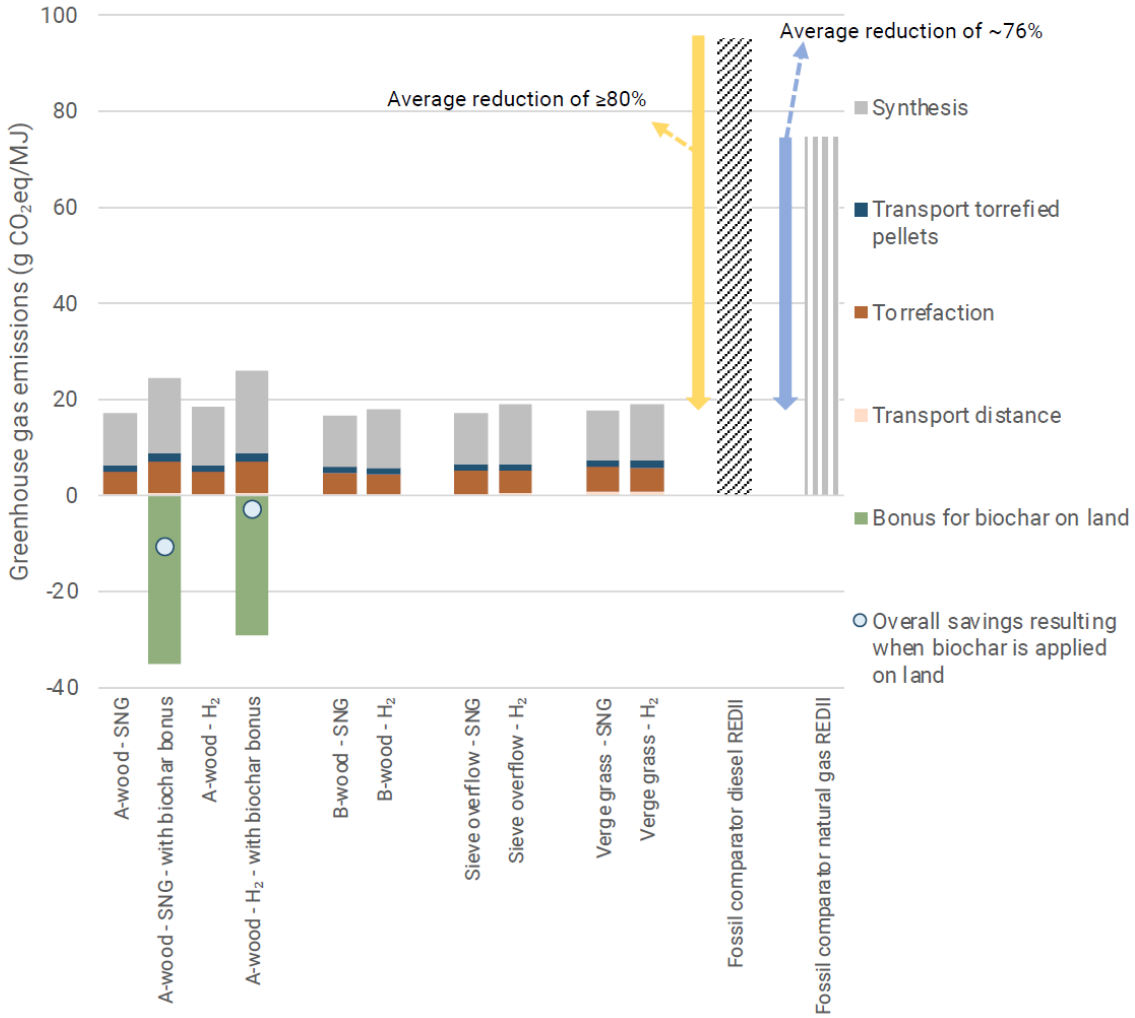
Fully circular
Low-quality waste streams are fully converted into high-value molecules (syngas and green CO_2) and products (biochar).

Affordable
Activities such as the scaling up and marketing of biochar and green CO_2 make it increasingly cheaper to produce syngas. So much so, in fact, that it can even compete with fossil alternatives on price.

CO_2 reduction
Waste streams are converted into usable products. This prevents combustion and carbon emissions, effectively removing CO_2 from the atmosphere.

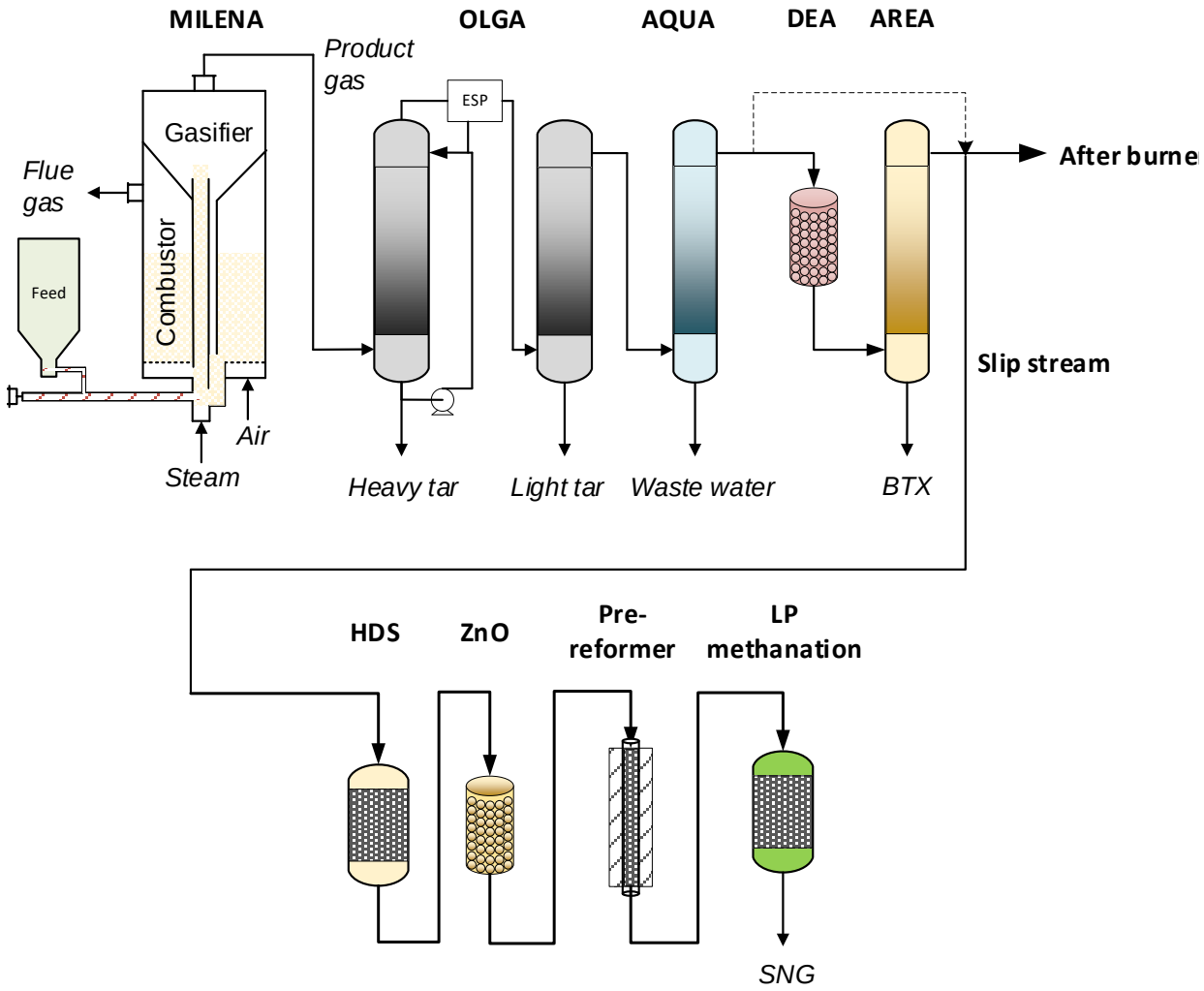
torrgas | gasunie crossing borders in energy

Torrgas LCA study - sneak preview



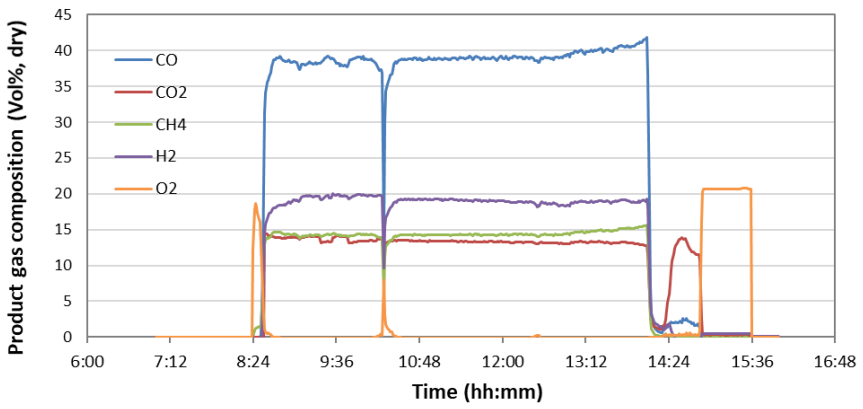
- SNG and H_2 similar GHG profile without biochar and CO_2 sequestration
- ~80% reduction in GHG emissions compared to fossil fuels
- Biochar allows negative emissions
- CO_2 sequestration not even included in this study, potential is even larger
- Effect of feedstock transportation is marginal

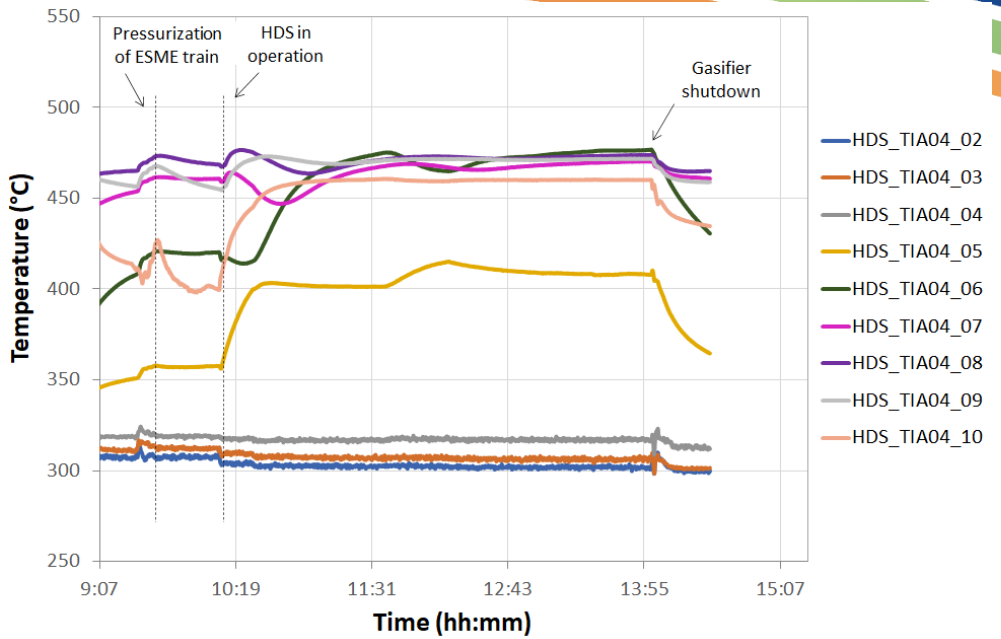
TNO – SNG development



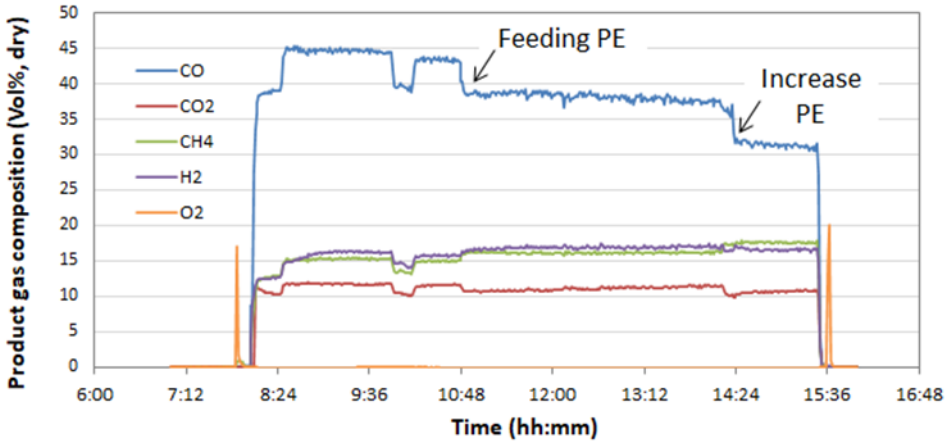
1. SNG developed based on clean biomass (demolition wood A/B)
2. Future feedstocks will contain more impurities
   - Sulphur can go up
   - Plastics can go up
3. This has an effect on specifically HDS and prereformer

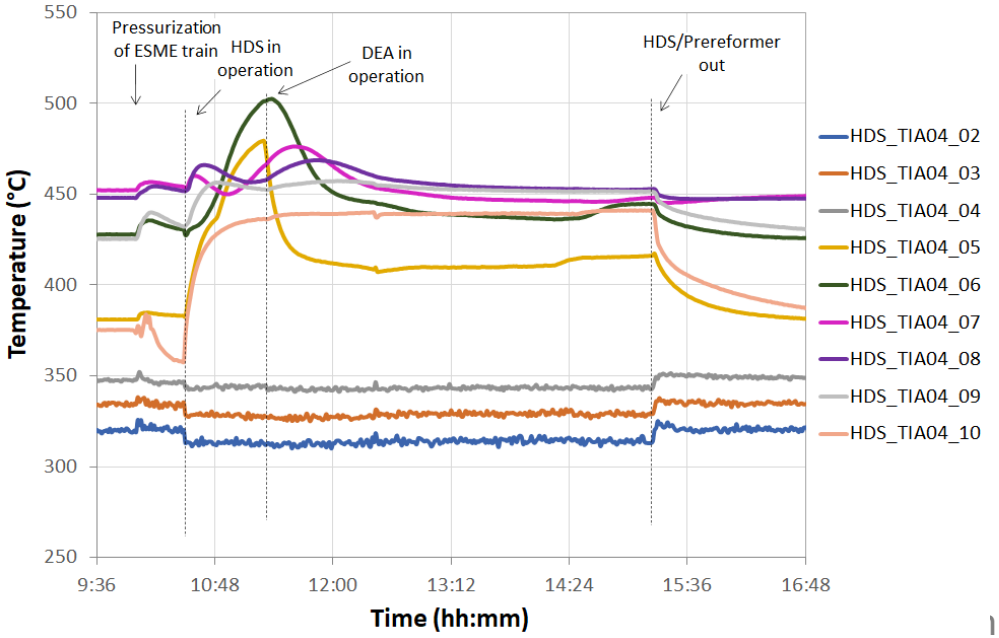
Plastics effect on HDS



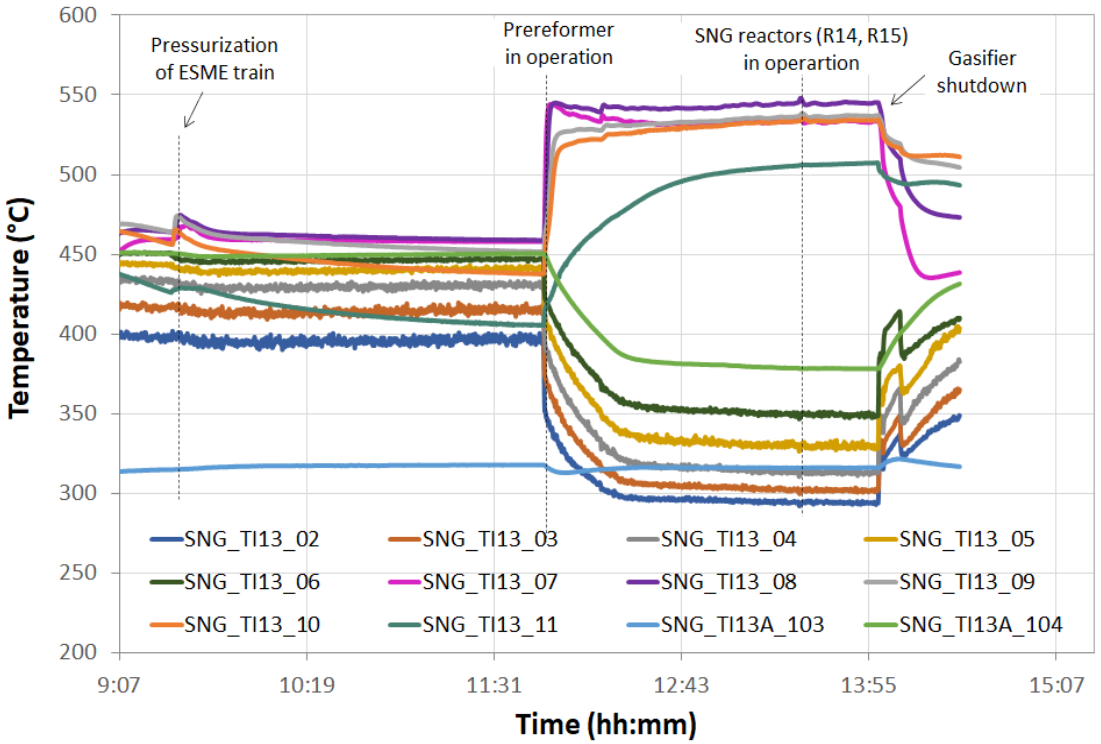


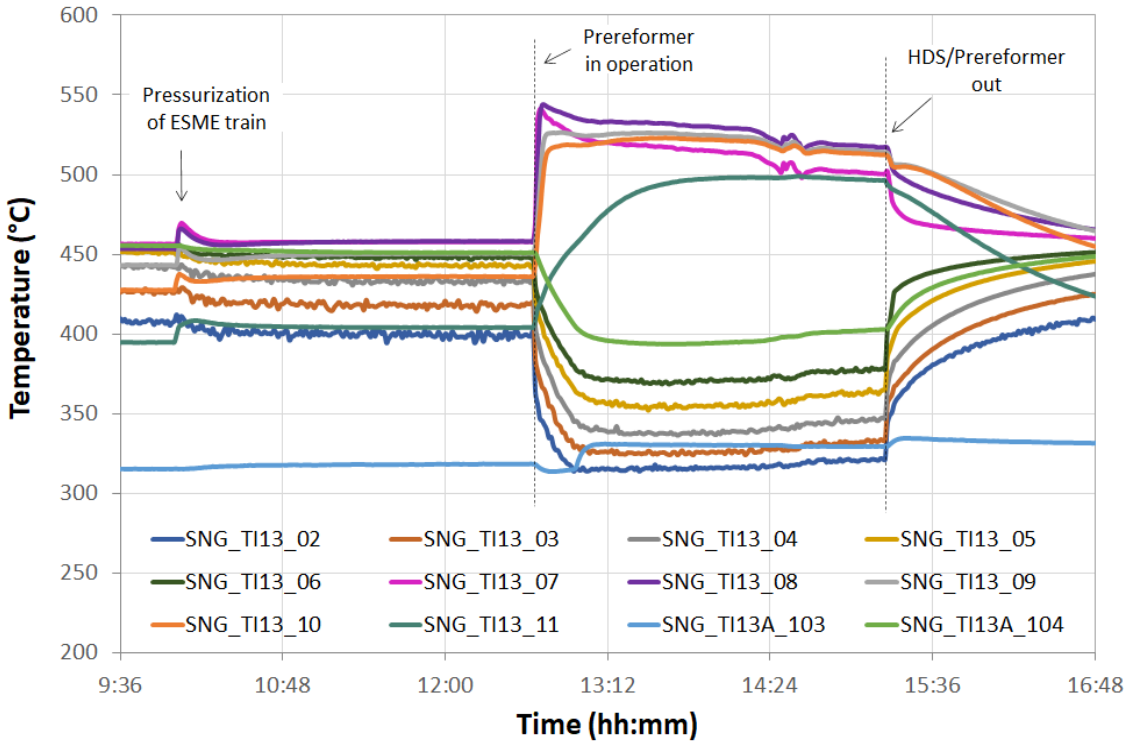
Temperature overshoot in the HDS due to exothermal effect of hydrogenation





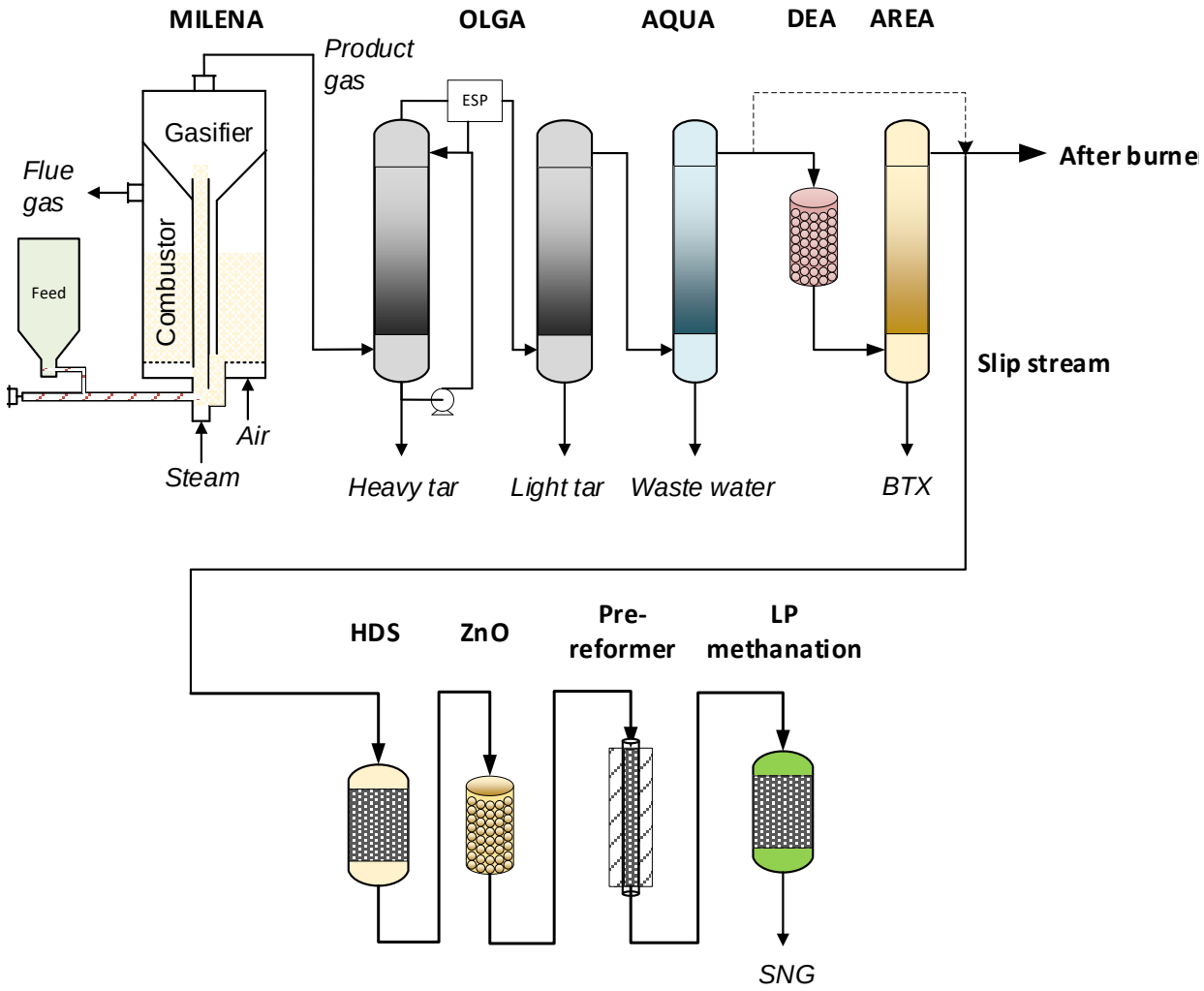
Plastics effect on Prereformer





Increasing aromatic content reduces the temperature effect in the pre-reformer (more to reform)
Increased aromatics require more steam….

TNO – SNG development

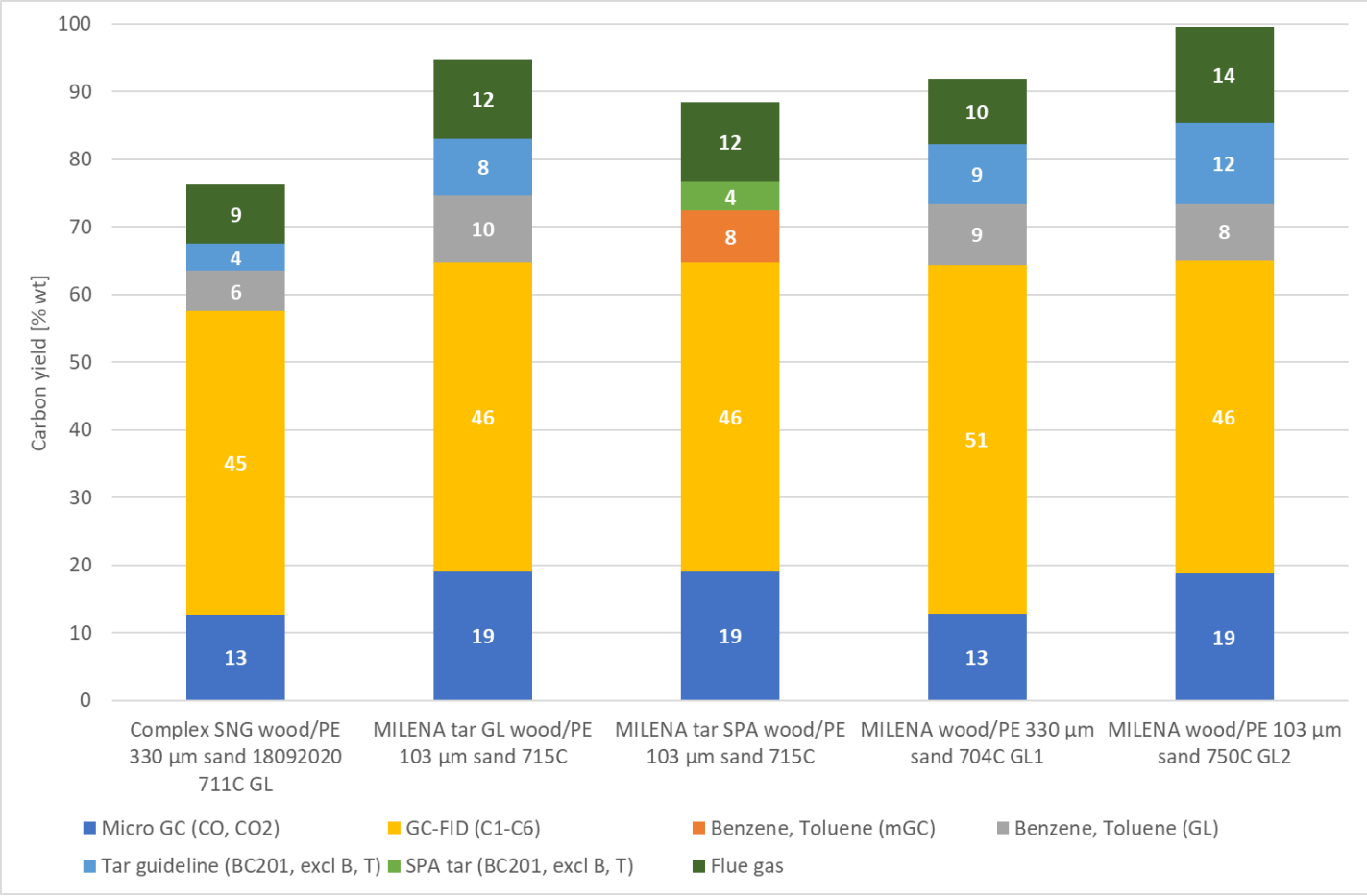


When adding plastic both olefins and aromatics increase, reducing the capability of the HDS/Pre-reformer to function properly

DEA reduces olefins, allowing HDS to return to its window of operation

AREA removes BTX allowing steam consumption on the pre-reformer to be reduced (perhaps skip it al together)

Gas analysis for olefin/aromatic rich gas



Biomass based gas analysis clearly underpredicts the carbon

1. Micro GC data for CO/CO_2
2. Short guideline for liquid components
3. Gas bags for H_2 and C_1-C_6

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