FlexSNG H2020 Project

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Flexible Production of Synthetic Natural Gas and Biochar via Gasification of Biomass and Waste Feedstocks

Minna Kurkela, Sanna Tuomi, Ilkka Hiltunen, Esa Kurkela / VTT Technical Research Centre of Finland Ltd. Po Box 1000, FI-02044 VTT, Finland

- International **cooperation with Canada** on advanced biofuels and bioenergy
- Duration: 43 months (2021–2024).
- Coordinator: VTT
- EU funding 4.5 M€

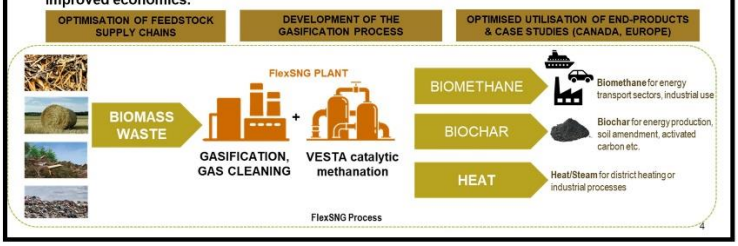
- **12 partners**: Finland, Greece, Italy, Denmark, Sweden, Germany, UK and Canada
- **Research organizations and universities**: VTT, CERTH, EIFER, DTU, Skogforsk, and Universite Laval and Polytechnique Montreal

Industry: SFW, WOOD, JM
SMEs: CREAT, ETA

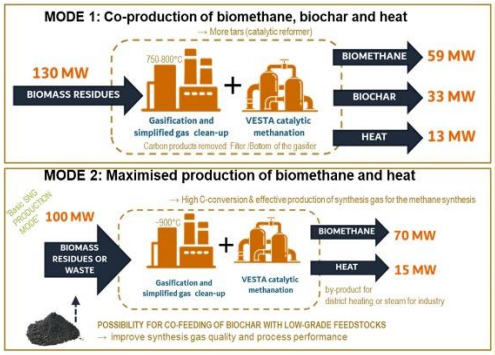
Consortium overview with partner roles and activities

FlexSNG concept

- To develop and validate (TRL5) **a flexible and cost-effective gasification-based process** for the production of **pipeline-quality biomethane, high-value biochar** and **renewable heat** from a wide variety of **low-quality biomass residues and biogenic waste feedstocks**.
- Cost-effectivity: To **optimize both the front-end feedstock supply chains** and the utilization of the two end-products, bio-methane and bio-char.
- **Flexibility of the feedstock basis & operation modes of the gasification process** will result in **improved economics.**



FlexSNG approach "one plant, two modes"

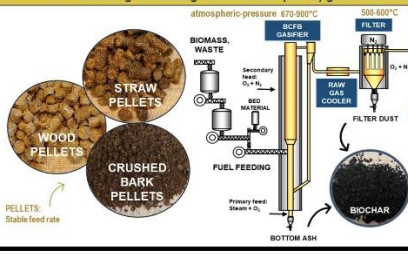


- The same plant is operated under two different modes depending on the market need of the products.
- **MODE 2:** is the basic SNG production mode - gasifier operated ~900°C with high carbon conversion & effective production of synthesis gas for the methane synthesis.
- **MODE 1**: Plant is operated at lower temperature with low C-conversion -> less biomethane produced; Biochar is product
- Gas composition for VESTA SNG is the same in both cases

First gasification test campaigns in 2021–2022

- Three one-week-long tests **to screen alternative designs and operation conditions** of the process under both target operation modes of the project
- Two alternative gasifier designs (**BCFB and standard CFB; 1 bar**) assessed for their suitability in co-production of good-quality biochar (feedstocks: clean wood, bark and straw)
- Essential unit operations in this gasification process: gasifier, hot filtration and catalytic reforming

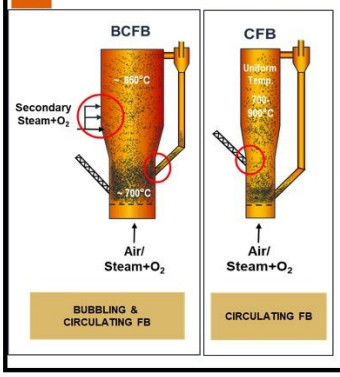
Bubbling Circulating Fluidised-Bed (BCFB) gasifier at VTT's Piloting Centre Bioruukki, Finland



✓ Very successful tests
✓ Target operation modes could be reached both CFB & BCFB gasifier design

FEED RATE	20–40 kg/h
OPERATION PRESSURE	1 bar
GASIFIER TEMP.	700–900 °C
CFB GASIFIER	1–3 m/s, Bed material recycling
GAS CLEANING	Hot filtration, Catalytic reforming, Final gas cleaning

Two Fluidized-Bed reactor types were tested



BCFB - Bubbling Circulating Fluidized Bed

- A combination of a bubbling fluidized-bed (BFB) bottom and a circulating fluidized-bed (CFB) top
- Bed is operated at lower temperature, freeboard at higher
- Cyclone recycle is connected to the upper part of the dense bed of the BFB reactor
- Mixture of coarse and fine bed material is used
- Part of biochar recover from bottom of gasifier

CFB gasifier

- CFB gasifier: Feedstock is fed above the dense bed and pyrolyzed in upper part
- High carbon conversion reached because recycling charcoal meets oxygen at the bottom of the bed
- Highly reliable and stable process; easy to shift operation conditions just by changing temperature
- Residence time is short resulting in higher tar content
- Practically all ungasified charcoal was elutriated out from the gasifier and was collected as filter fines.

Catalytic reformer is central part in FlexSNG

- Test campaigns: Filtration and reforming concepts operated without problems – even in low temperature CFB tests where the tar contents were the highest
- Pressure drops of the filter and the reformer remained stable (no filter blockage or soot deposits in reformer)

High Tar Conversions

WOOD pellets as feedstock
- Full conversion of tars
- Benzene conversion: 99.2-99.9%

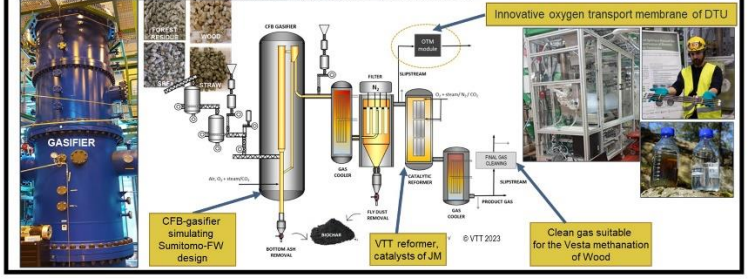
STRAW pellets as feedstock
- Tar conversion: 99.5-100%
- Benzene conversion: 92-97%

→ Next tests: use of 3-stage reformer to achieve higher benzene conversion with sulphur containing biomasses

Process Validation Campaigns

- First Pilot Test Campaign in May 2023 at the 500 kW_{th} Pressurised Fluidised-Bed Gasification Pilot Plant, VTT
- Wood, Forest residue & Straw pellets (upcoming→ more challenging waste-derived feedstocks & biochar as co-feed)
- To validate the performance of the gasification process & the innovative OTM unit by DTU
- Experimental work supported by modelling activities (CERTH, VTT)

Successful operation ~ 58 hours gasification



Upcoming dissemination actions

NEXT TOPICAL WORKSHOP

- ITW#2, Canada 5–8 Feb 2024 (Montréal)
- In the framework of the BIOFOR International Conference
- Organised by PM/Canada & ETA/Italy
- Disseminate the good work done by the FlexSNG project

OTHER ACTIVITIES

- A series of webinars to deliver information about project activities
- FlexSNG Newsletters, Videos, Scientific Articles, Press Releases, Presentations in upcoming conferences
- LinkedIn Posts & News posts

FINAL EVENT

- Final Event/Conference in Finland or webinar (at the end of the project, 2024)

Contact / Coordinator:
Sanna Tuomi, VTT
sanna.tuomi@vtt.fi

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