



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

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At the conclusion of the project, significant milestones have been achieved: the project was presented at numerous conferences, the webinar series successfully came to an end, the partners gathered for a final meeting in Helsinki, taking the opportunity to visit the coordinator's facility. Finally, the Final Event was successfully held online on the afternoon of December 2.

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1. FlexSNG at Tcbiomass2024

Tcbiomass2024 focused on the latest advancements in the thermochemical conversion of biomass and municipal solid waste (MSW) into renewable methane, LPG, liquid fuels and chemicals. The conference provided an excellent platform for exploring cutting-edge research and real-world opportunities for deploying these technologies.

During the event, Sanna Tuomi from VTT presented her work on “**Hybrid Gasification-Synthesis Process with CO₂ Recycling to Improve Synthetic Fuels Yield and Carbon Efficiency – Techno-Economic Assessment**”. In her presentation, she explored hybrid processes that integrate water electrolysis with biomass and waste gasification, which are gaining attention for their potential to enhance synthetic fuel yields and carbon efficiency.

Sanna discussed several key approaches:

- A straightforward method replaces the CO shift unit with electrolysis-derived hydrogen (H₂), adjusting the syngas' H₂/CO ratio for synthesis.

- A more efficient approach involves **CO₂ recycling**, where CO₂ separated from syngas is fed back into the gasifier or reformer, replacing part of the fluidizing steam. This increases CO concentration and allows for greater hydrogen addition.
- A further advanced concept maximizes **synthetic fuel output** by increasing CO₂ recycling and generating excess oxygen, which can be sold.



Figure 1: Tcbiomass2024, U.S.A.

The study also compared the **techno-economic performance** of these hybrid configurations to conventional thermal gasification. Focusing on pressurized steam/oxygen-blown circulating fluidized-bed gasification of biomass and waste, the analysis, based on Aspen Plus® simulations and experimental data from VTT's pilot-scale gasifier, highlighted the potential of these hybrid technologies in improving both fuel production and carbon efficiency.

2. FlexSNG Webinar Series – In case you miss it!

As mentioned in the last newsletter, the Webinars' series to disseminate the research conducted by the project partners has concluded. The conclusion of FlexSNG's successful webinar featured three 1-hour sessions and one extended session of 1.5 hours. Researchers shared insights into multiple value chain aspects and provided valuable perspectives on the project's improvements throughout the series

As highlighted in the fourth and final webinar, the FlexSNG project demonstrated innovative advancements in biomass gasification and methanation, providing flexible and cost-effective solutions to bioenergy challenges.



Figure 2: Webinar series

Here you'll find the full list of webinars with links to access the recordings in case you missed them.

- Webinar #1 - 10th April 2024 – Biochar: Production routes, properties and potential use. youtu.be/5E_3_ofMlek
- Webinar #2 - 8th May 2024 – Flexible and integrated biomass supply chains. youtu.be/XZ08mdWwetk
- Webinar #3 - 22nd May 2024 – A flexible gasification process. youtu.be/T6boiOYQaqw
- Webinar #4 - 25th Nov 2024 - Advanced Analytics in Support of the FlexSNG Gasification-Methanation Process at Large Capacity. youtu.be/1UbH6e2yRH4

3. FlexSNG at the BEEST IEA 2024

Ilkka Hiltunen from VTT presented the FlexSNG project at the BBEST IEA 2024 Conference. This event took place in São Paulo, Brazil, from October 22 to 24. At the event, an engaging oral presentation was delivered by Ilkka, who discussed the fascinating topic of **“Validation Tests of Flexible Fluidized-Bed Gasification Process for Co-Production of Synthesis Gas, and Biochar”**, charming the audience with precious understandings.

The presentation showed the experimental validation of FlexSNG project's technologies for producing synthetic natural gas and biochar from biomass and waste. Two operation modes were tested: co-production of biomethane and biochar and maximized biomethane production. Tests were conducted at VTT's 0.5 MW pressurized fluidized-bed gasification pilot plant, which includes a gasifier, hot filtration, catalytic reforming, and gas coolers. Three test campaigns were carried out with different feedstocks and operation modes.



Figure 3: Ilkka at the BEEST Conference

4. ICEESEN-2024 & FlexSNG

Kostis Atsonios from CERTH recently presented at the 4th International Conference on Energy, Environment, and Storage of Energy (ICEESEN-2024) in Cappadocia, Turkey. In his talk, he drew attention to the latest improvements in the FlexSNG project with the title **“Process Analysis of Flexible Gasification-Based Thermochemical Conversion Concepts of Biogenic Residues and Wastes into Biomethane and Biochar.”**

In exploring a wide range of key areas, the presentation concentrated deeply on several important topics:

- **Enhanced FlexSNG Concepts:** a detailed exploration of the integrated FlexSNG concepts and their potential to boost product yields and energy efficiency.

- **Advanced Process Modeling:** a deep dive into the methodology used to develop precise process models for simulating the FlexSNG process.
- **In-depth Simulation Results:** a comprehensive analysis of the main findings from process simulations, including a comparative study with conventional gasification-based pathways.

CERTH strives for a more sustainable future by efficiently transforming biogenic residues and waste into precious biofuels and biochar through the improvement of FlexSNG technology.

5. Final Event

The **FlexSNG project**, an ambitious initiative funded under the Horizon 2020 program, is nearing its conclusion, set for December 31st, 2024.

On December 2nd, a **Final Online Event** marked a significant milestone, showcasing the results of over 43 months of research and development.

FlexSNG is revolutionizing the energy sector by transforming agricultural waste into a clean, renewable fuel. This groundbreaking innovation not only propels us towards a more sustainable future but also stimulates local economic growth, creating new opportunities for development.

Key Achievements and Innovations

The FlexSNG project has successfully developed a flexible and efficient gasification process, transforming low-grade biomass and waste into valuable energy products. Key achievements include:

- **Industrial-scale validation:** the technology has been proven ready for full-scale industrial application, achieving a Technology Readiness Level of 5.
- **Operational Flexibility:** the gasification process developed is highly flexible, capable of adapting to various operating conditions and market demands, ensuring maximum efficiency and adaptability.
- **Optimized supply chain:** the project has streamlined the biomass supply chain, overcoming challenges related to geographical dispersion, feedstock quality, and seasonal variations.
- **High-value biochar:** the produced biochar offers numerous applications, including soil enhancement and carbon capture, contributing to a more sustainable future.



Figure 4.1: Promoting the event

Impacts and Benefits

The FlexSNG project offers a comprehensive solution for a sustainable future, combining environmental benefits with economic opportunities. By valorizing biomass residues and reducing greenhouse gas emissions, FlexSNG significantly contributes to a **circular economy**.

Additionally, the project enhances energy security by promoting the local production of biomethane, reducing reliance on fossil fuels. The biochar byproduct finds diverse applications in industry and agriculture, further solidifying the project's commitment to sustainability.

A Sustainable Future

The results of the FlexSNG project open up new prospects for the development of sustainable energy conversion technologies. The replicability of the process on an industrial scale and its integration into existing energy systems are the next challenges for the sector. The final event, with its large attendance, highlighted the interest and importance of this project for the future of clean energy.

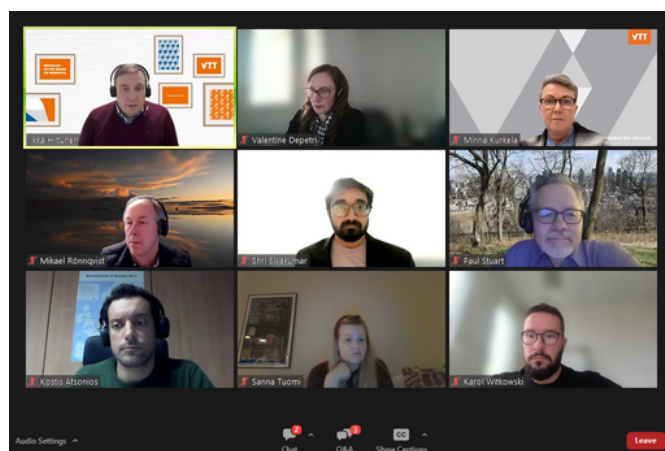


Figure 4.2: FlexSNG speakers at the Event

Find more details of the Final Event checking the last press release!

6. Meeting in Helsinki

The final partners meeting of the FlexSNG project took place on 13 and 14 November 2024 at the VTT Bioruukki in Espoo, Finland, with the participation of experts and project partners. During the first day, participants had the opportunity to hear presentations on the detailed results of each Work Package (WP), including publications and events in which the project took part.

The presentations covered crucial topics such as project management (WP1), sustainable procurement of raw materials (WP2), process design and techno-economic analysis (WP7) and case studies on environmental analysis and business potential (WP8). One of the most anticipated sessions was the Canadian presentation on the results of the MCDM (Multi-Criteria Decision Making) panel.



Figure 5.1: Workpackage presentations

The day ended with an open discussion on the topics discussed and a convivial get-together over a working dinner, where topics of future cooperation were discussed in depth.

On the second day, presentations focused on topics such as low-cost oxygen production (WP3), flexible gasification process (WP4), validation of enabling technologies (WP5), and bioenergy carrier solutions (WP6). WP9 then dealt with the dissemination of results and the exploitation of results.



Figure 5.2: FlexSNG partners

A particularly interesting highlight of the meeting was a visit to the VTT pilot gasification plant, which offered a practical insight into the technologies developed during the project.

The meeting concluded with a final discussion session and thanks to all participants for their contribution to the success of FlexSNG.



Figure 5.3: Visiting VTT pilot





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