

Advanced biomass CCHP (BIO-CCHP) based on gasification, SOFC and cooling machines

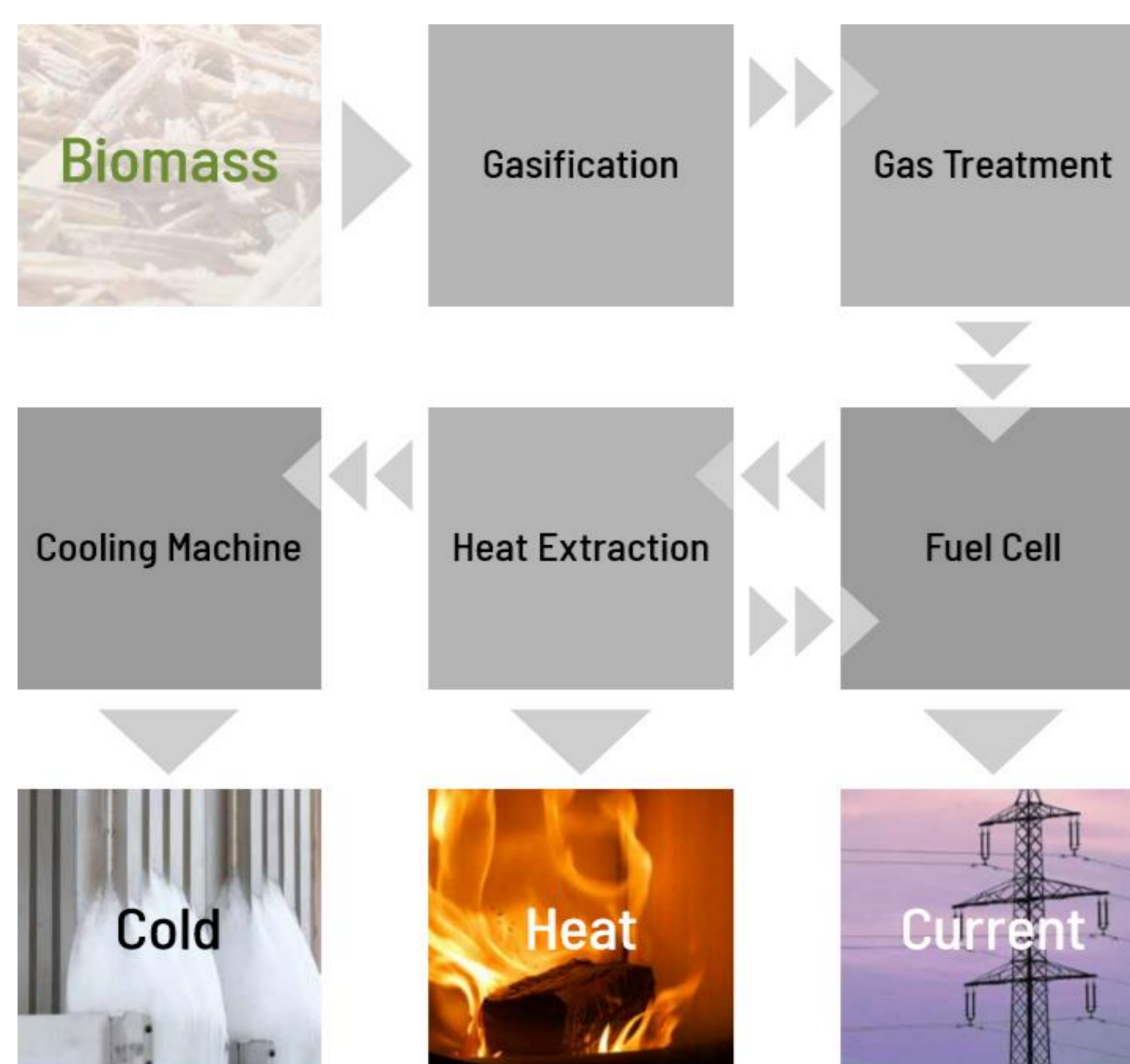
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Fixed Bed Conversion Systems

Project description

The overall objective is to develop a novel trigeneration system, BIO-CCHP, to produce energy, heat and cold with maximum efficiency and flexibility. It includes biomass gasification, a Solid Oxide Fuel Cell (SOFC) stack and a cooling machine.

Depending on the type of the used gasifier and the feedstock the amounts of trace substances in the producer gas differ significantly.



Graphic 1: Block diagram of the BIO-CCHP process

A few of them are listed here with the measured variation limits of the gasifiers relevant in this project:

- Particle matter: 0 - 30,000 mg/Nm³ - dry basis
- H₂S: 15 - 152 mg/Nm³ - dry basis
- COS: 1 - 27 mg/Nm³ - dry basis
- NH₃: 10 - 1,500 mg/Nm³ - dry basis
- HCN: 3 - 15 mg/Nm³ - dry basis
- Tars: 1.05 - 19,000 mg/Nm³ - dry basis

To make the producer gas economical applicable for a SOFC, a high temperature gas cleaning method will be evaluated and optimised with tests at different gasifiers. Long-term tests, coupled with CFD modelling, will allow to find a low-degradation operation mode for the SOFC stack fed with a producer gas from biomass gasification. Finally, a techno-economic analysis and optimisation and an industrialisation plan of BIO-CCHP will be conducted.

Gas cleaning & producer gas characterisation

This working package is aimed at the development of an adequate hot gas cleaning method for the proposed concept and its experimental confirmation of suitability for different gasification technologies.

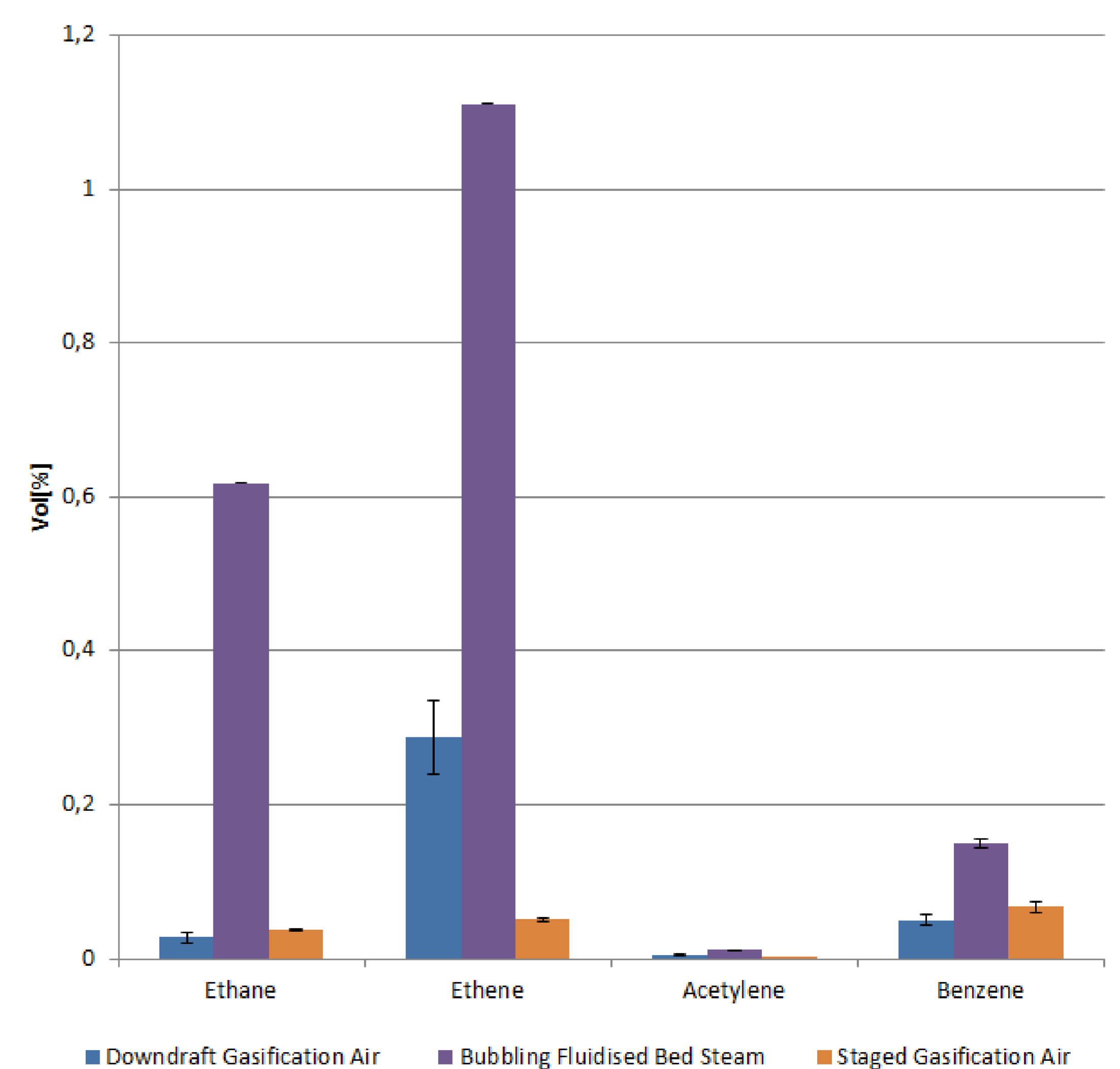


Graphic 2: Gas cleaning unit of BEST GmbH

Therefore experimental tests using real producer gas of different biomass gasification plants are conducted with a mobile gas cleaning unit.

Reliable data of the cleaned producer gas is essential for the evaluation of cleaning processes and SOFC-performance. Employed measurement devices are:

- Multicomponent online gas analysis device (NDIR + TCD + electrochemical measurement cell)
- Fourier-transform infrared spectroscopy (FTIR)
- Gas chromatography with mass spectroscopy and Flame Ionisation Detector (GC MS / FID / SCD)
- Wet chemical analysis
- Tar protocol



Graphic 3: C2-compounds and benzene concentrations in producer gases of different gasification technologies

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