



On-farm biogas to biomethane upgrading plant and filling station

Farms that have a biogas plant have the option to further upgrade the biogas to biomethane that can be stored as compressed natural gas (CNG) and afterwards can be used as a fossil-free alternative fuel for heavy duty vehicles like tractors or trucks.

The production of biogas on livestock farms is usually based on using field residues, manure and slurry, which all are renewable non-fossil resources. Commonly the raw biogas that originates from the anaerobic digestion of these resources is converted into thermal and electric energy in a combined heat and power plant (CHP). Plant sizes between 100kW_{el} and 250kW_{el} are economically feasible in practice. As an alternative, the raw biogas can be purified into biomethane and compressed to 250 bar for use as a BioCNG fuel.

The prototype biomethane upgrading plant utilized in RES4LIVE uses a single-stage membrane purification process with the return of the separated CO₂ to the digester next to the CHP operation for electricity and heat production. Between 10 and 20 % of the total volume flow of raw biogas can be used for CNG fuel, because this results in a CH₄ reduction in the remaining raw gas stream for the CHP - the gas is diluted, and if the methane content is too low, the engine in the CHP might not work properly any more. As an example, a biogas plant with 200 kW_{el} as a basic situation corresponds to a raw biogas volume of 100 Nm³ per hour. Economic feasibility starts in the range of 10 to 35 Nm³h⁻¹ raw biogas that is purified into BioCNG fuel. For cost-saving purposes, the compressor used to push the biogas through the single-stage membrane separating CO₂ and CH₄ at the same time compresses the biomethane to a storage pressure of 250 bar. Drawing the CNG from the storage, the filling station works by pressure difference until pressure balance with the gas storage of the vehicle is achieved.

For the operation of a 35 m³h⁻¹ raw biogas to BioCNG plant used at a capacity of 70 %, a full cost calculation results in fuel costs of 1.51 € kg⁻¹ BioCNG. Any monetary benefits from GHG quotas from the production and use of biofuel have not yet been taken into account and can have an additional positive effect. This operating mode requires an adequate amount of consumers on-farm or also commercial or private consumers, which should be planned accordingly in a business model.



BioCNG upgrade plant and fillig station (left), filling up a CNG tractor (right)



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