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Biomethane

DEFINITION & PROPERTIES

The term biomethane is used to describe methane that was derived from biomass. Biomethane has comparable properties to natural gas and thus can be transported and stored in the available facilities and infrastructure.
Currently available processes to produce biomethane are (1) Anaerobic digestion followed by upgrading and (2) Biomass gasification followed by methanation. In addition, methane can also be produced by combining CO_2 with H_2 in a Power to Methane pathway when using biomass-derived CO_2 (3). All these pathways use different feedstocks and conversion technologies.

PRODUCTION PROCESSES

(1) Anaerobic digestion

Anaerobic digestion and the following upgrading of biogas is the process with the highest relevance, accounting for about 90 % of total biomethane production worldwide. This process allows a range of different feedstocks, e.g. sewage sludge or biowaste. Microorganisms digest these feedstocks with the absence of oxygen in a biogas plant, resulting in biogas. Different separation processes are available for the upgrading to achieve biomethane, for example water scrubbing or membrane separation. While initially biogas was primarily used for power and heat production directly at the biogas plant, an increasing number of installations now upgrade the biogas to biomethane for further use.

Gas composition	Biogas	Biomethane	Natural Gas
Methane	50–75 %	94–99.9 %	93–98 %
Carbon Dioxide	25–45 %	0.1–4 %	1 %
Nitrogen	<2 %	<3 %	1 %
Oxygen	<2 %	<1 %	-
Hydrogen	<1 %	Traces	-
Hydrogen Sulphide	20 – 20,000 ppm	<10 ppm	-
Ammonia	Traces	Traces	-
Ethane	-	-	<3 %
Propane	-	-	<2 %
Siloxane	Traces	-	-
Water	2 – 7 %	-	-
LHV	16–28 MJ/m³	36 MJ/m3	37-40 MJ/m³

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Table 1: Comparison of biogas, biomethane and natural gas

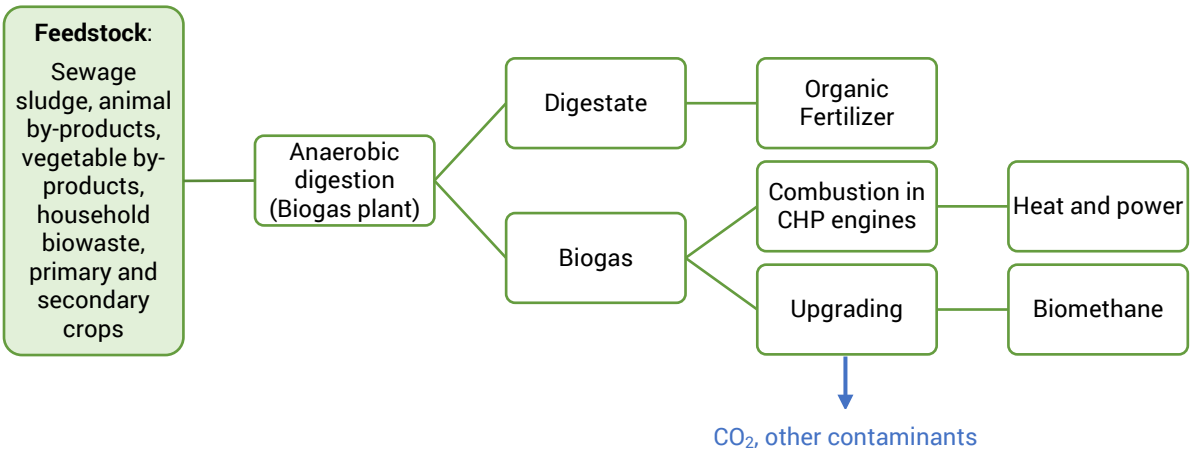
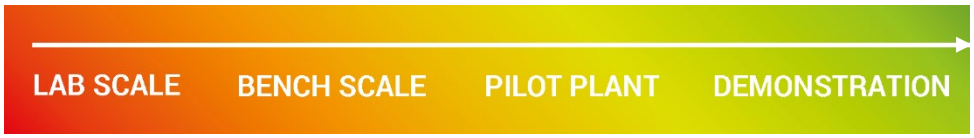


Figure 1: Production of biomethane through anaerobic digestion and upgrading

(2) Biomass gasification



The process of biomass gasification uses woody biomass as feedstock and applies high temperatures of 700-800°C and high pressure in a low-oxygen environment. This results in a mixture of gases like carbon monoxide, hydrogen and methane, called syngas. In the methanation process, this syngas is cleaned and the following methanation step produces pure biomethane (BioSNG) and removes CO_2, H_20 and other unwanted components.

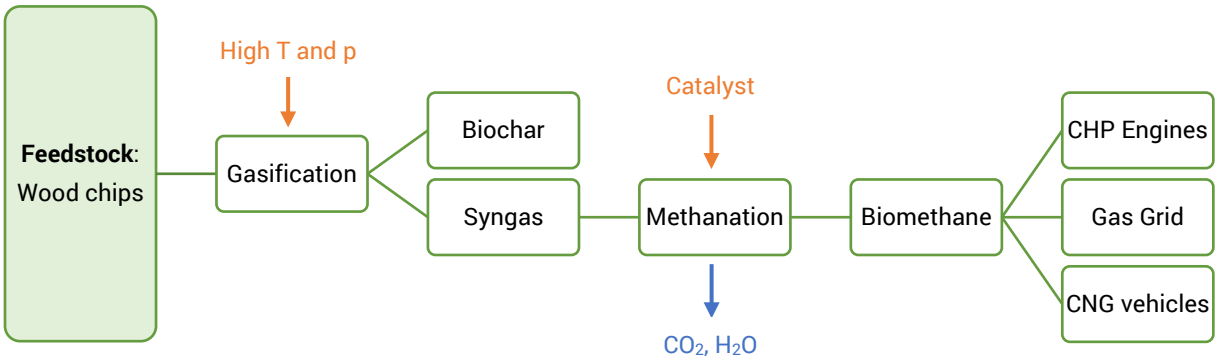


Figure 2: Production of biomethane through biomass gasification and methanation

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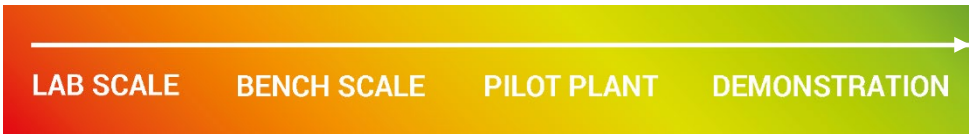
(3) Power to Methane



The Power to Methane (P2M) process presents a way to store renewable electricity surpluses in gaseous form (methane). In this process, electricity surplus is used for electrolysis, whereas water is hydrolysed to create hydrogen. CO_2 is used for the methanation of the hydrogen. CO_2 can be derived from biomass-based processes (e.g. biogas or bioethanol production), from ambient air, or from the flue gas of installations burning fossil sources. Depending on the source of CO_2, the resulting methane is either a biofuel, a renewable fuel of non-biological origin, or a recycled carbon fuel. All of these have GHG emission benefits over fossil methane.

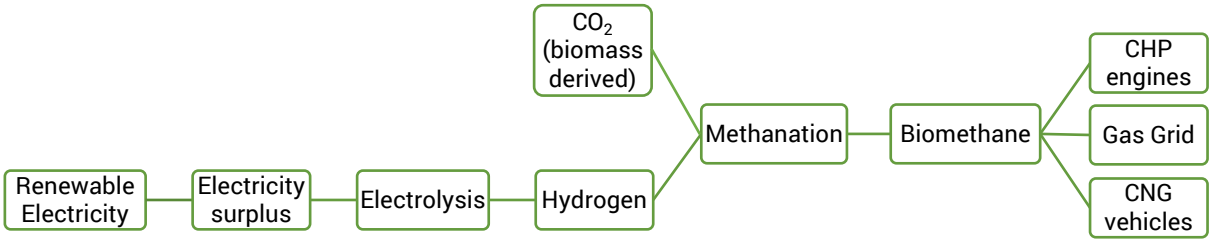


Figure 3: Production of biomethane through the Power to methane process

APPLICATIONS

Due to its similarity to natural gas, biomethane can be used in existing infrastructure. Possible applications are: as fuel in vehicle engines, as fuel in CHP plants as a large-scale application for heat and electricity production, for cooking purposes in households and for all purposes (e.g. industrial applications) for which natural gas is used from the gas grid.

EXAMPLES OF DEMOPLANTS

Operator:	NAWARO® BioEnergie AG Güstrow, Germany Biogas power plant
Commissioning:	2009
Technology:	Biogas power plant and upgrading
Plant:	20 fermenters in total, each with a capacity of 5,000 t
Feedstock:	400,000 tons per year, mainly maize
Production capacity:	43 - 46 million m³ biomethane per year

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Operator:	Formerly Goteborg Energi AB GoBiGas Phase 1 Gothenburg, Sweden Gasification and methanation demonstration plant
Commissioning:	2013-2018, restart planned
Technology:	Repotec gasification and Haldor Topsoe methanation technology
Feedstock:	Forest residues, wood pellets, branches and tree tops
Production:	SNG (11,200 t/y), heat (5 MW), power (electricity) (6 MW)

Operator:	Uniper SE Falkenhagen, Germany Power to Gas Demonstration Plant
Commissioning:	2016
Energy source:	Wind
Electrical input:	2 MW
Hydrogen Output:	360 Nm^3/h

SOURCES

- https://www.europeanbiogas.eu/about-biogas-and-biomethane/
- https://www.ieabioenergy.com/publications/biomethane-status-and-factors-affecting-market-development-and-trade/
- https://www.iea.org/reports/outlook-for-biogas-and-biomethane-prospects-for-organic-growth/an-introduction-to-biogas-and-biomethane
- https://www.iangv.org/natural-gas-vehicles/natural-gas/

FURTHER INFORMATION

- http://task37.ieabioenergy.com/plant-list.html
- http://www.gm-greenmethane.it/en-us/applications
- https://www.biogas-to-biomethane.com/Download/BTB.pdf
- https://www.uniper.energy/storage/de/geschaeft/power-to-gas
- https://demoplants.best-research.eu/
- https://www.nawaro.ag/