A glance at commercial biogas upgrading technologies

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Biogas upgrading process

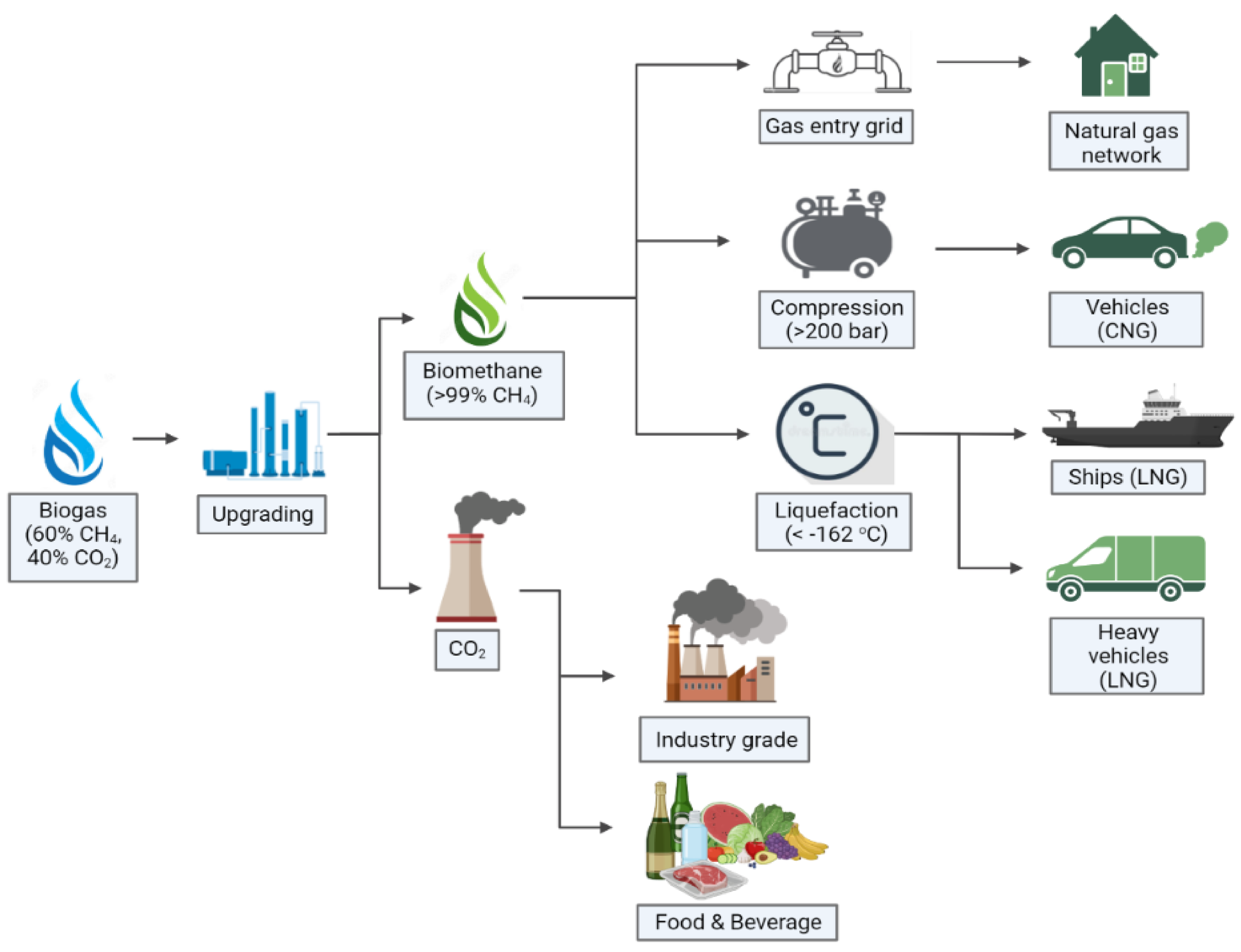


Figure 1. Flow diagram of the biogas upgrading process.

Nowadays, the need for transition to sustainable forms of energy is more pressing than ever. The conventional energy sources such as fossil fuels are finite and becoming increasingly scarce, and their extraction and usage greatly contribute to global warming and environmental deterioration.

Biogas, the end product of anaerobic digestion is key player in the emerging market for **renewable energy** since it combines renewable energy generation and organic waste management. It is challenging to find the right technology or combination of technologies that will allow biogas to be upgraded from modest methane levels up to 99% methane and be similar to natural gas in quality. The upgraded biogas, known as **biomethane**, is characterized as a product with high market value due to its wider applicability in sectors such as industry, transportation, electricity and heating.

Upgrading technologies in Europe

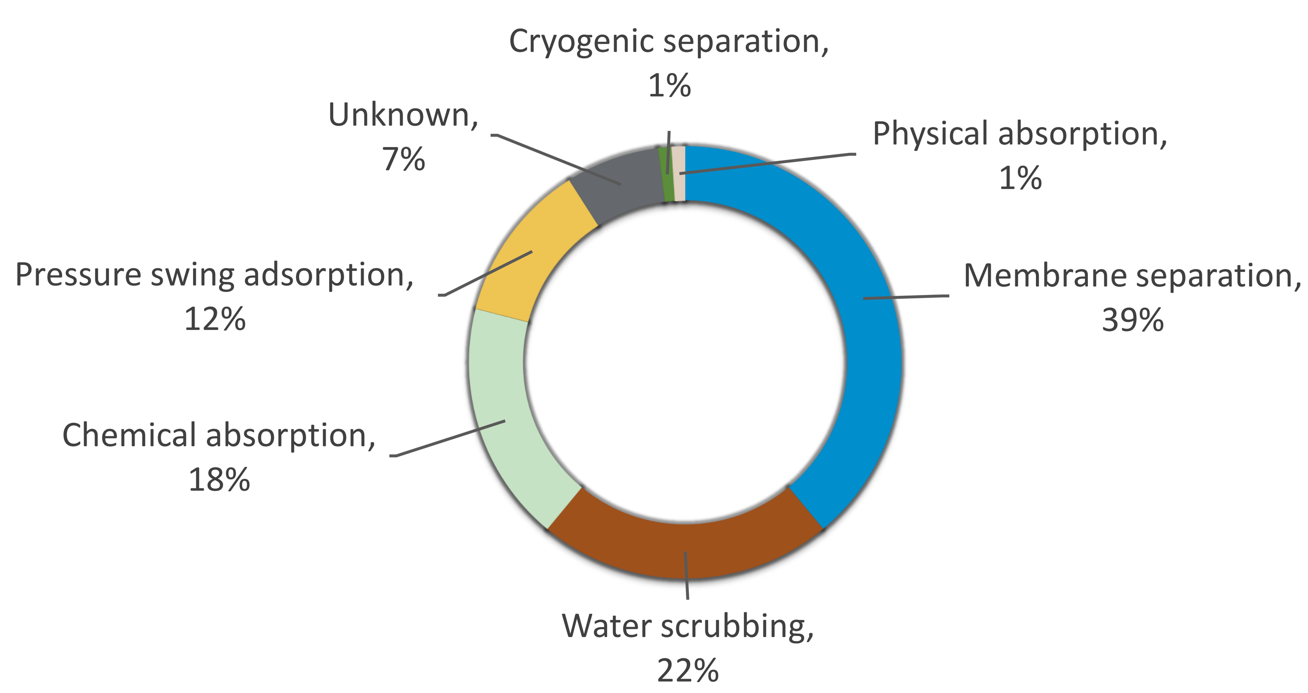


Figure 2. Use of biogas upgrading technologies (%) in Europe (EBA, 2021)

Membrane-based

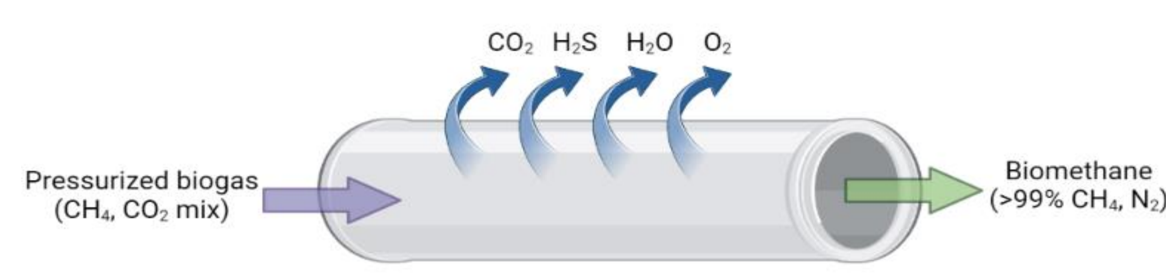
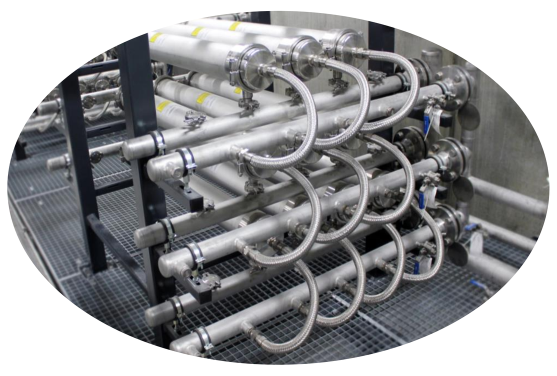


Figure 3. Membrane-based system



Selective flow of individual gas components across a semi-permeable membrane, achieving the production of **high purity biomethane**. Commercial membranes based on polyimide and cellulose acetate proved to be the most suitable for biogas separation and enrichment among the different kinds of membranes tested.

Water scrubbing

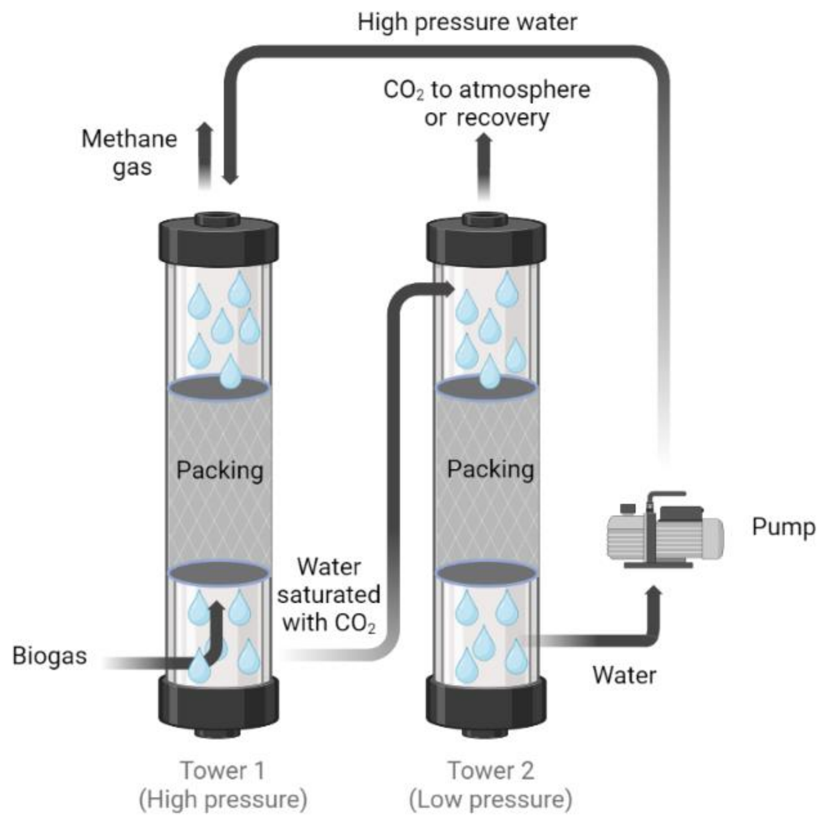


Figure 4 . Water scrubbing system

Biogas is inserted in a packed scrubber column and water fills in the tank in a countercurrent flow. CO_2 dissolves into the water, while CH_4 remains in the gas phase, allowing their separation. CH_4 purity varies between 80-99% depending on the remaining volume of N_2 and O_2 in the gas phase.

Chemical scrubbing

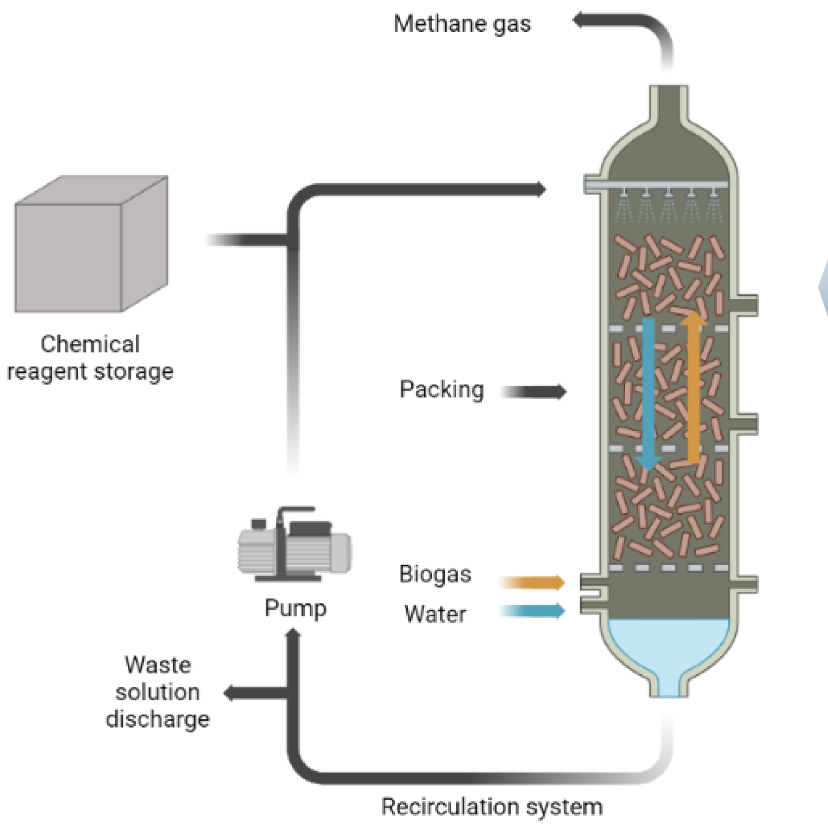


Figure 5. Chemical scrubbing system

Amine or alkali solutions are used to bind the CO_2 of biogas. Biogas is provided in the absorption column and the solution is provided in a countercurrent flow. Chemical solvent selectively reacts with CH_4 in this process, resulting in methane recovery, exceeding 99%.

Conclusions

- ✓ Biogas upgrading methods are enticing options for the cover of energy demands.
- ✓ Existing well-developed technologies are able to generate high purity biomethane, appropriate to be utilized as biofuel for transportation and/or gas grid injection.
- ✓ Emerging cost-efficient biological technologies (chemoautotrophic and photosynthetic) that need further attention.

Acknowledgements

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