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6. Competitiveness of biomethane

Biomethane as a constituent part of biogas has competitive advantages in different types of markets, as shown below:

Biofuels

Possibilities	Biomethane	Hydrogen	Fossil
Type	Supply and demand	Supply and demand	Supply and demand
Self-consumption	Yes	Yes	Yes
Direct sale	Yes	Yes	Yes
Sales Possibilities	All possible ways	All possible ways	All possible ways
Storage	Liquid (ISO tanks) 25.000Nm^3 = 250.000kWh, Compressed (220 bar cylinders)	Liquid (ISO tanks) 1.100 kg = 36.573 kWh, Compressed (550 bar cylinders)	Liquid (ISO tanks) Compressed (220 bar cylinders)
Thermal utilisation	Possible	Possible, but dangerous	Possible
Infrastructure	Existing	It does not exist yet	Existing
Effect on prices	Deflation	Inflation	Inflation

Electricity

Possibilities	Biogas	Biomethane	Solar PV	Wind	Fossil
Type	Supply and demand	Supply and demand	Supply (with fossil energy backup)	Supply (with fossil energy backup)	Supply and demand
Self-consumption	Yes	Yes	No (only with storage)	No (only with storage)	Yes
Direct sale	Yes	Yes	No (only with storage)	No (only with storage)	Yes
Sales Possibilities	All possible ways	All possible ways	Only via auction with fossil backup	Only via auction with fossil backup	All possible ways
Storage	Possible (gas storage)	Possible: Liquid (ISO tanks) Compressed (220 bar cylinders)	Possible: Batteries (Lithium); generating hydrogen for storage	Possible: Batteries (Lithium); generating hydrogen for storage	Liquid (ISO tanks) Compressed (220 bar cylinders)
Effect on prices	Deflation	Deflation	Inflation	Inflation	Inflation

WORLD BIOGAS ASSOCIATION

WBA Working Groups are member-only forums where industry leaders collaborate to address key technical, policy, and market challenges facing the global biogas sector. Each group focuses on a specific topic—such as R&D, finance, policy and regulation, carbon markets, or waste feedstocks—and meets regularly to share knowledge, develop guidance documents, shape WBA positions, and inform international decision-making.

By participating, members gain early access to insights, contribute to industry standards and recommendations, and connect directly with peers, experts, and policymakers. These groups are a powerful platform to raise your company's visibility, influence the direction of the sector, and stay ahead of market trends.

To learn more about the latest innovations and technologies for the AD industry, don't miss:

Engine Room Theatre

AD Showcase: New Technologies

10 July from 14:15 to 15:15

In this showcase session, you will be presented with the latest innovations for the AD industry. It will highlight groundbreaking technologies designed to improve efficiency, optimise operations, enhance safety, and drive the future of AD systems.

Sustainable Ventures, 5th Floor, Riverside Building, County Hall, Westminster Bridge Road, London SE1 7PB

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BITESIZE BIOMETHANE BRIEF

1. Where does biomethane come from?

Biomethane is produced by upgrading biogas – removing carbon dioxide (CO_2), trace gases, and impurities until it contains at least 90% methane (CH_4). Biogas has a CH_4 concentration ranging from 51% to 75%, depending on the type of feedstock used. There are two primary biogas production technologies:

- Anaerobic Digestion (AD), with its associated biomethane purification technologies.
  - The most widely used methods are membrane separation, Pressure Swing Adsorption (PSA), and amine washing.
  - Different methods are also used, such as methanation (H_2 + CO_2), and some are under research and development phase, including biomethane production from green hydrogen (H_2), biogas production without pressure, and at low temperatures.
  - All non-woody organic matter produces biogas in the absence of oxygen (anaerobic digestion).
- Gasification, which includes hydrogasification, thermal gasification, and pyro-gasification, with a primary focus on lignocellulosic biomass and some organic wastes.

Currently, the primary technology used globally is the Anaerobic Digestion – a well-established and mature technology – but Gasification is forecasted to have a great impact on biomethane production through the 2040s.

2. Examples of CH_4 and CO_2 separation technologies

The best choice for any given plant will depend on local factors, such as the availability of feedstock and other post-processing options.

- Water scrubbing – CO_2 dissolves in water, but CH_4 does not. Simple, environmentally friendly, and cheap.
- Chemical scrubbing – solvents are used in which one gas dissolves but the other does not. It can achieve high levels of CO_2 separation, but chemicals are more expensive than water.
- Pressure swing absorption – gas pressure is increased to the point that one gas adsorbs onto the enclosure walls and the other is free to leave.
- Membranes – a barrier which permits CH_4 to pass through, but CO_2 (a bigger molecule) does not—low cost.
- Cryogenic technologies – the gas is cooled to the point where it condenses into a liquid while the other remains gaseous. Great if you want to produce liquid biogas. Good at ensuring CH_4 is not wasted, but energy intensive.

Biological organisms consume the CO_2 and turn it into a different molecule. Cutting-edge technology, but organisms can be killed if not managed properly.

3. Biomass sources for biogas and biomethane production

Biogas and biomethane are produced from a wide range of biobased feedstocks. Feedstocks include non-woody materials, such as the organic fraction of municipal solid waste (MSW), livestock manures and slurries, agricultural and agro-industrial residues, food and beverage production wastewater and residues, energy crops, among others.

The primary biomass feedstock sources versus technology are summarised as follows:

Technology	Biomass Sources
Anaerobic Digestion	• Grass (Sileage) cut from grassland, not compromising feed production • Sequential and cover cropping subsequent to food crop harvesting • Agricultural residues following the main (food) crop harvesting • Animal Manure arising from all livestock (including pigs, chickens, cattle) • Biowaste, including domestic and commercial food, fruit and vegetable waste • Industrial wastewater pre-treatment • Sewage sludge produced as solid or liquid by-products in municipal systems
Thermal Gasification	• Forest residues (brash) from thinning and logging • Superfluous woody residues from landscaping and from maintenance • Lignocellulosic waste from secondary wood residues and timber production • Lignocellulosic Waste from paper and pulp production • Lignocellulosic harvest residues (including stalks) from food and grain cropping

4. Use of CO_2 captured during biogas upgrade

Different revenue streams open up the better purity of CO_2 you can achieve. Note that some streams may have specific requirements other than just CO_2 purity.

- **Industrial or medical grade, 99.5% pure.**
  e.g. welding, chemical manufacturing, and various therapies.
- **Bone dry, 99.8% pure.**
  e.g. used for atmospheres to grow plants.
- **Food or beverage grade, 99.9% pure.**
  e.g. carbonated drinks.
- **Anaerobic or laser grade, 99.95% pure.**
  e.g. used to produce anaerobic environments or lasers.
- **Super-critical fluid grade, 99.998% pure.**
  e.g. turned into a liquid for transport or other applications.
- **Research grade, 99.999% pure.**
  e.g. carrier gas for chromatography.

5. Injecting H_2 into biogas to increase the yield of biomethane

- Methanation
- Converts excess renewable electricity into H_2 via electrolysis.
- Combines H_2 with carbon dioxide (CO_2) from biogas to produce additional CH_4.
- Enhances gas grid injection and energy storage capabilities.

Hydrogen (H_2) is emerging as a promising tool to enhance the efficiency of anaerobic digestion by increasing CH4 yields through the conversion of CO_2. One method under exploration is *in-situ H_2 addition*, where H_2 gas is injected directly into the active digester. This can support the activity of hydrogenotrophic methanogens, microorganisms that use H_2 to convert CO_2 into CH_4. By providing an additional H_2 source, this approach has the potential to shift the gas composition towards a higher CH_4 content, without increasing the organic loading rate. While there are operational challenges to manage, such as gas mixing, H_2 solubility, and microbial balance, early trials and research suggest it could be a useful strategy for optimising biogas yield within existing infrastructure.

A second approach involves *ex-situ methanation*, where the CO_2 from biogas is reacted with H_2 in a separate reactor, outside the digester. This process can be either biologically or catalytically driven, and aims to produce additional CH_4 by converting surplus CO_2 using renewable H_2. Ex-situ systems offer greater control over reaction conditions and separation from the biological dynamics of the main digester. While still at the demonstration and early commercialisation stages, both in-situ and ex-situ H_2 integration pathways show potential to improve the overall energy output and carbon efficiency of AD plants, particularly when linked with surplus or curtailed renewable electricity sources.