

BIOGASES: BEYOND ENERGY

As part of a balanced, forward-looking renewable energy mix, biogases are set to play a pivotal role in delivering Europe's long-term energy security and climate mitigation objectives. The benefits of biogases go far beyond the reduction of greenhouse gas (GHG) emissions. This series of six factsheets will explore the multiple solutions that biogases are already providing in the development of a European bioeconomy.

1. Energy system integration



About energy system integration

Flexibility – in the form of flexible operations and power generation, stronger grids, more energy storage and demand response – is paramount in enabling the transition to a power system dominated by renewables, which will include increasing quotas of variable sources providing fluctuating levels of electricity.

Enabling and encouraging different energy sectors to work together optimises the function of the energy system as a whole: it is more effective than decarbonising and making separate efficiency gains in each sector individually.

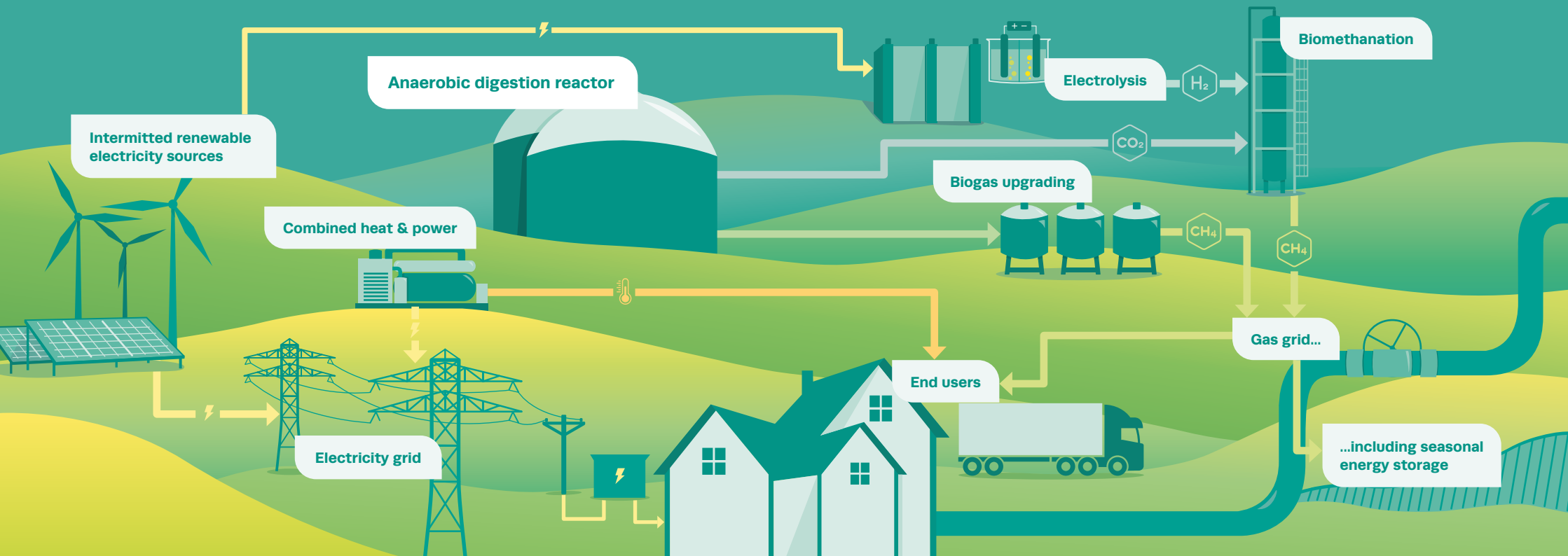
Biogas and biomethane can be produced at a relatively constant pace and then used to generate electricity as needed, making it possible to offer dynamic electricity production that can accommodate fluctuations in electricity demand. This promotes grid stability and provides additional options for seasonal energy storage.

How do biogases contribute to energy system integration?

Biogas and biomethane are an important source of flexibility in the energy system. They contribute to all energy outputs – electricity, heat and transport – and can support the further integration of variable renewables via three main pathways:

1. **Cogeneration or combined heat and power systems (CHP): Biogas cogeneration plants** allow the simultaneous production of electricity and heat (the latter as hot water or steam). Biogas-CHP plants can accommodate daily fluctuations in energy demand thanks to the flexibility of the CHP engine.
2. **Bio-methanation: Power and gas grids work together**, using surplus renewable electricity to produce biomethane, which can be stored or injected into the gas grid. Surplus electricity from the power grid is converted into hydrogen, which is then combined with the biogenic CO₂ from an anaerobic digestion (AD) plant to produce biomethane.
3. **Biomethane: Biogas upgraded to biomethane can fulfil** all the functions of natural gas, including transport and seasonal energy storage.

Biogases contribution to energy system integration



Facts

How do biogas-CHP plants contribute to energy system flexibility?

A: Combined heat and power (CHP) plants generate electricity and heat simultaneously. Electricity produced can be used on-site or fed into the power grid, while the heat can serve local consumers or district heating. Cogeneration is an efficient form of energy conversion: it yields significant energy savings compared to the separate production of electricity and heat.

Supply and demand within the electrical power grid must always be balanced; in order to achieve this, Transmission System Operators (TSO) require reserve power. Biogas-CHP plants are particularly well-placed to provide this thanks to their flexibility in dispatching and controlling their energy output. CHP engines can be quickly tuned to produce more output when demand is high or less when demand is already being met by other renewables.

In this way, biogas-CHP engines contribute to electricity grid stability and support future power system scenarios dominated by variable renewable sources.

How do biomethane plants contribute to energy system flexibility?

A: Produced by upgrading biogas, biomethane is a flexible and sustainable energy carrier. Biomethane helps match energy production to usage, providing an important form of seasonal energy storage. It can be injected into the existing gas infrastructure, which in itself functions as an energy storage unit and has the capacity to cover up to 2-3 months of current gas consumption in the EU.

Biomethane offers dispatchable power generation and the decarbonisation of existing fossil-based district heating systems, as well as greening the gas grid and supporting applications in industry and transport.

How do biomethane and hydrogen benefit from each other?

A: Biomethane and hydrogen will increasingly complement each other in Europe's future energy mix, with several synergies already in place today.

The bio-methanation process is a good example of the mutually beneficial nature of these two energy carriers when used in conjunction with each other. Green hydrogen, produced from excess green electricity, can be combined with raw biogas to convert the biogenic CO₂ into biomethane. This methanation process allows biomethane to function as an energy storage solution: excess green electricity is stored in the gas grid in the form of biomethane. Conversely, where hydrogen is the required energy carrier, biohydrogen can be produced from biomethane or raw biogas directly.

Why are complementary technologies so fundamental for the success of the energy system?

A: The fastest and most cost-efficient way in which to decarbonise the EU economy is the simultaneous deployment of complementary energy solutions. Although the electrification of end uses offers a partial route towards decarbonisation, heat accounts for half of EU energy consumption and transport emissions are on the rise. Biogas and biomethane will contribute significantly to energy system integration, providing renewable alternatives in all sectors.

In most cases, the combination of electricity with gas decarbonisation technologies yields the most cost-effective results. In the transport sector, for example, a 40-tonne electric truck would require a 6.4-tonne battery in order to travel 1000 km, whereas a gas-powered vehicle of the same size can travel the same distance using just 280 kg (620 litres) of Bio-LNG.

Case studies

ENGIE – Centrale Biométhane Du Vermandois

The biogas plant located at Eppeville, in the Hauts-de-France region, is part of the BIOMETHAVERSE project, which demonstrates five innovative bio-methanation technologies.

The plant has a capacity of 27 GWh, an amount of gas comparable to the consumption needs of 2,500 people. It is fed with 40,000 tonnes per year of agro-industrial and agricultural residues. The digestate is valorised through land-spreading (1,212 ha on 29 farms).



The plant is developing an additional pilot to demonstrate bioelectrical methanation. The aim of the pilot is to increase the biomethane output by combining green electricity, digestate and raw biogas in an innovative process.

NawaRo Plant in Schleswig-Holstein



Located in Schleswig-Holstein in northern Germany, the NawaRo plant began operation in 2010. The plant digester is fed with manure from pigs, cattle and horses, along with grass, silphium and other feedstocks. By processing these materials, the plant prevents the emission of up to 8,000 tonnes of CO₂ each year.

The NawaRo plant comprises four CHP units that generate almost 9 million kWh of electricity per year; this is marketed directly. On completion of current conversion work, the plant is expected to operate as a regenerative

storage power plant with a storage capacity of at least 60 hours.

A 20 kV power grid is being built for the plant's own power supply, while the heat generated is fed into the Tüttendorf and Gettorf heating networks.

Recommendations



Internalise the costs of daily and seasonal energy storage, flexibility and practices such as peak shaving to avoid peak demand charges on the electrical grid.



Plan the future of gas grids, providing the necessary grid reinforcement to allow decentralised plants to access energy markets and contribute to energy supply.



Adopt a holistic approach to the decarbonisation of the energy system, including investing in green energy sources and developing seasonal storage options.



Ensure that current and future legislation packages are consistent with each other, building on the existing regulatory framework that underpins liquidity and competitiveness within the internal market.



Provide end users with efficient options for decarbonisation, allowing them to choose the most suitable energy carriers and offering them effective energy solutions.

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