BIOGAS

Putting biogas at the heart of the bioeconomy

Treating organic wastes in an anaerobic environment (without oxygen) produces biogas, which can be used in several ways to replace fossil natural gas. And while biogas production uses mature technology, the industry has plenty of scope to grow – as this article from the World Biogas Association suggests.

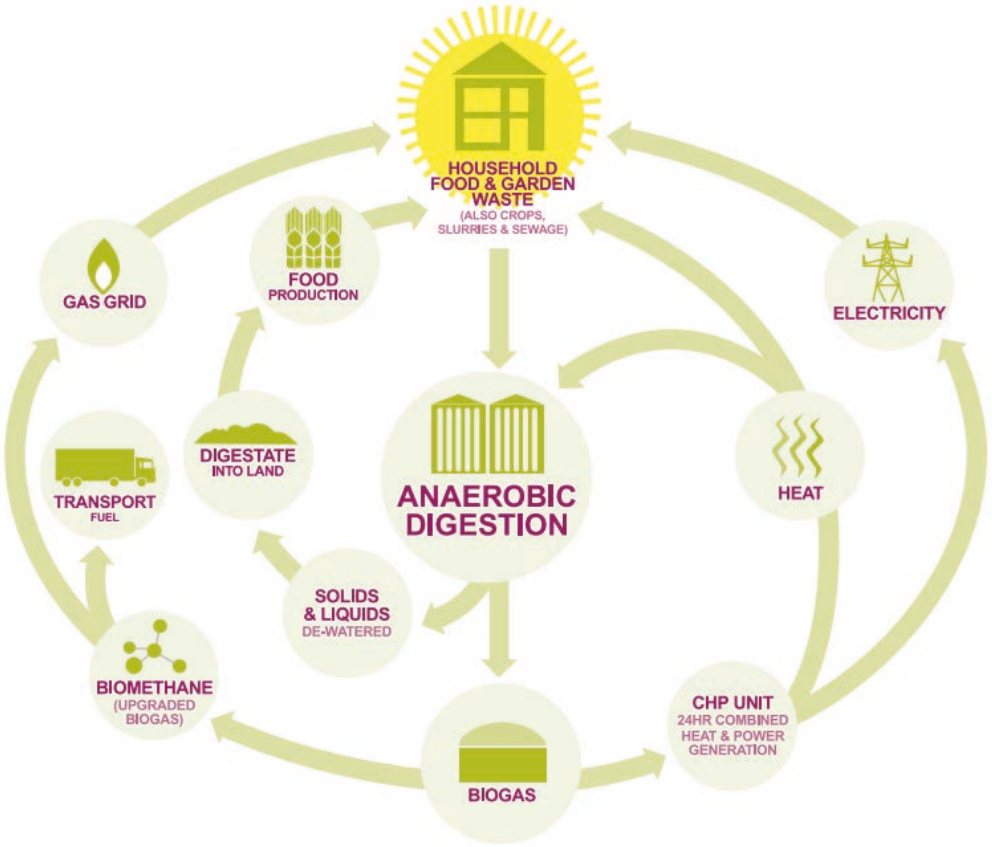
At the COP25 meeting in Madrid last December, the President of the World Biogas Association (WBA), David Newman, presented the Deputy Executive Secretary of the UN Climate Change Secretariat with a *Biogas Industry and Climate Change Declaration*. In this declaration, key players including SHV Energy, Suez, Engie, Clarke Energy and Greenlane Biogas commit to deliver a 12% reduction in global greenhouse gases emissions by 2030, subject to appropriate and adequate policy support from governments.

The declaration outlines the ability of anaerobic digestion (AD) technology to cut global emissions by up to 4bn tonnes of carbon dioxide (CO2) equivalent.

The target illustrates the enormous, yet still untapped, potential of the biogas industry. A recent WBA report: *The Global Potential of Biogas*, found that only 2% of the organic wastes available to generate biogas is currently being treated through the AD process, leaving an estimated 83bn tonnes of food waste, sewage, manure and other organic matter untreated and emitting harmful gases in the open air, in landfill or when incinerated.

In addition to removing methane-emitting waste from the environment and recycling it into green gas for use in hard-to-decarbonise sectors such as heat, transport and agriculture, AD also produces a digestate biofertiliser, which can replace fossil-based equivalents to replenish soil.

The biogas industry is therefore more than just a renewable energy source. It provides low-carbon alternatives to inorganic fertilisers in farming and supports global waste management strategies. As such, it can play a major role in decarbonising the global economy.



The anaerobic digestion (AD) process
Illustration: ADBA

Organic matter to gas

Biogas is produced from the breaking down of organic matter such as food waste, sewage, wastewater and agricultural waste under oxygen-free conditions in a digester. AD plants can produce energy both at small scale (eg for households and farms) and at large scale for entire cities.

There are currently an estimated 132,000 small, medium and large digesters in the world. Statistics from the International Renewable Energy Agency (IRENA) show a global capacity of 18 GW for the biogas industry in 2018, producing 88 TWh of biogas each year. Europe is by far the largest contributor with 73% of the global production, and Germany leads the industry, with close to 11,000 plants currently in operation. Outside of Europe, the US and China are the largest producers, with a combined capacity of 3 GW, and output of 16 TWh per year.

Raw biogas produced by AD is either sent to a combined heat and power (CHP) unit to generate electricity and heat for use locally, or upgraded into biomethane – also known as renewable natural gas. This biomethane can be injected into a national gas grid or used as a transport fuel.

Biogas is composed of

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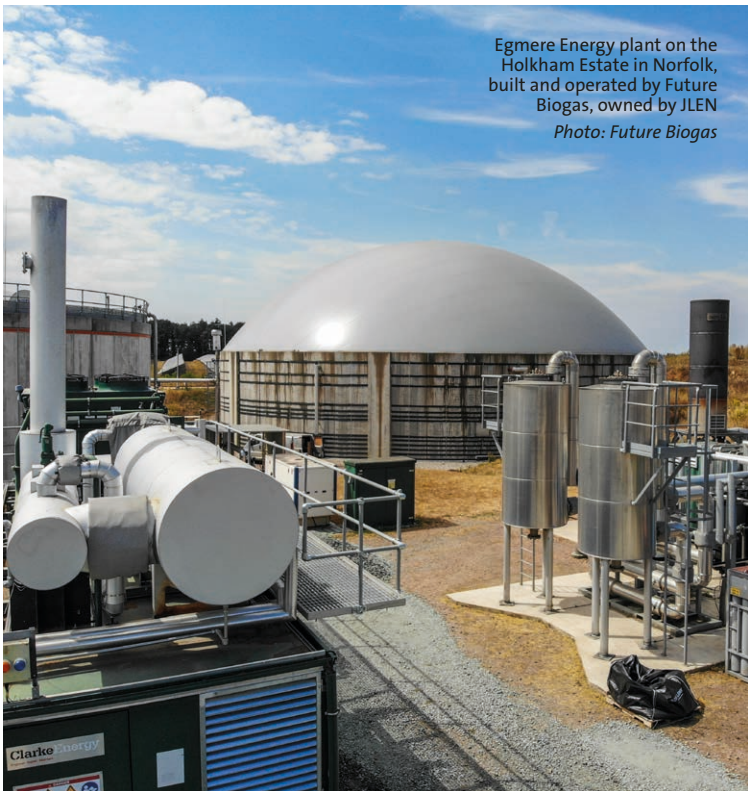
biomethane and CO2. Where this is upgraded to biomethane, the CO2 can be captured and utilised by various industries, including food and drink manufacturing. Alternatively, excess electricity generated from renewables can be used to create hydrogen gas which, when mixed with the raw biogas, can convert CO2 into additional biomethane, nearly doubling the amount of renewable gas produced.

Meanwhile, the nutrient-rich digestate produced through AD can be used as an organic fertiliser for farming – offering a low carbon option to replenish soils and improve crop yields. Residue from the crop yields, alongside urban food waste, will in turn provide the organic waste needed as feedstock for the new AD treatment cycle – creating a sustainable circular economy model. It is for this reason that the International Energy Agency has called AD the 'hub of the bioeconomy ecosystem.'

The global biogas industry has grown by over 90% between 2010 and 2017, yet there is still huge scope for further growth. The WBA estimates that to achieve the 12% emissions reduction ambition, the industry needs to build over a million new plants over the next decade. However, multiple barriers need to be removed before it can reach its full commercial and economic capacity.



Egmere Energy plant on the Holkham Estate in Norfolk, built and operated by Future Biogas, owned by JLEN

Photo: Future Biogas

Feedstock availability and land use issues

The biggest challenges for the industry to reach its full potential are the recovery of as much organic matter as possible for AD treatment, and the integration of this mature, ready-to-use technology into global energy and waste strategies and networks. AD has to secure policy incentives and investments across multiple government departments, joining solar and wind as an integral part of the energy mix, but also becoming recognised for delivering the additional environmental benefits of merging waste and energy streams.

AD needs to be identified as the preferred method of treatment of *all* biodegradable wastes and policy measures must be implemented to ensure that the feedstock available is fully exploited and the broader infrastructure put in place to

Biogas in transport

Decarbonising transport is a major challenge facing the economy, not only to tackle climate change, but also as a public health imperative.

For example, transport in the UK is responsible for 26% of all carbon emissions and 45% of all NOx pollution. Although the UK government's ban of the sale of diesel and petrol vehicles by 2040 does not cover heavy goods vehicles, lorries and buses, this sector has already been making the switch to biogas as an alternative clean fuel.

Waitrose, Ocado and Hermes are using biomethane-fuelled delivery fleets. The Post Office is trialling biogas trucks on its long-haul routes and cities are introducing green gas into their public transport infrastructure. Nottingham has been leading the way with over 50 double decker buses in service, followed closely by Bristol.

Fleet operators who have switched to biogas have reported a reduction in CO2 output of around 85–95%. Analysis by the UK Anaerobic Digestion and Bioresources Association (ADBA) concludes that the UK industry has the capacity to produce enough biomethane to power 80% of the country's entire bus fleet and the potential to power 75% of all HGVs.

David Rix, Managing Director at Roadgas, which supplies biogas for the Nottingham bus fleet, says: 'At present, there is a highly organised biogas supply market with a structured supply chain. Sourcing compressed biomethane is relatively simple and with the rise in demand for liquid biomethane for LNG-powered vehicles, I envision increasing levels of supply coming into the market very soon. Furthermore, with the growth of the anaerobic industry as a solution for the UK's waste problems, the potential to produce biogas is enormous.'

Waitrose has introduced a fleet of 50 compressed biomethane-fuelled trucks

Photo: Scania Waitrose

The food versus energy crops dilemma

Growing a single type of crop, called monocropping, presents short-term benefits, for example selecting the easiest crop to grow that requires the least amount of water and other resources. However, monocropping has negative impacts on biodiversity as well as soil quality – with only one crop consistently grown, pests that feed on it will proliferate and create an ecological imbalance. The pesticides used to combat this may also become inefficient due to pests' resistance over time.

It is wrongly believed that monocropping is necessary to produce large quantities of bioenergy crops and that it necessarily affects food crops. Energy crops can be grown sustainably within the agricultural system to both prevent the negative impacts of monocropping and ensure that the multiple requirements placed on the land are met.

This is achieved by implementing crop rotations across several plots of land, or sequentially growing different crops on the same piece of land. This ensures that the balance between energy and food crops is maintained.

Italy is leading the way with its 'BiogasDoneRight' model, in which 600 farmers, organised as the Italian Biogas Consortium, are redesigning their own farming systems to demonstrate how it is possible to produce food and fuel more sustainably as well as increase the economic viability of agriculture.

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produce biogas on a large scale. For example, mandatory food waste collections, applicable to commercial and industrial units as well as households, with financial support given to municipalities to implement them, can significantly increase the quantity of wastes processed and exploited through AD.

Generating feedstock also involves making the best use of the land – an area which has been controversial for the sector, as critics cite a conflict between growing crops for food against growing crops for energy. There are solutions to this: rotation and sequential cropping (see box).

The industry is working closely with farmers to ensure that land use in agriculture is optimised to produce both the food needed to meet demand and the feedstock required to generate biogas. Great efforts are also made to reduce food waste, which would ensure that less land is required to feed the population and make more land available for energy and other types of crops.

Cities have also been at the forefront of integrating biogas in their infrastructures, investing in more efficient food waste collection systems and AD plants to generate biomethane for their public transport and refuse collection fleets. The C40 Cities network has provided global leadership in addressing these issues, working with the WBA in providing food waste management guidance to municipalities around the world.

At the inaugural World Biogas Summit last July, Niclas Svenningsen, Head of UN Climate Change – the UNFCCC Secretariat – described the biogas industry as a 'multiple wins' sector and called for biogas to feature in every country's Nationally Determined Contribution to the Paris Agreement.

With COP25 failing to deliver clear decisions to implement climate emergency measures, the urgency and importance of unlocking the industry's potential has been heightened. COP26 will no doubt be a pivotal moment for both world environmentalists and the global sector.

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