



Market Report



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Foreword

Biogas enthusiasts worldwide will not be surprised to know that Germany is still the largest global biogas producer. With decades of incentives especially to crop-based production on farms, its nearly 10,000 anaerobic digesters have been a model for development elsewhere, especially in Europe, whilst technology providers from Germany have learnt from experience and sell successfully abroad.

However, the industry faces challenges as political support for climate change actions has weakened leading to one German commentator claiming Germany is now a drag on climate ambitions¹.

The report also outlines the challenge of treating the potentially large growth of food waste which derives from the 2018 EU Waste Directive obligation to separately collect and treat all household and business food waste by 2023. Large scale plants able to handle volumes of urban waste will be needed as well as the support mechanisms for these; we shall see how Germany handles this challenge over the next 5 years.

Enjoy reading the report, written by Dr Sarika Jain.

David Newman
President, World Biogas Association

Overview

Germany is the leading biogas producer in Europe and the world. After years of tremendous growth, the industry has significantly slowed down and is in a state of transition. This is partly due to change in regulations supporting the biogas industry, such as the Renewable Energy Sources Act amendment to energy auctions, sustainability criteria limiting the use of energy crops, and partly due to saturation of certain segments of the industry.

The German biogas industry, which has historically been driven by large energy crop-based digesters, is now opening its doors to small manure-based digesters, upgrading plants and flexible energy generation. There is still targeted potential in the market to grow and mature, even if not at the scale we have seen so far.

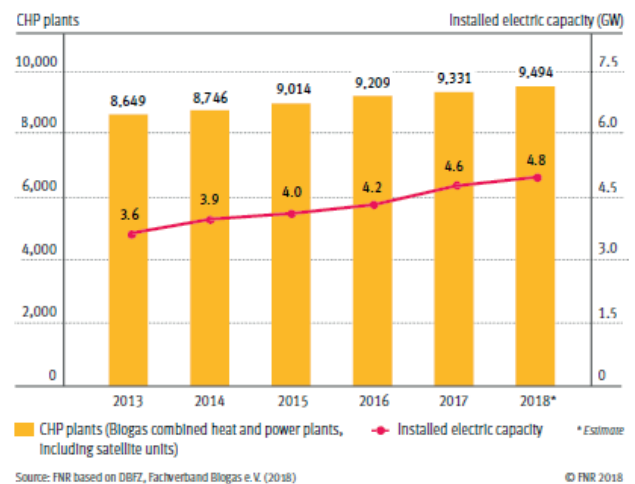
¹ <https://tinyurl.com/y6992ftv>

German biogas technology providers, supply-chain and developers are looking at international markets for growth and indeed, they have decades of experience and expertise to share with the rest of the world.

Current status

- Germany has an estimated 9,706 biogas plants operating as of 2018². That is the highest number of biogas plants in any country in Europe and the world, excluding small scale community plants prevalent in China and South East Asia.
- There are 9,494 operating combined heat and power biogas plants in Germany with a total installed capacity of 4.8GW. 32,500GWh of electricity and 17,184GWh of heat were generated in 2017 using biogas³. The installed capacity of CHPs in Germany has been growing slowly since 2016. This may be attributed to a change in environmental policy, which has been discussed under the section Barriers.

Development of biogas CHP plants in Germany

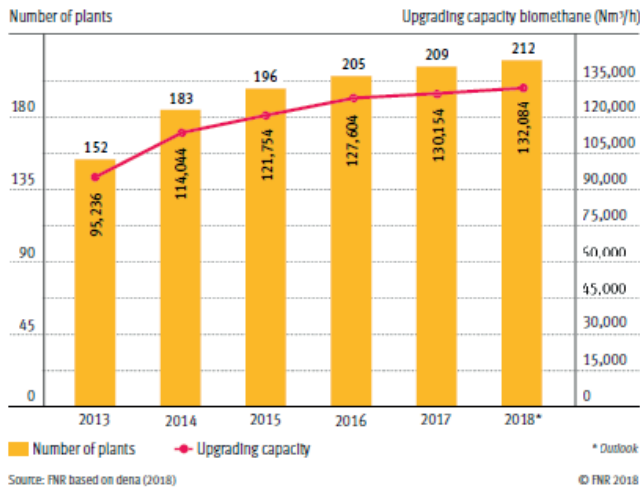


- There are 212 biogas plants in Germany that upgrade biogas to biomethane. They have a total upgrading capacity of

²⁻³ Agency for Renewable Resources, FNR (2019) Bioenergy in Germany: Facts and Figures 2019

132,084 Nm³/hr⁴. Of the total 500 approximately upgrading plants in Europe, Germany has the highest number followed by the UK (96), Sweden (64) and France (47)⁵.

Plants for biomethane production



- **The biogas plants in Germany are predominantly farm based.** Energy crops (48.9%) and livestock manure (44.5%) make up for a large proportion of the feedstock. Municipal biowaste (4.2%) and residues from industry, trade and agriculture (2.4%) account for the remainder⁶.
- **Of the energy crops used for the production of biogas in Germany,** maize silage accounts for 69% by weight, grass silage for 14%, the rest from other crops like whole crop cereal silage (6%), sugar beets (3%), grain (2%), catch crops (1%), landscape conservation material (<1%) and others (5%)⁷.
- **Of the farm manure used for biogas production,** 72% is cattle slurry, 9% is solid cattle dung, 10% pig manure, 3% poultry manure, 1% solid pig dung, <1% is dry poultry manure and 5% other feedstock⁸.
- **Biodegradable waste⁹** – In 2015, 13.85 million tonnes of biodegradable waste from bio-bins, green waste from gardens and parks, market waste and other sources were collected separately and treated in composting facilities and anaerobic digestion plants. Of the collected biowaste, 7.37 million tonnes were processed in 868 composting facilities and around 6.48 million tonnes were treated in 1,392 anaerobic digesters (including combined digestion and composting facilities).
- **Market Master Data Register¹⁰** – For greater transparency and reliable data, the Federal Network Agency is creating a register for all players of the electricity and gas market including plant operators, network operators and energy suppliers. Registration and submission of annual data are mandatory.

⁴ Agency for Renewable Resources, FNR (2019) Bioenergy in Germany: Facts and Figures 2019

⁵ IEA task 37 (2017) Upgrading plants list 2017 <https://tinyurl.com/y4azp6yp>

⁶⁻⁸ Agency for Renewable Resources, FNR (2019) Bioenergy in Germany: Facts and Figures 2019

⁹ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2018) Waste Management in Germany 2018 <https://tinyurl.com/y2as9nzw>

¹⁰ Market master Data Register MaStR <https://tinyurl.com/y936gehq>

- **Landfill gas¹¹** – Germany implemented a ban on landfilling of untreated organic waste in 2005. Since then, organic waste must undergo mechanical-biological or thermal treatment to minimise the release of landfill gas and leachate. Hence, landfill gas production in Germany is minimal.

Potential

- **Biodegradable waste** – Biodegradable waste from households and industry accounts for 6.6% of feedstocks for biogas generation in Germany¹². With increasing restrictions on the proportion of energy crops that can be used and special tariffs being made available for electricity generated from waste, a shift towards utilisation of wastes for producing biogas can be expected¹³.
- **Modification of composting plants** – About half of the biodegradable waste collected in Germany is digested while the other half is composted. In 2016, 16 digesters were built on existing composting facilities to capture energy from feedstock before the digestate went through the composting process¹⁴. With 868 operating composting facilities, there is a potential for additional energy capture and revenue by adding a digester.
- **Upgrading to biomethane** – With decreasing support for electricity generation via the EEG, it can be expected that the new plants being planned and built and also the existing plants that are coming to an end of their guaranteed tariff period will look at other avenues to increase income. With 212 of the 9,706 biogas digesters upgrading biogas to biomethane, there is potential for a shift in this sector¹⁵.
- **Transport sector** – Germany set a target of reducing GHG emissions by 40% compared to 1990 levels by 2020. However, this target is likely to be missed and one of the sectors lagging behind in cutting emissions is transport¹⁶. With the Federal Emission Control Act (BImSchG) and Biofuel Sustainability Regulation (Biokraft-NachV) requiring companies in the oil industry (supplying fuels for transport) to cut their emissions and meet sustainability criteria for biofuels, it is likely that biomethane, which is a small part of the current fuel mix, will see growth to meet the obligations¹⁷. Adding to this reasoning is the increasing pressure the EU is applying on using palm oil as a feedstock for renewable transport fuels.

¹¹ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2018) Waste Management in Germany 2018 <https://tinyurl.com/y2as9nzw>

¹² Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2018) Waste Management in Germany 2018 <https://tinyurl.com/y2as9nzw>

¹³ Federal Ministry for Economic Affairs and Energy (2017) Renewable Energy Sources Act 2017 <https://tinyurl.com/y2r5lzhv>

¹⁴ Daniel-Gromke J, et al. (2017) Current developments in production and utilisation of biogas and biomethane in Germany <https://tinyurl.com/y32qbv79>

¹⁵ Agency for Renewable Resources, FNR (2019) Bioenergy in Germany: Facts and Figures 2019

¹⁶ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2014) Climate Action Programme 2020 <https://tinyurl.com/yg9x2bp2>

¹⁷ Federal Ministry for Economic Affairs and Energy (not dated) Biofuels and Alternative Fuels <https://tinyurl.com/y6d3d9wd>

- **Heat utilisation** – Heat utilisation via CHP units was at first incentivised, then regulated in Germany. Now, while there is no obligation or incentive to utilise heat, the competitive pricing of electricity via the EEG has driven operators to focus their attention on heat utilisation to increase their efficiency and profitability.
- **Technical Biogas Potential¹⁸** – According to Gromke et al (2017), there is a technical potential of generating 155 to 265TWh HS energy per year from agricultural, industrial and municipal waste in Germany. Only a third of this potential has been realised.

Drivers

- **Climate Action Plan 2050¹⁹** – Germany aims to become greenhouse gas neutral by 2050, and reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. The Climate Action Plan 2050 is the German government's long-term greenhouse gas development strategy and outlines long- and medium-term targets; 2030 targets for individual sectors; describes the necessary pathways for them; lists initial measures for implementation; and establishes a process for monitoring and updating policies and measures.
- **Climate Action Programme 2020²⁰** – In 2007, Germany set the goal of reducing greenhouse gas emissions by 40% as compared to 1990 levels by 2020. In 2014, the Climate Action Programme 2020 was adopted. It includes over 100 individual measures designed to meet this target and a process of monitoring progress towards the target on an annual basis. According to government estimates in 2017, it is likely that the reduction achieved will be 32% by 2020, a shortfall of 8% or 100 million tonnes of CO₂eq²¹. Germany has come up with an action plan to expedite the achievement of this target.
- **Renewable Energy Sources Act (EEG)²²** – The EEG which came into force in the year 2000 has been a key driving force in building Germany's renewable energy capacity via feed-in tariffs. It has been revised since then to include special tariffs for small manure-based plants with an installed capacity of 75kWel and using more than 80% manure as feedstock, to restrict the use of maize and cereals as feedstock for energy

generation and incentivise flexible generation through additional payments and regulations. Since 2017, the transition from feed-in tariffs to auction-based renewable energy allocation has started. In a trial, 5% of the new renewable energy capacity has been opened to other operators from the other European Member States²³.

- **Renewable Energies Heat Act (EEWärmeG)²⁴** – The Renewable Energies Heat Act which came into force in 2009, is aimed to increase the share of renewable energy in heat to 14% by 2020. It required all new buildings to source a certain percentage of their water and space heating and cooling from renewable energy, depending on the technology used. There are provisions for district heating networks, use of CHPs and waste heat.
- **Federal Emission Control Act (BImSchG)²⁵** – Federal Emission Control Act requires companies in the oil industry (supplying fuels for transport) to cut their emissions by 4% between 2017 and 2019 and by 6% compared to a reference value. This reference value is calculated based on the amount of gasoline, diesel and biofuel placed by the company in the market and their emission factors. The biofuels used to meet the obligation must also meet the sustainability criteria defined in Biofuel Sustainability Regulation (Biokraft-NachV).
- **Digestate utilisation** – 97% of digestate produced in Germany is used in agriculture with the rest being used for landscaping and other purposes²⁶. The Fertiliser Ordinance dictates the quality and requirements for organic fertilisers that can be applied to the soil. The Bundesgütegemeinschaft Kompost (BGK) operates a voluntary quality assurance certification scheme via which it has certified digestate from 171 digesters²⁷. This increases their marketability.

Barriers

- **2017 amendment of EEG** – Via an amendment of the EEG in 2017, Germany is now transitioning away from feed-in tariffs towards competition-based funding for renewable energy. New and already built biogas plants over 150kW capacity will have to compete in a technology specific auction for installed capacity and will then be eligible for variable compensation for the difference in the spot price of electricity and the bidding price. The plants are also required to comply with flexible operating conditions. The response of the industry has been cool with only 22 bids being received for 27.551 MWe of the 122.446 MWe tendered in 2017²⁸. In 2018, in addition to the 150MWe capacity allocation, the capacity from 2017 was rolled over. 79 bids for 77MW capacity were received, most operators preferring to stay with the feed-in tariffs that they are currently eligible for under 20-year guarantees²⁹.

²³ Federal Ministry for Economic Affairs and Energy (2017) Renewable Energy <https://tinyurl.com/y32kgwe2>

²⁴ IEA (2015) Renewable Energies Heat Act <https://tinyurl.com/y3emd59n>

²⁵ Federal Ministry for Economic Affairs and Energy (not dated) Biofuels and Alternative Fuels <https://tinyurl.com/y6d3d9wd>

²⁶ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2018) Waste Management in Germany 2018 <https://tinyurl.com/y2as9nzv>

²⁷ Bundesgütegemeinschaft Kompost (2019) Facts and Figures – Biowaste <https://tinyurl.com/y3brjhpj>

²⁸ IEA Country Reports (2017) Germany <https://tinyurl.com/y3l7r6m3>

²⁹ Bioenergy International (2018) Great potential and huge challenges ahead for the German biogas sector <https://tinyurl.com/y6rrkma9>

¹⁸ Daniel-Gromke, J.; Rensberg, N.; Denysenko, V.; Erdmann, G.; Schmalfuß, T.; Hüttenrauch, J.; Schuhmann, E.; Erler, R.; Beil, M. (2017). Efficient small scale biogas upgrading plants: potential analysis & economic assessment. In: Ek, L.; Ehrmrooth, H.; Scarlat, N.; Grassi, A.; Helm, P. (Hrsg.) Papers of the 25th European Biomass Conference: Setting the course for a bio-based economy. Extracted from the Proceedings of the International Conference held in Stockholm, Sweden. Florence (Italy): ETA-Florence Renewable Energies. ISBN: 978-88-89407-17-2. pp. 1105-1109.

¹⁹ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2016) Climate Action Plan 2050 <https://tinyurl.com/y4qs86rm>

²⁰ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2014) Climate Action Programme 2020 <https://tinyurl.com/yygx2bp2>

²¹ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2018) Cabinet adopts 3rd Climate Action Report <https://tinyurl.com/y25bjv2j>

²² Federal Ministry for Economic Affairs and Energy (2017) Renewable Energy Sources Act 2017 <https://tinyurl.com/y2r5l2vh>

- **Sewage Sludge Ordinance** – 64.5% of sewage sludge from wastewater treatment plants in Germany is incinerated, 23.9% is used as fertiliser in agriculture and 9.6% in landscaping³⁰. The Sewage Sludge Ordinance which came into effect in January 2017, requires recovery of phosphorus and phasing out of the application of sewage sludge to land as fertiliser for wastewater treatment plants treating more than 50,000 population equivalents by 2032. This has resulted in reduced utilisation of digestate³¹.

Case study

Konnern Biomethane Refinery³²

Inputs: 120,000 tonnes per year of maize, whole crop silage, cereals, sugar beet residues supplied by 30 farmers within 15km of the digester.

Outputs: 28.8 million m³ per year of raw biogas is generated and fed into the gas grid.

What is unique: One of the largest biogas parks feeding biomethane into the grid, the park was built in 2008 and consists of 4 pre-storage tanks, 16 digester tanks, 4 secondary digester and 16 storage tanks.

Wobbelin Biogas Plant³³

Inputs: Silage and cattle slurry from farm consisting of 1,000 hectares of land, 629 dairy cattle and young cattle.

Outputs: 1 MWel is generated via 2 CHP units.

What is unique: The waste heat from the CHP units is used to heat 10,000m² tomato greenhouse, strawberry tunnel and asparagus fields. This has increased the resilience of the farm to weather conditions and also enabled the farmer to bring produce to the market ahead of other suppliers.

Conclusions

“ Looking at the current size of the biogas market in Germany, we see that the investment in new plants has died. Nevertheless, the spendings for innovative products such as increasing flexibility, improving fermentation, separation and other processing technology for fermentation residues are still a huge market.

As a supplier of digesters, we also feel that the international demand of biogas technology from Germany is huge. Now, other countries whose governments support renewable energy production are enlarging our sales areas.

Benjamin Budde, Erich Stallkamp ESTA GmbH

“ This WBA report provides an excellent overview of the Germany biogas industry – the leading country in the world for biogas production and leading technology provider throughout the world.

Compared to other renewable energy sources, the estimated 9,706 biogas plants in Germany provide a constant and reliable source of energy that can be produced around the clock.

The Biogas industry has still a lot of potential and will remain a key contributor to a circular and sustainable bio-economy in Germany.

John Booth, Pumpenfabrik Wangen GmbH

³⁰ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2018) Waste Management in Germany 2018 <https://tinyurl.com/y2as9nztv>

³¹ <https://tinyurl.com/y3yf7t8q>

³² Nordmethan (not dated) Konnern Biomethane Refinery <https://tinyurl.com/y52kxcqo>

³³ EnviTec Biogas (not dated) The biogas plant in Wobbelin, Germany <https://tinyurl.com/y465299m>

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Have a question about membership?

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Seeking advice? Want to get connected to influential

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