

GERMANY'S BIOGAS INDUSTRY AND THE PROSPECTIVE BUSINESS OPPORTUNITIES

— USE OF BIOMETHANE AND BIO-LNG TO GROW IN THE TRANSPORTATION SECTOR —

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SUMMARY

- The use of biogas in Germany's power generation industry has expanded under the impetus of the feed-in tariff (FIT) scheme introduced with the Renewable Energy Sources Act.
- In order to significantly reduce its greenhouse gas (GHG) emissions, it is essential for Germany to expand the use of renewable energy in the transportation sector. Against this backdrop, GHG regulations in the transportation sector have been strengthened, and there is development towards the use of biomethane and bio-LNG as green fuels for heavy-duty vehicles, which are difficult to electrify.
- The growing demand for biomethane and bio-LNG will create various business opportunities. The biogas industry is expected to develop not just in Germany but throughout Europe.

1. INTRODUCTION

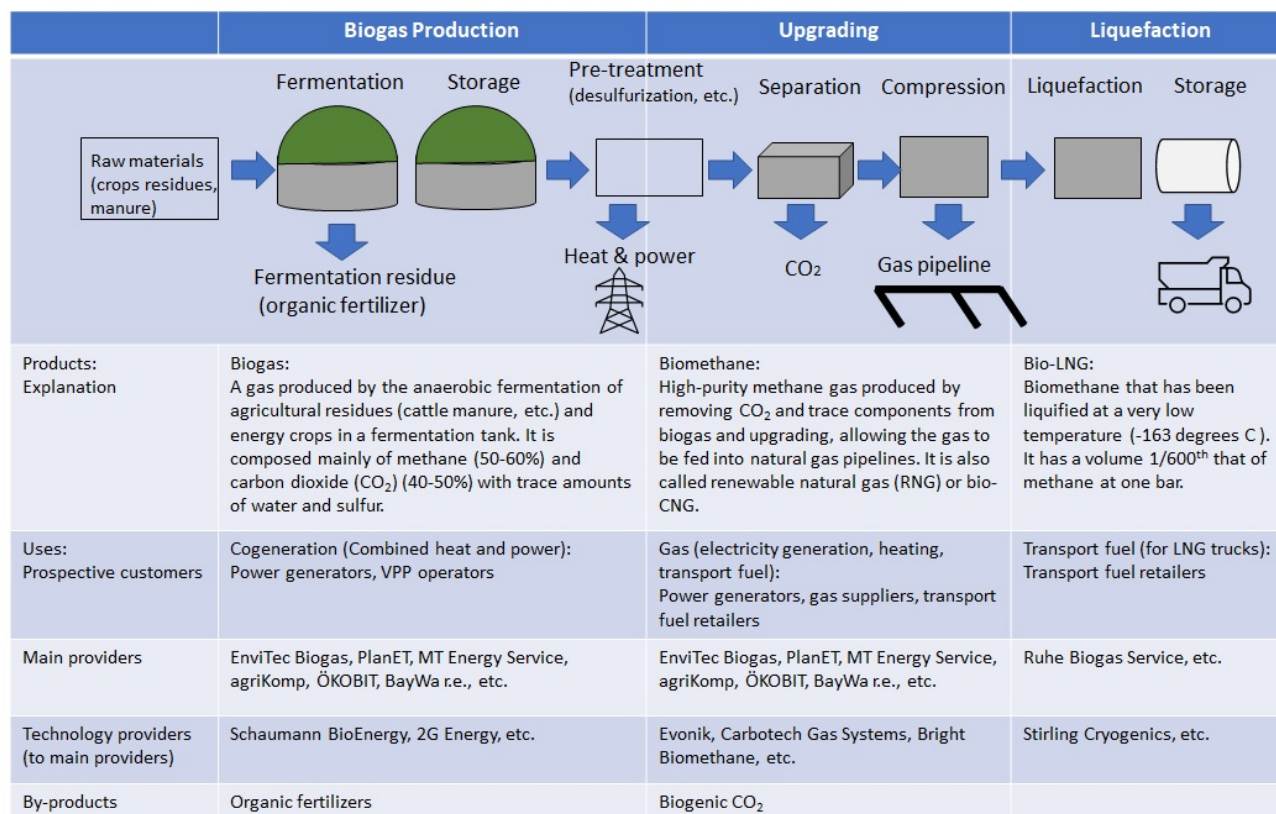
In Germany, the use of renewable energy has expanded under the impetus of the feed-in tariff (FIT) scheme that came into force with the introduction of the Renewable Energy Sources Act in 2000. In 2020, 45% of Germany's electricity was generated from renewable energy sources. Breaking down by source, biogas power has become Germany's third largest renewable energy source after wind and solar power. In the transportation sector, however, only 7.5% of energy is derived from renewable sources, and most of which from biodiesel (a little under 70%) and bioethanol (a little under 20%). For Germany to achieve decarbonization in future, it will be essential to increase the share of renewable energy used in transportation, a sector which has seen hardly any reduction in greenhouse gas (GHG) emissions for the past 30 years, and the use of biomethane and bio-LNG fuels is likely to gain ground. This report provides an overview of the current state of the biogas industry, the history of its development to date and potential future changes, and also considers the business opportunities offered by biogas.

2. GERMANY'S BIOGAS INDUSTRY AND POTENTIAL FUTURE CHANGES

2-1. What is biogas?

Biogas is a gas produced by the anaerobic fermentation in a fermentation tank of agricultural residues, including livestock manure, and energy crops (crops cultivated for the purpose of energy production, such as corn). Gas that has been obtained by refining (upgrading) biogas and increasing its purity is referred to as biomethane, and biomethane that has been liquified at a low temperature is called bio-LNG (see Figure 1. "Products: Explanation").

Figure 1: Biogas, biomethane, and bio-LNG production value chain



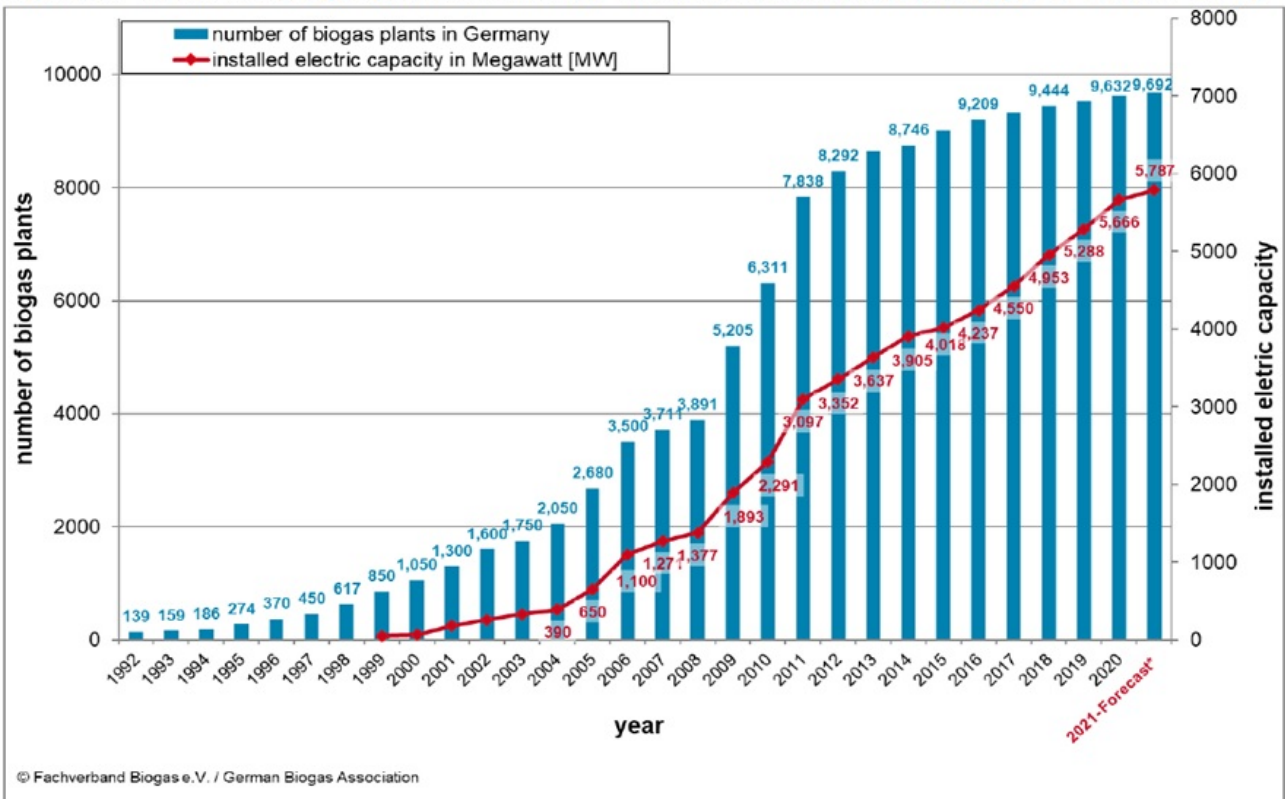
Source: Created by the author based on information on the website of the European Biogas Association, etc.

2-2. State of the biogas industry

The German biogas industry has developed on the bedrock of the earnings stability provided by the FIT. As of 2020, the cumulative installed capacity of German biogas power plants reached 5,700MW (power generation base), producing 33TWh of power annually (approximately 6% of all electricity generated in Germany). The industry employs 46,000 people, and with a market scale of 9.7 billion euros is the world's largest biogas market. The industry also exports engineering technology for biogas plants. There are about 9,600 biogas plants in the country, 98% of which are for the power generation sector. Approximately 200 plants are equipped with upgrading facilities, and these plants convert biogas into biomethane and feed it into the natural gas grid. Following the revision of the Renewable Energy Sources Act in 2008, the FIT purchase price was raised for small biogas plants of 150kW or less, and a bonus was introduced for the use of manure and other biowaste as raw materials. As a consequence, the industry expanded rapidly, with more than 1,000 biogas plants being built annually between 2009 and 2011. Subsequent to that, the growing public burden imposed by the surcharge that financed the FIT became an issue, and in 2014, the FIT purchase price was reduced when the Renewable Energy Sources Act was revised, and a policy of systematically increasing renewable energy through a tendering system was adopted. As a result, the growth in the construction of new biogas plants has slowed in recent years (Figure 2).

According to Germany's Agency for Renewable Resources (FNR), Germany's bioenergy supply in 2020 amounted to 315TWh (9.6% of the country's total primary energy [power generation sector and others]), and has the potential to reach up to 465TWh by 2050. However, there is a limit to the amount of biomass such as energy crops, wood, and agricultural residues that is used as the raw material for biogas. While it is possible to import raw materials from neighboring countries, 'local production for local consumption' is the guiding principle because transporting biomass is uneconomical due to its low energy density,. For the FNR's projection to be realized, it will be important to make effective use of the limited raw material resources available.

Figure 2: Number of biogas plants in Germany and installed electric capacity (as of October 2021)



Source: German Biogas Association "Biogas market data in Germany 2020/2021"
[https://www.biogas.org/edcom/webfvb.nsf/id/EN-German-biogas-market-data/\\$file/21-10-14_Biogasindustryfigures_2020-2021_english.pdf](https://www.biogas.org/edcom/webfvb.nsf/id/EN-German-biogas-market-data/$file/21-10-14_Biogasindustryfigures_2020-2021_english.pdf)

2-3. The potential for greater use of biofuel in the transportation sector

Renewable energy power generators can only benefit from the FIT for a period of 20 years from the start of a plant's operation. For plants built in the 2000s, this period began drawing to an end from 2020 onwards, and the biogas industry is today in need of a new post-FIT business model. For this reason, although the use of biogas currently occupies the mainstream in the biopower generation sector, with the tightening of GHG emission regulations in the transportation industry, demand for biomethane and bio-LNG is likely to increase.

Germany's GHG reduction quota, which is designed to reduce GHG emissions in the transportation sector, requires fuel retailers to ensure that a certain percentage (quota) of the transport fuel they supply consists of fuel, such as biofuel, that contributes to the reduction of CO₂¹. The percentage at the time of the quota's introduction in 2015 was 3.5%, and this was progressively raised to 4% in 2017 and 6% in 2020. However, despite the fact that Germany's overall GHG emissions fell by 35% between 1990 and 2019, GHG emissions in the transportation sector barely declined at all. If Germany is to achieve its goal of reducing overall GHG emissions by 65% compared to 1990 levels by 2030, reducing GHG emissions in the transportation sector is an urgent task. The GHG reduction quota will increase to 7% in 2022 and will be raised gradually thereafter to 25% by 2030.

As far as the automobile market is concerned, there has been a rapid expansion in the sale of electric vehicles (EV) of passenger cars, with EVs (including PHEVs) accounting for 13.6% of new vehicle registrations in 2020. The German government aims to have at least 15 million electric vehicles on the roads by 2030. However, it is difficult to electrify trucks and other heavy-duty vehicles, and these vehicles will need to switch to greener fuels. Although the use of hydrogen is attracting attention, it will take time to develop the refueling infrastructure and

¹ While a system known as the "Biofuel Quota" requiring transport fuel retailers to supply a certain percentage of biofuel to the market was in place up to 2015, from 2015, it was replaced by the GHG reduction quota, which places greater emphasis on reducing GHG emissions.

for fuel cell vehicles (FCV) to become widespread. Accordingly, the movement towards supplying biomethane and bio-LNG for heavy-duty vehicles is spreading. As of 2020, there were approximately 850 CNG (compressed natural gas) stations in Germany, more than half of which supplied biomethane. There are also 40 existing LNG stations, and that number rises to close to a 100 when those under construction are included. For example, the oil giant Shell is actively establishing LNG stations, the first of which it opened in Hamburg in 2018. By December 2021 it had established 25 stations, and it plans to increase this number to 40 by the end of 2022. The plan is to switch from supplying LNG to bio-LNG at these stations, and in the long term, to focus on producing synthetic fuel combining CO₂ with hydrogen (e-fuel).

3. PROSPECTIVE FUTURE BUSINESS OPPORTUNITIES

3-1. Business opportunities spanning the entire biogas supply chain

Future business opportunities that may emerge from these changes across the entire value chain shown in Figure 1 could include operation of biogas plants, provision of technologies such as upgrading and liquefaction, bio-LNG sales, as well as brokerage and authentication services linking users and suppliers. In particular, business opportunities can be expected to expand in future as demand for biomethane and bio-LNG grows in the transportation sector. At the same time, there are also challenges to the use of biomethane and bio-LNG in the transportation sector. In Germany, there are many small businesses (farmers, etc.) operating biogas plants of 500kW or less, and the capital investment required for the equipment to upgrade to biomethane is a substantial burden for these businesses. Furthermore, a certain volume is required to make it economically viable to convert biomethane to bio-LNG through liquefaction. Possible solutions to these problems could be for companies to support the cost of capital investment, and to liquify biomethane and natural gas derived from fossil fuels together in large-scale facilities as well as to calculate and evaluate the actual bio-LNG volume involved using a mass balance approach².

There are also other potential business opportunities making use of the by-products of biogas plants. Some examples include sales of organic fertilizers, production of dry ice for the food industry from emitted CO₂, and production of synthetic fuels such as e-methanol by reacting CO₂ with hydrogen.

The introduction of GHG emission regulations in the shipping industry could also create further demand for biomethane and bio-LNG. It may also be possible to use biomethanol produced from biomethane as a fuel. In 2021, Maersk, the world's largest shipping company, placed an order for a methanol ship to be built by South Korea's Hyundai Heavy Industries. This suggests that Maersk is aiming for zero GHG emission transportation, and the company has its sights set on powering its vessels with e-methanol or biomethanol in the future. Demand for biomethanol may also be created in the chemicals industry in the same way.

3-2. Potential for the development of the biomethane and bio-LNG industries in Europe

While Shell and other companies are building LNG stations in Germany, bio-LNG is to date being deployed on a commercial basis in only a few countries in Europe. If the use of biomethane and bio-LNG for heavy-duty vehicles progresses in Germany, which is Europe's largest automobile market, decarbonization of the transportation sector is likely to progress throughout Europe as a whole. A unified system is required for the distribution of biomethane across national borders, and such a system is currently under development within a framework known as the European Renewable Gas Registry (ERGaR). The biomethane and bio-LNG industries

² A method for allocating the amount of specific raw materials contained in an end product that has been processed using a mixture of raw materials with different characteristics (in this case, biomethane and natural gas) based on the amount of each raw material input in the production process. Among other things, this approach is used for electricity, bioplastics, and other products derived from renewable sources.

have the potential to develop not only in Germany but also throughout Europe, and future developments warrant continued attention.

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