

Biogas Market - Global Industry Size, Share, Trends, Opportunity, and Forecast, Segmented, By Source (Municipal, Agricultural, Industrial), By Application (Vehicle Fuel, Electricity, Heat, Upgraded Biogas, Cooking Gas), By Region & Competition, 2019-2029F

Market Report | 2024-12-20 | 184 pages | TechSci Research

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Report description:

Global Biogas Market was valued at USD 70.5 billion in 2023 and is expected to reach USD 100.1 billion by 2029 with a CAGR of 5.84% during the forecast period. The biogas market encompasses the production, distribution, and utilization of biogas, a renewable energy source derived from the anaerobic digestion of organic matter such as agricultural waste, manure, municipal waste, plant material, sewage, green waste, and food waste. Biogas primarily consists of methane (CH4) and carbon dioxide (CO2) and can be used for heating, electricity generation, and as a vehicle fuel. The market is driven by increasing global energy demands, stringent environmental regulations aimed at reducing greenhouse gas emissions, and the need for sustainable waste management solutions. Technological advancements in biogas production and purification processes, alongside government incentives and subsidies for renewable energy projects, further stimulate market growth. The agricultural sector significantly contributes to biogas production, leveraging organic waste materials to generate energy and reduce environmental impact. The market is segmented by application, feedstock, and technology, with key applications including power generation, heat generation, and transportation fuel.

Key Market Drivers**Increasing Environmental Regulations and Government Policies**

Governments worldwide are progressively implementing stringent environmental regulations and policies to combat climate change and reduce greenhouse gas emissions. These regulations are a major driver for the biogas market, as biogas production significantly reduces methane emissions from organic waste, a potent greenhouse gas. For instance, the European Union's Renewable Energy Directive mandates member countries to achieve specific renewable energy targets, including biogas. The directive aims for a 32% renewable energy share by 2030, providing significant incentives for biogas production. Similarly, the

U.S. Environmental Protection Agency (EPA) has implemented the Renewable Fuel Standard (RFS) program, which requires a certain volume of renewable fuel, including biogas, to replace or reduce the quantity of petroleum-based transportation fuel, heating oil, or jet fuel. Such policies are also seen in emerging economies. India, under its National Policy on Biofuels, aims to promote biogas production through various subsidies and support schemes. The Indian government's SATAT (Sustainable Alternative Towards Affordable Transportation) initiative plans to set up 5,000 compressed biogas (CBG) plants by 2023. These policies are not only reducing environmental footprints but also creating a substantial market for biogas as a cleaner, renewable energy source. Furthermore, these regulations encourage industries to adopt sustainable practices, including waste management and renewable energy utilization, thereby driving the demand for biogas plants. Agricultural policies, particularly in countries with extensive agricultural sectors, also support biogas production from agricultural residues, animal manure, and other organic waste, thereby integrating waste management with renewable energy production. Thus, stringent environmental regulations and supportive government policies worldwide are pivotal in propelling the biogas market by fostering an environment conducive to investment, innovation, and expansion in biogas technology and infrastructure. In May 2024, ONGC and EverEnviro Resource Management have established a strategic 50-50 joint venture to develop 10 Compressed Biogas (CBG) plants across India. This initiative aims to reduce the country's dependency on imported gas and enhance domestic renewable energy production. The collaboration will leverage a variety of feedstocks, including agricultural waste, agro-industrial waste, energy crops, and municipal solid waste (MSW), with a target to mitigate approximately 750,000 tons of CO₂ equivalent annually. Satyan Kumar, Executive Director and Chief Corporate Strategy Officer at ONGC, emphasized the company's commitment to achieving Net Zero by 2038, highlighting the critical need for transitioning to clean energy through the utilization of agro-industrial and municipal solid waste. EverEnviro Resource Management, with ambitions to establish over 100 CBG plants across India, is currently executing more than 20 CBG projects in Madhya Pradesh, Uttar Pradesh, Delhi, and Punjab. This endeavor involves a significant capital investment of nearly USD 235.06 million and is projected to yield an output of 320 metric tons per day of CBG. This joint venture not only signifies a substantial step towards sustainable energy but also underscores the strategic alignment of ONGC and EverEnviro in fostering a greener future for India.

Rising Demand for Renewable Energy and Energy Security

The global energy landscape is experiencing a significant shift towards renewable energy sources to ensure energy security and sustainability. This transition is a crucial driver for the biogas market. As countries strive to reduce their dependence on fossil fuels and mitigate the risks associated with energy imports, biogas emerges as a reliable, locally produced renewable energy source. The inherent versatility of biogas, which can be used for electricity generation, heating, and as a vehicle fuel, makes it an attractive option for diverse energy needs. For example, in Europe, the demand for renewable energy has seen a sharp rise, driven by the EU's targets and individual countries' commitments to achieving net-zero emissions by mid-century. Germany, one of the largest biogas markets, has extensively integrated biogas into its renewable energy strategy, utilizing it for electricity production and injecting it into the natural gas grid. In Asia, China's rapid industrialization and urbanization have spurred a significant increase in energy consumption, prompting the government to invest heavily in renewable energy, including biogas. The Chinese government's 13th Five-Year Plan included substantial investments in biogas production facilities to address both energy needs and environmental concerns. In North America, the Renewable Natural Gas (RNG) industry is growing, driven by state-level policies like California's Low Carbon Fuel Standard (LCFS) that encourage the use of low-carbon fuels, including biogas. Furthermore, biogas production supports the circular economy by converting organic waste into valuable energy, thus addressing waste management issues and reducing landfill reliance. This aspect is particularly relevant for municipalities and industries seeking sustainable waste solutions. As a result, the rising demand for renewable energy, coupled with the need for energy security and sustainable waste management practices, is significantly driving the growth of the biogas market globally.

Technological Advancements and Cost-Effectiveness

Technological advancements in biogas production, upgrading, and utilization are significantly driving the growth of the biogas market by enhancing efficiency and cost-effectiveness. Innovations in anaerobic digestion technology, which is at the heart of biogas production, have led to improved biogas yields and process stability. For instance, advancements in pre-treatment technologies, such as thermal hydrolysis, enzyme addition, and mechanical disruption, have increased the breakdown of complex organic materials, thereby enhancing biogas production. The development of high-efficiency biogas upgrading technologies, like pressure swing adsorption (PSA), membrane separation, and water scrubbing, has made it possible to purify biogas to the quality

of natural gas, also known as biomethane, more economically. This purified biogas can be injected into the natural gas grid or used as a transportation fuel, opening new revenue streams for biogas producers. Moreover, improvements in biogas digesters, including better materials, modular designs, and automated control systems, have reduced operational costs and made biogas plants more scalable and adaptable to various feedstock types. These technological advancements are complemented by decreasing costs of associated technologies like combined heat and power (CHP) systems and biogas storage solutions.

Additionally, digitalization and the Internet of Things (IoT) are playing a crucial role in optimizing biogas plant operations. Smart sensors and data analytics allow for real-time monitoring and control of the anaerobic digestion process, leading to increased efficiency, reduced downtime, and better maintenance planning. The integration of these technologies ensures that biogas production remains economically viable and competitive with other renewable energy sources. The cumulative effect of these technological advancements is a significant reduction in the overall cost of biogas production and an increase in its economic attractiveness. Consequently, the continuous evolution of technology and the resultant cost-effectiveness are crucial drivers for the expansion and adoption of biogas across various sectors, including agriculture, waste management, and energy production.

Key Market Challenges

Economic Viability and Financial Constraints

One of the most significant challenges facing the biogas market is the economic viability and financial constraints associated with biogas production and utilization. Despite its potential as a renewable energy source, biogas production is often hampered by high initial capital costs for infrastructure, including anaerobic digesters, gas upgrading systems, and storage facilities. These costs can be prohibitively expensive for small and medium-sized enterprises (SMEs) and individual farmers who lack access to substantial funding or financing options. Moreover, the operational and maintenance costs of biogas plants can be high, further straining financial resources. Additionally, the profitability of biogas projects is highly dependent on the availability and cost of feedstock, which can fluctuate based on seasonal variations and market demand for agricultural and organic waste. In regions where the waste management infrastructure is underdeveloped, securing a consistent and cost-effective supply of feedstock becomes challenging. Furthermore, biogas production often competes with other waste-to-energy technologies and renewable energy sources, making it difficult to attract investment without substantial government incentives and subsidies. The lack of long-term financial support and incentives from governments can also deter potential investors and project developers. Consequently, many biogas projects struggle to achieve financial sustainability, leading to a slower growth rate in the market. The economic viability of biogas is further complicated by the need for competitive pricing of biogas products such as electricity, heat, and biomethane. Biogas must compete with conventional fossil fuels and other renewable energy sources, which are often cheaper due to established infrastructures and economies of scale. In regions where energy prices are regulated, biogas producers may face additional challenges in setting competitive prices that can ensure profitability. Overall, overcoming the financial constraints and achieving economic viability requires a concerted effort from stakeholders, including government agencies, financial institutions, and the private sector, to provide adequate funding, subsidies, and financial incentives that can support the growth and sustainability of the biogas market.

Regulatory and Policy Barriers

Regulatory and policy barriers represent another major challenge in the biogas market, significantly impacting its development and expansion. The regulatory landscape for biogas production and utilization varies widely across regions, often characterized by a lack of coherent and supportive policies that can facilitate the growth of the sector. In many countries, regulatory frameworks are either absent or inadequate, failing to address the unique requirements and potential of biogas as a renewable energy source. This lack of clear and consistent regulations creates uncertainty for investors and project developers, deterring investment and innovation in the sector. Additionally, stringent regulations related to environmental standards, safety, and operational permits can pose significant hurdles for biogas projects. Compliance with these regulations often requires substantial time and financial resources, adding to the already high costs of biogas production. Furthermore, bureaucratic red tape and lengthy approval processes for biogas plant construction and operation can cause delays and increase project risks. The absence of standardized guidelines for biogas production and quality control can also lead to inconsistencies in biogas output, affecting market confidence and consumer acceptance. Moreover, the lack of integration of biogas policies with broader energy and environmental policies can hinder the development of a cohesive and supportive regulatory environment. For instance, inadequate grid access and integration policies can limit the ability of biogas producers to sell electricity to the grid, affecting their revenue streams. Similarly,

insufficient support for the use of biogas in transportation and heating sectors can restrict market opportunities. In some regions, subsidies and incentives for competing renewable energy sources, such as solar and wind, are more favorable than those for biogas, creating an uneven playing field. To overcome these regulatory and policy barriers, there is a need for comprehensive and harmonized policies that recognize the environmental and economic benefits of biogas. Governments should establish clear and supportive regulations, streamline approval processes, and provide incentives that can encourage investment and innovation in the biogas sector. Collaboration between policymakers, industry stakeholders, and regulatory bodies is essential to create a conducive regulatory environment that can drive the growth and sustainability of the biogas market..

Key Market Trends

Expansion of Renewable Energy Mandates and Incentives

The global biogas market is experiencing robust growth, driven significantly by expanding renewable energy mandates and government incentives. Countries worldwide are increasingly recognizing the need to shift from fossil fuels to renewable energy sources to combat climate change and achieve sustainability goals. As a result, many governments are implementing favorable policies, subsidies, and tax incentives to promote the adoption of biogas technology. For instance, the European Union's Renewable Energy Directive mandates that member states meet specific renewable energy targets, thereby encouraging the development and utilization of biogas. Similarly, countries like India and China are investing heavily in biogas infrastructure as part of their national renewable energy plans. These mandates are not only propelling the demand for biogas plants but also fostering innovations in biogas production and utilization technologies. The financial incentives provided by governments reduce the initial capital burden on biogas plant developers and operators, making biogas projects more economically viable. This trend is further supported by international organizations and green financing institutions, which are offering low-interest loans and grants for biogas projects. The cumulative effect of these measures is a substantial increase in the number of biogas plants being constructed globally, thereby driving the growth of the biogas market.

Technological Advancements in Biogas Production and Utilization

Technological advancements are playing a pivotal role in shaping the future of the biogas market. Innovations in anaerobic digestion processes, feedstock optimization, and biogas upgrading technologies are significantly enhancing the efficiency and profitability of biogas production. For instance, advancements in pre-treatment technologies, such as thermal hydrolysis and enzymatic hydrolysis, are improving the biodegradability of feedstock, resulting in higher biogas yields. Moreover, the development of co-digestion techniques, which involve the simultaneous digestion of multiple feedstocks, is optimizing the biogas production process and reducing operational costs. Additionally, advancements in biogas upgrading technologies, such as membrane separation and pressure swing adsorption, are enabling the production of high-purity biomethane that can be injected into natural gas grids or used as vehicle fuel. These technological improvements are not only making biogas a more competitive alternative to conventional energy sources but also expanding its application potential across various sectors, including transportation, electricity generation, and heating. Furthermore, digitalization and the integration of Internet of Things (IoT) technologies are enhancing the monitoring and management of biogas plants, leading to improved operational efficiency and reduced downtime. As a result, technological advancements are significantly driving the growth and adoption of biogas globally.

Segmental Insights

Application Insights

The Electricity segment held the largest Market share in 2023. The biogas market in the electricity segment is experiencing robust growth, driven by several key factors. The increasing demand for renewable and sustainable energy sources is a significant driver. Governments and organizations worldwide are seeking to reduce carbon footprints and reliance on fossil fuels, promoting biogas as a viable alternative. This push for cleaner energy aligns with global climate goals and various policy frameworks that incentivize the adoption of biogas for electricity generation. Secondly, technological advancements in biogas production and utilization are enhancing the efficiency and scalability of biogas plants. Innovations in anaerobic digestion, gas upgrading technologies, and co-digestion processes are making biogas a more competitive and reliable energy source. These technological improvements lower operational costs and increase the energy yield from biogas, making it an attractive option for electricity generation. Thirdly, the rising availability of feedstock for biogas production, such as agricultural waste, organic municipal solid waste, and industrial by-products, is bolstering the market. Effective waste management practices and the circular economy concept encourage the use of organic waste for biogas production, reducing environmental pollution and providing a sustainable

energy solution. This growing feedstock availability ensures a steady supply of raw materials for biogas plants, supporting the continuous generation of electricity. Overall, these drivers are propelling the biogas market in the electricity segment towards significant growth and wider adoption.

Regional Insights

Europe region held the largest market share in 2023. The Biogas Market in Europe is being driven by several key factors. Firstly, stringent environmental regulations and ambitious climate targets set by the European Union are propelling the adoption of biogas as a renewable energy source. Policies such as the Renewable Energy Directive (RED II) mandate member states to increase their share of renewable energy, with biogas playing a crucial role in meeting these targets due to its low carbon footprint and ability to utilize organic waste. Secondly, the increasing focus on waste management and circular economy principles is encouraging the development of biogas projects. Governments and industries are recognizing the dual benefits of biogas production in reducing waste and generating energy, thus supporting investments in biogas infrastructure and technology. This drive towards sustainability is further amplified by financial incentives and subsidies provided by governments, which make biogas projects economically viable. Advancements in biogas production technologies are enhancing the efficiency and scalability of biogas plants. Innovations such as improved anaerobic digestion processes, biogas upgrading technologies, and the integration of biogas with other renewable energy systems are making biogas a more attractive and competitive energy source. These technological advancements not only reduce production costs but also improve the quality and versatility of biogas, thereby fostering its adoption across various sectors including agriculture, municipal waste management, and the energy industry. Overall, the combination of regulatory support, economic incentives, and technological innovations is significantly driving the growth of the biogas market in Europe.

Key Market Players

■■■Agrinz Technologies GmbH

■■■L'AIR LIQUIDE S.A.

■■■DMT International

■■■Gasum Group

■■■HomeBiogas Ltd.

■■■PlanET Biogastechnik GmbH

■■■Biokraft International AB

■■■Kanadevia Inova Group

Report Scope:

In this report, the Global Biogas Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

■■■Biogas Market, By Source:

- o Municipal
- o Agricultural
- o Industrial

■■■Biogas Market, By Application:

- o Vehicle Fuel
- o Electricity
- o Heat
- o Upgraded Biogas
- o Cooking Gas

■■■Biogas Market, By Region:

- o North America
 - United States
 - Canada
 - Mexico
- o Europe

- France
- United Kingdom
- Italy
- Germany
- Spain
- Asia-Pacific
 - China
 - India
 - Japan
 - Australia
 - South Korea
- South America
 - Brazil
 - Argentina
 - Colombia
- Middle East & Africa
 - South Africa
 - Saudi Arabia
 - UAE
 - Kuwait
 - Turkey

Competitive Landscape

Company Profiles: Detailed analysis of the major companies presents in the Global Biogas Market.

Available Customizations:

Global Biogas Market report with the given Market data, TechSci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

□□Detailed analysis and profiling of additional market players (up to five).

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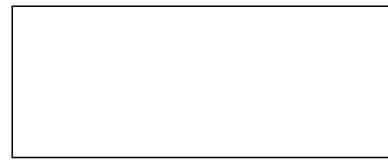
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