

HARNESSING THE POWER OF BIOGAS:

*Evaluating Electric Power vs.
Renewable Natural Gas
Production*



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As the energy landscape shifts and sustainability efforts grow, businesses are consciously doing more to lower their overall carbon footprint. Technological innovation allows power and fuels to be produced from new sources – and in new ways. One of these technologies is biogas.

The two most common pathways for biogas use are electricity generation and Renewable Natural Gas (RNG) production. Electricity generation offers stable, steadily rising income and resilient on-site power with lower infrastructure requirements - making it ideal for sites with high power needs. RNG production is a compelling opportunity due to high financial returns, strong policy support, and the ability to deliver product directly into pipelines. We will compare the qualities, barriers, and benefits of both and answer common questions:

- What is biogas, how is it produced, and what are its economic and environmental benefits?
- Why are electricity generation and RNG production common choices?
- What is a strategic framework for evaluating electricity vs. RNG? What are the financial, regulatory, and operational trade-offs?
- How is biogas used in the industrial sectors where it's most common?
- What are the barriers to power generation and RNG projects?

With these answers, you'll be able to confidently decide - after weighing all factors - whether biogas through electricity generation or renewable gas production is the best path for you and your business. We hope this paper helps guide you towards making the right decision, and if further support is needed, our team is ready to advise.

WHAT IS BIOGAS AND WHY IS IT IMPORTANT?

Biogas is a renewable fuel produced through the anaerobic digestion of organic matter. This matter is usually material such as food waste, animal manure, sewage, and agricultural residues, and is broken down by microorganisms in the absence of oxygen. As these bacteria devour the waste, they release biogas, which is primarily composed of methane (CH₄), carbon dioxide (CO₂), and small amounts of hydrogen sulfide (H₂S), water vapor, and other gases like nitrogen.

Biogas offers users several benefits and opportunities:

- **Environmental benefits** – In addition to eliminating waste that is likely to have adverse environmental impacts, biogas use reduces greenhouse gas (GHG) emissions by capturing methane that would otherwise escape into the atmosphere. Methane has a substantially higher Global Warming Potential (GWP) than CO₂, trapping up to 28 times as much heat.

- **Energy security** – Biogas provides a local renewable energy source, reducing dependence on fossil fuels and lowering net carbon emissions.
- **Economic benefits** – As farms and municipalities turn waste into energy, they can reduce their power expenses and potentially be compensated for providing additional power back onto the grid.
- **Waste management** – Biogas use allows farms and municipalities to turn a nuisance – like odor and pest issues – into a vital resource.

The most common biogas applications today include RNG production and electricity generation. Each has distinct benefits, barriers, and sector-specific applications.

BIOGAS FOR ELECTRICITY GENERATION

What is it?

Electricity generation refers to the utilization of biogas as a fuel for generator sets. This is ideal for sites where the source of the fuel, e.g. the waste, is plentiful and close to the generation source because biogas solutions typically transform the waste and produce power – all in the same site. It's common to transform your biogas solution into one, leveraging Combined Heat and Power (CHP), capturing waste heat and applying it to power heating tasks that a boiler would otherwise be utilized for. This combined approach reduces fuel costs and GHG emissions while significantly increasing efficiency.

What are the benefits of electric power generation with biogas?

Generating electricity from biogas has become an attractive option, driven by several key benefits:

- **Predictable revenue:** It provides steadily rising revenue generation, especially as data center demand continues to drive up local electrical rates.
- **Lower policy risk:** It is generally less exposed to policy changes and market volatility, making it attractive for long-term planning and financing.
- **Rate trends:** Electricity prices in some regions are typically increasing faster than inflation, boosting project viability.
- **Infrastructure independence:** Electricity generation can be deployed anywhere biogas is produced, without reliance on pipeline access.

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What are the challenges of biogas electric power generation projects?

Biogas electricity projects also face several notable challenges, which include:

- **Maintenance and feedstock logistics:** Ongoing supply and upkeep costs often outweigh electricity revenues.
- **Solar and wind competition:** Other renewables are cheaper, more scalable, and attract stronger investment.
- **Grid interconnection:** Rural projects face costly, complex, and time-consuming connection requirements.
- **Limited incentives:** Biogas electricity typically receives fewer subsidies and carbon credits compared to RNG.

What are the common applications of biogas electric power generation projects?

Wastewater Treatment Plants (WWTPs):

- **When it makes sense:** Most WWTPs are currently using biogas in CHP systems. Electricity generation is preferred due to on-site energy needs, simplicity, and lower capital costs.

Landfills:

- **When it makes sense:** Electricity generation is often chosen for older or smaller sites with limited gas quality or supply volume.

Livestock and Dairy Agriculture:

- **When it makes sense:** Ag operators have historically focused on electricity generation, and it remains a viable solution for smaller farms or those without pipeline access.

Food Waste:

- **When it makes sense:** Electricity generation is simpler and more cost-effective for local or municipal digesters.

BIOGAS UPGRADING: RENEWABLE NATURAL GAS (RNG)

What is RNG?

RNG is biogas that has been purified (or “upgraded,” to use a common industry term) in a process that removes CO₂ and impurities. RNG is typically injected into natural gas pipelines and primarily used as transport fuel but is emerging as a practical alternative for industrial heat, electricity generation, and CHP plants helping operators achieve carbon reduction benefits.

What are the benefits of upgrading biogas to RNG?

Upgrading biogas to Renewable Natural Gas (RNG) has become increasingly popular, driven by several advantages:

- **Higher economic returns** – RNG qualifies for valuable environmental credits such as Renewable Identification Numbers (RINs) and Low Carbon Fuel Standard (LCFS) credits.
- **Fuel flexibility and infrastructure compatibility** – RNG can be injected into existing natural gas pipelines or used as compressed natural gas (CNG) for vehicles, expanding market access.
- **Policy incentives and climate goals** – Governments typically promote RNG development as a strategy to reduce GHGs and diversify energy sources.

What are the challenges of upgrading biogas to RNG?

Despite strong potential, RNG projects face notable barriers:

- **Market volatility:** RNG revenues depend heavily on fluctuating LCFS and RIN credit markets.
- **Pipeline access:** RNG projects need proximity to natural gas infrastructure, which isn't always available.
- **Regulatory compliance:** Permitting and compliance for RNG projects can be time-consuming and varies by region.
- **Capital investment:** Upgrading demands significant upfront spending on purification and compression systems.

What are the common applications of biogas RNG projects?

Wastewater Treatment Plants (WWTPs):

- **When it makes sense:** Facilities upgrade biogas to RNG, especially where incentives and infrastructure allow. Co-digestion with food waste or industrial organics can improve biogas yield, making RNG more economically feasible.

Landfills:

- **When it makes sense:** Larger, newer facilities favor RNG due to higher energy yield and strong policy incentives that offer greater monetization potential.

Livestock and Dairy Agriculture:

- **When it makes sense:** There's been a strong shift in the market towards RNG production, especially at larger clustered farms.

Food Waste:

- **When it makes sense:** RNG is gaining traction due to its high methane yield per ton of waste and is favored when waste volumes are high and carbon credit markets can be accessed.

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CHOOSING THE RIGHT BIOGAS PATHWAY

Biogas represents a versatile and sustainable energy solution derived from organic waste, with applications in both electricity generation and RNG production. While RNG is gaining traction due to stronger policy incentives and higher financial returns, electricity generation remains a stable and resilient option. The industry is evolving, with sector-specific trends showing a shift toward RNG in agriculture and landfills, while wastewater treatment plants and food waste digesters maintain a mix of both technologies.

Each type of project presents unique considerations that should be thoughtfully addressed, for example, infrastructure access. RNG projects require proximity to natural gas pipelines to deliver product and capture credit revenues. Where pipeline access is limited or absent, electricity generation offers a more reliable and cost-effective solution, especially for farms, food waste digesters, and wastewater treatment plants with strong on-site energy needs.

Recognizing these challenges early helps teams plan more effectively, align with policy frameworks, and identify where expert support or infrastructure upgrades can unlock greater impact. With the right technologies, and policy support, biogas is well-positioned to drive a more circular, resource-efficient energy future.