

Natural Energy Solutions



Serving our customers with renewable natural gas



Air Liquide has developed an efficient, state-of-the-art membrane-technology that makes upgrading biogas efficient and cost-effective, providing a continuous, reliable source of renewable energy. Air Liquide has acquired strong in-house know-how for landfill gas well management, and design, engineering, construction and operation of biogas upgrading plants. This experience, along with our industry leading biogas upgrading technology, helps our plants run reliably and with the highest safety standards.

Biogas Uses

Air Liquide has a long history of meeting the strict quality and reliability requirements for gases used in hospitals, blast furnaces, glass and electronics manufacturing, and many other industries. We apply this same expertise to our biogas systems. There are a wide variety of uses for **renewable natural gas (RNG)** as evidenced by Air Liquide's RNG technology in services and industry.

Customer Benefits

Our customers have found many benefits from using our **RNG**, including:

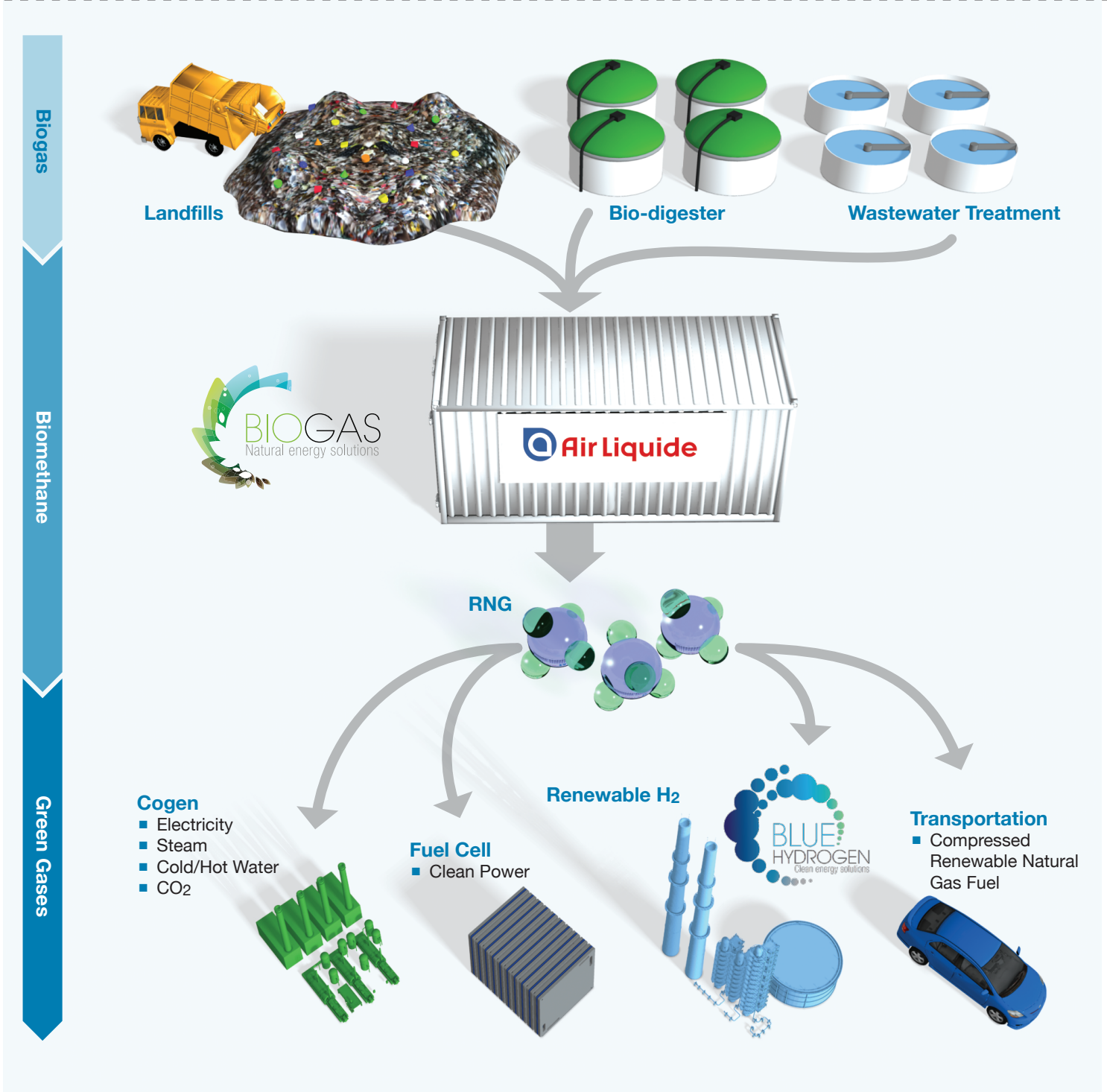
- Meeting state mandates for power plants using renewable gas as a fuel resource.
- Meeting EPA and other renewable fuel mandates that require all fuel producers to use increasing quantities of renewable fuel.
- Attaining voluntary renewable fuel standards to help reduce greenhouse gases and reduce the consumption of non-renewable fossil fuels. **RNG** also has an advantage over solar or wind power in that the supply is not interrupted by weather conditions.
- Using **RNG** to run fuel cells providing a local, reliable and secure source of electric power.
- **RNG** from biogas can be sourced from all across the country, using existing natural gas infrastructure to send RNG directly to your site.

Environmental Benefits

- When biogas from landfills, sewage treatment plants, and other sources is upgraded to create natural gas as a renewable energy source, the EPA estimates that there is an **88% reduction in emissions** over fossil fuels, making renewable natural gas one of the lowest carbon fuels available.
- Delivering biogas directly to users as **RNG** is up to **two times efficient** as burning raw biogas to generate electricity.
- The Air Liquide biogas upgrading system processes toxic and volatile gases without requiring expensive chemical handling and treatment.
- Using **RNG** helps achieve energy security and independence through long-term supply and pricing options while providing new marketing opportunities.

Biogas Purification and Delivery Life Cycle

The graphic below illustrates the phases of our biogas upgrading process cycle from the collection of raw biogas, through the treatment process to produce RNG, and finally delivery of RNG for its various uses.



Are you looking for renewable energy sources to meet your organization's renewable energy goals and regulatory requirements? Look no further than RNG available from Air Liquide and its supply partners.



Advanced Membrane Technology, Proven Installations World Wide

Air Liquide maintains an advanced gas membrane research facility right here in the U.S. at our Research Center in Newark, Delaware. In addition to membranes for biogas upgrading, our premier researchers also lead in the advancement of membrane technology for air separation, recovering hydrogen and helium from various industrial streams, and recovering hydrocarbons by removing CO_2 at offshore platforms. This breadth of experience allows us to leverage the advances in one area of gas membrane technology to our other membrane technologies, constantly moving our membrane solutions forward in all industries.

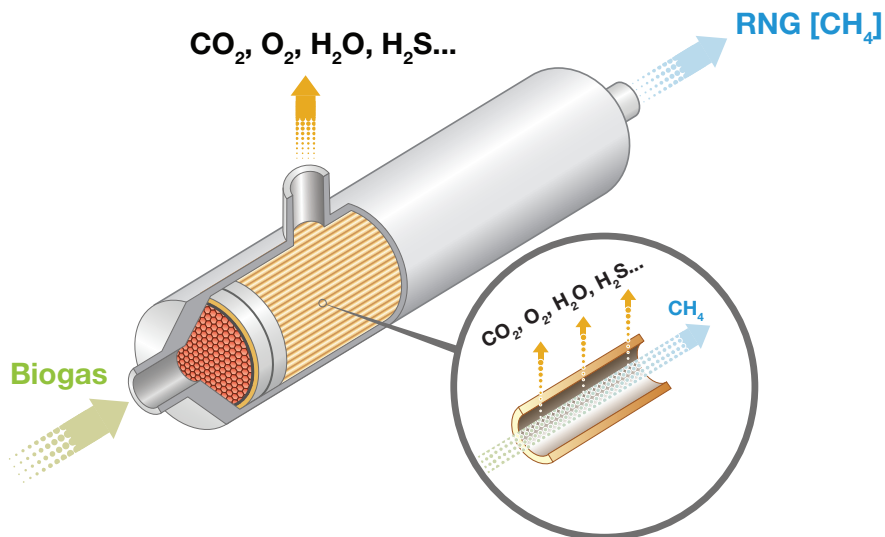
How It Works

Let's take a look at how our membrane technology processes raw biogas to create **RNG**:

- Raw biogas is treated to remove compounds causing volatile gases and odors. Then it is fed to our biogas purification modules, which separate methane and carbon dioxide via Air Liquide's proprietary polymer membranes.
- This efficient system purifies raw biogas to produce high-quality **RNG** which can then be delivered to customers by injecting it into the standard natural gas pipeline infrastructure or by transporting liquefied RNG in tankers.

Design, Engineering, Construction and Operation Expertise

At Air Liquide, we bring 50+ years of cumulative experience to the biogas industry. Our experience ranges from landfill gas well management to achieve desired raw gas quality to design, engineering & construction of **RNG** projects. We are committed to on-time delivery and operation of **RNG** projects with a high degree of safety and reliability.





With Air Liquide's global experience in engineering and construction of large, complex projects, we are constantly developing improvements in the RNG industry and sharing these benefits with our partners, customers and suppliers.

Air Liquide — Your Trusted Partner

Proven Reliability

Producing **RNG** is only half the story, as it also must be reliably delivered to the natural gas supply system. Air Liquide is also a world leader in gas transportation. Our Operations Control Center in Houston specializes in the transport, logistics, and the delivery of a wide variety of gases including oxygen, hydrogen, argon, and RNG by pipeline or tanker, and across many types of geographies and environments.

Air Liquide has demonstrated the expertise required to meet any transportation challenges that a renewable natural gas project might present, whether by liquefying the **RNG** and transporting by tankers, or connecting production directly to the natural gas supply grid.

The Technical and Financial Resources for Successful Project Completion

With 100+ years in the gas treatment business, we are on sound financial and technical footing.

Backed by our financial resources and stability, you can be assured that we will see your project through from planning to full implementation, regardless of its size.

By installing gas treatment and processing systems in hundreds of plants world wide, we have built strong project management and engineering skills that can be applied to the unique conditions of your project.

Experience with Large-Scale Turnkey Systems

Our team members have designed, built, and operated multiple **RNG** plants, and we have biogas upgrading technology at over 25 sites worldwide. We own a biogas upgrading plant near Atlanta, Georgia, taking local landfill gas and purifying it, injecting it into the local gas pipeline, and then transporting to customers. We have demonstrated experience with running plants at full production levels with a high degree of reliability, safety, and quality.



Let's Talk

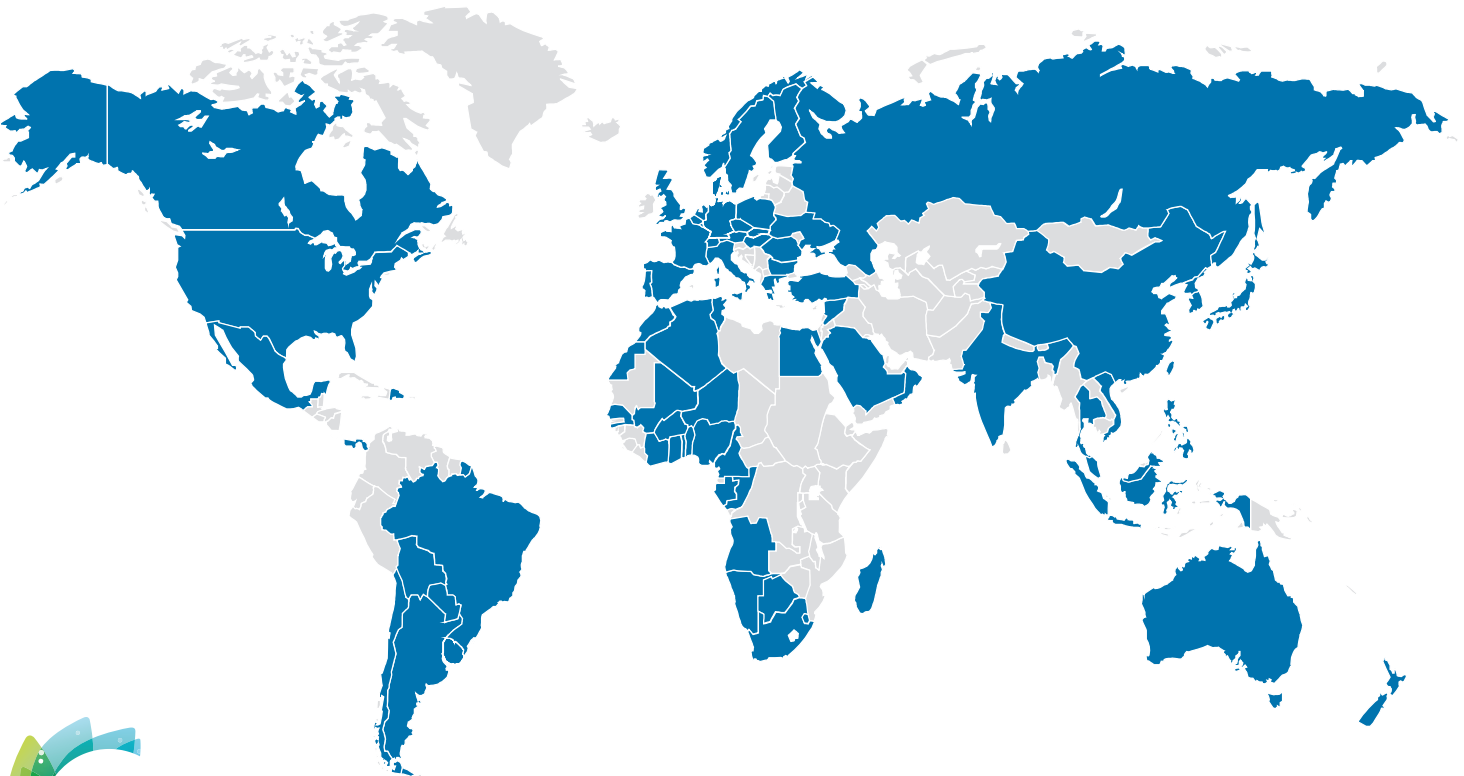
If you are interested in complying with renewable energy mandates, helping to cut greenhouse gases, or reducing your dependence on fossil fuels, Air Liquide has a compelling solution for you. Contact us to set up a meeting at your convenience to discuss your requirements and consider how RNG produced using our biogas upgrading system can help meet them. We look forward to talking with you and helping you to achieve your renewable energy goals.

Contact

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World leader in gases, technologies and services for Industry and Health, Air Liquide is present in 80 countries with more than 50,000 employees and serves more than 2 million customers and patients. Oxygen, nitrogen and hydrogen have been at the core of the company's activities since its creation in 1902. Air Liquide's ambition is to be the leader in its industry, delivering long-term performance and acting responsibly.

Air Liquide ideas create value over the long term. At the core of the company's development are the commitment and constant inventiveness of its people.

Air Liquide anticipates the challenges of its markets, invests locally and globally, and delivers high-quality solutions to its customers and patients, and the scientific community. The company relies on competitiveness in its operations, targeted investments in growing markets and innovation to deliver profitable growth over the long-term.