



PlanET STATERON

EMPOWERING YOUR RNG FUTURE WITH A
FULLY INTEGRATED TECHNOLOGY SOLUTION



PlanET BIOGAS

LEADING RNG & BIOGAS PLANT DESIGN & MANUFACTURING

650+



BIOGAS PLANTS IN OPERATION WORLDWIDE, INCLUDING **90+ AD TO RNG PLANTS.**

25+



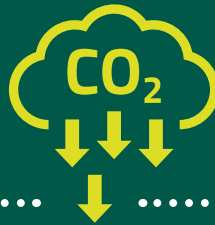
YEARS OF EXPERIENCE, ESTABLISHED IN 1998 AND SERVING THE **NORTH AMERICAN MARKET SINCE 2006.**

RNG...

green gas & an environmentally responsible choice

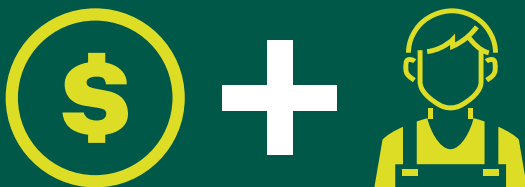
reduced carbon intensity compared to natural gas

supports regional, national & international climate initiatives



IMPROVES VALUE CHAINS IN THE AGRICULTURAL, INDUSTRIAL, AND ENERGY SECTORS, AND SUPPORTS LOCAL JOBS

reduces the demand for fossil fuels & reduces carbon emissions

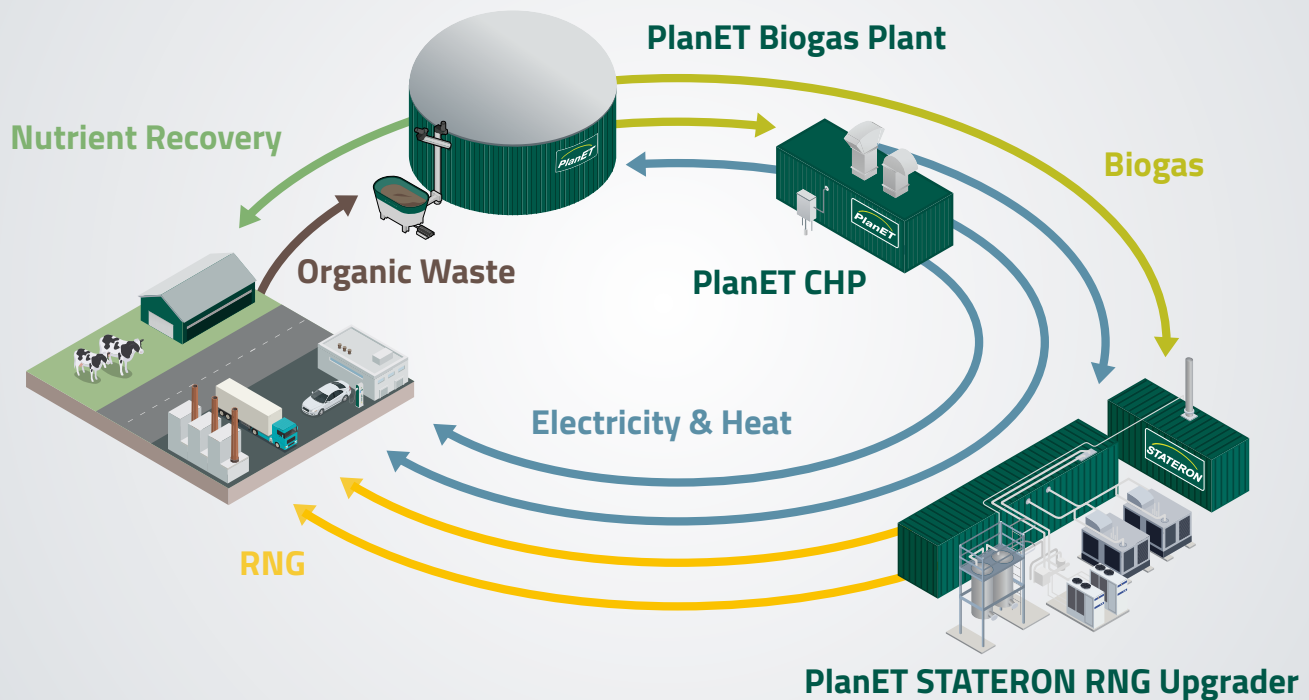


is an alternative for feed-in tariff & net metering

AD = Anaerobic Digestion, RNG = Renewable Natural Gas

THE POTENTIAL FOR BIOGAS & RNG

ELECTRICITY, HEAT AND FUEL



What is RNG?

RNG is Renewable Natural Gas and is also known as biomethane. It is a form of sustainable energy that is produced from biogas and is generated through the anaerobic digestion of various sources of organic waste.

RNG has many advantages. It can be used interchangeably with conventional natural gas in existing infrastructure, appliances and applications. This means RNG can be injected into natural gas pipelines to be used for heating, cooking, electricity generation and transportation in the same way as conventional natural gas. This in turn translates into various economic, environmental and organic waste management advantages. In addition, RNG can help reduce overall greenhouse gas emissions and combat climate change.

Turning Organic Waste into RNG

There are 4 major considerations to transform organic waste to pipeline RNG.

1. Feedstock Collection: Agreements are established with waste management companies, landfills, wastewater treatment facilities, and agricultural farms to secure a steady supply of organic waste feedstock. This feedstock includes materials such as manure, agricultural residuals, food waste, and other organics.

2. Preprocessing & Anaerobic Digestion (AD): The collected feedstock undergoes preprocessing to remove non-organic materials and contaminants. The organic waste is then transferred to a biogas plant which contains an anaerobic digester system, where microorganisms break it down in the absence of oxygen. This anaerobic digestion process produces biogas, consisting mainly of methane and carbon dioxide.

3. Biogas Treatment & Upgrading to RNG: The biogas produced from anaerobic digestion contains a mixture of methane, carbon dioxide, and other impurities. The biogas is conditioned and purified to remove impurities (hydrogen sulfide, ammonia, VOCs, Siloxanes & moisture). Once the biogas is conditioned and purified, it can be upgraded to RNG. This process involves removing additional impurities, particularly carbon dioxide, to achieve a high methane content similar to conventional natural gas. Different upgrading technologies can be used, such as pressure swing adsorption (PSA) or membrane separation.

4. Injection into Gas Grid: The final step is injecting the upgraded RNG into the natural gas grid or truck filling station. RNG can be blended with conventional natural gas and distributed through existing pipelines, making it compatible with the existing gas infrastructure.

PlanET STATERON RNG UPGRADER TECHNOLOGY

Advantages of our system

- Industry leading methane yield and recovery
- Selected high-quality plant components
- Best in class energy efficiency for lower OPEX
- Fully automated system that is easy to operate



PlanET STATERON RNG Technology

Our company has built its reputation on delivering modular, energy efficient solutions that are focused on lifecycle value and customer operability. This is the same approach we took when developing the PlanET STATERON. Extending our technology offering to RNG is a natural evolution in our development as we continue to be driven by pure energy.

PlanET STATERON uses one of two carefully selected types of technology, creating a turn-key solution for each of our customer's unique requirements, ensuring optimal efficiency and operational uptime.

Our **STATERON M-Series** is a packaged 3-Stage membrane system that uses the principle of selective permeability through the membrane surface.

Our **STATERON P-Series** uses Pressure Swing Adsorption (PSA) technology, a widely used process in the gas industry.

Our containerized systems are designed for ease of onsite installation and operation while allowing for seamless expansion in the future. The PlanET STATERON Upgrader Systems along with our AD technology offerings transforms organic waste materials such as

manure and food waste, into readily usable energy that connects with the Natural Gas distribution network.

Gas cleaning

There are three significant phases to the gas cleaning process:

1. Desulfurization by oxygen injection in AD tank

Direct oxygen injection allows for desulfurization of the biogas while it is still inside the digester. Using only oxygen means that other impurities are not introduced into the gas stream while strict oxygen injection control means meeting the most stringent pipeline specifications. Oxygen generators for injection can be installed into a process module, a PlanET technical container, or nearby the digester.

2. Dehydration / water removal

The raw biogas saturated with water enters the PlanET STATERON system where it is cooled in a dryer. A separator then eliminates the liquid fraction of the biogas, and the gas is reheated through a blower and the pressure is boosted.



Our services for our clients

- Feedstock Analysis, Biogas Potential & RNG Production Feasibility, Project & Site Evaluations
- Engineering design and technology equipment supply (including PlanET STATERON M-SERIES & P-SERIES)
- Advice on RNG and carbon credit markets
- Planning, regulatory and permitting support
- Construction support and commissioning
- Biological, technical and operational service and support

3. Active carbon filtration gas cleaning

The dry biogas is then directed to the activated carbon beds which are used to eliminate pollutants such as hydrogen sulfide, ammonia, VOC's and siloxanes. This activated carbon pre-treatment is made up of a number of filters, installed in a lead-lag configuration with operational flexibility in mind. Any one of the filters can be bypassed and enable carbon media to be replaced without shutting down the RNG PlanET STATERON system operation at full RNG plant production.

Gas Upgrading - Carbon Dioxide Removal

The treated biogas is turned into Renewable Natural Gas once the carbon dioxide is removed and the gas' methane content is upgraded to pipeline quality.

For this step we use one of two effective technologies:

- **STATERON M-Series** - utilizes Membrane Separation to remove carbon dioxide in the biogas.
- **STATERON P-Series** - uses Pressure Swing Adsorption (PSA) technology.

STATERON M-Series - Membrane Separation

Membrane separation, in the STATERON M-SERIES, is an effective technique that leverages semi-permeable membranes to selectively separate gas components based on their molecular size and permeability. This

process takes advantage of the fact that carbon dioxide (CO_2) can readily penetrate through the membrane, while methane (CH_4) does not, allowing for the efficient removal and separation of CO_2 . By employing membrane separation, the gas can be upgraded to Renewable Natural Gas (RNG) by eliminating CO_2 and enhancing the methane content.

STATERON P-Series - PSA

Pressure Swing Adsorption (PSA), in the STATERON P-SERIES, is based on the principle that different components have a different adsorption potential than others. In this case, CO_2 is adsorbed in the PSA columns that are filled with molecular sieve media, while CH_4 is concentrated to produce RNG.

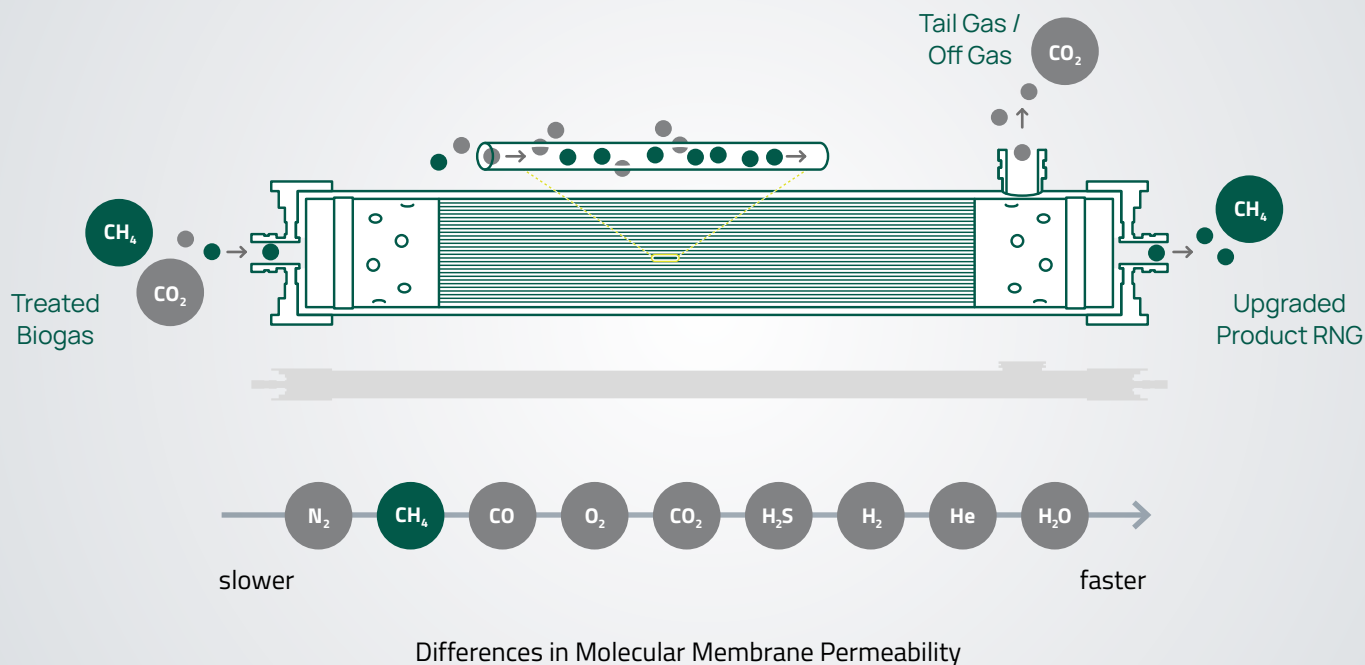
High CO_2 Tail-gas & CO_2 Utilization

For both the STATERON M-SERIES and STATERON P-SERIES RNG upgrader plants, the concentrated CO_2 off-gas or tail gases, which have a very low methane percentage, can be directly vented to the atmosphere.

However, instead of venting the high CO_2 tail gas/off-gas stream to the atmosphere, there are alternative technologies available to further purify or process the tail gas, allowing for the potential sale, capture, or utilization of the CO_2 .

PlanET STATERON M-SERIES

MEMBRANE TECHNOLOGY



PlanET STATERON M-Series

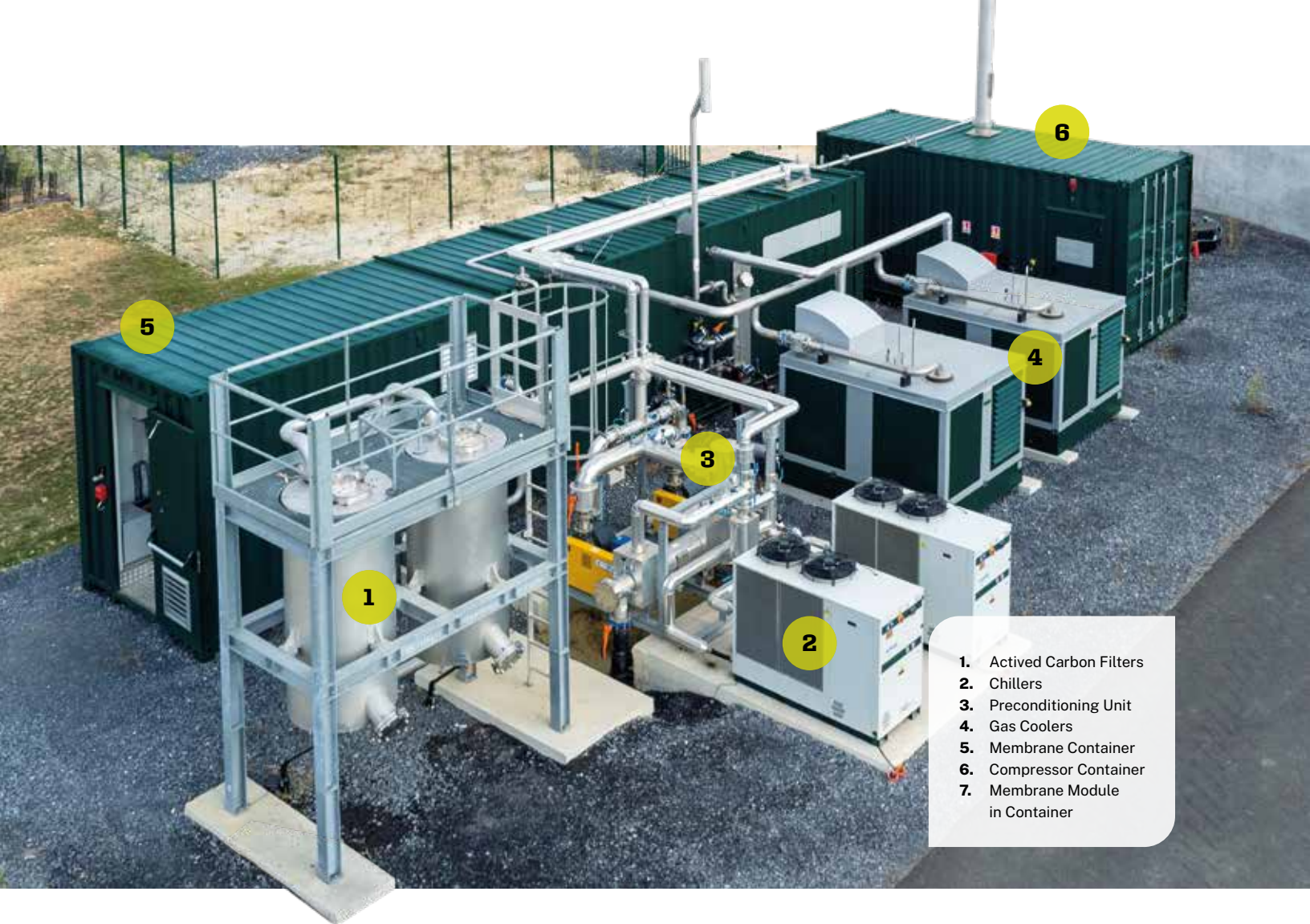
PlanET STATERON M-SERIES upgrading plants utilize a 3-stage membrane arrangement. Unlike other technologies, fluctuations in biogas input can be handled by our membrane system's compressor controls.

Our PlanET STATERON M-SERIES upgraders require no consumables other than activated carbon for biogas pre-treatment, and oil for the compressor. This advanced process does not consume water and the only discharges are purge-gases (also known as tail gases which can be directly vented) and condensates. The operating cost of our process remains low due to minimal electrical consumption.

The membrane method of cleaning biogas uses the principle of selective permeation through the membrane surface. Gases with higher solubility as well as smaller molecular volumes such as Carbon Dioxide (CO₂) penetrate the membrane quickly. Large, less soluble gases such as Methane (CH₄) permeate the membrane slowly. The driving power necessary for the ultimate separation of the gases is achieved by a partial pressure gradient.

Our packaged 3-Stage Membrane System uses several thousand hollow-fibre membrane modules bundled in a stainless steel tube. These hollow fibres are composed of polymer material which selectively separate CO₂ and CH₄ contained in the biogas stream. This gas separation procedure operates at room temperature, thus no external heat source is required.





1. Activated Carbon Filters
2. Chillers
3. Preconditioning Unit
4. Gas Coolers
5. Membrane Container
6. Compressor Container
7. Membrane Module in Container

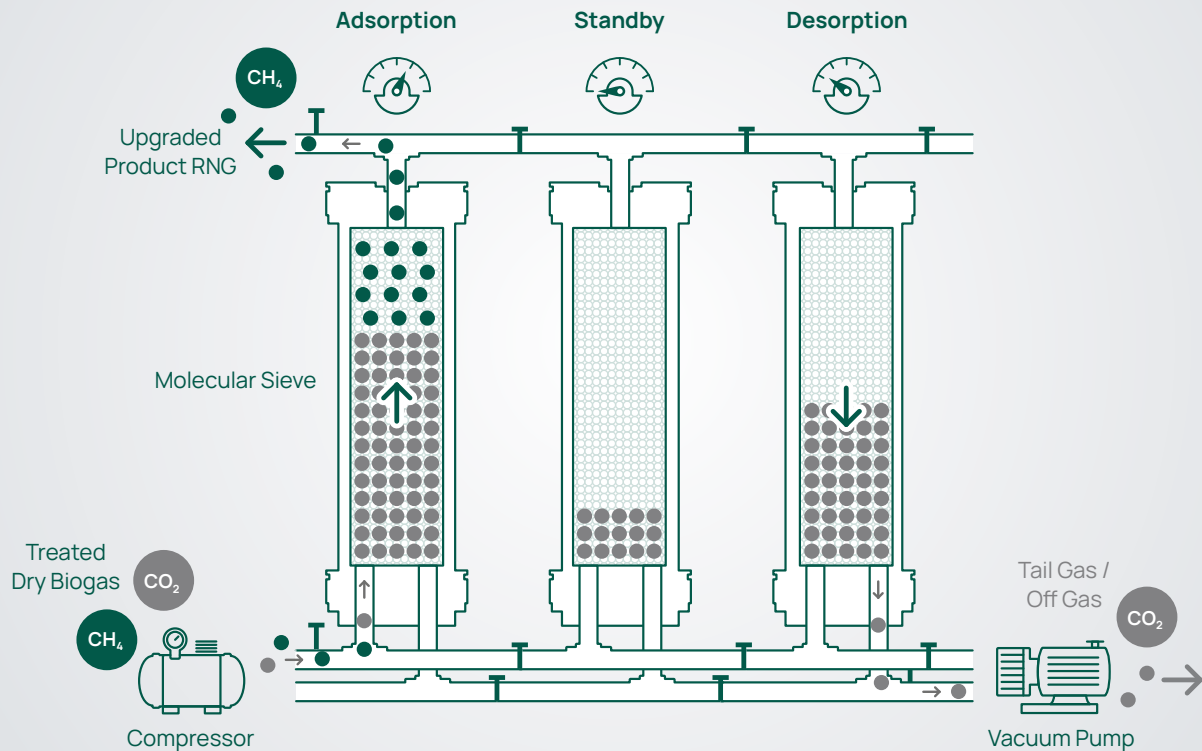


The PlanET STATERON M-SERIES ADVANTAGES

- High methane recovery (up to 99.6%)
- Low parasitic energy consumption
- Simple process control & high availability
- Fully automatic start-up & turndown function
- Methane content in the product gas can be adjusted to meet gas grid specifications
- No chemical, solvent or biological risks
- No process water required and no waste water produced
- No thermal oxidizer needed or tail gas to flare
- Modular design and shop fabrication for reduced onsite installation
- Local construction & commission support services, as well as ongoing operation & maintenance (O&M) support across North America

PlanET STATERON P-SERIES

PSA TECHNOLOGY



PlanET STATERON P-Series

Pressure Swing Adsorption (PSA) upgrading plants are reliable and efficient RNG systems designed to purify biogas composed of 50% to 70% CH₄ and other contaminants, thereby producing a product gas (RNG/Biomethane) in natural gas quality, which can be injected into the natural gas grid compressed to CNG.

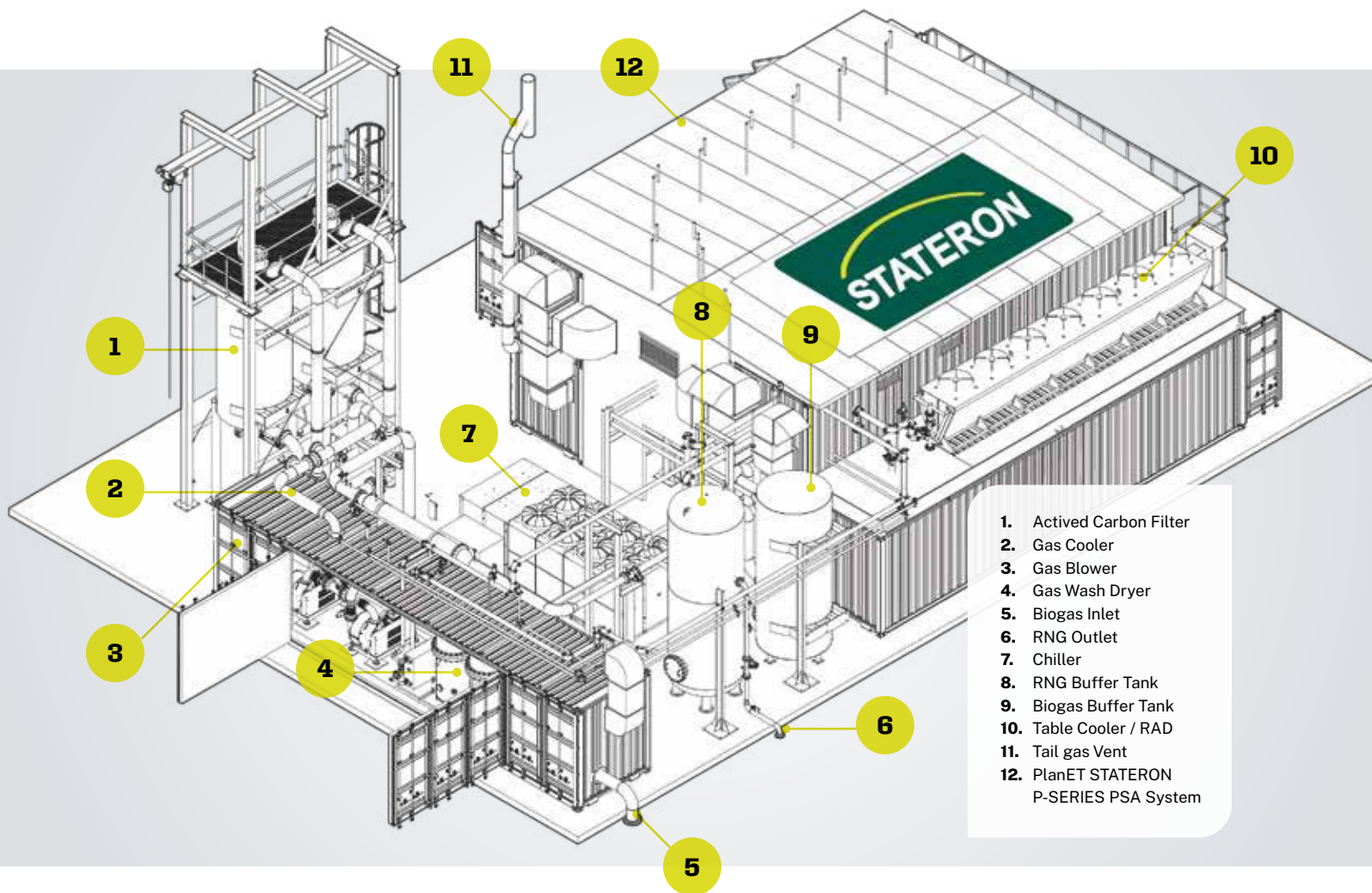
The PSA process used in the system is a physical process widely applied in the gas industry to purify different gas streams for a variety of industrial applications. The system is self-regulating, fully automated, and can adapt to varying inlet gas quality or volume flow, producing constant demand for grid injection.

The STATERON PSA system employs a fully dry gas phase process, ensuring that only gas is involved in the purification process. There is no interaction with water, chemicals, or any other liquid media throughout the process.

The PSA upgrading process is based on the principle that different components have a different adsorption potential than others. In this case, CO₂ is adsorbed in a molecular sieve, while CH₄ is concentrated.

The up-grading process can be explained in two simple process steps: Adsorption and Desorption. The PlanET STATERON PSA system automatically synchronizes adsorption/desorption of different vessels to allow for the production of a steady and continuous biomethane quality, even at varying inlet gas quality or volume flow. The only adjustable parameter is the cycle length.

Unlike other upgrading systems and due to a special guard bed, the STATERON PSA system is less sensitive to the performance of the activated carbon filters. Micro containments, resulting from upset digester operations that break through the activated carbon filters, are captured in the guard bed integrated in the PSA Adsorber. These micro containments include Hydrogen Sulfide, VOCs, oil mist and other harmful molecules in the biogas. They cannot move into the main adsorber or filter material and deteriorate the surface, which enhances the performance of the upgrading unit and increases the adsorbent life of the PSA molecular sieve media. In addition, the PSA guard beds are regenerated together with the main PSA adsorbers within each regeneration cycle, no accumulation can occur and the material does not have to be replaced like in other upgrading processes.



1. Activated Carbon Filter
2. Gas Cooler
3. Gas Blower
4. Gas Wash Dryer
5. Biogas Inlet
6. RNG Outlet
7. Chiller
8. RNG Buffer Tank
9. Biogas Buffer Tank
10. Table Cooler / RAD
11. Tail gas Vent
12. PlanET STATERON P-SERIES PSA System

The modular constructed PlanET STATERON PSA system uses a low operating pressure of only ~3 bar(g), individually sized rotary vane machines for biogas compression and vacuum regeneration, and the selection of high-quality components to reduce energy consumption to a minimum. Energy consumption as low as 0.16 kWh/Nm³ can be achieved, resulting in the most efficient upgrading process in the market. The system has a guaranteed uptime of > 97%, which coupled with low parasitic energy consumption provides unmatched value to our clients.

The PlanET STATERON P-SERIES PSA upgrading plant is a reliable, efficient, and highly automated system that produces a steady and continuous RNG quality, even at varying inlet gas quality or volume flow. The PSA process used in the system is highly flexible and requires low energy consumption, resulting in the most efficient upgrading process in the market. Additionally, the system uses a completely dry gas phase in addition to an integrated guard bed process, and has a lifetime warranty of the molecular sieve media of > 15 years.

The PlanET STATERON P-SERIES ADVANTAGES

- High methane recovery (> 98%)
- Lowest energy consumption of all RNG upgrader technologies
- Simple process control and high availability (> 99% availability)
- Fully automatic start-up and turndown function
- Methane content in the product gas can be adjusted to meet gas grid specifications
- No pressure surges in the adsorbent PSA columns and no dust formations
- Adsorbent lifetime >15 years
- No chemical, solvent or biological risks
- No process water required and no waste water produced
- No thermal oxidizer needed or tail gas to flare
- Modular design and shop fabrication for onsite installation
- Local construction & commission support services, as well as ongoing operation & maintenance (O&M) support across North America

PROJECT SPOTLIGHT

THE LARGEST AD TO RNG PLANT IN WESTERN CANADA



The Lethbridge PlanET STATERON P-SERIES RNG plant is a groundbreaking achievement in RNG production through uncertain times. Since its commissioning in 2021, this exceptional facility has demonstrated unparalleled operational reliability, surpassing industry standards and delivering exceptional performance. Utilizing the advanced Pressure Swing Adsorption (PSA) technology, it effectively transforms raw biogas into high-quality RNG, seamlessly integrated into the ATCO Energy's provincial natural gas grid.

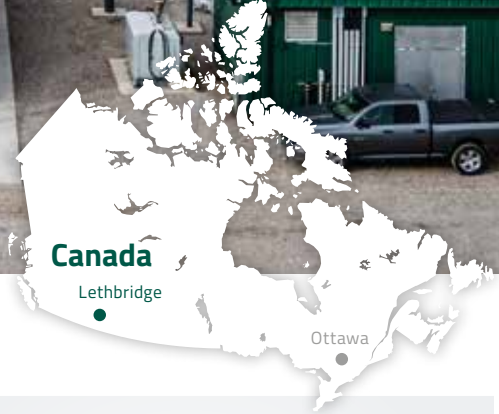
With an impressive capacity of 1190 scfm (1920 Nm³/h), the Lethbridge PlanET STATERON PSA plant sets new benchmarks. Praised for its remarkable efficiency and reliability, this plant ensures a steady supply of RNG with high turndown ratios.

Notably, the Lethbridge PlanET STATERON PSA plant represents a triumph of resilience amid challenging times. Despite the backdrop of the global COVID-19 pandemic, the design and equipment supply agreement was signed in early 2020, and the PlanET STATERON RNG P-SERIES upgrader commenced operations in the summer of 2021. This accomplishment exemplifies our





Video
↙



dedication to delivering cutting-edge solutions even in the face of adversity.

This remarkable biogas facility in Lethbridge has pioneered the path for biogas development in Canada. Boasting a processing capacity of 100,000 tonnes per year, it proudly stands as the largest biogas plant in Western Canada.



Commissioned	AD & CHP plant -2013 STATERON P-SERIES -2021
Number of Digesters	3 Digesters (1.04 Mgal / 3927 m ³ each)
CHP Electrical Output	2.85 MWe
RNG Upgrader Technology	Pressure Swing Adsorption (PSA)
Biogas Upgrade	1190 scfm / 1920 Nm ³ /h
Annual RNG Production Capacity	~ 330,000 MMBTUs ~ 350,000 GJs

Anaerobic Digester Feedstock

Cow, hog & poultry manure, slaughterhouse wastes, food waste, fats, oils and greases (FOG), whey and potato residuals

PROJECT SPOTLIGHT

PlanET STATERON M-SERIES IN BRITISH COLUMBIA



FortisBC Energy Inc. (FortisBC), a regulated utility, took a significant step towards increasing the supply of Renewable Natural Gas (RNG) within its system with the help of PlanET. By partnering with the Dicklands Farms project, located in Chilliwack, British Columbia, FortisBC will be injecting RNG into its gas distribution network. This innovative project utilizes PlanET AD technology and the PlanET STATERON M-Series to produce RNG from agricultural and food waste.

Through the process of anaerobic digestion (AD), food and agricultural waste undergoes decomposition and generates biogas. PlanET AD technology plays a crucial role in this process, facilitating efficient anaerobic digestion and in-tank desulfurization.

The biogas produced from the AD process is then upgraded into RNG using the PlanET STATERON M-Series packaged 3-stage membrane system. This advanced biogas upgrading technology cleans the biogas by removing impurities like carbon dioxide, hydrogen sulfide and moisture. The result is

high-quality RNG that meets the necessary standards for injection into the FortisBC natural gas grid.

The Dicklands Farms project takes a very innovative approach using a three goal strategy.

1. Responsibly manage local organic food waste, agricultural waste and manure
2. Reduce methane emissions from waste
3. Produce low-carbon energy (RNG)

This comprehensive approach helps to reduce methane emissions from agricultural waste, transforms it into a valuable low-carbon energy source and also produces organic pellet fertilizer and clean water.

At peak production, the Dicklands Farms project is projected to generate enough RNG to meet the annual gas needs of approximately 2,000 homes in British Columbia. This significant output of low-carbon RNG contributes to FortisBC's commitment to sustainability, reducing greenhouse gas emissions, and promoting a cleaner energy system.



Through the collaboration between FortisBC, Dicklands Farms, and PlanET Biogas, anaerobic digestion and biogas upgrading technologies are paving the way for a more sustainable energy future in British Columbia. By combining agricultural and food waste with innovative technologies, this project serves as a model for reducing waste, lowering emissions, and providing renewable energy solutions.



Commissioned	PlanET STATERON M-SERIES -2023
Number of Digesters	2 Digesters (1.49 Mgal / 5654 m ³ each)
RNG Upgrader Technology	3-stage membrane
Biogas Upgrade	780 scfm / 1260 Nm ³ /h
Annual RNG Production Capacity	~ 210,000 MMBTUs / ~ 220,000 GJs

Anaerobic Digester Feedstock
 Dairy and chicken manure along with packaged food waste

ABOUT PlanET



25+

YEARS OF EXPERIENCE IN THE BIOGAS INDUSTRY

15+

YEARS IN NORTH AMERICA

100%

DEDICATED TO ANAEROBIC DIGESTION, BIOGAS UTILIZATION & RNG TECHNOLOGY SOLUTIONS

PlanET Biogas Global

Founded in 1998, PlanET Biogas is an innovative international company with offices in Germany, France, United States, Canada, Italy, and Brazil. We have extensive experience and knowledge of the global market for biogas technologies and specialize in the design, construction, and servicing of anaerobic digestion and biogas utilization systems including RNG plants.

PlanET Biogas in North America

PlanET's group of North American companies are subsidiaries of PlanET Biogas Group, headquartered in Germany. With offices in Colorado, New York and Ontario, PlanET's localized presence is well positioned to support your project anywhere in North America.

With a specific emphasis on the agriculture, slaughterhouse, food, and organic waste sectors, PlanET Biogas has solidified our position as key providers of AD & RNG technology solutions. Our expertise and experience enable us to address the unique challenges and requirements of these sectors, providing tailored solutions to meet the needs of our clients.

PlanET Biogas Group New Headquarters

2022 marked the opening of PlanET Biogas Group's headquarters in Gescher, Germany. This state-of-the-art facility showcases our commitment to sustainability by integrating a renewable energy concept that combines RNG-fueled CHP, geothermal technology,





650+

BIOGAS PLANTS
OPERATIONAL WORLDWIDE

90+

AD TO RNG PLANTS IN
OPERATION WORLDWIDE

350+

EMPLOYEES
WORLDWIDE

and solar power. With a focus on meeting our energy needs and reducing peak loads, we efficiently generate electricity and heat while minimizing our carbon footprint. Our geothermal system provides heating and cooling, and solar panels contribute clean energy. Additionally, we have installed 18 charging stations to support electric vehicles.

Research & Development

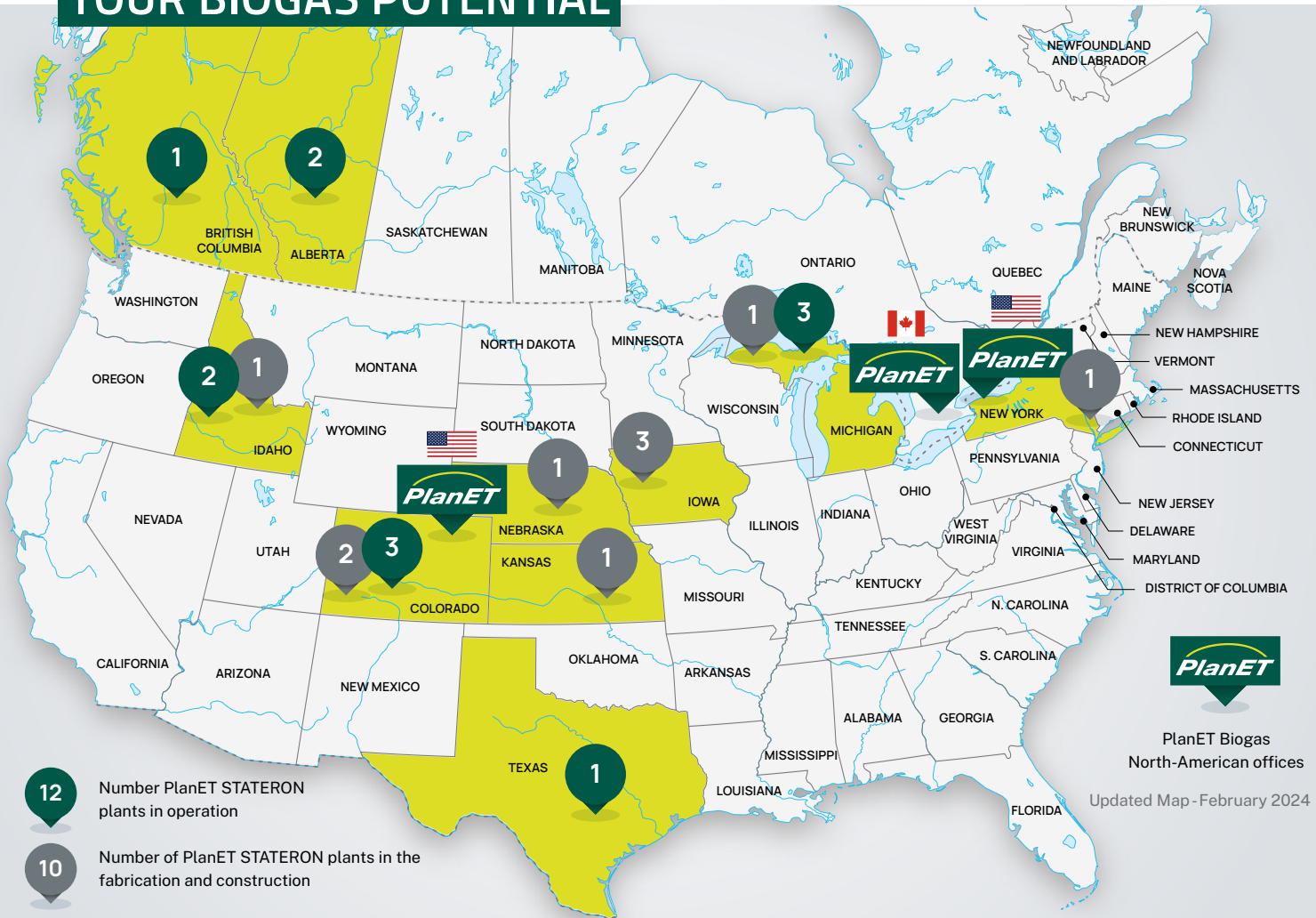
We actively engage in research and development, collaborating on scientific projects dedicated to organics resource recycling, upcycling, and diversion, as well as the beneficial use of biogas. This commitment directly benefits our customers by ensuring that our products and technology incorporate the latest scientific findings. We gain valuable insights into emerging technologies and best practices, enabling us to continually enhance the performance of our biogas plants. By staying at the forefront of research and innovation, PlanET provides our customers with state-of-the-art engineering design and technology solutions that improve energy production, organic waste management, and environmental sustainability.



Our clients

We serve a diverse customer base, including gas & electric utilities, fuel suppliers & distributors, agricultural businesses (including farms & slaughterhouses), the food & beverage industry, organic waste diversion companies (involved in processing pre- & post-consumer food waste & source-separated organics), municipalities, and other industries seeking sustainable energy solutions.

JOIN US AND ELEVATE YOUR BIOGAS POTENTIAL



Please contact us!



PlanET Biogas USA Inc.

3370 Walden Avenue, Suite 120
Depew, NY 14043
United States

Phone: + 1 877 266 0994
E-mail: contact-usa@planet-biogas.com



PlanET Biogas USA Inc.

33247 Highway 85
Lucerne, CO 80646
United States



PlanET Biogas Solutions Inc.

157 Cushman Rd.
St. Catharines, ON, L2M 6T4
Canada
Phone: + 1 905 935 1969
E-mail: info@planet-biogas.ca