BIOGAS WORLD

Biomethane Report

Market Intelligence

December 2022

U.S.A.

biogasworld.com

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About BiogasWorld

BiogasWorld is a business generation network and project support platform, connecting the suppliers of products and services with project developers. We accelerate the biogas and biomethane industry worldwide.

With the experience of working with hundreds of suppliers and collaborating to over 50 biogas and biomethane (RNG) projects in North America, BiogasWorld offers to project developers a wide range of services to help them reduce the cost and duration of their project implementation.

For more details, feel free to contact us at info@biogasworld.com.

Project Leads

Access public and private opportunities for your business; find funding and grant opportunities for your projects.

Market Intelligence

Support your business development efforts and grow your business by getting access to market intelligence and tools.

Online Promotion

Promote your business in biogas and biomethane industry and generate business opportunities through our online platform.

Notice to Readers

Terminology: Biomethane Vs. RNG

There are two terms widely used to describe upgraded biogas: biomethane (used in Europe) and Renewable Natural Gas or RNG (used in North America). To make the reading of the report easier, we opted to use the term "biomethane", however, some direct references to existing legislation and programs in the US will use "RNG" to make it easier for readers to make additional research.

Energy Conversion

The report uses a number of energy units to present the information due to the fact that different sources of information may use various units of energy. When reading the report, you will find helpful the following table containing approximate energy conversions for biomethane as reference.

Table 1. Energy Conversion

Unit of Energy	Conversion
1 PJ	1 000 000 GJ
	0,9478 TBTU
	947 817 MMBTU
	277 780 TWh
	26 518 000 m3 Biomethane (RNG)
	0,9478 Bcf

Abbreviations

PJ Petajoule
GJ Gigajoule
TBTU Trillion British Thermal Units
MMBTU Metric Million British Thermal Unit
TWh Terra Watt hours
Bcf Billion cubic feet

U.S.A.

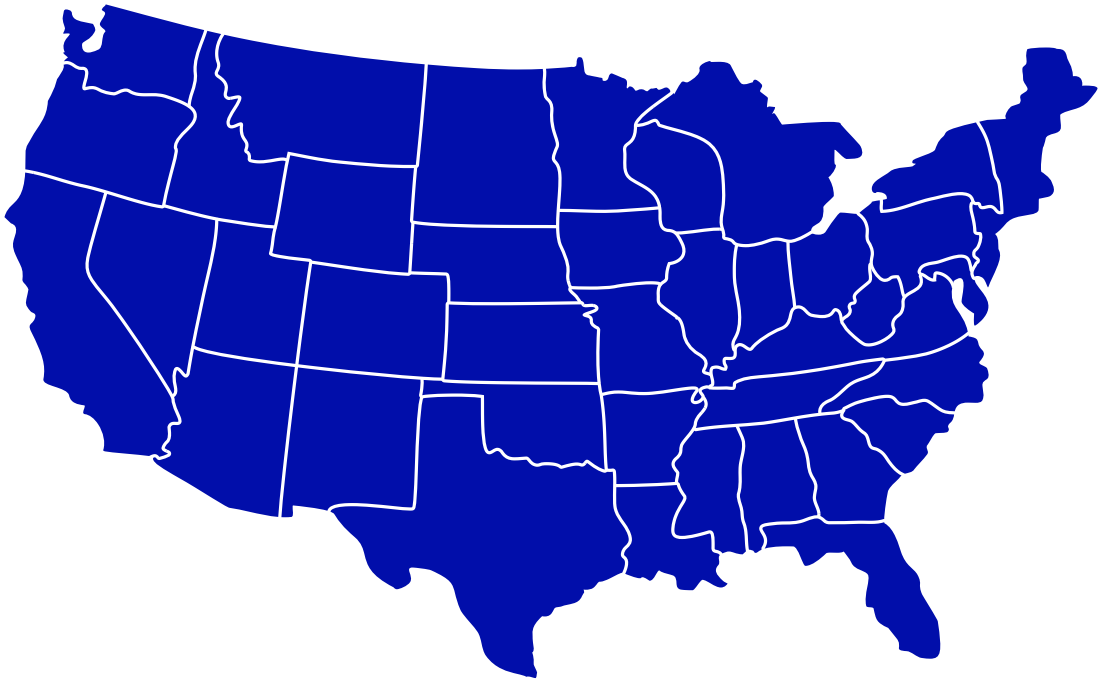
Market Overview

Current Market Overview

There are 227 operating biomethane facilities[1] in the US with the majority of facilities injecting the upgraded biomethane into the gas grid with the purpose of being used as vehicle fuel. The overall increase of operating facilities is 40% as compared with 2021 statistics.

The biggest growth in 2022 occurred in agricultural sector, where the number of operational plants increased by 55%, to 83, as compared to the end of 2021. The majority of RNG facilities remains landfills (96 plants), however, agricultural digesters may surpass landfill stations by the end of 2023 (82 plants). The states with the most biomethane production are Wisconsin, Texas, Pennsylvania, Ohio and California.

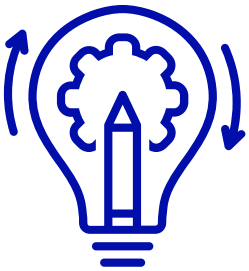
At the end of November 2022, the EPA reported over 17.4 billion RINs generated for the RFS in 2022, down from 19.9 billion last year. Of the total, nearly 489.9 million were D3 cellulosic biofuels generated in the first 10 months of 2022.



[1] It is important to note that operating units in clusters are not counted separately; cluster is considered as one project.

Current Market Overview

Projects in Development

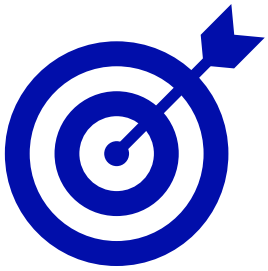


According to BiogasWorld's database, there is currently 118 RNG facilities under construction and another hundred at various stages of development, scheduled to be online within the next 2-3 years.

The majority of facilities are planning to inject the biomethane into the grid to use as vehicle fuel.

Across the US, there are estimated to be 1,600 CNG, and 140 LNG vehicle refuelling stations. Future projections predict the Pacific US to produce between 193-371 billion ft3 of RNG per year (representing 66-126% of SoCalGas' projected 2035 consumption).

Market Opportunities



Per AGA, there are activities in 37 US states to promote the use of RNG (legislations, regulations or utility-led activities).

Following the passage of the IRA, major opportunities exist for the development of new RNG projects, which increase with the usage of American-made materials and unionized labour.

The most valuable projects for 2021-2022 remain to be dairy and swine biogas projects, due to their extremely low CI scores and qualification for D3 and D6 RINs.

Biomethane Potential

In a recent report by Anew, it was estimated that RNG could decarbonize as much as 48% of current gas demand.

NREL estimates that biomethane potential is 516.5 PJ (Only 5% was used in 2018). There are potentially 475 landfills and 250+ agricultural biomethane projects.

A recent study by Argonne National Laboratory found high potential for WWTPs to supply RNG, with 66% of WWTPs within 5 miles of a NG pipeline. Further, 77% of this potential energy lies in facilities greater than 5 mgd.

Upgrading Snapshot

Out of 227 operating RNG projects, the information on used upgrading technology is available for 130 units. The results are presented in the Figures below. Figure 2 presents the available information based on the number of installations, whereas Figure 3 presents the data based on the installed capacity.

Note that the category "Other" includes the information combined for two plants: one using the mix of water scrubbing and PSA, another one, membrane and PSA.

Figure 2. Operational RNG upgrading plants in the US, number of plants

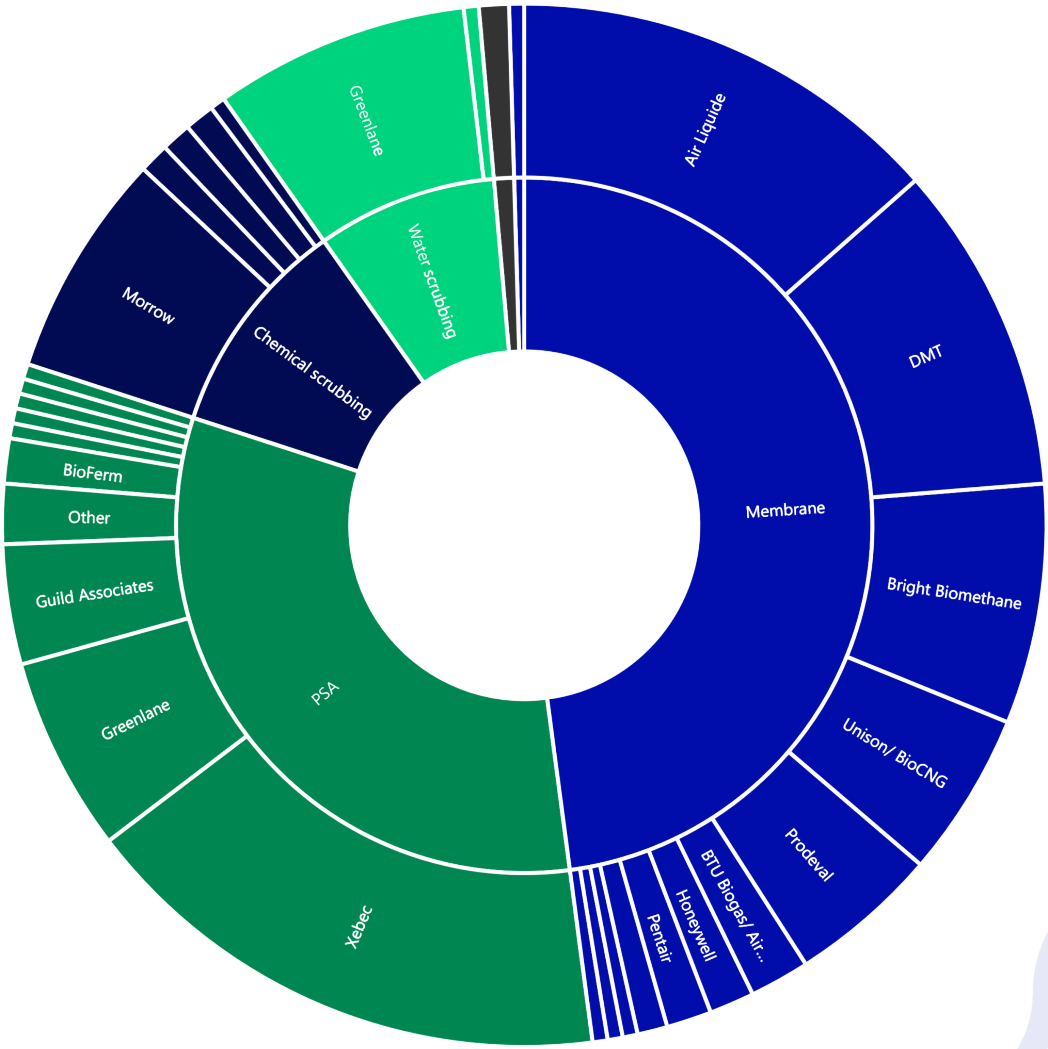
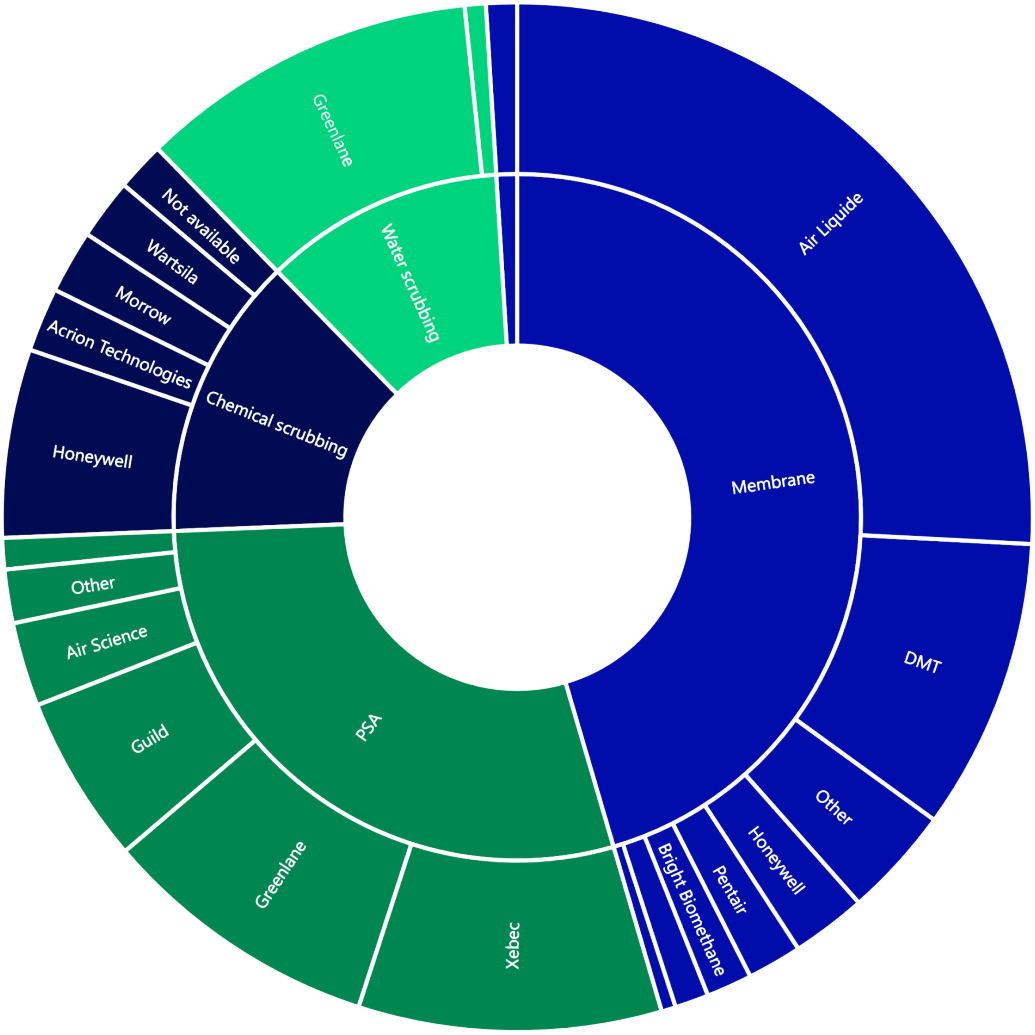


Figure 3. Operational RNG upgrading plants in the US, capacity, m3/hr



U.S.A.

Market Drivers

Federal and Multi-State - Market Drivers

- Renewable Fuel Standard (RFS) requires minimum volume of renewable fuel in transportation fuel (36 bln gallons of renewable fuel by 2022).
  - EPA tracks compliance through the Renewable Identification Number (RIN) system. Biogas is qualified as valuable cellulosic RINs (D3 or D5).
  - In December 2022, it was announced that an upcoming bill aims to change how RINs will be priced and generated, reducing compliance costs and issuing RINs at a fixed cost

- In December 2022, the EPA released a proposal for the guidance of some key biogas areas under the RFS, including multi-year fuel volumes for RNG and biogas used for electricity.
  - The proposal releases fuel volumes for the 2023-2025 period, which up until this point were released yearly and limited to +8%
  - Additionally, the proposal creates a framework for the creation of "eRINs", electric vehicle credits for biogas CHP, as well as the inclusion of a new method for accounting, which the ABC believes will increase food waste recycling

- Renewable Portfolio Standard (RPS) requires retail electricity suppliers to generate/procure a min % of electricity from eligible renewable energy sources. 62% of States currently have renewable standards in place, and another 14% have renewable goals.

- The Inflation Reduction Act (IRA) was passed into law in August of 2022, and includes many tax incentives for biogas and biomethane production. The Act features a baseline credit, which gets expanded upon for meeting a number of additional requirements (all stacking upon one another):
  - Investment Tax Credit for RNG and heat from biogas: 20% base
  - Domestic content requirements: 10%
    - Based off of the Buy America Act, and relates mainly to iron, steel, and manufactured products (which must account for 40% of the total)
    - Congressional document does not suggest domestic content relates to services such as consulting or engineering
  - Wage: base is 30% investment tax credit (ITC) and 2.6 c/kWh production tax credit (PTC) (adjusted for inflation)
  - Apprenticeship: projects beginning in 2022 must have 10% of hours worked by registered apprentices, increasing to 12.5% for 2023 and 15% thereafter
  - Energy Community or Environmental Justice areas: 10% for 'energy communities' and 10-20% for environmental justice areas
  - An update to IRS Section 45Q, (a CCUS carbon credit) enhancing the tax credit to provide higher $/GJ, which will increase or decrease depending on the type of energy and presence of CCUS. It will also for direct pay and transferability

Federal and Multi-State - Market Drivers (Continued)

- Regional Greenhouse Gas Initiative (RGGI) to cap and reduce CO2 emissions from the power sector. This initiative allows the avoided methane emissions to generate offsets that can be sold for compliance. This initiative is applicable for Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The initiative provides funding to energy projects which reduce the regions dependence on fossil fuels

- In November 2021, the U.S. Methane Emissions Reduction Action Plan was released, outlining targets for reducing methane emissions within the US. The plan includes:
  - A federally enforceable 'backstop' limit on landfill emissions, aiming to reduce landfill methane by 70%
  - Several new programs to address agricultural emissions including sequestration, improving markets for low-carbon products, and capturing agricultural methane emissions for the purpose of renewable energy

- HR 5899: the Biomass and Biogas for Electric Vehicles Act (Nov. 2021), allows biomass facilities which generate electricity to participate in and generate credits for the federal RFS program- former requirements demanded 100% traceability for transportation fuels, while the changes allow for the extrapolation of total electricity in the grid used to charge vehicles

- The Growing Renewable Energy and Efficiency Now (GREEN) Act was introduced to the House in February 2021. If passed, it will allow certain types of renewable sources (including biomass and municipal waste) to be claimed as energy property for the purpose of claiming energy tax credits. The Bill also includes the extension of a number of tax credits not encompassed within the BBB, and further expands tax credits which benefit the development of energy storage technologies.

- The Alternative Fuel Tax Credit (AFTC) was extended in August of 2022 for the next 3 years, beginning retroactively in January 2022
  - Provides a credit of USD 0.50 / gallon for RNG as transportation fuel

- Rural Energy for America Program (REAP) (OneRD Guarantee Loan Initiative)
  - $304 million USD has been designated for anaerobic digesters and other underutilized renewable energy technologies
  - The IRA has added approximately USD 2 billion in additional funding for REAP

- Landfill Methane Outreach Program (LMOP): voluntary program encouraging the recovery and beneficial use of MSW biogas
  - December 2022, the EPA updated the Landfill Methane Outreach Program (LMOP) National Map, locating American landfills and identifying their gas use

Federal and Multi-State - Market Drivers (Continued)

- States with yard debris bans from landfills include Arkansas, Delaware, Illinois, Indiana, Maryland, Michigan, Minnesota, Missouri, New Hampshire, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, South Dakota, West Virginia, and Wisconsin
  - Some states with landfill yard waste bans provide an exemption for landfills with gas collection systems, these states include Florida, Georgia, Iowa, and Nebraska
- A new bill was introduced in December 2022, which creates a USD 1 /gallon tax credit on the sale of RNG fuel
- States with food scrap collection mandates to prevent landfilling include California, Connecticut, Massachusetts, New Jersey, New York, Oregon, Vermont, and Washington

Arkansas - Market Drivers

- SB 136 was passed into law in March of 2021. The bill allows gas utilities to purchase NG alternatives including RNG and hydrogen if it is deemed to be in the public's interest

California - Market Drivers

- State renewable energy goal: 50% by 2026, 60% by 2030, 100% by 2045
- The CPUC set RNG targets for California utilities, 13-02-08 (CA Renewable Gas Standard), approved in February 2022, which requires a percentage of all gas used to originate from certain types of RNG
  - The programs focus is on developing the necessary infrastructure and utilizing municipal organic waste, and sets a limit on the use of dairy gas
- SB1383: California target of organic waste reduction - 75% by 2025
- Low Carbon Fuel Standard (LCFS): 20% reduction in transportation fuel carbon intensity by 2030

California - Market Drivers (Continued)

- Short-lived Climate Pollutants (SLCP) strategy: Aims to reduce GHG emissions across California from compounds such as black carbon (soot), methane (CH4), and fluorinated gases (e.g., hydrofluorocarbons or HFCs).
  - February 2022, the CPUC set further targets for reducing SLCPs to 40% below 2013 levels by 2030
  - Waste, landfills, agriculture, and forest management were identified as priority sectors
  - Short Lived Climate Pollutants organic waste and food collection regulation: came into force January 1, 2022
    - Requires municipalities to create and operate organics diversion plans

- AB1826: Organic Waste Ban: commercial generators (should either compost or digest anaerobically)

- Cap-and-trade program: extended until 2030, with changes being presented late 2022 for ratcheting-up of regulations

- SB1352: Mandatory RPS for gas utilities
  - Requires utilities to establish a biomethane procurement program and supply 5% of total volume in RNG by 2022 and 20% of total volume by 2030

- AB2313: Biomethane Interconnector Monetary Incentive Program covering up to 50% of the interconnection costs with a cap of USD 3 million per project.
  - Program is available until December 31, 2026, or until program has exhausted USD 40 million cap.
  - It is funded by California utility customers and administered by Southern California Gas Company.

- AB118: Alternative and Renewable Fuel and Vehicle Technology Program – annual budget of USD 100 million to support applicable projects- project is extended through to 2024

- AB3163: adds non-combustion thermal conversion of organic wastes as method to generate biomethane as of 2022
  - September 2022, the government of California passed SB 1109, extending the requirement for electric utilities to purchase energy from biomass facilities

Colorado - Market Drivers

- SB 21-161: establishes rules for utility voluntary reduction programs and establishes 2019s GHG emissions as the baseline: targets 5% of RNG by 2025, 10% by 2030 and 15% in 2035. RNG must also account for at least 35% of a utility's emissions reduction
  - Introduced March 2021 and tabled as of November 2022
- Docket No. 22A-0251G: seeks the approval for a voluntary RNG/offset pilot program, currently waiting on approval
- SB 21-264: gas utilities must file a clean heat plan with the Public Utility Commission, targeting 4% reduction below 2015 GHG levels by 2025 and 22% by 2030. RNG may only account for 1% of the 2025 target and 5% of the 2030 target
- The city of Boulder has implemented a landfill organics ban
- Sales tax exemption for anaerobic digestion equipment (HB14-1159)

Connecticut - Market Drivers

- Connecticut Dept. of Energy and Environmental Protection (DEEP) targeting 100% zero-carbon energy by 2040
- Docket No. 19-07-04: enacted June 2021, includes gas quality and interconnection standards for the injection of RNG into the gas network
- CT HB 5118: allows DEEP to direct utilities to enter purchase agreements with RNG suppliers on behalf of networks and allows for (specified) cost recovery
  - Introduced in February 2022
- Organic waste ban: commercial and industrial sector food waste limited to 52 tons/year
- HB 5250: introduced in 2020 aims to increase the use of RNG, reintroduced February 2021 as CT HB 6409
- CT SB 60: introduced January 2021, streamlines the permitting and siting processes of anaerobic digesters
- Adopted interconnection standards for biogas derived from organic materials in June of 2021
- HB 5118: creates a grant program available to municipalities for the reduction of sloid waste and the implementation of waste mitigation measures, such as anaerobic digestion
- Special Act No. 22-8: July 2022, launches a hydrogen task force, which includes an examination of sources of clean hydrogen including biogas

Florida - Market Drivers

- SB 896: In April 2021, biogas and renewable natural gas were added to the existing definitions of renewable energies under state law. Additionally, cost recovery measures for utilities were put in place to levelized the cost between RNG and NG within a 'reasonable and prudent' range

Hawaii - Market Drivers

- HB 1242: gas RPS is required according to renewable portfolio requirements of 40% of sales by 2030, 70% by 2040 and 100% by 2045
  - The RPS supports the development of renewable electricity (including, but not limited to, biomass, MSW, CHP, LFG, and anaerobic digestion
- HB 1242 reintroduced in January of 2021 as SB 289 and passed in January 2022

Illinois - Market Drivers

- HB 3115: introduced February 2021, and would allow NG utilities to seek authorization from ICC for RNG infrastructure investments and supply contracts, and would allow consumers to purchase RNG directly from their utilities
- HB 3315 also includes portfolio goals of 2% RNG supply by 2030 and at least 3% by 2035 for utilities

Iowa - Market Drivers

- HF 522: enacted May of 2021, alters regulations to allow manure to be stored and processed via anaerobic digestion for the production of biogas as an alternative to current requirements

Massachusetts - Market Drivers

- Massachusetts long-term climate plan targets a 33% reduction by 2025, compared to 1990 levels, ramping up to 50% by 2030

- Renewable Portfolio Standard requires 35% of energy by 2030 to be sourced from renewables
  - AD and LFG are categorized as Class I in the RPS

- Organic waste ban: any waste generator producing more than 1 ton a week, unlike other bans, there are no exceptions based on proximity to processing facilities

- H 5060: signed July 2022, allows some AD facilities to collect energy credits under the Clean Peak Standard starting in 2023

- H 4081 introduced in August 2021, and would establish a renewable heating standard as of 2025
  - Also allows 'prudent' cost recovery which arise as a result from the implementation of renewable fuels

- February 2021, H 3887 was filed to study the opportunities RNG provided for a source of low emissions heating. Report deadlines have been extended several times throughout 2022, no information available following June 2022 deadline

Michigan - Market Drivers

- State renewable energy standard voluntary goal: 15% by 2021, 35% by 2025, 50% by 2030
- HB 6036: introduced in 2020, aims to extend PACE financing program to include anaerobic digestion
- SB 138: introduced February of 2021, would require the PSC to develop and keep updated an inventory of biogas and RNG resources available in the state
- SB 82: earmarks USD 250,000 in the state budget for the PSC to conduct a study of RNG potential in the state
  - The report found 313.5 trillion Btu/y theoretically available, 148 trillion Btu/y technically feasible, and 57.2 trillion Btu/y easily achievable in Michigan by 2050, with the ICF estimating production costs between USD 10 and 50 per MMBtu

Minnesota - Market Drivers

- HF 239 / SF 421 (reintroduced as HF 6 and passed in June of 2021) allows gas utilities to propose innovative resource plans, defined to include biogas, RNG, and power-to-hydrogen. Up to 7.5% of revenue requirements can be invested for RNG and it may also apply for an additional green tariff.
- SF 3336 / HF 3681 provides research funding for AD feedstock availability by directing grant funding from the Agricultural Utilization Research Institute
- Hennepin County has implemented a landfill organics ban, and is in the process of developing a new anaerobic digester for the processing of MSW

Missouri - Market Drivers

- HB 734: passed in May 2021, requires utilities to develop and implement a voluntary RNG program for customers, and recover incurred costs

Nevada - Market Drivers

- SB 154: requirement for Public Utilities Commission of Nevada to adopt regulations authorizing LDCs to engage in RNG activities, with a target of 1% of biomethane of total amount of gas sold by 2025, 2% by 2030 and 3% by 2035

New Hampshire - Market Drivers

- June 2022, SB 424 is approved. Allows PUC to procure RNG and qualified RNG infrastructure if deemed to be in the public interest
  - Cost of RNG cannot exceed 5% of the utilities total gas volume delivered and cannot exceed 3% annually
- SB 577: allows biologically derived thermal energy to generate credits under the states RPS carve-out

New Jersey - Market Drivers

- A3726: classifies landfills with gas capture technology as recycling facilities, and classifies methane captured from landfills, biomass, or anaerobic/aerobic facilities as a “Class 1 renewable energy”
- NJ A 577: directs the BPU to establish an RNG program and invest in RNG infrastructure by the gas utility and allows the utility to invest up to 5% of the total revenue requirement annually
- NJ S3526/ A5655: introduced March of 2021 and if signed would encourage the procurement and investment of RNG by gas utilities. It sets portfolio targets at 5% by 2024, increasing by 5% every five years to 30% by 2050.

New York - Market Drivers

- Clean Energy Standard 2.0 approved in October 2020
- In February 2019, legislation has been introduced that will require New York State to adopt a Low Carbon Fuel Standard aiming at reducing the overall carbon intensity of State's transportation fuel supply 20% by 2030. This bill has been stalled in environmental committees since March 2020
- Food scraps recycling requirement took effect January 1, 2022, requiring designated generators to donate surplus food and to divert the remaining for organics processing
- Currently, NY Climate Leadership and Community Protection Act excludes biogas and RNG from renewable energy due to the current differentials in potential supply and desired demand
- NY A 9392: introduces waste-to-energy within the states acceptable definitions of renewable energy
- August 2022, the state governments of NY and NJ announced a USD 200,000 grant, administered through the EPA, for the development of AD technology
- May 2022, NY DEC announced draft regulations which would reduce the waste sent to landfills and limit LFG emissions
- New York City has implemented a landfill organics ban

North Carolina - Market Drivers

- Renewable Energy Portfolio Standard includes a specific requirement for a portion of renewable energy from swine and poultry farming wastes
- SB 605: Streamlines permitting processes for turning hog waste into RNG, and creates 'general permits' for livestock farm owners to construct and operate manure digesters

Ohio - Market Drivers

- HB 166: allows gas utilities to recover investment costs as part of a normal rate case

Oregon - Market Drivers

- State renewable portfolio standard outlines that by 2025 at least 8% of aggregate electrical capacity must be derived from small-scale community renewable energy projects at a capacity of 20MW or less
- Clean Fuels Program (CFP, 2016): 10% reduction in transportation fuel carbon intensity in 10 years.
  - CFP Expansion, 2022: clarifications for Green-e requirement for biogas to electricity projects
- SB 98: legislates RNG targets of 15% by 2030, 20% by 2035, and 30% by 2050
- SB 314: allows gas utilities to recover some of the costs of establishing infrastructure which supports alternative fuels for transportation vehicles
- Any business that "cooks, assembles, processes, serves, or sells food" must source-separate its food waste and send it to an authorized facility for processing
- The city of Seattle has implemented a landfill organic ban, and the city of Portland has implemented a food scrap collection program

Pennsylvania - Market Drivers

- Alternative and Clean Energy Program
- ICI food waste diversion programs in the state are estimated to divert 145,000 t/y of food waste, with an estimated 111,000 tons of additional capacity

Tennessee - Market Drivers

- SB 1959: authorizes gas utilities to apply for cost recovery on RNG and hydrogen
  - Rate adjustment cannot exceed 2% of the annual revenue requirement, and third-party procurements cannot exceed 3%of total annual cost of gas

Rhode Island - Market Drivers

- State renewable energy standard voluntary goal: 38.5% in 2035
- Organic waste ban: industrial, commercial, and institutional sectors

Vermont - Market Drivers

- State renewable energy standard voluntary goal: 75% by 2032
- New Standard Offer RFP
- Organic waste ban: all generators of organic waste, including residents

Virginia - Market Drivers

- HB 558: passed in March 2022 and allows the VCC to approve utility applications for the incorporation of RNG, hydrogen, and low-emission gases into their network
  - Also allows for the cost recovery of expenses related to biogas infrastructure
  - No project can supply gas that exceeds the more than 3% the utilities annual demand, and no combination of projects can exceed an annual supply volume of 15%
- HB 461: aims to establish the tax credit for renewable energy property
- The 2022 Virginia Energy Plan includes several recommendations for the development of new energy infrastructure in the state, including the use of federally available funds for the development of biogas infrastructure

Washingston - Market Drivers

- Low Carbon Fuel Standard (2021) aims to reduce GHG emissions from transportation fuels 10% below 2017 levels by 2028 and 20% by 2035
- HB 1070: introduced in 2020 aims to provide tax exemption for sales of RNG when used as transport fuel
- HB 2580: provides a tax incentive for digesters and promotes the investment in RNG
- HB 1257: requires utilities to offer voluntary RNG program, with a charge not greater than 5% of the charge to retail customers
- E2SHB 1799: requires food which would otherwise be landfilled to be donated, composted, or anaerobically digested
- In December 2022, the WA Department of Ecology announced it is working on a new rule which would require all landfills within the state to reduce their methane emissions. The rule would apply to all active and closed landfills which have received waste since 1992

Wisconsin - Market Drivers

- Focus on Energy: utilities program for renewable energy
- Energy Innovation Grant Program: the 2021 EIGP round is due January 14, 2022
- LRB 3473: November 2021, establishes a USD 1 million grant program for the development of regional biodigesters
- AB 1072: March 2022, PSC is directed to establish an interconnect standard and issue a report on methods for the state to support financing of RNG infrastructure
- The 2021-2023 executive budget allocates grant funding for the DATCP to establish regional biodigesters for the produce RNG or electricity

Gas Utilities and Biomethane Quality Specifications

Gas Utilities and RNG Quality Specifications

The gas utilities with RNG (biomethane) programs are presented in this section of the report.

Avista

- States: Idaho, Oregon, Washington
- October 2022, Avista published an RFP in Washington for the procurement of RNG, with first deliveries no earlier than January 1, 2023
- In March 2022, Avista began seeking PUC approval for voluntary RNG program in Idaho
  - Program would entail the voluntary purchase of 1.5 therm blocks for USD 5

BGE First Maryland

- State: Maryland
- Received approval for G-9: RNG Interconnection Service in October 2021, allowing an RNG interconnection tariff

Black Hills Energy

- State: Colorado, Nebraska, Kansas
- Announced plans in November 2022 to offer customers a voluntary RNG and carbon offset program, purchased in blocks (available to both Nebraska and Colorado customers)
  - Blocks sold for USD 5 each and offset approximately 33% of average residential gas use and will begin in January 2023

Chesapeake Utilities Corporation

- State: Delaware
- Interstate RNG gas quality tariff has been approved
- In 2020, announced the partnership with Bioenergy DevCo and CleanBay Renewables to develop anaerobic digestion facilities and distribute RNG to its customers
- Acquired Plant Found Energy in November 2022, granting access to their chicken litter RNG technology and two facilities in MD

Centerpoint Energy

- States: Arkansas, Louisiana, Minnesota, Mississippi, Oklahoma, and Texas
- The RNG Program (RNG Interconnection Tariff) has been approved in January 2021 with slight alterations by Minnesota Public Utilities Commission
- May of 2021 Centerpoint filed a petition to establish a carbon intensity framework for RNG and a threshold carbon intensity requirement for RNG interconnection producers
- Gas specification is based on CA Rules 21 and 30, but has the right to make amendments to the requirements

Con Edison

- State: New York
- In January 2020, it is approved to purchase RNG and was granted a recovery benefit for RNG interconnection costs
- Long-Range gas system plan published in January 2022, RNG sale and transportation guide effective December 1, 2022
- RNG operators are responsible for the payment of imbalance charges

Dominion Energy Carolina Gas

- State: North Carolina, South Carolina, Utah, Idaho
- Partnered with Smithfield Foods to create Align Renewable Natural Gas to convert biogas to RNG. The joint venture to operation in North Carolina, Virginia, Utah, Arizona and California.
- Carolina's: Announced GreenTherm in September 2022, a new voluntary program to allow customers to purchase offsets and develop LFG collection for as low as USD 3 per month
- Utah & Idaho: announced CarbonRight program in 2022, allowing the individual purchase of carbon offset blocks starting at USD 5 per month (one block is estimated to negate average residential gas use)

DTE Energy

- State: Michigan
- Direct link to the Program: BioGreenGas Program (active since 2013), changed to DTE CleanVision in January 2021
  - Allows customers to offset 25%, 50%, 75%, or 100% of their emissions since 2021
- Main program objective is to capture landfill biogas and turn it into RNG, however DTE is making significant investments in the state's WWTPs, converting sludge to RNG(For example in Grand Rapids, MI)

Duke Energy (and its subsidiary Piedmont Natural Gas)

- State: North Carolina
- Offers voluntary RNG program to supply RNG to local customers, as blocks offered in $3 increments
  - The GreenEdge program is also available to Piedmont customers
- Gas quality standard and alternative gas requirement tariff was approved for a 3 year pilot program in 2018. In 2021 the program was extended for an additional 3 years.
- Swine manure and wastewater approved as acceptable feedstocks and no longer fall under the pilot program
- Owns RNG production facilities which supply Duke with RNG
- Announced new RNG projects in April of 2022

Hawai'i Gas

- State: Hawai'i
- Purchased by Argo Infrastructure Partners, LP in July of 2022, a sale Hawai'i Gas president claimed will accelerate the companies RNG and hydrogen development

Intermountain Gas

- State: Idaho
- Provides RNG transportation through pipelines only

Liberty Utilities

- State: Georgia, Illinois, Iowa, Kansas, Massachusetts, Missouri, New Hampshire
- DPU 22-32: filed March 2022, would allow Liberty to enter into 20-year purchase agreement purchasing RNG at a fixed price, increasing annually and establish a voluntary RNG program for customers
- Currently filing a petition for the New Hampshire PUC to approve an RNG supply and transportation contract. Liberty currently has commitments to sell 65% of the RNG and is exploring a voluntary tariff.

National Grid

- State: New York, Rhode Island and Massachusetts
- In April 2019, National Grid proposed a Green Gas Tariff to enable voluntary purchase of RNG for its downstate customers: includes 4 tiers to select amounts of RNG.
- Case 20-G-0381 (January 2022) authorizes National Grid to procure up to 1% locally sourced RNG, increasing by 1% per year for 5 years
  - Also allows for long-term RNG supply contracts
- Partnered with the NYC Dept. of Environmental Protection for the Newton Creek Renewable Gas Demonstration Project, turning biogas from its WWTP to RNG

Nicor Gas

- State: Illinois
- In July of 2021, its RNG interconnection pilot project was approved, and USD 20M in capital was invested for RNG and its interconnection within its jurisdiction, up to USD 4M/project
- January 2021 Nicor began seeking approval for its TotalGreen pilot project to offset consumption with 5-20% RNG

Northeast Gas Association

- NGA represents natural gas distribution companies, transmission companies, liquefied natural gas importers, and associate member companies. These companies provide natural gas to over 12 million customers in nine states (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont)
- Interconnect Guide issued in August 2019

Northwestern Energy

- State: South Dakota
- NG22-006: August 2022 Northwestern Energy was approved to inject RNG into its grid via virtual pipeline

NW Natural

- State: Oregon
- Smart Energy program allows businesses and residents to pay an additional tariff which contributes to the development of biogas projects
- Issued RFP July 2021, seeking RNG resources, environmental attributes of various feedstocks, and/or resources on renewable hydrogen
- Signed agreements with various RNG producers to purchase approximately 2% of Oregon's annual sales in RNG
- In November 2021, NW Natural announced a 21-year RNG supply deal with Archea Energy for the environmental attributes equalling 1 million MMBtu of RNG annually
  - Commenced at the beginning of 2022 and by 2025 the full quantity will be delivered yearly
- Announced partnership with BioCarbN to convert methane produced at Tyson Foods facilities into RNG, investing in several projects

One Gas

- States: Texas, Oklahoma, Kansas
- In April of 2021 ONE Gas announced its partnership with Vanguard Renewables, developing and expanding farm-based RNG projects across Kansas, Oklahoma, and Texas
- Currently exploring offtake options for RNG for large industrial and commercial emitters
- Received permission from OK PUC to invest up to USD 5 million in RNG infrastructure within the state
  - Preparing a program proposal to allow customers to opt-into receiving RNG for a fixed-cost

Pacific Gas and Electric Company - PG&E

- State: California
- PG&G bioenergy portfolio includes biomass, digester gas, landfill gas, and municipal solid waste projects.
- Additionally, the utility promotes the use of dairy biomethane
- Direct link to the program: PG&E
- PG&E's gas quality requirements are specified in its tariff Gas Rule 21 and are summarized in the document
- Partnered with SoCal Gas in June of 2020 to further advance new electrochemical technology that converts carbon dioxide content in raw biogas to pipeline quality RNG

Puget Sound Energy

- State: Washington
- Launched its voluntary RNG program in December 2021, allowing the purchase of offset blocks, up to 100% of household emissions
  - As of June 2022, the program had 1200 participants
- Contract with Klickitat PUD to procure RNG (announced in 2020) (potentially up to 2.5 million dekatherms)

Roanoke Gas

- State: Virginia
- Announced a WWTP project with the Western VA Water Authority to produce commercial quality RNG

SoCalGas

- State: California
- Direct link to the program: SoCalGas Renewable Gas Program
- Biomethane Monetary Incentive Program assists with Biomethane Interconnectors, and is available until either the end of 2026, or its 40 million USD is exhausted
- SoCalGas gas quality requirements are specified in its tariff Rule 30
- In December of 2020, SoCalGas got the approval to offer RNG to residential customers

South Jersey Industries

- February 2021 SJI acquired a minority interest in REV LNG, LLC, and began looking to expand its portfolio of anaerobic digesters/RNG upgrading at a number of dairy farms
- May 2021, SJI announced plans to spend USD 280 million over five years on up to 25 dairy RNG facilities

Southwest Gas Corp

- State: Arizona, Nevada
- Offers RNG services, including biogas collection and upgrading, RNG interconnection and transport to the producers of RNG
- In Nevada, the utility entered into partnership with the City of Las Vegas WWTP to procure biogas and offer RNG to customers
- May 2021, it began the process of developing new RNG facilities and ensuring existing ones become connected to the grid

Summit Utilities

- State: Maine
- Voluntary RNG Attribute Program has been approved to establish a voluntary RNG Program for customers that will be able to choose RNG annual usage, between 10 to 100% of their average annual usage
  - Attributes derived form LFG
- Investing in RNG projects through its subsidiary Peaks Renewables

San Diego Gas & Electric Company

- In January 2018, SDG&E has issued a draft solicitation for dairy biomethane pilot projects, jointly with SoCalGas, PG&E and SouthWest Gas
- Submitted its application to offer a voluntary RNG program alongside SoCalGas, anticipated to start by the end of 2021

Teco Peoples Gas

- State: Florida
- RNG program began in 2018 and is offered to RNG producers and offers biogas gathering, cleaning and conditioning, RNG transportation and interconnection
- Will begin developing, building, owning, and operating its own RNG facility in partnership with Alliance Dairies

UGI

- State: Ohio, Kentucky, Pennsylvania, & New York
- July 2022, UGI announced a purchase and sale agreement with Archea Energy for RNG
- August of 2021, UGI announced a commercial food waste digester near Cincinnati, expected to be operational early in 2023, which will produce approximately 250,000 MMBTUs of RNG each year

Vermont Gas

- State: Vermont
- VGS Renewable Natural Gas Program
- Case No. 19-3529-PET: Received approval in August of 2021 to allow the blend of up to 2% /year RNG into its gas grid
- Voluntary customer participation through agreement with ability to choose % of RNG in their natural gas supply (10%, 25%, 50% or 100%)
- Case No. 22-2230-PET: signed a contract with a NY landfill to supply 4% of RNG demand, increasing to 13% by 2030
  - Could increase rates by up to 3.6% if all the gas is used by VGS, however, the utility can resale some to reduce overall impact
- Vermont Gas and NG Advantage rolled out new initiative to deliver RNG to business and institutional customers (pipeline and virtual pipeline)
- In November 2022, the PUC approved Vermont gas's controversial request to import LFG from out of state

WEC Energy

- State: Wisconsin
- Received approval from the PUC in July 2022 for the injection of RNG into their gas network to displace fossil gas use
  - Allows direct injection from digesters rather than virtual pipelines to injection points
- Under the program, the utility pays for the construction, operation, and maintenance of facilities connected to digesters, and in exchange, would contract the sale of discounted gas for a period of 10 yrs

XCEL

- State: Colorado, Minnesota
- Issued an RFI in May 2020 to initiate the work on the program to deliver RNG across several states.
- In Colorado, Xcel is exploring a voluntary RNG offering

Biomethane Specifications

As in Canada, biomethane quality standards are not federally regulated. In majority of cases, each biomethane project negotiates the acceptance standards with gas utility on a project-by-project basis.

Overall, the lack of standardization is considered as one of the concerns for biomethane industry developments and several standards have been proposed over the past years.

Critical parameters of biomethane quality in US specifications are summarized in the table below. Please note that the table contains the specifications of utilities that have standards adopted for biomethane, as well as general specifications of TransCanada and other US pipelines for reference.

Biomethane Slippage

Methane slippage, the quantity of methane lost in the CO2 stream during the upgrading process, is one of the important characteristics to take into account.

There are no federal or state/provincial rules as for the maximum allowed level of biomethane slippage in the USA. The majority of related activities focus on the reporting of GHG emissions (for example, USEPA GHG Reporting). As for state reporting, California, for example, requires a facility to report to CA Air Resources Board if it exceeds 10,000 metric tons of carbon dioxide equivalent (MMT CO2e) of methane (1 kg methane is approximately equal to 25 kg CO2e) (for more details, please visit Regulation for the Mandatory Reporting of Greenhouse Gas Emissions).

The methane emissions in natural gas sector by OIES in 2017 show USA reported 0.5% of methane emissions. Thus, it will be safe to assume that the same standards will be applicable to RNG/biomethane activities of the utilities.

An interview with a California utility confirmed that no guidelines or standards are used for biomethane slippage, but the utilities will always try to minimize such emissions as much as possible.

A Danish study conducted by Rambøll found methane slippage to be quite high at biogas facilities, with many rogue emissions going unreported. It is worth noting that nearly all rogue emissions could be eliminated through the implementation of best practices.

In November 2022, the EPA proposed a new regulation which would reduce permissible methane emissions from sources not previously covered. The new standards would cut emissions by 87% below 2005 levels.

Table 2. Gas Critical Parameters – US Specifications

Contaminant/ Property	Unit	Vermont Gas	PG&E	SoCalGas	SDGE	DTE Energy	National Grid	NWNatural	Northeast Gas Association	Alliance USA	Empire	GLGT	Iroquois	Northern Border	NWP	PNGST	SOCAL	Tennessee GP	Viking	Dominion Transmission	Equitrans LP	Florida Gas Transmission Co.	Colorado Intrastate Gas Co.	Questar Gas Co.	Gas Transmission Northwest Co.
Heating Value	Btu/scf	>805	Project-by-project	990-1150 on a dry basis	990-1150 (gross) on a dry basis	950-1100	-	985-1115	970-1110	> 962	950-1200	967-1069	967-1110	> 967	> 985	967-1100	990-1150	967-1110	967-1110	967-1100	970	1000-1100	968-1235	950-1150	995
Wobbe Index, WN	BTU/Scf	-	-	1279-1385	1279-1385	-	-	1290-1400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Dioxide, CO2	% vol	≤ 2	≤ 1	≤ 3%	3	≤ 2	≤ 2	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 3	< 3	<3	< 3	3	3	1	3	2	2
Oxygen, O2	% vol	≤ 1.6	≤ 0.1	≤ 0.2%	0.20%	≤ 0.0005	≤ 0.2	0.2	0.1 - 0.4	< 0.4	< 1	< 1	< 0.2	< 0.4	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.2	0.2	0.25	0.001	0.1	0.4
Nitrogen, N2	% vol	-	-	-	-	-	< 2.75	2	2	-	-	< 3	< 2.75% N2 +O2 4% N2 + CO2	-	< 3 incl. O2 , CO2	< 4 incl. CO2	< 4 incl. CO2 , CO2 and inerts	< 4 incl. CO2 , O2 Max 2.75% N2 + CO2	< 4 incl. CO2	-	-	-	-	-	-
Total Inerts	% vol	-	-	≤ 4% (incl CO2, N2, O2, inerts)	≤ 4% (incl CO2, N2, O2, inerts)	-	-	2.7	-	-	-	-	-	-	-	-	-	-	-	5	4	3	-	3	-
Water, H2O	lbs/MMcf	≤ 4	≤ 7 at 800 psig	≤ 7 at or below 800 psig. Above 800 psig, the dew point not exceeding 20°F at delivery pressure	≤ 7 at or below 800 psig. At above 800 psig, not exceeding 20 ° F at delivery pressure.	≤ 5	< 7	7	-	< 4	< 7	< 4	< 4 at 14.73 psi & 60°F	< 4	< 7	< 7	< 7 at < 20°F at > 800psi	< 7 at 14.73psi at 60°F	< 7 at 14.73psi at 60°F	7	7	7	7	5	4
Hydrogen, H2	% vol	-	0.1	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrogen Sulfide, H2S	grains /100Ccf	≤ 0.13	1.3	0.25	1.3	0.3	< 0.17	0.25	-	< 1	< 1	< 0.25	< 0.25	< 0.3	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	0.25	0.3	0.25	0.25	0.25	-
Mercaptan Sulfur	ppm	-	8	5	5	≤ 4.125 of hydrogen sulphide, ≤ 8.25 of mercaptan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Sulphur, S	grains/Ccf	-	0.75	0.75 incl. COS and CS2, hydrogen sulfide, mercaptans and mono, di and poly sulfides.	< 0.75 incl. COS and CS2, hydrogen sulfide, mercaptans and mono, di and poly sulfides	≤ 5.0 (including hydrogen sulfide and mercaptan sulphur)	-	5	-	< 5	< 20	< 20	< 1.25	< 2, (0.3 mercaptan)	Non Laplata Facilities Max 5 , Laplata Facilities 0.75, 0.3 mercaptan	< 20	< 0.75 (0.3 mercaptan)	< 10	< 20	-	-	-	-	-	-
Ammonia, NH3	% vol	-	0.001	0.001	0.001	-	-	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siloxanes, Si	Grain/ 100cf	-	0.0004	0.0004	0.0004	-	-	0.019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bacteria	-	-	-	-	-	-	-	shall not contain microbiological	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biologicals	-	-	4 x 104 / scf (qPCR per APB, SRB, IOB7 group) and commercially free of bacteria of > 0.2 microns	4 x 10^4/scf and commercially free of bacteria of >0.2 microns	4 x 10^4/scf and commercially free of bacteria of >0.2 microns	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Particles, dust, etc.	-	-	Free of	Free of	Free of	Free of	Commercially free of	Commercially free	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper, Cu	ppmv	-	0.02	0.02	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, As	ppmv	-	0.006	0.006	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury, Hg	ppmv	-	0.08	0.08	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vinyl Chloride , CH2CHCl	ppmv	-	0.33	0.33	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
p-Dicholorobenzene	ppmv	-	0.95	0.95	0.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	ppmv	-	6	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
n-Nitroso-di-npropylamine	ppmv	-	0.006	0.006	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Antimony	ppmv	-	0.12	0.12	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	ppmv	-	0.009	0.009	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercaptans	ppmv	-	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(Alkyl Thiols) 6						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methacrolein	ppmv	-	0.37	0.37	0.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	ppmv	-	240	240	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liquids		-	Free of	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrocarbon Dewpoint	°F	-	45 at 800 psig or below, but measured at 400 psig; or 20°F at above 800 psig, also measured at 400 psig	Not exceed 45 at 400 psig for gas delivered at 800 psig or less. At 800 psig, not to exceed 20 ° measured at a pressure of 400 sig.	For 800 psig or below, not to exceed 45 ° F at 400 psig. For above 800 psig not to exceed 20 ° at a pressure of 400 psig.	≤ 0º at 500 psig.		15	-	< 23 at opt. pres.	Not specified	Not specified	< 15 or less	< -5 (800psia), -10 (1000 psia), -18 at (1100 psia)	< 15° (100-1000psia)	Not specified	Not specified	<15°	Not specified	-	-	-	-	-	-
Temperature	° F	-	60 - 100	50-105	50 - 105	≤ 100	-	35-120	-	< 122	40-120	20-120	<120	32-120	Non Laplata Facilities <120 Laplata 40- 120	< 120	50-105	<120	<120	-	-	-	-	-	-
Contaminant/ Property	Unit	Vermont Gas	PG&E	SoCalGas	SDGE	DTE Energy	National Grid	NWNatural	Northeast Gas Association	Alliance USA	Empire	GLGT	Iroquois	Northern Border	NWP	PNGST	SOCAL	Tennessee GP	Viking	Dominion Transmission	Equitrans LP	Florida Gas Transmission Co.	Colorado Intrastate Gas Co.	Questar Gas Co.	Gas Transmission Northwest Co.
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Selected References

1. American Gas Association. (2022). “RNG Activity Tracker.” AGA.

2. Congress.gov. "Text - H.R.5376 - 117th Congress (2021-2022): Inflation Reduction Act of 2022." August 16, 2022. https://www.congress.gov/bill/117th-congress/house-bill/5376/text.

3. Energy Information Administration. (2022). “What are Renewable Portfolio Standards?” EIA. https://www.eia.gov/energyexplained/renewable-sources/portfolio-standards.php

4. Ha, Miae, Gutenberger, Gretchen, Ou, Longwen, Cai, Hao, and Hawkins, Troy R. 2022. "Opportunities for Recovering Resources from Municipal Wastewater". United States. https://doi.org/10.2172/1876441. https://www.osti.gov/servlets/purl/1876441.

5. US Department of Energy. (2022). “Renewable Fuel Standard.” US Department of Energy: Alternative Fuels Data Center. https://afdc.energy.gov/laws/RFS.html

6. US Environmental Protection Agency. (2022). “Landfill Methane Outreach Program (LMOP).” EPA. https://www.epa.gov/lmop

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