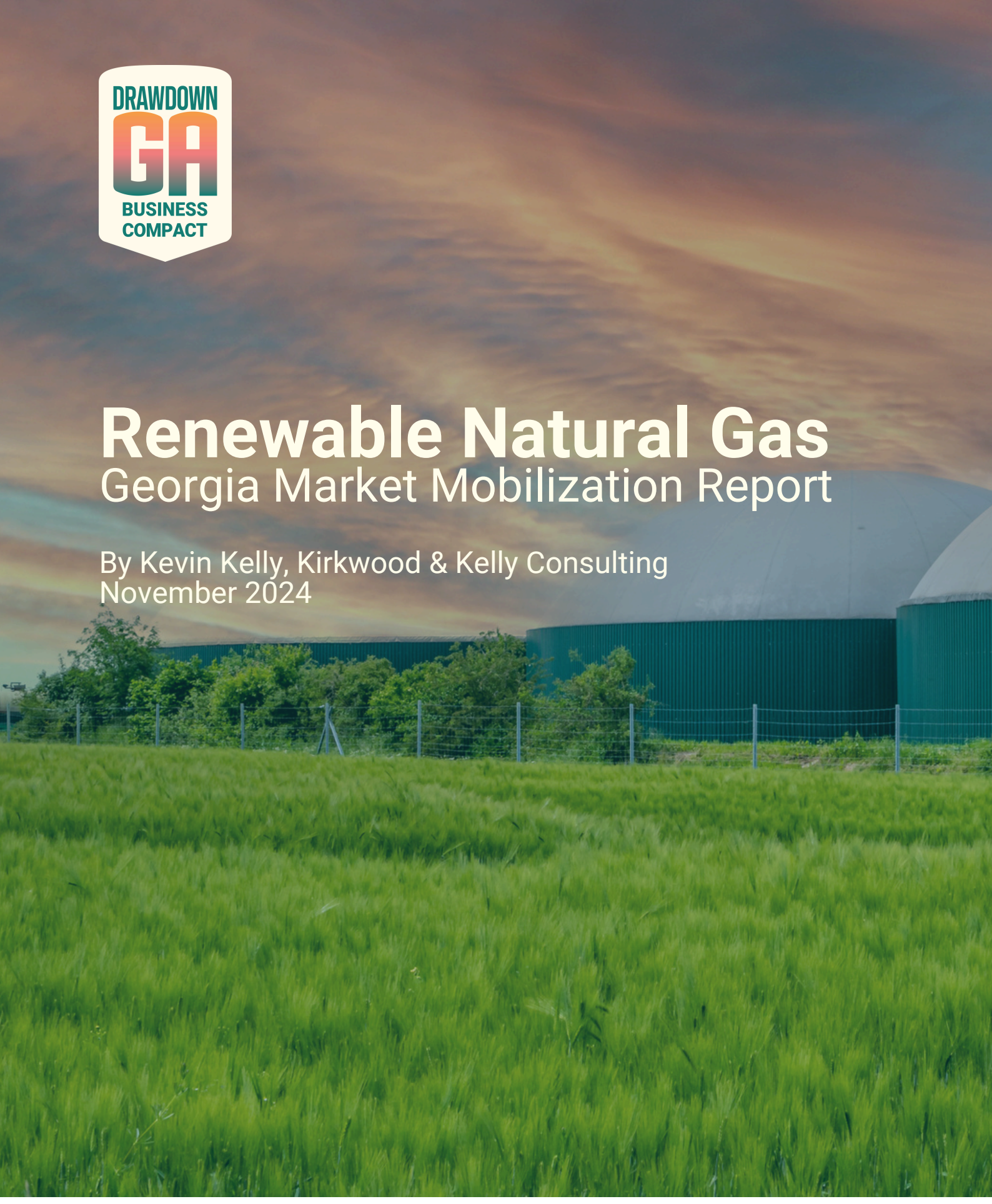
DRAWDOWN GA BUSINESS COMPACT

Renewable Natural Gas
Georgia Market Mobilization Report

By Kevin Kelly, Kirkwood & Kelly Consulting
November 2024



KIRKWOOD & KELLY

Georgia Tech Scheller College of Business
Ray C. Anderson Center for Sustainable Business

Ray C. Anderson Center for Sustainable Business

We focus on educating tomorrow's business leaders, partnering with industry practitioners, and supporting high-impact research to accelerate the development of sustainable business practices.

Vision

We empower the leaders of tomorrow to create sustainable businesses and communities.

Mission

Our mission is to create and share the knowledge that current and future leaders depend on to drive innovation and to integrate sustainability into their organizations and communities.

CONNECT WITH THE CENTER

Website | LinkedIn | Instagram | Newsletter

Drawdown Georgia Business Compact

The Ray C. Anderson Center for Sustainable Business is working closely with corporate, government, nonprofit, and academic partners to create the Drawdown Georgia Business Compact, a state-wide business consortium aimed at achieving a just, prosperous, and sustainable transition towards net zero carbon emissions in the state of Georgia by 2050.

CONNECT WITH THE COMPACT

Website | LinkedIn | Instagram

Acknowledgements

This report owes its depth and clarity to the valuable insights shared by experts and stakeholders who contributed their time and knowledge on Renewable Natural Gas (RNG) markets, project development, and greenhouse gas reduction strategies. Their perspectives on challenges and opportunities, both nationally and in Georgia, were instrumental in shaping the analysis and recommendations. The participation of stakeholders, including Compact Members, further enriched this work by highlighting practical experiences with natural gas usage and RNG procurement. Their contributions were essential to the development of this report, and their efforts in advancing sustainable solutions are greatly appreciated.

Contents

Executive Summary

The Drawdown Georgia Business Compact (the Compact) is a voluntary collaboration of almost 70 businesses that support the Drawdown Georgia goal of accelerating progress toward net zero carbon emissions in Georgia by 2050. The Compact includes several focus areas, including a Renewable Natural Gas (RNG) working group composed of Members aiming to lower emissions associated with natural gas use.

Key Highlights

Member companies have strong but narrow interest in RNG.

The market supporting Scope 2 emissions reductions (associated with electricity use) is accessible and active and most Member Companies pursue Scope 2 emissions reduction engagements. The market supporting Scope 1 emissions reduction is less mature and poses challenges that deter many. But for those Members with significant process heat demands and corresponding levels of natural gas use, Scope 1 emissions reduction opportunities interest them deeply.

RNG projects are happening.

Available data suggests that developers are actively pursuing RNG projects in Georgia. Permit application records and expert interviews indicate that agricultural, food waste, landfill gas, and wastewater treatment plant biogas and RNG projects are under development.

Direct-piped projects appeal.

Compact Members are interested in direct-piped biogas or RNG projects, but they acknowledged that the logistics of these projects can be daunting. Stakeholders often have not identified large, closely-situated sources and interested buyers with significant demand.

Voluntary market headwinds blow.

This study primarily focuses on opportunities in the voluntary compliance market, where interested buyers contract for environmental attributes from eligible projects to meet their decarbonization goals. There appear to be significant headwinds in the voluntary market, including:

- **Greenhouse gas (GHG) accounting:** There is unclear guidance on how to report RNG use in the GHG Protocol, which erodes companies' interest.
- **Potential "competition" with other Scope 1 solutions:** RNG appeals to stakeholders because it does not require equipment retrofits, but companies are always seeking the best cost-effective, long-term solutions and are simultaneously evaluating other Scope 1 approaches, including electrification and green hydrogen.
- **Market immaturity:** The voluntary RNG market, based on Thermal Renewable Certificates, is newer and less established than the voluntary clean electricity market, based on renewable energy certificates (RECs).

Drawdown Georgia Business Compact and Renewable Natural Gas

Drawdown Georgia Solutions

Drawdown Georgia is a research initiative to identify proven and cost-competitive climate solutions that make the most sense for Georgia to reduce the state's climate impact. Drawdown Georgia takes its inspiration from Project Drawdown, a global effort acting on climate change. With support from the Ray C. Anderson Foundation, Georgia Tech led a multi-university collaboration that released its initial findings in October 2020. That work identified the 20 high-impact climate solutions that put Georgia on a path to advance drawdown – that point in the future when levels of greenhouse gasses in the atmosphere stop climbing and start to decline.[1]

Drawdown Georgia's 20 high-impact climate solutions are organized in five sectors:

- Electricity
- Buildings & Materials
- Food & Agriculture
- Land Sinks
- Transportation

This report focuses on landfill methane, one of the electricity sector high-impact solutions, as well as renewable natural gas (RNG) more generally.[2]

Renewable Natural Gas Working Group

In alignment with Drawdown Georgia, Georgia Tech's Ray C. Anderson Center for Sustainable Business convenes a consortium of almost 70 Georgia businesses to work collectively on growing climate solutions in the state – the Drawdown Georgia Business Compact (the Compact). The Compact operates several working groups, including the Renewable Natural Gas (RNG) Working Group. The RNG Working Group focuses on helping participating Members explore ways to reduce their Scope 1 emissions associated with natural gas consumption. The RNG Working Group has met regularly since early 2023 and includes Member companies with direct natural gas use, natural gas utility representatives, and other interested stakeholders.

GHG Protocol & Scope 1, 2, & 3 Emissions

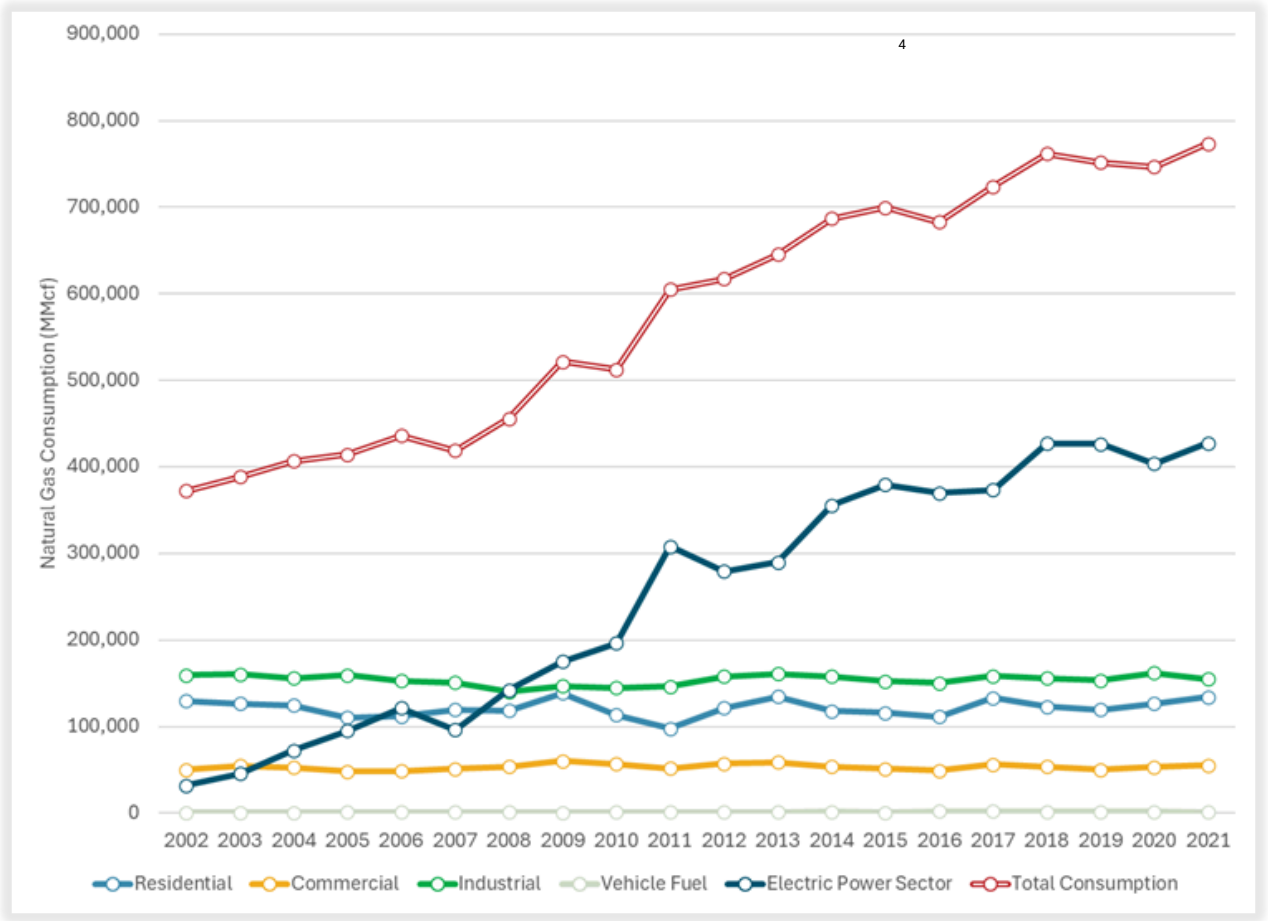
The GHG Protocol establishes global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from private and public sector operations. It is the world's most widely used GHG accounting standard. The Protocol classifies a company's GHG emissions into three scopes. Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.[3]

Natural Gas Consumption and Uses in Georgia

Natural Gas Consumption in Georgia by Sector

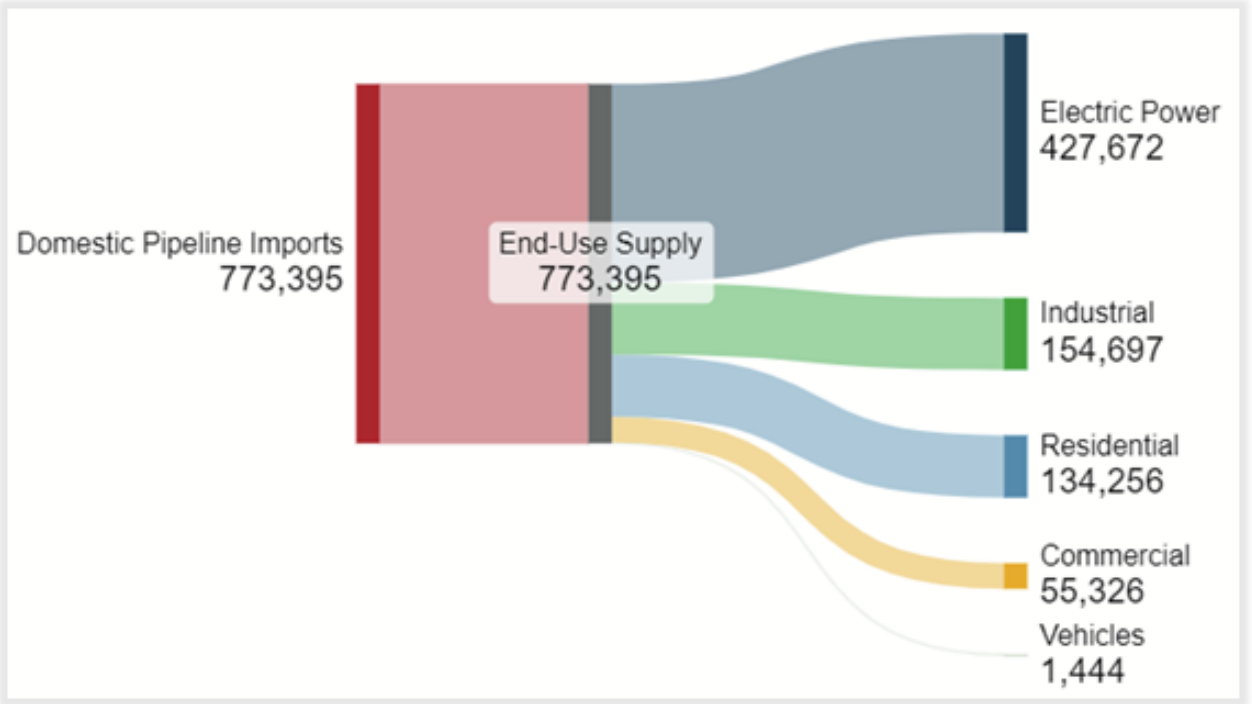
As Figure 1 reflects, total natural gas consumption in Georgia has increased consistently over the last twenty years due to a corresponding increase in gas use by the electric power sector. Over these decades, commercial and industrial consumption has remained level while residential use has fluctuated slightly.

Figure 1. Georgia Natural Gas Consumption by Sector and Total , 2003-2022



Georgia does not have any natural gas production and satisfies its natural gas needs through pipeline imports from other states. In the past, Georgia also received natural gas imports from other countries through the Elba Island liquefied natural gas (LNG) import terminal. But as U.S. natural gas production has increased over the last 15 years, Elba Island's import volumes have decreased – to zero in 2021 and 2022. Figure 2 depicts Georgia's end-use natural gas consumption in 2022. Industrial and commercial use accounted for 27 percent of the state's gas use.[5]

Figure 2. 2022 Georgia Natural Gas Sources & Consumption by Sector (million CF)[6]



Georgia GHG Emissions

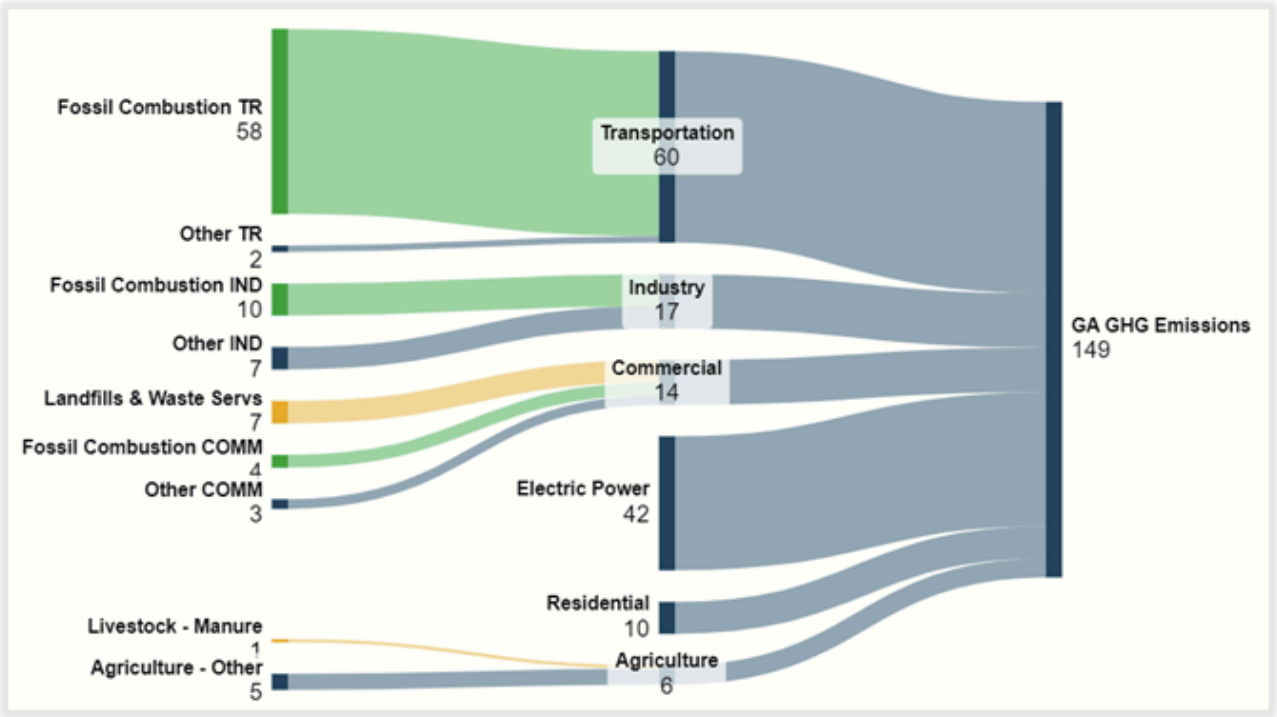
In 2021, Georgia's greenhouse gas (GHG) emissions totalled 149 million metric tons of carbon equivalents. The respective sector contributions are shown in Table 1. These emission values include both CO2 emissions from fuel combustion, such as the end-use of natural gas in a furnace or boiler and the end-use of gasoline in an engine, along with fugitive emissions of GHGs, such as the emissions of methane from landfills, animal waste facilities, and wastewater treatment plants.

Table 1. Share of Georgia 2021 GHG Emissions by Economic Sector [7]

Economic Sector	Share of Total GA 2021 GHG Emissions
Transportation	40%
Electric Power	28%
Industry	11%
Commercial	10%
Residential	7%
Agriculture	4%

Figure 3 shows the sectoral and relevant activity contributions to Georgia's total 2021 GHG emissions. Biogas and RNG projects have the potential to (a) displace CO2 emissions from fossil combustion in the transportation, industry, and commercial sectors (green "nodes"), and (b) reduce fugitive methane emissions from landfill and waste services and from animal manure handling (yellow nodes).

Figure 3. Georgia 2021 GHG Emissions by Economic Sector & Activity (million metric tons CO2e)[8]



Understanding Biogas and Renewable Natural Gas

What is Biogas? What is Renewable Natural Gas?

Biogas refers to gas resulting from the decomposition of organic matter under anaerobic conditions. The principal constituents are methane and carbon dioxide. The most common sources of biogas are municipal solid waste landfills and anaerobic digesters at wastewater treatment plants and animal waste facilities. Raw biogas has a methane content between 45 and 65 percent (a “medium Btu gas”), depending on the source of the feedstock, and must go through a series of treatment steps to be converted into RNG.

Renewable natural gas (RNG) describes biogas that has been cleaned up to high Btu (a.k.a. pipeline quality) gas that consists of 96 to 98 percent methane. Treatment might be done in stages and includes removing moisture, carbon dioxide (CO2) and trace level contaminants (including siloxanes, volatile organic compounds, or VOCs, and hydrogen sulfide), as well as reducing the nitrogen and oxygen content.[9]

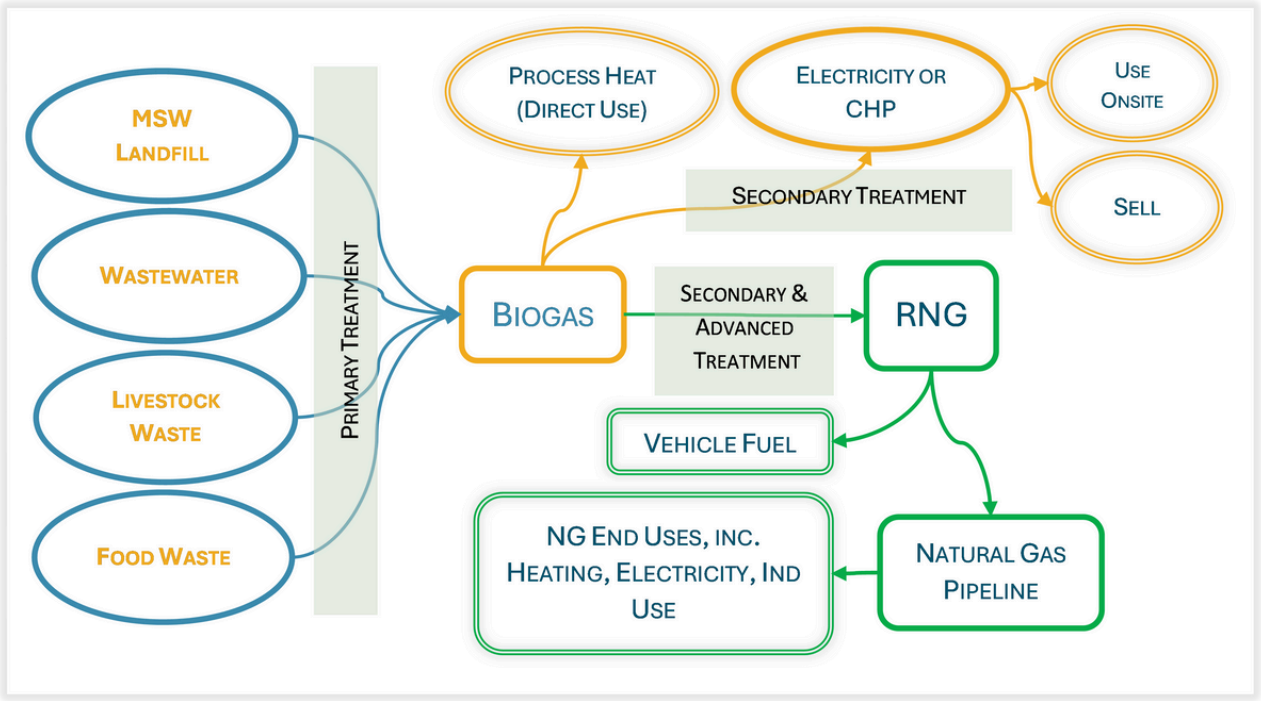
Common Biogas/RNG Sources and Projects

As mentioned above, the most common sources of biogas in the United States and in Georgia are municipal solid waste landfills, anaerobic wastewater treatment plants, and animal waste/food waste digesters. In the case of landfills, the raw biogas may be captured and flared simply to destroy the methane per federal regulations.

Any end-use of biogas (beyond flaring) typically involves treatment. The first stage of treatment (primary treatment) includes the removal of moisture and particulates. This level of treatment may suffice for direct use in a boiler. Secondary treatment entails the advanced removal of moisture, the removal of contaminants (i.e., siloxanes and sulfur), and compression. At this point, the biogas can be converted to electricity, usually using an onsite use reciprocating piston (RP) internal combustion engine.

To become RNG, the gas must go through advanced treatment that includes further compression and the removal of carbon dioxide, oxygen, nitrogen, and volatile organic compounds. This final stage of treatment produces RNG with similar heat content as natural gas.[10] Figure 4 depicts these sources, treatment processes, and end uses.

Figure 4. Biogas and RNG Sources, Treatment Stages, and End Uses



Landfills generate methane as a byproduct of their operation. The anerobic conditions necessary for methane production are inherent in the design of municipal waste landfills. Many landfills are required to capture and burn the methane. The 1996 EPA Standards of Performance for New Stationary Sources and Guidelines for the Control of Existing Sources, created under the Clean Air Act, set emission standards for new and existing MSW landfills that have accepted waste since 1987 and contain more than 2.5 million metric tons or 2.5 million cubic meters of waste. These landfills must collect LFG emissions and can dispose of them either through open flaring or through other forms of controlled combustion. The baseline carbon or carbon equivalent emissions must take into account this fact when considering the emissions benefits from LFG-derived biogas or RNG projects.[11]

Methane production in wastewater treatment and animal and food waste operations is different. For instance, many wastewater treatment plants in the United States use an

activated sludge treatment process that is aerobic. In this case, the liquid treatment process produces minimal methane emissions.[12] To perform anaerobic digestion, a wastewater treatment plant must enclose its secondary treatment tanks to create anaerobic conditions and capture the resulting biogas. There can be anaerobic conditions inherent in wastewater collection with associated methane emissions typically occurring at the point of discharge into the wastewater treatment plant (i.e., headworks), but there are no current regulations that require the capture of these emissions.

Methane production from animal waste operations depends on numerous factors.[13] Confined swine and dairy livestock operations often manage their waste in anaerobic lagoon systems which can produce significant fugitive methane emissions, but the extent of methane emissions depends on temperature and the residency of manure in the lagoons. Methane emissions from other types of livestock operations vary depending on a range of factors. There are no regulations currently in place requiring the capture of these emissions.

Climate Benefits of Biogas and RNG

Biogas and RNG projects can yield a net reduction in GHG emissions by capturing fugitive emissions of methane and combusting the methane to deliver energy services, such as process or space heat. This approach can result in lower total GHG emissions than would otherwise occur.

Capturing fugitive methane emissions and converting "waste to energy" have powerful appeal. Biogas and RNG potentially offer Compact Members a way to address Scope 1 emissions without significant equipment changes. But biogas and RNG projects face real challenges, often related to geography and economics. Common opportunities and challenges are summarized below.

Project Opportunities	
Natural Appeal	The notion of converting waste to energy and avoiding the release of potent methane into the atmosphere has strong natural appeal. In some respects, RNG embodies the concept of a circular economy.
Compatibility with Current Equipment	While burning biogas directly may require equipment adjustments, RNG is a direct substitute for natural gas. In either case, users can switch to direct use of these alternative fuels with little to no equipment change outs.

Project Opportunities	
Resurgent Project Development	Projects appear to be happening in Georgia, even encompassing previously ignored feedstocks like food waste. Current markets are helping to stimulate a boom in biogas and RNG projects.
Decarbonization Goals	More and more companies are committing to decarbonization goals, driving interest in carbon solutions, including Scope 1 emissions solutions. Several Compact Members with significant process heat demands expressed keen interest in biogas and RNG options.
Good Project Examples	There are many examples of good projects in operation or under development. Several participating Compact Members referenced projects they particularly admired.

Project Challenges	
Source Proximity	The location of biogas sources (landfills, wastewater treatment plants, livestock operations, or food waste digesters) often do not align well with potential off-takers or pipelines. For direct-use projects, these sources may not be sufficiently close to an industrial user or an RNG fueling facility, driving up the cost and complexity of building such a project. Additionally, RNG sources may be far from pipeline interconnection points, imposing additional costs on projects delivering pipeline gas.
Cost for Voluntary Market Participants	The compliance markets have stimulated demand for biogas and RNG and, in turn, driven up the revenue expectations of project developers. In this way, the voluntary markets compete with the compliance markets. Particularly in an era of low natural gas prices, the relatively high price offerings for RNG can make it challenging to justify the procurement.
Greenhouse Gas (GHG) Accounting	Voluntary market participants pursue biogas and RNG projects to reduce their Scope 1 emission. The GHG Protocol currently offers unclear guidance on how to report RNG use and its compliance value. This can significantly dampen companies' interest.

Project Challenges	
"Competition" with Other Scope 1 Solutions	RNG appeals to stakeholders because it does not require equipment retrofits, but companies are always seeking the best cost-effective, long-term solutions and are simultaneously evaluating other Scope 1 approaches, including electrification and green hydrogen.
Market Immaturity	The voluntary RNG market, based on Thermal Renewable Certificates, is newer and less established than the voluntary clean electricity market, based on renewable energy certificates (RECs).
Constrained Economics for Onsite Electricity Production	Biogas projects can support onsite electricity production. This production is particularly useful for customers with large onsite electricity demands (e.g., wastewater treatment plants). But if that customer purchases marginally priced electricity, the resulting bill savings may be diminished. Additionally, electric utilities will often pay customers with onsite generation the utility's "avoided cost" for any excess electricity they export to the grid.

Biogas and RNG Projects in Georgia

Existing Biogas and RNG Projects in Georgia

Operational biogas and RNG projects in Georgia (complete list available in Table A1, Appendix A) can be summarized in the following broad categories:

- **Landfill Gas:** There are 19 operational landfill gas projects in Georgia. Most of these (14 of 19) use extracted biogas to produce electricity with reciprocating internal combustion engines (a.k.a. landfill gas to electricity or LFGTE projects). Two projects use biogas to produce both process heat and electricity (i.e., combined heat and power or CHP), in both cases at a facility 3-6 miles away. Two are direct use projects; one provides boiler fuel, and another provides fuel to a brick kiln. Only one produces RNG for vehicle fueling.
  - Of the 14 LFTGE projects, at least six sell all their electricity or their excess electricity (net electricity used onsite) to Georgia Power as a Qualifying Facility (see "PURPA, Qualifying Facilities, & Avoided Cost" sidebar). Five of these do so under Georgia Power's Proxy Unit methodology which affords these units more robust compensation for their electricity.
  - Five of the 14 LFTGE projects sell their electricity to Green Power EMC, a renewable energy wholesale provider to electric membership cooperatives in Georgia.

PURPA, Qualifying Facilities, and Avoided Cost

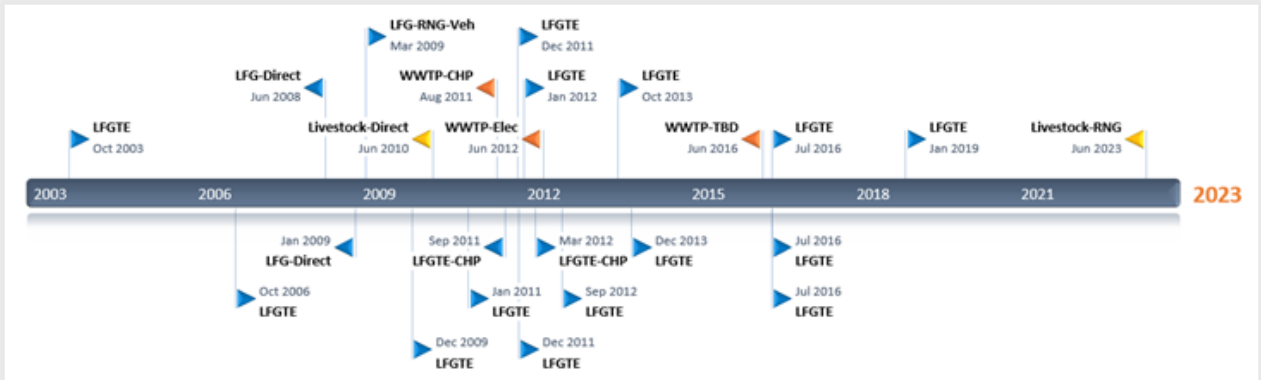
The Public Utility Regulatory Policies Act of 1978 (PURPA) expanded competition in the electric power sector and promotes energy conservation and greater use of domestic and renewable energy resources. A key element of the Act was the definition of "Qualifying Facilities" (QFs) - small renewable energy or cogeneration facilities - and the associated requirements that utilities allow QFs to interconnect with the grid and that they buy the QF's energy and capacity at the utility's avoided cost. PURPA defines avoided cost as "… the incremental costs to an electric utility of electric energy or capacity or both which, but for the purchase from the qualifying facility or qualifying facilities, such utility would generate itself or purchase from another source."[14]

- **Wastewater Treatment Anaerobic Digesters:** Data on operational biogas anaerobic digesters at wastewater treatment plants (WWTP) in Georgia is not readily available. Initial research indicates that there are three such facilities operating in the state. One of them uses biogas in combined heat and power, one generates electricity, and the end-use for the third one is unknown.

- **Animal Waste Anerobic Digesters:** Data on operational animal waste anaerobic digesters is, likewise, not readily available. Initial research indicates that there are two animal waste anaerobic digesters in operation in Georgia, one producing RNG for pipeline injection and one in a research facility at the University of Georgia that produces biogas for a boiler and/or furnace.

As the timeline in Figure 5 shows, most operational biogas/RNG projects began operation in the nine-year period from 2008 – 2016. The burst of landfill-based biogas/RNG activity in Georgia these years is mirrored at the national level; nearly 60 percent of all the projects listed in the US EPA's Landfill Methane Outreach Program database started operation in the twelve years from 2005 – 2016 (inclusive).[15]

Figure 5. Timeline of Existing/Operational Biogas and RNG Projects in Georgia



Potential RNG Projects and Sources in Georgia

Available information on biogas and RNG projects in Georgia that are currently planned or under development are summarized below. A full list is included in Table A2, Appendix A, and Table A3 that lists landfills that the U.S. EPA's Landfill Methane Outreach Program (LMOP) considers "candidate" projects. This data is necessarily limited and partial; details about projects in development are often closely held and not readily available.

Landfill Gas

- *Planned:* there appear to be four landfill projects that are planned or under development, all of them designed to produce RNG.
- *Candidate:* LMOP assesses existing landfills for their potential to support biogas projects and designates certain landfills as "candidates." LMOP defines a candidate landfill as one that is accepting waste or has been closed for five years or less, has at least one million tons of waste, and does not have an operational, under-construction, or planned biogas project. Candidate landfills can also be designated based on actual interest by the site.[16] LMOP has identified 22 candidate landfills in Georgia, ten of which do not have a landfill capture system in place while the other 12 capture and burn the gas in flares.

Wastewater Treatment Anaerobic Digesters

- No publicly available data concerning new or planned biogas projects at WWTPs in Georgia was found, though anecdotal evidence indicates there may be projects under consideration or development.

Animal Waste Anaerobic Digesters

- At least one diary manure anaerobic digester project is under development in Georgia that is designed to produce RNG. USDA's Rural Energy for America Program (REAP) awarded this project a grant.

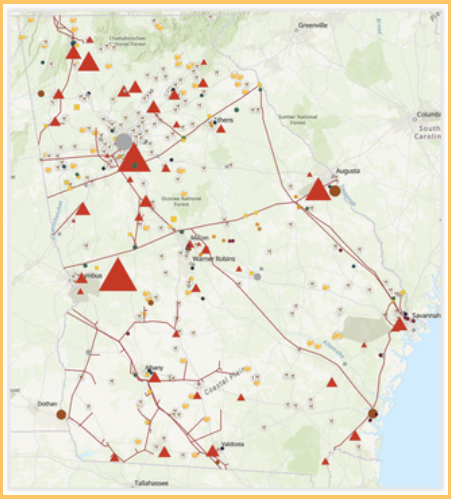
Food and Mixed Waste Anaerobic Digesters

- There appear to be three mixed organic waste projects currently under development in the state.

Biogas and RNG Resource Mapping

The Drawdown Georgia Business Compact commissioned the Georgia Institute of Technology's Center for Spatial Planning Analytics and Visualization to develop an interactive GIS map of RNG resources in Georgia. The map enables stakeholders to assess the proximity of potential biogas or RNG sources and off-takers.

ACCESS THE MAP HERE



RNG, Trading, and Carbon Accounting

RNG Market Mechanisms

Renewable natural gas, like renewable electricity and renewable transportation fuel, is a physical energy commodity that also has environmental attributes that are independently valuable. The environmental attributes of these clean or renewable energy sources can be traded separately from the underlying commodity, allowing for flexibility and efficiency in clean energy procurement that would be impossible otherwise. For instance, a Renewable Energy Certificates or REC represents the environmental attributes of one megawatt-hour of clean electricity generation (e.g., solar electricity).

A company interested in reducing its climate impact can purchase RECs commensurate to offset its electricity use, even though its point of electricity use may be far from the renewable energy generator. Similar trading mechanisms exist for renewable fuels and RNG and since RNG can substitute for natural gas used in buildings, factories, and vehicles, there is overlap.

Renewable Thermal Certificate (RTC): represents the environmental attributes associated with the production, transport, and use of one dekatherm of renewable thermal energy (e.g., one dekatherm of RNG). These are sometimes referred to as Renewable Fuels Certificates.

Renewable Identification Numbers (RINs): The U.S. EPA uses Renewable Identification Numbers (RINs) to track renewable transportation fuels. The RIN system allows EPA to monitor compliance with the Renewable Fuel Standard, a federal program that requires transportation fuels sold in the United States to contain minimum volumes of renewable fuels. After blending, RINs are separated from the blended gallon and are used by obligated parties (blenders, refiners, or importers) as proof that they have sold renewable fuels to meet their RFS mandated volumes.

Registries and Renewable Thermal Certificate (RTC) Trading

The RTC trading market is in its early stages, like the electricity Renewable Energy Certificate (REC) market was years ago. Today, several large REC registries/trading systems cover the bulk of the United States. These systems rationalize the trading of renewable attributes by providing clear accounting of the development, ownership, and retirement of these attributes. Currently, M-RETS appears to be leading the way on accounting for RTCs, primarily used in the voluntary market. M-RETS issues one RTC for each dekatherm of RNG produced and delivered to the pipeline. M-RETS RTC also allows for optional carbon intensity valuation.

Low Carbon Fuel Standard Credits: is a tradeable carbon offset credit within the California LCFS market. One LCFS Credit = 1 metric ton of CO2 equivalent reduced. Credits are awarded based on carbon intensity of the renewable fuel compared to the carbon intensity of the fuel it is replacing.

RNG Markets

RNG producers may qualify to sell the environmental attributes of their physical gas volumes into different markets.[17, 18, 19, 20]

- **Voluntary Market:** is the market that exists between interested buyers and willing sellers, apart from any market created by regulation. In the voluntary market, RNG is typically marketed and purchased as RTCs. Buyers purchase RTCs to offset commensurate consumption of fossil natural gas on a one-to-one basis, like RECs. The end-user of the RTC can claim the environmental benefit of using RNG instead of conventional natural gas. Third-party registries, like M-RETS, can play a key role in tracking environmental attributes such as RTCs from renewable natural gas.

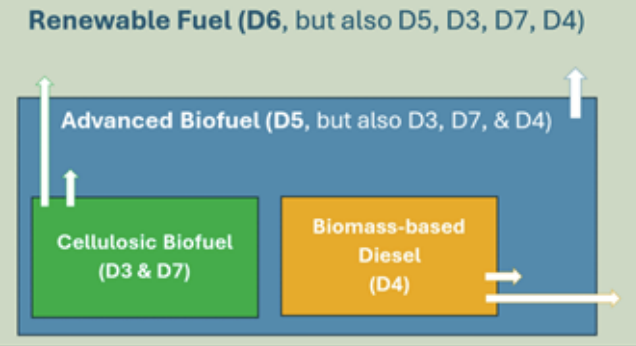
- **Renewable Fuels Standard Market (RFS):** as mentioned above, the RFS is a federal program that requires transportation fuel sold in the United States to contain a minimum of renewable fuels, with an aim of reducing GHG emissions and US reliance on foreign oil while expanding the nation's renewable fuels market. If a party can demonstrate that RNG is used as transportation fuel and meets appropriate requirements at the federal or state level, a Renewable Identification Number (RIN) can be generated and sold to those entities with Renewable Volume Obligations under the RFS, such as refiners.

Understanding RINS

Each year, the US EPA issues volume requirements for several categories of renewable fuels such as cellulosic biofuels, advanced biofuels, renewable fuels, and biomass-based diesel. RINs exist for each of the fuel categories and are numbered accordingly.

- D3 – cellulosic biofuel
- D7 – cellulosic diesel
- D4 – biomass-based diesel
- D5 – advanced biofuel
- D6 – renewable fuel

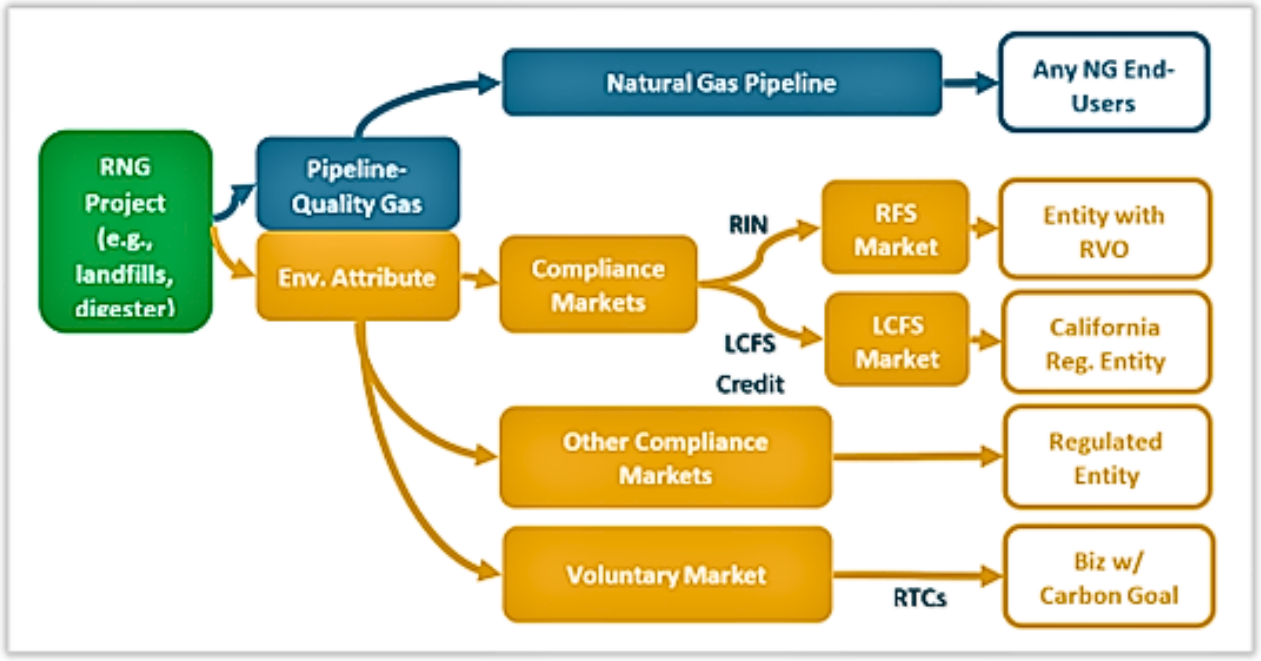
As seen in the diagram, (based on Renewable Fuels Association guide), the categories are nested.



Arrows indicate how excess "high" value RINs can be used to meet lower requirements. For instance, excess cellulosic RINs can be used to meet advanced biofuel and renewable fuel requirements. Excess advanced biofuel RINs can be used to meet renewable fuel requirements.

- **Other Compliance Markets:** The states of Washington and Oregon also operate clean fuel programs, like the California program. Given the California market's scale and comparative longevity, this report will focus on the California program but recognizes the Oregon and Washington markets as viable market opportunities for RNG.

Figure 6. Potential Pathways of Gas Commodity and Environmental Attributes from RNG Projects



Notes:

- LCFS: Low Carbon Fuel Standard, the clean fuel standard in California
- LCFS "Credit" is a tradeable carbon offset credit in the LCFS market. 1 LCFS Credit = 1 metric ton (MT) of CO2 equivalent reduced. Credits are awarded based on carbon intensity of the renewable fuel compared to the carbon intensity of the fuel it is replacing.
- RFS: Renewable Fuel Standard, federal clean fuel program
- RIN: Renewable Identification Number
- RVO: Renewable Volume Obligation under the RFS
- RTC: Renewable Thermal Certificate – a denomination of RNG attributes equal to 1 dekatherm of RNG produced and transported

Biogas Technical Assistance Program

In 2017, the Georgia Environmental Finance Authority awarded a limited number of grants to local governments that own a landfill or WWTP to conduct site-specific feasibility studies of biogas utilization. Under this program, GEFA offered to reimburse 75 percent of the cost of the Site Assessment Report up to a maximum grant amount of $25,000.

These studies reflect in-depth analysis of biogas feasibility at up to eight facilities in Georgia and shed light on the opportunities and challenges of biogas utilization. Recipients of the grants include:

- Dekalb County – for assessment at Pole Bridge Wastewater Treatment Plant [21]
- City of Gainesville – for assessment at Flat Creek Water Reclamation Facility [22]

Carbon Emission Credits for Biogas and RNG Projects

Accounting for carbon emission reductions associated with the use of RNG through the procurement of certificates is complicated. Accurately accounting for the incremental benefits of a biogas and RNG project must consider how the biogas is generated, what would have happened in the absence of the project, and the fuel to be replaced.

For instance, a landfill gas project that converts an uncapped landfill with fugitive methane emissions to one that captures the methane and converts it to RNG has much greater climate benefit than a landfill project implemented at a landfill that already captures and flares its landfill gas (thereby destroying the methane). RNG production from dairy manure can have very high climate benefit because, in the absence of the project, there would be significant fugitive methane emissions. Many have begun using the California LCFS "Pathway Certified Carbon Intensities" as a guide to relative climate benefits of different fuels.

The GHG Protocol currently has no official guidance on the accounting of "biomethane certificates" which likely serves as a significant drag on the voluntary RNG market.[23]

RNG as a Solution in Georgia

Focus on the Voluntary Market

While the compliance markets represent compelling revenue opportunities for project developers and are stimulating the development of new and creative RNG projects, the voluntary market stands out as the subject of interest for this study. This initiative aims to help Compact Members and other natural gas users decarbonize their operations, including their Scope 1 emissions related to the use of natural gas for facility and fleet operations. The AstraZenece project below provides a strong voluntary market example.

Astra Zeneca Case Study [24]

AstraZeneca is partnering with Vanguard Renewables to procure RNG for AstraZeneca's U.S. facilities for the next 15 years or more. This is one of the largest business-to-business RNG purchases in the North American voluntary market to date. Under the agreement, Vanguard will supply 650,000 MMBtu/year of RNG from three new-build, on-farm anaerobic digesters. This will meet nearly all of AstraZeneca's gas demand at its U.S. research and manufacturing sites by the end of 2026. Procuring RNG from Vanguard Renewables supports AstraZeneca's transition to 100 percent renewable energy and achieving science-based net zero by 2045 at the latest.

In 2020, AstraZeneca's procurement team issued a Request for Information (RFI) to RNG providers, and then selected multiple respondents, including Vanguard Renewables, to bid in a Request for Proposals (RFP) process. It took AstraZeneca and Vanguard Renewables two and a half years from the RFI and initial conversations to execute the contract and initiate RNG delivery. The RNG contract structure is similar to a power purchase agreement for renewable electricity. Under the contract, Vanguard Renewables covers the capital costs of constructing the digesters and AstraZeneca pays a fixed price (per MMBtu) for RNG deliveries with an agreed-upon escalator over the 15-year term. Vanguard Renewables will inject RNG from the new digesters into common carrier gas pipelines, matching AstraZeneca's U.S. gas consumption on a one to one energy basis (by MMBtu) as tracked by a gas marketer. AstraZeneca will then purchase and retain all the environmental attributes associated with the RNG to reduce its Scope 1 emissions.

Vanguard Renewables conducted the GHG emissions analysis of a prototypical on-farm digester producing RNG across each of the selected frameworks and found that carbon intensity ranged from -15 to -120 gCO2e/MJ. Carbon intensity is a measure of the lifecycle GHG emissions of a fuel per unit of energy. Producing RNG using waste that would otherwise emit methane to the atmosphere results in a negative carbon intensity.

Recommendations and Next Steps

To address the challenges and opportunities outlined in this report, a proactive approach to reducing Scope 1 emissions is essential, particularly through strategies such as Renewable Natural Gas (RNG) and biogas adoption. Many stakeholders, including Compact Members, face significant emissions from natural gas usage and are exploring innovative pathways to mitigation. RNG and biogas projects are already gaining traction in Georgia, demonstrating that despite certain barriers—particularly in voluntary markets—viable solutions can be implemented. Policy support that enhances the economic feasibility of these projects could further amplify their local and regional benefits.

A key next step involves fostering stronger connections between RNG developers, interested businesses, and other stakeholders. Organized meetings with developers or brokers could identify practical collaboration opportunities. Alternatively, issuing a request for information (RFI) or request for proposals (RFP) could provide valuable market insights while signaling demand for RNG solutions. These efforts could pave the way for scalable, locally impactful projects that contribute to broader emissions reduction goals.

Additionally, exploring complementary strategies to reduce Scope 1 emissions is crucial. Stakeholders could investigate policies that improve the economics of voluntary market RNG projects, such as favorable tax treatments or other supportive measures, leveraging insights from national organizations like the RNG Coalition. Expanding the scope to evaluate other technologies, such as electrification and green hydrogen for onsite process heat, could further diversify and strengthen pathways toward emissions reduction. By advancing these efforts collaboratively, stakeholders can position themselves as leaders in sustainable innovation while driving meaningful progress toward climate and economic goals.

References

1 Ray C. Anderson Foundation. 2024. *About Drawdown Georgia*. Available at https://www.drawdownga.org/about-us/.

2 Ray C. Anderson Foundation. 2024. *Georgia's 20 Solutions*. Available at https://www.drawdownga.org/solutions/.

3 World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). Undated. About Us. Available at https://ghgprotocol.org/about-us.

4 United States Energy Information Administration. 2024. *Natural Gas Consumption by End Use: Georgia*. Available at https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_nus_m.htm.

5 U.S. Energy Information Administration. 2024. Georgia: State Profile and Energy Estimates. Available at https://www.eia.gov/state/analysis.php?sid=GA#:~:text=Natural%20gas%20and%20nuclear%20power,of%20the%20state's%20net%20generation.

6 U.S. Energy Information Administration. 2024. *Natural Gas Consumption by End Use…* Op cit.

7 U.S. Environmental Protection Agency. 2023. *Greenhouse Gas Inventory Data Explorer*. Available at https://cfpub.epa.gov/ghgdata/inventoryexplorer/.

8 U.S. Environmental Protection Agency. 2023. *Greenhouse Gas Inventory Data Explorer*. Ibid.

9 U.S. Environmental Protection Agency. 2024. *Basic Information about RNG*. Available at https://www.epa.gov/lmop/renewable-natural-gas.

10 U.S. Environmental Protection Agency. 2024. *An Overview of Renewable Natural Gas from Biogas*, page 20. Available at https://www.epa.gov/system/files/documents/2024-01/lmop_rng_document.pdf.

11 Cross, John Michael. 2013. On behalf of Environmental and Energy Study Institute. *Fact Sheet – Landfill Methane*. Available at https://www.eesi.org/papers/view/fact-sheet-landfill-methane.

12 Global Methane Initiative. 2023. *Methane Mitigation from Municipal Wastewater Treatment Plants*, pages 1 and 2. Available at https://www.globalmethane.org/documents/gmi-wastewater-factsheet.pdf.

13 Global Methane Initiative. 2023. Ibid.

14 Georgia Interfaith Power & Light (GIPL), Southern Environmental Law Center, Southface, and Vote Solar. 2020. *Utility Avoided Cost – A Tool for Valuing Renewable Energy and Utility Energy Efficiency Programs in Georgia*. Available at https://www.southface.org/wp-content/uploads/2022/01/Utility-Avoided-Cost-Summary-2021_Katie-Southworth.pdf.

15 U.S. Environmental Protection Agency. 2024. LFG Energy Project Data Files [March 2024]: Detailed file of currently operational projects (March 2024).xlsx. Available at https://www.epa.gov/system/files/documents/2024-03/opprjslmopdata-detailed.xlsx.

16 U.S. Environmental Protection Agency. 2024. *Landfill Data Files [March 2024]*. Available at https://www.epa.gov/lmop/landfill-technical-data#:~:text=Candidate%20landfills%20(March%202024)%20(,landfills%20can%20also%20be%20designated.

17 3Degrees. 2023. Renewable Natural Gas – A new tool to address natural gas emissions. Available at https://3degreesinc.com/resources/renewable-natural-gas/#:~:text=The%20end%2Duser%20of%20the,gas%20purchase%20agreements%20(GPAs).

18 Anew. 2022. *RNG - Climate Work Explained - What is an RNG Environmental Attribute*? Available at https://anewclimate.com/insights/climate-work-explained-rng-attributes.

19 U.S. Environmental Protection Agency. 2023. Renewable Natural Gas from Agricultural-Based AD/Biogas Systems. Available at https://www.epa.gov/agstar/renewable-natural-gas-agricultural-based-adbiogas-systems.

20 Greene, Phil for American Biogas Council. 2019. *101 for LCFS*. Available at https://americanbiogascouncil.org/101-for-low-carbon-fuel-standard/#:~:text=For%20RNG%20produced%20out%20of,a%20vehicle%20fleet%20in%20California.

21 Dekalb County. 2017. *DeKalb County Receives Grant for Biogas Feasibility Study*. Available at https://www.dekalbcountyga.gov/news/dekalb-county-receives-grant-biogas-feasibility-study.

22 Access WDUN. 2017. *Gainesville to look at feasibility of harnessing biogas from Flat Creek facility.* Available at https://accesswdun.com/print/2017/4/526828/gainesville-to-look-at-feasibility-of-harnessing-biogas-from-flat-creek-facility.

23 GHG Protocol. 2023. *Interim Update on Accounting for Biomethane Certificates*. Available at https://ghgprotocol.org/blog/interim-update-accounting-biomethane-certificates.

24 Renewable Thermal Collective. 2024. *AstraZeneca and Vanguard Renewables U.S. RNG Agreement: Case Study February 2024.* Available at https://www.renewablethermal.org/astrazeneca-vanguard-case-study/.

Appendix A: Georgia Biogas and RNG Projects

Table A1: Existing/Operational Biogas and RNG Projects in Georgia (sorted by Start Date)

Project	Biogas Source	Project Type / End-Use	County	Start Date	Off Take Arrangement	Notes
WI Taylor County Disposal	Landfill	Electricity – RP Engine	Taylor	10/1/2003	Green Power EMC	
Seminole Road MSW Landfill	Landfill	Electricity – RP Engine	DeKalb	10/12/2006	Georgia Power Co. (operates as QF)	
Old Dixie Highway MSW Landfill	Landfill	Direct - Boiler	Whitfield	6/12/2008	Trinseo, LLC	
Macon Bibb Walker Road MSWL	Landfill	Direct - Direct Thermal (brick kiln)	Bibb	1/1/2009	Cherokee Brick & Tile	
Live Oak LF	Landfill	RNG- Vehicle Fuel	DeKalb	3/1/2009	Southern Company Gas	
Superior Landfill & Recycling Center	Landfill	Electricity – RP Engine	Chatham	12/31/2009	Georgia Power Co. (operates as QF)	
UGA Double Bridges Farm	Livestock	Direct use – boiler / furnace fuel	Clarke	2010		Swine operation with 100 swine
SR247 MSW Landfill	Landfill	Electricity – RP Engine	Houston	1/11/2011	Flint Energies	
F Wayne Hill Water Resources Center	WWTP	Combined Heat & Power	Gwinnett	Aug 2011		
Dougherty County Fleming/Gaissert Road LF	Landfill	Combined Heat & Power	Dougherty	9/23/2011	Marine Corps Logistics Base	LFG piped 3 miles to CHP plant
Catoosa County MSW LF	Landfill	Electricity – RP Engine	Catoosa	12/5/2011	Tennessee Valley Authority (TVA)	
Wolf Creek Landfill, LLC	Landfill	Electricity – RP Engine	Twiggs	12/12/2011	Green Power EMC	
WI Taylor County Disposal	Landfill	Electricity – RP Engine	Taylor	1/16/2012	Green Power EMC	
Hickory Ridge Landfill	Landfill	Combined Heat & Power	DeKalb	3/31/2012	Coca-Cola Refreshments (operates as GA Power QF)	LFG piped 6 miles to CHP plant
Clayton County SR 3 Lovejoy Landfill	Landfill	Electricity – RP Engine	Clayton	9/24/2012	Clayton County, GA	
Athens-Clarke County Landfill	Landfill	Electricity – RP Engine	Clarke	10/4/2013	Georgia Energy Cooperative	
R. M. Clayton Water Resource Facility	WWTP	Electricity (to be verified)	Fulton	2012	Onsite	
Evergreen Landfill	Landfill	Electricity – RP Engine	Lowndes	12/31/2013	Green Power EMC	
Oak Grove Landfill	Landfill	Electricity – RP Engine	Barrow	7/22/2016	Georgia Power Co. (operates as QF)	
Pine Ridge Landfill	Landfill	Electricity – RP Engine	Butts	7/22/2016	Georgia Power Co. (operates as QF)	
Richland Creek Road Landfill	Landfill	Electricity – RP Engine	Gwinnett	7/22/2016	Georgia Power Co. (operates as QF)	
Thomasville Wastewater Treatment Plant	WWTP	TBD	Thomas	2016		
WI Taylor County Disposal	Landfill	Electricity – RP Engine	Taylor	1/1/2019	Green Power EMC	
Vanguard Renewables	Livestock	RNG Pipeline Injection	Sumter	2023	Dominion Energy	Dairy operation

Table A2: Proposed or Under Development Biogas and RNG Projects in Georgia (sorted by Project Name)

Project	Biogas Source	Project Type / End-Use	County	Est Start Date	Off Take Arrangement	Notes
Augusta Bio-Refinery	Mixed Org Waste	RNG Pipeline Injection		Unknown		Denied by Augusta Commission
Broadhurst Environmental Landfill	Landfill	Unknown	Wayne	Unknown		Submitted an air permit application to GA EPD as "Lightning Renewable - Broadhurst RNG"
Brooksco Biogas LLC	Livestock	RNG		9/20/2025		Awarded $1 million REAP grant in Sep 2023 to construct a dairy manure RNG project
Columbus Pine Grove MSWLF	Landfill	RNG – Pipeline Injection	Muscogee	6/30/2024	Peach State Natural Gas	
Columbus-Schatulga Road SLF	Landfill	RNG – Pipeline Injection	Muscogee	6/30/2024	Peach State Natural Gas	
Gainesville Bioenergy Facility	Mixed Org Waste	RNG	Hall	July 2026		
Gordon County Redbone Ridges LF	Landfill	RNG – Pipeline Injection	Gordon	12/31/2024	Transco	Believed to be same as "Fidem Energy of Gordon RNG Plant" as appears in GEOS.
Synthica Energy	Industrial Org Waste	RNG	Floyd	Late 2025		

Table A3: Candidate Landfill Biogas Projects (sorted by Project Name)

Landfill Name	County	LFG Collection System in Place?
Atkinson County - SR 50 MSWL	Atkinson	No
Bartow County MSWLF	Bartow	Yes
Broadhurst Environmental Landfill	Wayne	Yes
Camden County SR 110 MSW Landfill	Camden	No
Cedar Grove Landfill	Lamar	No
Chesser Island Road Landfill, Inc. MSWL	Charlton	Yes
City of LaGrange Landfill	Troup	Yes
City of Thomasville MSWLF	Thomas	Yes
City of Tifton / Omega / Eldorado Road LF	Tift	No
Crisp County Landfill	Crisp	No
Deans Bridge Road MSWLF	Richmond	Yes
Decatur County Solid Waste Facility	Decatur	No
Eagle Point Landfill LLC	Forsyth	Yes
Grady Road Landfill	Polk	Yes
Hall County Candler Road MSWLF	Hall	No
Murray County Landfill	Murray	No
Newton County Landfill	Newton	Yes
Pine Bluff Landfill	Cherokee	Yes
R & B (Banks) Landfill	Banks	Yes
Savannah-Dean Forest Road SL	Chatham	No
Turkey Run Landfill	Meriwether	Yes
Walker Mountain Landfill	Floyd	No

Appendix B: Understanding Natural Gas Units

Natural measurement units can be confusing, in part because both volumetric and heat content units are commonly used in reporting and pricing. The common volumetric unit is cubic feet (CF) and its common multiples (i.e., 100, 1,000, and 1,000,000 cubic feet). The common heat-content units are the British Thermal Unit or Btu and therm, which is defined as 100,000 Btu. Table B1 below provides an overview of commonly used measurement terms and their equivalencies (assuming 1,038 Btu per cubic foot).

Table B1. Description of Natural Gas Measurement Units

	Volumetric				Heat Content			
Abbreviation	**cf**	**Ccf**	**Mcf**	**MMcf**	**Btu**	**Therm**	**Dekatherm**	**MMBtu**
Definition	Cubic Foot	100 Cubic Feet	1,000 Cubic Feet	1,000,000 Cubic Feet	British Thermal Unit	100,000 Btu	10 therms (1,000,000 Btu)	1,000,000 Btu's
Equivalent - 1 CF	1	0.01	0.001	0.000001	1,038	0.01	0.001	0.001
Equivalent - 1 dekatherm	1,000	10	1	0.001	1,038,000	10	1	1

Where:

- C = 100
- M = 1,000
- MM = 1,000,000
- Btu = amount of energy required to raise one pound of water one degree Farenheit (at 39º) at sea level, about the equivalent released by burning a kitchen match
- In 2022, the US average annual heat content of delivered natural gas was 1,038 Btu per cubic foot

Georgia Tech Scheller College of Business
Ray C. Anderson Center
for Sustainable Business

DRAWDOWN GA BUSINESS COMPACT

Email
drawdownga-businesscompact@gatech.edu

Website
www.drawdowngabusiness.org