American Gas Association

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Re: AGA Response to DOE RFI on Industrial Decarbonization
DE-FOA-0002687: REQUEST FOR INFORMATION ON INDUSTRIAL DECARBONIZATION PRIORITIES

February 28, 2022

Dear Principal Deputy Assistant Secretary Speakes-Backman:

The American Gas Association (AGA) appreciates the opportunity to provide information in response to the U.S. Department of Energy's (DOE) DE-FOA-0002687 Request for Information (RFI) on Industrial Decarbonization Priorities released for comment on January 27, 2022.

The American Gas Association, founded in 1918, represents more than 200 local energy companies that deliver clean natural gas throughout the United States. There are more than 77 million residential, commercial and industrial natural gas customers in the U.S., of which 95 percent — more than 73 million customers — receive their gas from AGA members. AGA is an advocate for natural gas utility companies and their customers and provides a broad range of programs and services for member natural gas pipelines, marketers, gatherers, international natural gas companies, and industry associates. Today, natural gas meets more than one-third of the United States' energy needs.

In response to the RFI, AGA is submitting is recent study, released on February 8, 2022, that describes the crucial role of gas infrastructure for any pathway toward decarbonizing energy across sectors – including industries and manufacturing. ***Net-Zero Emissions Opportunities for Gas Utilities***[1] presents a national-level approach that leverages the unique advantages of gas technologies and distribution infrastructure. The study underscores the range of scenarios and technology opportunities available as the nation, regions, states and communities develop and implement ambitious emissions reductions plans. The following sections of this letter provide excerpts from the AGA study relating to opportunities to achieve industrial decarbonization through gas utilities and their infrastructure.

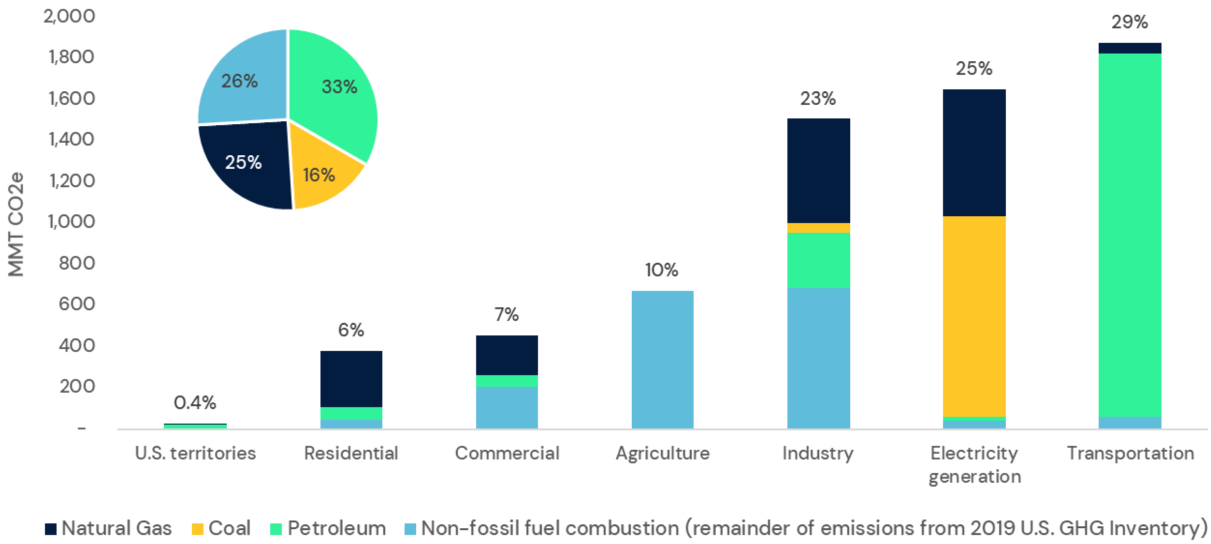
[1] See the AGA Net Zero Emissions Opportunities for Gas Utilities Study at: https://www.aga.org/research/reports/net-zero-emissions-opportunities-for-gas-utilities/.

Natural gas is a core component of the U.S. energy system, and the industrial sector values it for its affordability, flexibility, reliability, and resiliency.

The scale of the U.S. economy's dependence on natural gas highlights the crucial role of gas infrastructure on any pathway to net-zero greenhouse gas emissions by 2050, and the need to address associated carbon dioxide and methane emissions. Additionally, the ability of the natural gas system to store and transport large amounts of energy to meet extreme peaks in seasonal energy use represents an important and valuable resource that should not be ignored when building pathways to achieve net-zero greenhouse gas emissions goals.

As shown in Exhibit 4, the industrial sector accounts for 23% of U.S. direct economy-wide greenhouse gas (GHG) emissions. Natural gas consumption in the industrial sector accounts for approximately 30% of the industrial sector's GHG emissions and approximately 7% of economy-wide U.S. GHG emissions.

Exhibit 4 – Total U.S. Direct Greenhouse Gas Emissions by Economic Sector in 2019



Source: EPA[2]

There is a range of pathways to achieve net-zero greenhouse gas emissions for industry utilizing the gas system. An integrated approach to decarbonization that leverages the advantages of the gas distribution system is likely to support a more effective, reliable, and resilient transition to a net-zero energy system that minimizes negative impacts on the industrial sector.

[2] Greenhouse Gas Inventory Data Explorer | US EPA: See https://cfpub.epa.gov/ghgdata/inventoryexplorer/index.html#allsectors/allsectors/allgas/econsect/current.

Energy utilities across the U.S. have seen ongoing success with demand-side management (DSM) programs aimed at improving the efficiency of electric and natural gas end uses. In a 2020 report from Lawrence Berkeley National Laboratory, researchers examined the results from 37 different utilities/program administrators across 12 states over six years and found an average overall levelized program cost of saved natural gas across all of those portfoflios of $0.40/therm.[2] Commercial and industrial efficiency programs were especially cost-effective, yielding an average cost of just $0.18/therm. That level of cost-effectiveness is difficult to match through non-efficiency approaches to gas demand reduction, and it underscores the importance of energy efficiency in any successful decarbonization plan.

Industrial users represent some of the best candidates to adopt emerging technologies like green hydrogen and carbon capture and storage, and the potential spillover benefits for the industry included in this analysis from the broader drive to bring those technologies to maturity.

Carbon capture, utilization, and storage (CCUS) offer a climate change mitigation solution by removing CO_2 from point sources or the atmosphere and storing it underground. Current operational CCUS-equipped power plants and large industrial facilities can reduce around 90% of CO_2 emissions according to their original design. But, it is technically feasible to design future plants with the capacity to remove 99% or more emissions using the same existing technologies.

There are a variety of CO_2-capture approaches that fall under the CCUS umbrella. Carbon can be captured from a large point source such as a new or existing gas-fired power plant, municipal solid waste landfill, manure management system, or industrial source involving fossil fuel or biomass use, hydrogen production, among other sources. These volumes of captured CO_2 can be permanently stored in deep geological formations. In addition, CO_2 can be used onsite for enhanced oil and natural gas recovery or transported and used in different applications in the medical, agricultural, and industrial sectors.

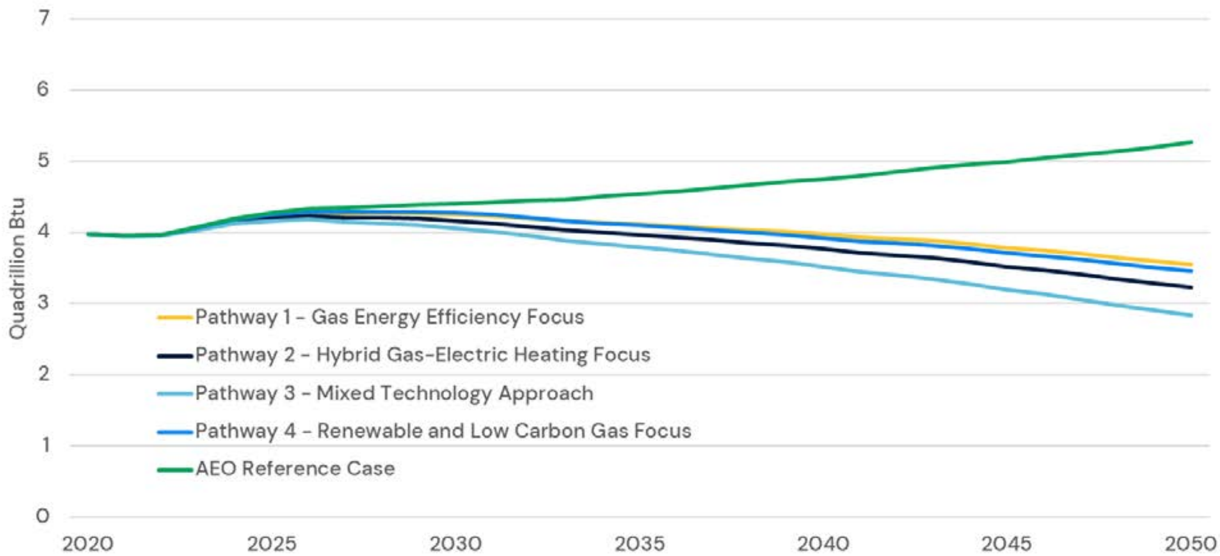
Bioenergy carbon capture and storage (BECCS) is another negative-emissions technology option under consideration that involves capturing the CO_2 from power plants or industrial processes that are using biogenic fuels (and hence would have been considered carbon-neutral even without CCUS). The utilization of the gas CO_2 capture system to support the combination of CCS and renewable gases could support net negative emissions outcomes.

Significant energy efficiency improvements are assumed in all industrial pathways. Thus the industrial gas demand trends shown below for the different pathways are relatively

[2] *Cost of Saving Natural Gas through Efficiency Programs Funded by Utility Customers: 2012–2017,* Lawrence Berkeley National Laboratory, 2020: https://escholarship.org/uc/item/0164134n

similar. Higher levels of adoption of hydrogen clusters are assumed in Pathway 4, which leads to additional gas demand reductions relative to the other pathways. Dedicated hydrogen infrastructure adoption is shown as a reduction in pipeline gas demand within this chart.

Exhibit 32 – Industrial Gas Consumption in Study Scope (Gas Utilities Industrial Customer at 50% of Total Industry)



Additional details on 2050 industrial gas demand reductions by measure type are shown in Table 4. For Pathways 1, 2, and 3, energy efficiency drives higher savings levels, representing 48%, 45%, and 39% of total natural gas savings, respectively. Aligned with the results from residential and commercial sectors, Pathway 3 shows higher savings from selective electrification measures than the rest of the approaches, and Pathway 4 results indicate a higher adoption of hydrogen clusters.

Table 4 – 2050 Industrial Sector Gas Demand Reductions by Measure Type

Measure	Trillion Btu							
	Pathway 1 - Gas Energy Efficiency Focus		Pathway 2 - Hybrid Gas-Electric Heating Focus		Pathway 3 - Mixed Technology Approach		Pathway 4 - Renewable and Low Carbon Gas Focus	
Selective Electrification	124	6%	471	20%	862	32%	124	5%
Dedicated Hydrogen Infrastructure	511	23%	511	22%	511	19%	906	39%
Gas Energy Efficiency	1,077	48%	1,055	45%	1,059	39%	775	33%
Carbon Capture and Sequestration	533	24%	301	13%	266	10%	519	22%
Total	**2,245**	**100%**	**2,338**	**100%**	**2,698**	**100%**	**2,324**	**100%**

The industrial sector modeling is intended to measure natural gas consumption and emissions reduction for the four decarbonization pathways scoped in this study. The analysis focused on customers to whom utilities deliver natural gas, not industrial customers who deliver gas directly from inter- or intra-state pipelines (bypassing the local distribution company). This non-utility portion of industrial customers is assumed to remain roughly 50% of the total industrial natural gas consumption in the AEO reference case for all end uses.

Measures evaluated are energy efficiency, direct use of 100% hydrogen, selective electrification, and carbon capture and storage. Those measures were studied for different end uses, including space heating, steam boilers, machine drive, CHP, and other uses.

Table 21 showcases the percentage of energy savings relative to the AEO reference case in 2050. There are two main assumptions behind this calculation:

1. **Maximum end-use applicability**: This assumption indicates the share of maximum turnover by end-use during 2050. All measures' lives are set for less than 30 years, and their maximum turnover in 2050 is spread linearly from each measure's starting year to 2050. Table 22 shows end uses included by measure and the percentages of maximum turnover assigned. When the maximum turnover is zero percent, the end-use is not considered for that pathway and measure. It is the case of space heating electrification under pathways 1 and 4 (see Table 22).

2. **Annual efficiency improvement**: This input includes efficiency by end-use relative to the reference case for selective electrification, energy efficiency, and direct use of 100% hydrogen measures. Table 23 showcases the incremental efficiency relative to the reference case in 2020, and the expected annual efficiency improvement of every measure by end-use. It is assumed, in most of the end-uses, that energy efficiency and hydrogen measures are as efficient as the reference case during 2020. Even in these cases in which efficiency levels are identical, there is still significant room for additional efficiency improvements in the future. For instance, in the case of energy efficiency for space heating, despite having the same efficiency level as the baseline, a higher annual efficiency improvement is expected during the subsequent years, which will generate space for energy savings.

Using the inputs described above, the model generates outputs that contain natural gas consumption and GHG annual savings for each measure.

Table 21 – Assumptions Driving Industrial Gas Demand (Percentage of 2050 Reference Case)

Industrial Emission Reduction Strategies	Pathway 1 - Gas Energy Efficiency Focus	Pathway 2 - Hybrid Gas-Electric Heating Focus	Pathway 3- Mixed Technology Approach	Pathway 4 - Renewable and Low Carbon Gases Focus
Incremental Energy Efficiency (saving relative to 2050 reference case)	20%	20%	20%	15%
Direct Use of 100% Hydrogen	10%	10%	10%	17%
Carbon Caputre and Storage	10%	5%	5%	10%
Selective Electrification	2%	9%	16%	2%

Table 22 – Maximum End-Use Applicability by 2050

Measure	End Use	Maximum End Use Applicability 2050			
		Pathway 1 - Gas Energy Efficiency Focus	Pathway 2 - Hybrid Gas-Electric Heating Focus	Pathway 3- Mixed Technology Approach	Pathway 4 - Renewable and Low Carbon Gases Focus
Selective Electrification	Non-Energy	0%	0%	0%	0%
	Space Heating	0%	38%	50%	0%
	Direct-Fired Process Heating	5%	10%	20%	5%
	Steam Boilers	0%	0%	0%	0%
	Machine Drive	0%	10%	25%	0%
	CHP	0%	5%	10%	0%
	Other	0%	25%	25%	0%
Direct Use of 100% Hydrogen	Non-Energy	0%	0%	0%	0%
	Space Heating	5%	5%	5%	5%
	Direct-Fired Process Heating	15%	15%	15%	20%
	Steam Boilers	5%	5%	5%	10%
	Machine Drive	5%	5%	5%	5%
	CHP	5%	5%	5%	20%
	Other	5%	5%	5%	5%
Energy Efficiency	Non-Energy	100%	100%	100%	100%
	Space Heating	100%	100%	100%	100%
	Direct-Fired Process Heating	100%	100%	100%	100%
	Steam Boilers	100%	100%	100%	100%
	Machine Drive	100%	100%	100%	100%
	CHP	100%	100%	100%	100%
	Other	100%	100%	100%	100%
CCS	Non-Energy	0%	0%	0%	0%
	Space Heating	0%	0%	0%	0%
	Direct-Fired Process Heating	20%	12%	12%	20%
	Steam Boilers	20%	12%	12%	20%
	Machine Drive	0%	0%	0%	0%
	CHP	20%	12%	12%	20%
	Other	0%	0%	0%	0%

Table 23 – Annual Efficiency Improvement

Measures	End Use	Efficiency Relative to Reference Case 2020	Annual Efficiency Improvement			
			Pathway 1 - Gas Energy Efficiency Focus	Pathway 2 - Hybrid Gas-Electric Heating Focus	Pathway 3 - Mixed Technology Approach	Pathway 4 - Renewable and Low Carbon Gases Focus
Selective Electrification	Non-Energy	1.00	0.0%	0.0%	0.0%	0.0%
	Space Heating	3.75	0.5%	0.5%	0.5%	0.5%
	Direct-Fired Process Heating	4.00	1.0%	1.0%	1.0%	1.0%
	Steam Boilers	1.25	0.0%	0.0%	0.0%	0.0%
	Machine Drive	3.17	0.1%	0.1%	0.1%	0.1%
	CHP	1.00	0.0%	0.0%	0.0%	0.0%
	Other	2.00	0.0%	0.0%	0.0%	0.0%
Direct Use of 100% Hydrogen	Non-Energy	1.00	0.5%	0.5%	0.5%	0.5%
	Space Heating	1.00	0.5%	0.5%	0.5%	0.5%
	Direct-Fired Process Heating	1.00	1.0%	1.0%	1.0%	1.0%
	Steam Boilers	1.06	0.3%	0.3%	0.3%	0.3%
	Machine Drive	1.00	0.5%	0.5%	0.5%	0.5%
	CHP	1.00	0.3%	0.3%	0.3%	0.3%
	Other	1.00	0.5%	0.5%	0.5%	0.5%
Energy Efficiency	Non-Energy	1.00	1.0%	1.0%	1.0%	1.0%
	Space Heating	1.00	2.0%	2.0%	2.0%	1.5%
	Direct-Fired Process Heating	1.00	2.0%	2.0%	2.0%	1.5%
	Steam Boilers	1.00	1.5%	1.5%	2.0%	1.5%
	Machine Drive	1.00	0.0%	0.5%	0.5%	1.0%
	CHP	1.00	1.0%	1.1%	1.2%	1.0%
	Other	1.00	0.0%	1.0%	1.0%	1.0%
Reference Case	Non-Energy	1.00	0.5%	0.5%	0.5%	0.5%
	Space Heating	1.00	0.4%	0.4%	0.4%	0.4%
	Direct-Fired Process Heating	1.00	1.0%	1.0%	1.0%	1.0%
	Steam Boilers	1.00	0.3%	0.3%	0.3%	0.3%
	Machine Drive	1.00	0.5%	0.5%	0.5%	0.5%
	CHP	1.00	0.3%	0.3%	0.3%	0.3%
	Other	1.00	0.5%	0.5%	0.5%	0.5%

Because industrial decarbonization could take decades, as the RFI notes,[3] it is critical to identify and consider the decarbonizing technologies currently available to reduce greenhouse gas emissions today and in the next five years. While the industrial sector continues to research and invest in the decarbonizing technologies of tomorrow, the natural gas sector is working with their industrial customers now to achieve emission reductions. For example, near term reductions can be achieved through fuel switching industrial customers from coal, petroleum or coke to natural gas. In addition, below are other significant measures AGA members are advancing in partnership with their industrial customers:

- **Combined Heat and Power ("CHP") Technology.** CHP is an efficient approach to generating electric power that involves capturing the heat created from producing electricity, which is often wasted in a conventional plant, and turning it into steam or hot water that can be used for space heating, cooling, domestic hot water, and industrial processes. The U.S. Department of Energy ("DOE") should consider policies that provide for more widespread adoption of CHP, based on the success of AGA members in implementing such projects. For example, Atmos Energy partnered with Mississippi State University ("MSU") to build the MSU Clean Energy Microgrid, which uses CHP technology powered by an onsite natural gas generator to provide electricity, hot water, and heating to a 130-unit student

[3] U.S. Department of Energy, *DE-FOA-0002687: Request for Information on Industrial Decarbonization Priorities*, 2 (Jan. 27, 2022).

housing complex.[4] In doing so, MSU will save approximately $116,000 every year in electric utility costs and will reduce CO_2 emissions by more than 827 tons annually.[5] CHP technology provides a continuous supply of electricity and thermal energy for critical loads and can withstand long multi-day grid outages when they occur. The onsite electric generation provided with CHP can also reduce grid congestion and help the end user avoid distribution costs. Importantly, this technology improves competitiveness by reducing fuel use and associated costs, and it is readily available to aid in industrial decarbonization efforts.

- **Renewable Natural Gas ("RNG") expansion.** Companies across the U.S. are implementing RNG projects that provide energy to industrial customers, and we expect the number of RNG projects to continue to rise in the future.[6] For example, Atmos Energy currently transports approximately eight Bcf of RNG annually, having added two Bcf to RNG transport volume in 2021.[7] Importantly, RNG reduces the impacts of organic wastes and provides a circular waste management strategy for the agriculture and food industries. Solid waste is expected to grow nearly 70% by 2050 due to natural human activity. RNG provides a near-term solution for effectively managing this waste issue and getting us on the path to implementing a source of clean, reliable fuel.[8]

- **Fuel Cell Technology.** Fuel Cell technology can provide reliable, efficient solutions to reduce industrial sector emissions in the near-term. A Fuel Cell is an electrochemical device that converts the chemical energy from the methane in natural gas into electricity through a chemical reaction with oxygen. Using no combustion, Fuel Cell power creates a clean alternative for on-site power and provides reductions in emissions of pollutants like carbon dioxide and nitrogen oxide which are harmful to the environment. Fuel Cells provide critical energy backup for large industrial facilities and can also be used to power commercial businesses and critical public safety facilities. AGA member Atmos Energy is currently exploring the uses of this emerging technology. For example, in 2021, Atmos Energy commenced the installation of its first natural gas-powered Fuel Cell at one of its facilities in Dallas, Texas. This unit will come online in early 2022 and is expected to produce natural gas-driven, sustainable, low-carbon power equivalent to approximately 25% of Atmos Energy's Texas usage. In addition, Atmos Energy currently has a program in its Mississippi division to offer incentives to industrial customers for the installation of this technology. To ensure that the Mississippi Fuel Cell program will meet efficiency standards and reduce greenhouse gas emissions, all projects receiving an incentive must meet a

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[4] Atmos Energy Corporation, *University Students Rely on Clean Energy Microgrid*, (Apr. 21, 201), https://www.atmosenergy.com/newsroom/university-students-rely-clean-energy-microgrid.
[5] *Id.*
[6] American Gas Association, *AGA RNG Activity Tracker*, (Nov. 2021), https://www.aga.org/globalassets/rng-activity-tracker_nov2021.pdf.
[7] Atmos Energy Corporation February 2022 Analyst Presentation, p. 20, https://www.atmosenergy.com/company/webcasts-and-presentations.
[8] *See* The Coalition for Renewable Natural Gas, *Renewable Natural Gas*, https://www.rngcoalition.com/about-rng (last visited Feb. 23, 2022).

minimum efficiency of 55%. Thus, widespread deployment of Fuel Cells could significantly reduce greenhouse gas emissions and harmful criteria pollution from emergency, backup, and auxiliary power sources fueled by petroleum-based fuels.

As DOE considers these near-term decarbonization options, it should consider the benefits that come with adopting a technology-neutral approach to addressing climate change. We will need to invest in a diverse array of decarbonizing technologies in order to attain net-zero emission goals while ensuring continued energy reliability and affordability for all economic sectors.

AGA appreciates the opportunity to comment. If you have any questions, please do not hesitate to contact me or Rick Murphy rmurphy@aga.org.

Respectfully Submitted,

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