A Vision for the Future

Presentation to NACAA Climate Change Committee

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American Gas Association
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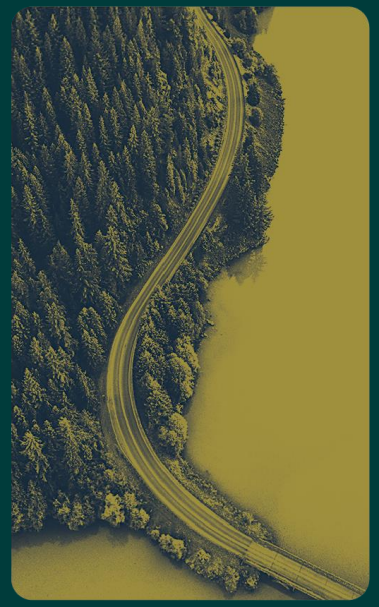

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1 per minute

One new residential customer signs up for natural gas service every minute, and approximately 60 businesses begin new natural gas service every day.

$1,041

Households that use natural gas for heating, cooking and clothes drying save an average of $1,041 per year compared to homes using electricity for those applications.

69%

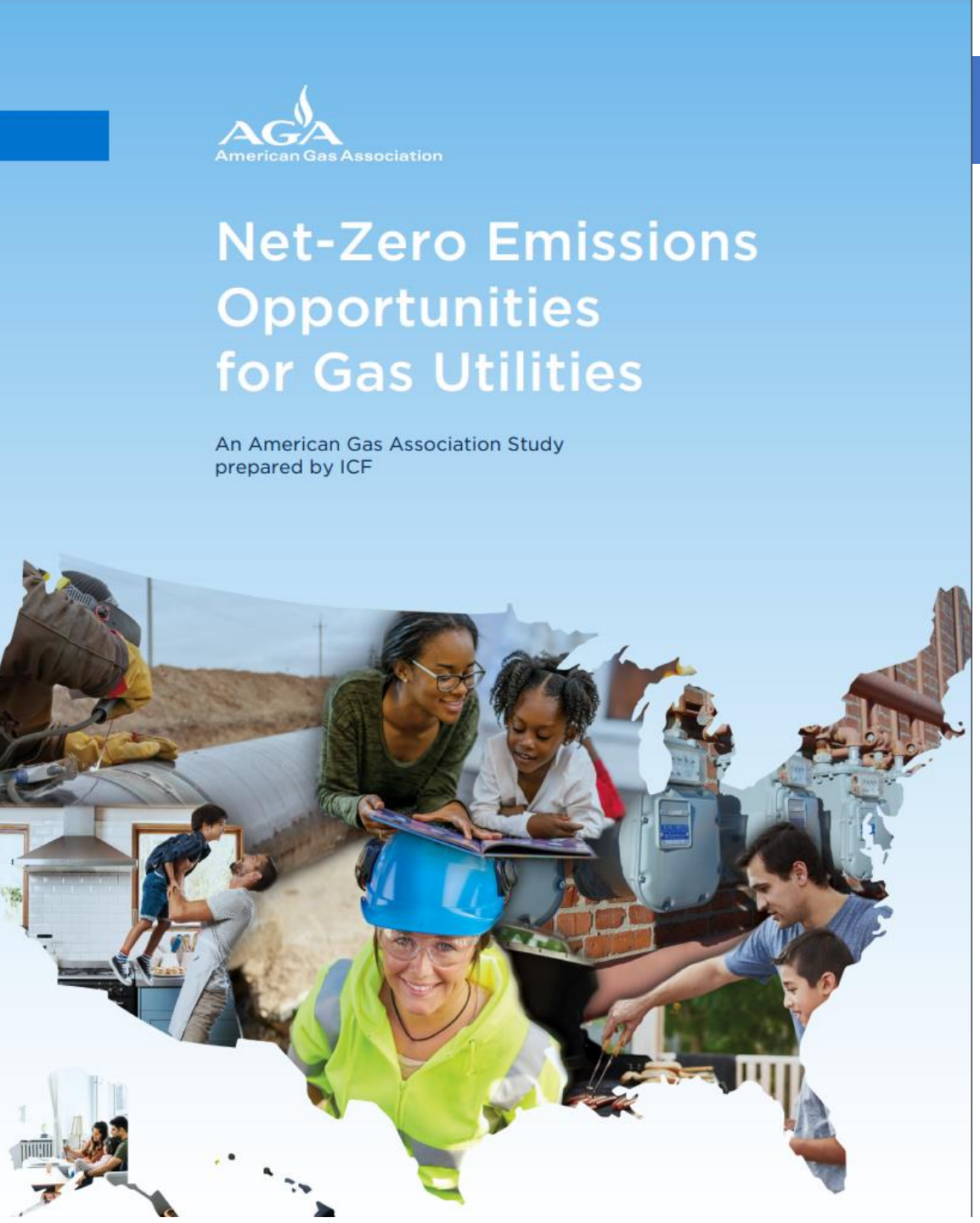
Emissions from the natural gas distribution system have declined 69% since 1990.

$125M

America's natural gas utilities are investing $125 million to advance low- and zero-carbon energy technologies and reduce emissions.

$95M+

Natural gas utilities invest more than $95 million every single day in infrastructure upgrades and energy efficiency innovations.

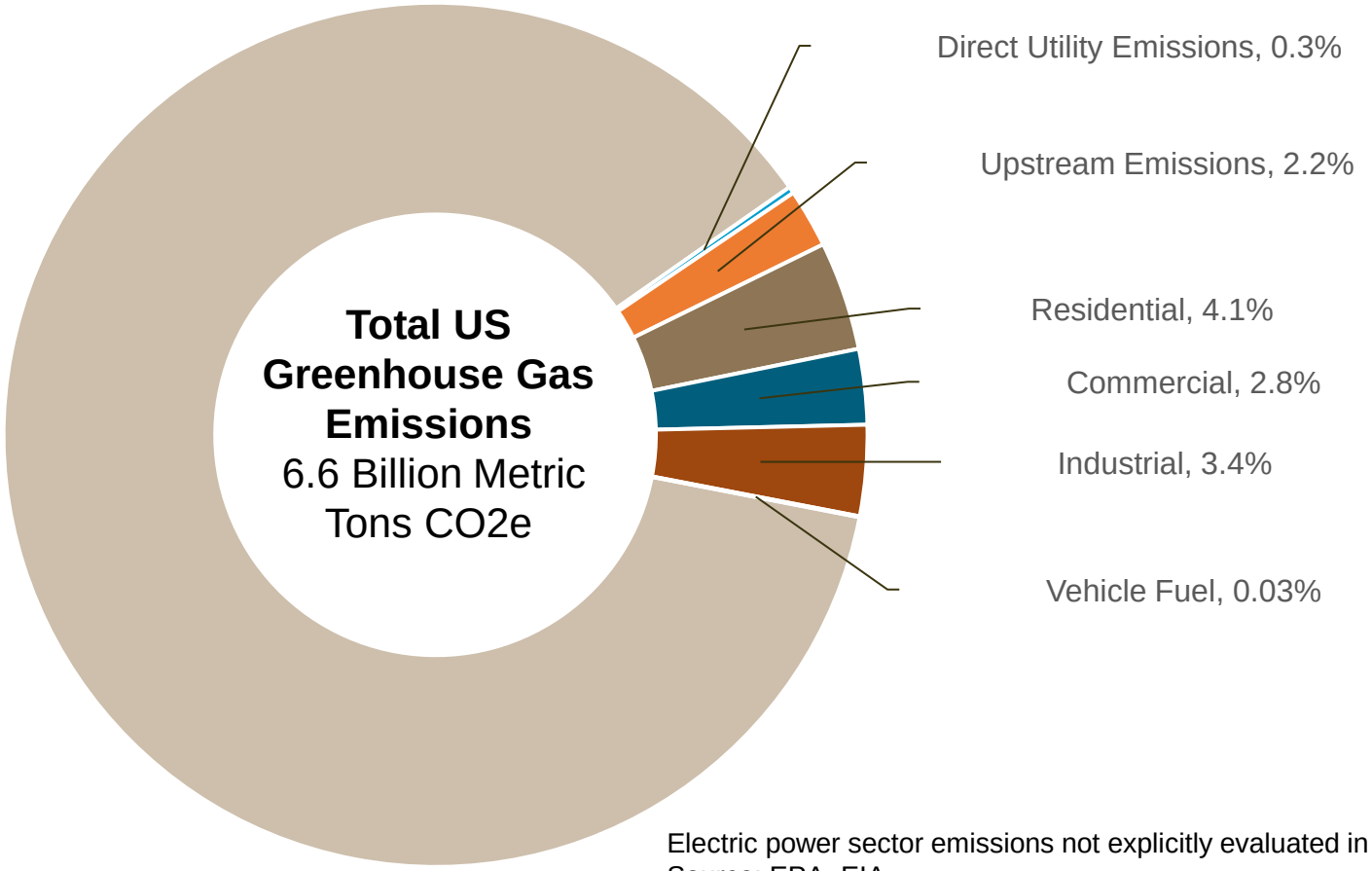


Key Findings

- Gas utilities and infrastructure play crucial and enduring roles in pathways to net-zero emissions
- **Gas utilities can meet net-zero GHG emissions targets**
- Gas infrastructure can increase the likelihood of successfully reaching net-zero targets while minimizing customer impacts, maintaining reliability and storing large amounts of energy to meet seasonal and peak demand
- **Large amounts of renewable and low-carbon electricity and gases, and negative emissions technologies, will be required**
- Supportive policy and regulatory approval will be essential

Gas Utility Associated GHG Emissions: 13% of total U.S. GHGs.

Gas Utility Associated GHG Emissions by Category 2019



Electric power sector emissions not explicitly evaluated in study
Source: EPA, EIA

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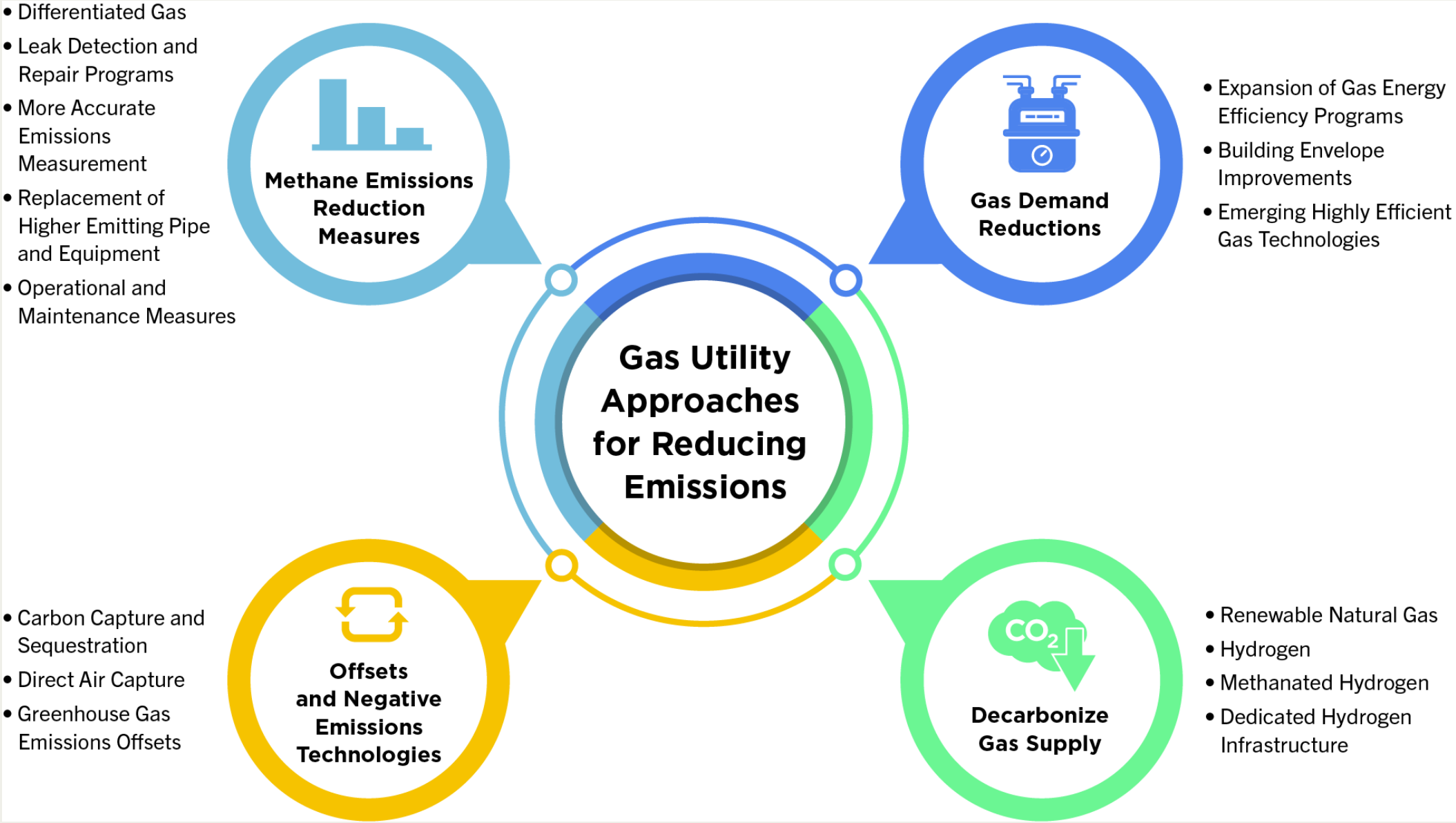
Many Solutions Exist to Reduce Emissions



Supply-Side Resources

Geological natural gas:

This portion of remaining gas demand which continues to be met by shale / conventional natural gas production

Renewable natural gas (RNG)

This includes RNG produced by Anaerobic Digestion and Thermal Gasification from a variety of feedstocks

Hydrogen blending into gas supply:

Hydrogen that is assumed to be mixed into existing gas infrastructure without requiring significant infrastructure upgrades

Methanated hydrogen (RNG)

This supply represents RNG (or low carbon gas that can be blended without limit in existing gas infrastructure) that was produced from a clean hydrogen feedstock, through the addition of biogenic CO2 in a methanation process.

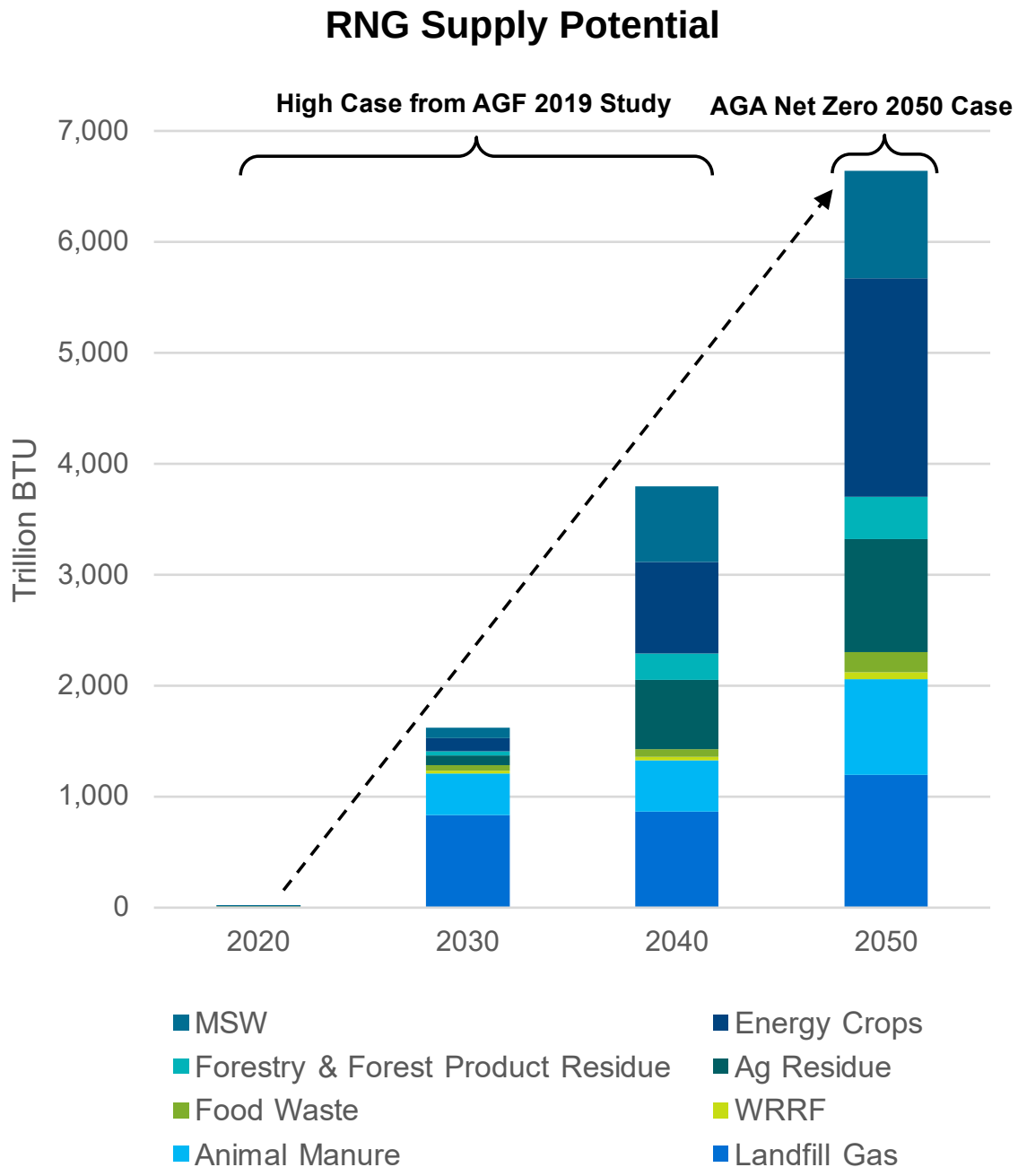
Dedicated hydrogen infrastructure:

This represents the build out of new infrastructure to enable targeted customers/clusters to convert to higher levels of hydrogen use. These volumes include hydrogen used for industry (all scenarios) and hydrogen used in residential/commercial buildings (scenario 4 only), but do not include hydrogen used in the transportation sector for fuel cell vehicles.

The *Potential* For Renewable Natural Gas and Hydrogen Supply is Significant

- Feedstocks are abundant and geographically diverse

- RNG production technologies are commercialized, and with the right policy support and market demand are poised to scale rapidly in the U.S.



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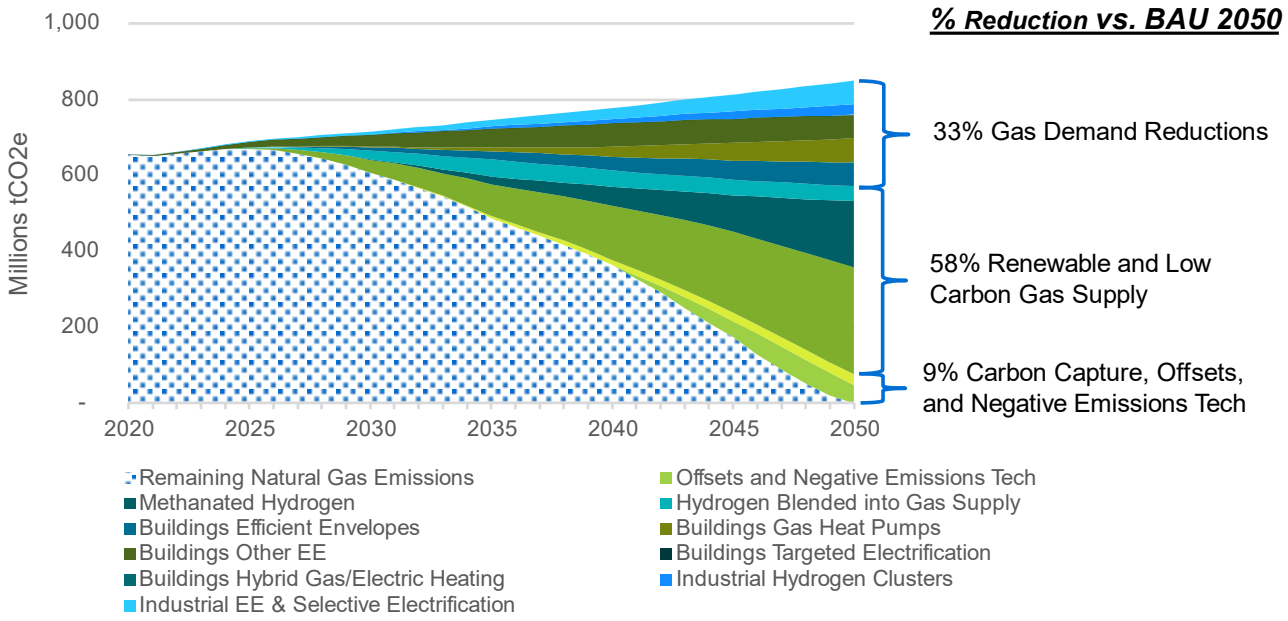
Scenario 1: Gas Energy Efficiency Focus Components and Pathway

Gas Energy Efficiency Focus

- Gas heat pumps
- Major building shell retrofits
- High-efficiency gas appliances
- Other energy efficiency (E.E.) measures
- RNG & hydrogen blending
- Negative emissions technologies
- Aggressive fuel-neutral building energy codes

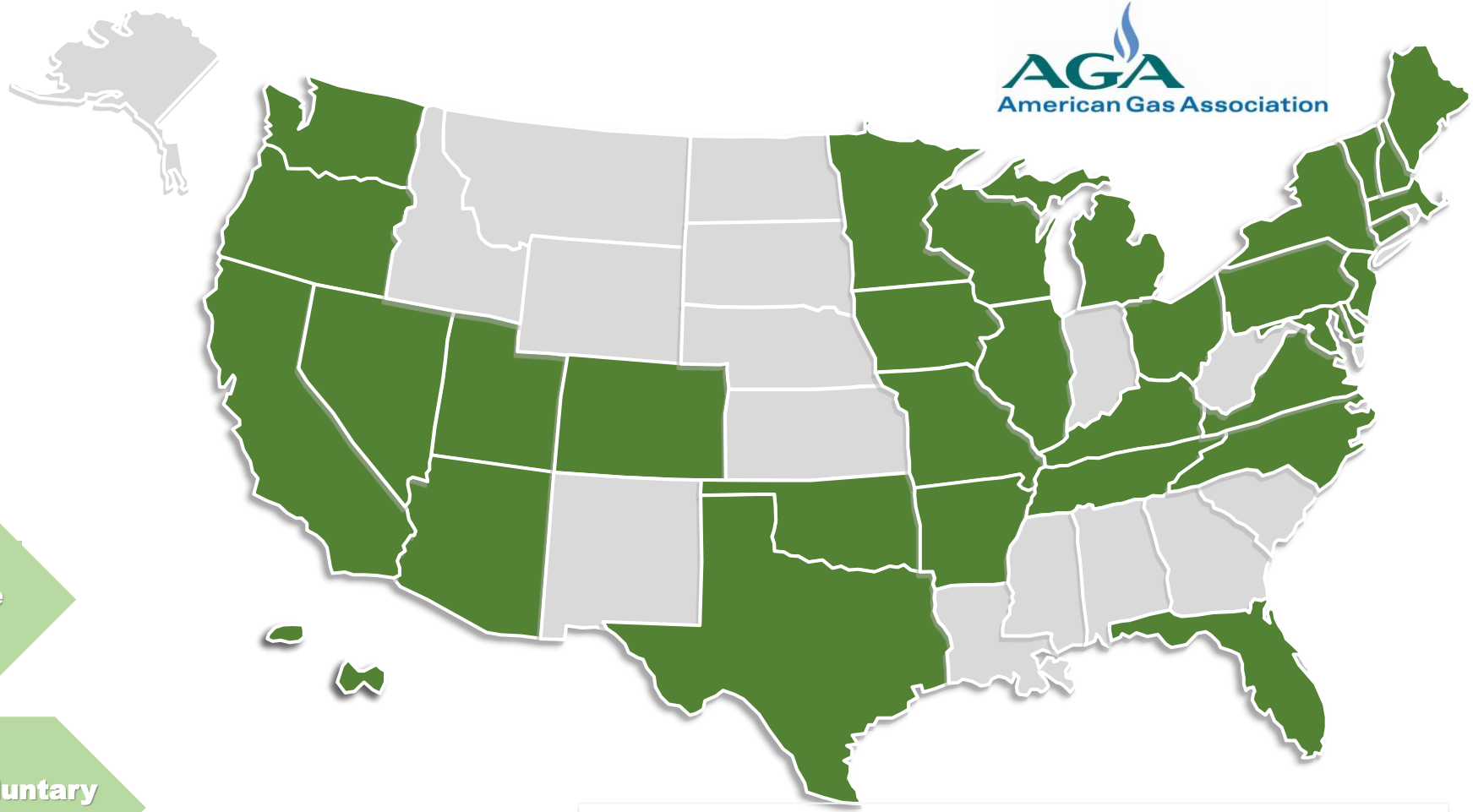
Pathway to Net-Zero Customer GHGs (Gas Energy Efficiency Focus)



Key Insights

- 24% customer growth over the 30-year period
- The potential of gas heat pumps is significant, but requires technology deployment
- Gas DSM programs and infrastructure can drive emission reductions

Renewable Natural Gas State Activity



53 Bills have been introduced

27 Bills have become law

State Legislative Proposals

17 Natural Gas Utilities have begun developing or have implemented Voluntary Green Tariffs

Voluntary Programs

21 Natural Gas Utilities are engaged in RNG production projects

Utility Led RNG Projects

Activity in 33 states to promote the use of RNG in the residential or commercial sector through either legislative, regulatory, or utility led action.

*this data does not include RNG interconnection activity

THANK YOU

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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 76 million residential, commercial and industrial natural gas customers in the U.S., of which 95 percent — more than 72 million customers — receive their gas from AGA members. Today, natural gas meets more than 30 percent of the United States' energy needs.

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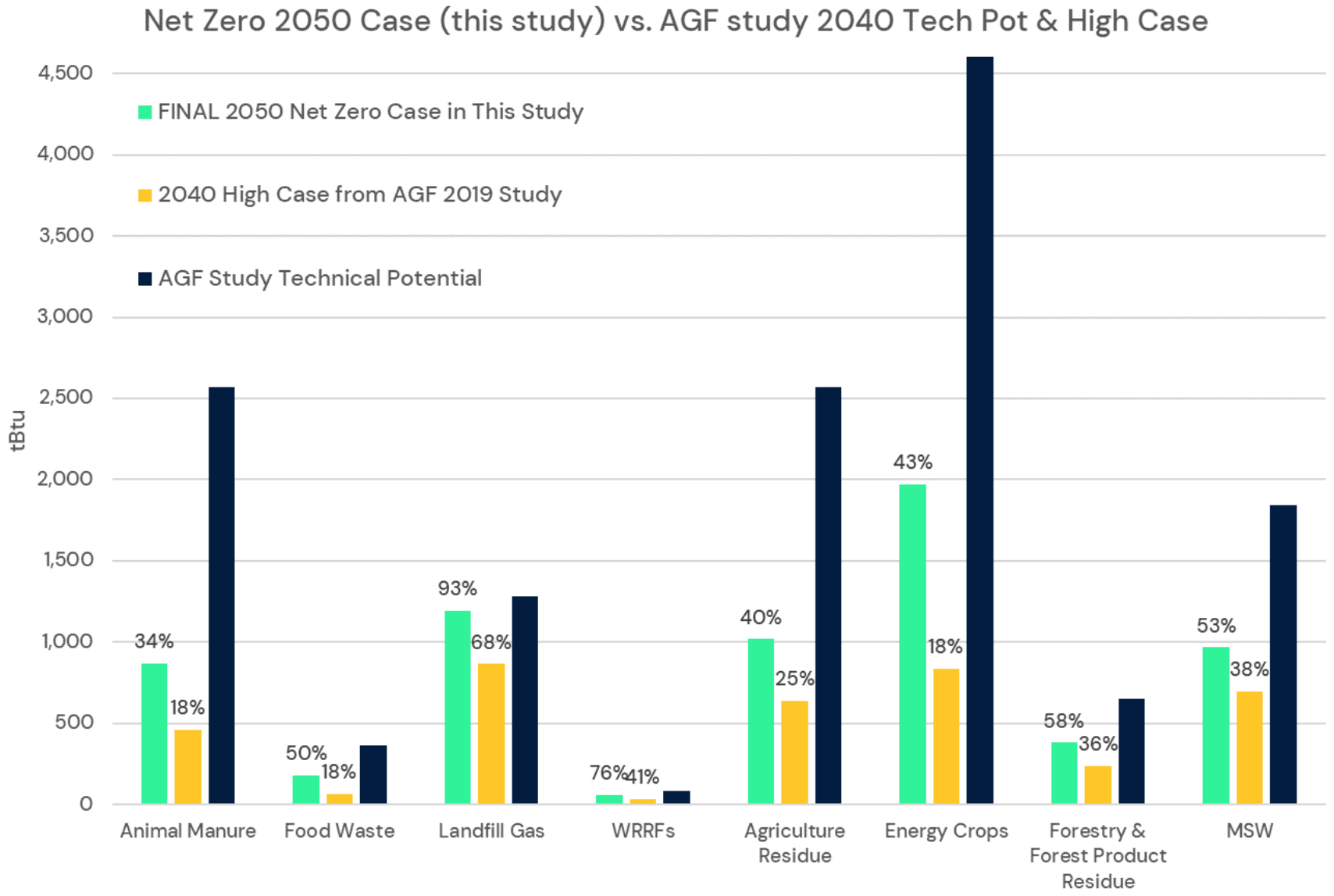
RNG Feedstocks

Feedstock for RNG		Description
Anaerobic Digestion	**Animal manure**	Manure produced by livestock, including dairy cows, beef cattle, swine, sheep, goats, poultry, and horses.
	Food waste	Commercial, industrial and institutional food waste, including from food processors, grocery stores, cafeterias, and restaurants.
	Landfill gas (LFG)	The anaerobic digestion of organic waste in landfills produces a mix of gases, including methane (40–60%).
	Water resource recovery facilities (WRRF)	Wastewater consists of waste liquids and solids from household, commercial, and industrial water use; in the processing of wastewater, a sludge is produced, which serves as the feedstock for RNG.
Thermal Gasification	**Agricultural residue**	The material left in the field, orchard, vineyard, or other agricultural setting after a crop has been harvested. Inclusive of unusable portion of crop, stalks, stems, leaves, branches, and seed pods.
	Energy crops	Inclusive of perennial grasses, trees, and annual crops that can be grown to supply large volumes of uniform and consistent feedstocks for energy production.
	Forestry and forest product residue	Biomass generated from logging, forest and fire management activities, and milling. Inclusive of logging residues, forest thinnings, and mill residues. Also materials from public forestlands, but not specially designated forests (e.g., roadless areas, national parks, wilderness areas).
	Municipal solid waste (MSW)	Refers to the non-biogenic fraction of waste that would be landfilled after diversion of other waste products (e.g., food waste or other organics), including construction and demolition debris, plastics, etc.

Source: ICF descriptions from 2019 AGF RNG study and 2022 AGA Net-Zero Study

RNG Supply – Feedstock Utilization Comparison



Source: ICF

Summary of Proposed Supply Side Resources in 2022 AGA Net-Zero Study

Low Carbon Source	Upper Limit on Available Supply of Energy in 2050	Other limits on use of this source	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
RNG – Anaerobic Digestion	2306 tBtu	N/A	100% of supply (2306 tBtu)	100% of supply (2306 tBtu)	85% of supply (1960 tBtu)	100% of supply (2306 tBtu)
RNG – Thermal Gasification	4339 tBtu	N/A	75% of supply (3254 tBtu)	80% of supply (3471 tBtu)	45% of supply (1953 tBtu)	75% of supply (3254 tBtu)
Methanated Hydrogen / Hydrogen Added to Thermal Gasification for Increased RNG	4339 tBtu	Not to exceed RNG thermal gasification	75% of supply (3254 tBtu)	10% of supply (651 tBtu)	45% of supply (1953 tBtu)	75% of supply (3254 tBtu)
Hydrogen Blending into Gas Supply / Existing Infrastructure	N/A	Max 20% blend by volume	20% of supply volume (755 tBtu)	10% of supply volume (272 tBtu)	20% of supply volume (528 tBtu)	20% of supply volume (810 tBtu)
Dedicated Hydrogen Infrastructure*	N/A	N/A	511 tBtu	511 tBtu	511 tBtu	1031 tBtu
Total 2050 Low/No Carbon Gas Supply (tBtu)			10,080	7,211	6,904	10,656
		% of Total Demand:	93%	93%	92%	92%
Total 2050 Demand (tBtu)			10,781	7,761	7,541	11,571

*Uptake in this category driven by demand-side analysis assumptions for customer conversion to H2

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Source: ICF