**IMPACT OF ELECTRIFICATION AND DECARBONIZATION ON GAS DISTRIBUTION COSTS**

(Selected excerpts, compiled by Ken Dolsky)

Alternative fuels such as biogas are another path to decarbonization but these will be expensive. In our biogas scenario, average utility costs per customer increase by about a factor of four (300%). Page iv

Biofuels and synthetic natural gas do release carbon dioxide when they burn and methane (also a greenhouse gas) when they leak, but some biofuels could potentially displace equivalent emissions in their production.

For example, biofuels can be made from plants that remove carbon dioxide from the atmosphere as they grow, or can be made from animal excrement or landfills, which, if not used to produce fuel, would instead release methane into the atmosphere as the waste breaks down in the environment. However, most of these fuels do have some carbon emissions that will need to be offset and their potential production falls far short of current natural gas usage (Nadel 2022). We also note that this discussion applies to fuels with very low emissions; mixing moderate amounts of these fuels with natural gas will retain most of today’s emissions from natural gas. Page 1

many older gas distribution systems require investments to maintain safe and reliable service; as we discuss later in this report, in some systems these upgrades can cost billions of dollars. Page 2

Based on their empirical findings, they projected the impact of customer departures on costs for remaining customers. This estimate is summarized below in figure 1, which shows exponential growth as customers exit the system. For example, their midpoint estimate is that if 50% of gas customers leave the system, the average customer bill will increase about 60%. Yet, if 75% of gas customers leave the system, the average customer bill would increase by 150%. Page 2

For biogas we use a 2022 report prepared for the New York State Energy Research and Development Authority (NYSERDA) that looked at seven technical pathways for producing methane biogas. For each pathway they estimated the 2040 cost to produce methane. Individual pathways ranged from $11–35 per million Btu, with most of the pathways above $20 per million Btu (ICF 2022). We used the simple average of pathways, which was $25.61 per million Btu (the $11 pathway, which is landfill gas, is available only in limited quantities). It should be noted that the biogas scenario only includes the price of fuel and does not include any investments that some gas distribution systems might need to make to safely handle biogas or other alternative fuels. Page 21

Results of these alternative gas cost scenarios are shown in figure 7. The high and low natural gas prices differ only a little from the reference case in utility cost per customer (–11% to +11% for 2040), while the biogas scenario is much more expensive, with fuel costs about six times higher than the reference case and total utility costs per customer 315% higher than the reference case (e.g., total costs are more than four times those of the reference case).19 This last scenario is highly sensitive to the price of biogas. Even if somehow the price of biogas could be cut in half relative to the NYSERDA data, the result would still be an average utility cost of $1,741 per customer, more than doubling the reference case utility cost per customer. Page 21

The high costs of the biogas scenario imply that widespread use of biogas is probably not a least-cost decarbonization strategy (not to mention the fact that biogas is likely to be in limited supply).24 For a substantial majority of homes, electrification is likely to be a less expensive option on both an operating cost and a total life-cycle cost basis. Page 27

Conclusions

Residential and commercial gas service will become significantly more expensive as states, cities, and utilities move to decarbonize their systems. Decarbonization will involve electrification and potentially some use of alternative fuels. Even without decarbonization, gas service will become much more expensive in areas needing extensive gas pipe replacement.

Electrification has been found by other studies to be the lowest-cost route to decarbonization for most U.S. homes (e.g., Nadel and Fadali 2022). As more homes are electrified and leave the gas system, fixed gas system costs will be reallocated to remaining customers. We looked at illustrative scenarios with 25%, 50%, and 75% electrification, finding that average utility costs per customer can increase 20–119%, varying with the scenario. And in scenarios combining some electrification with increased capital investment for pipeline replacement, average utility costs per customer can increase by more than a factor of four.

Alternative fuels such as biogas could play a role in decarbonization, but these will be expensive. In our biogas scenario, average utility costs per customer increase by about a factor of four, suggesting building energy decarbonization would benefit more from strategic planning than from seeking an alternative to efficient electrification for most applications.28 (Work by Nadel (2022) finds that about 90% of fuel use in the United States can be electrified, but alternative fuels will be needed for the remaining applications such as long-distance transportation (planes, trucks, ships, and trains), high-temperature industrial process heat, and backup heat for very cold days in cold climates.)

Our analysis finds that the costs of maintaining the gas distribution system in urban areas with old gas pipes that will need replacement, and in rural areas, will generally be higher. If decarbonization and cost management spurs discussions on retirement of some portions of the gas distribution system, these may be the best places to start. Comprehensive weatherization packages can help reduce energy use and bills.

Weatherization packages will be particularly important for high cost of gas service scenarios such as those characterized by the use of biofuels, high electrification, and high pipe replacement.

Utilities and regulators should explore the best solutions for decarbonization in their regions.

Long-term planning will be needed as will innovative financial and accounting structures to help manage costs. This and previous studies show that cost increases for remaining gas customers are modest in the early stages of electrification before increasing exponentially.

This is likely to hold across geographic regions and urban/suburban/rural utilities, but specific strategies to manage these impacts will require tailoring to local conditions. It is important for policymakers and energy planners to be proactive in anticipating these effects to institute measures to mitigate them for all customers and avoid them for households that already carry a significant energy burden.