BEFORE THE PUBLIC SERVICE COMMISSION OF THE DISTRICT OF COLUMBIA

In the Matter of the Investigation into Washington Gas Light Company's Strategically Targeted Pipe Replacement Plan	**Formal Case No. 1179**

PREPARED DIRECT TESTIMONY OF CONOR LYMAN

EXHIBIT SC (B)

On Behalf of
Sierra Club

December 10, 2024

Table of Contents

Exhibit List

Exhibit Sierra Club (B)-1	Resume of Conor Lyman

Figures List

Tables List

I. Introduction

Q PLEASE STATE YOUR NAME, TITLE, AND EMPLOYER.

A My name is Conor Lyman and I am a Senior Research Scientist for Groundwork Data, currently contracted by Rewiring America.

Q ON WHOSE BEHALF ARE YOU TESTIFYING?

A I am testifying on behalf of the Sierra Club.

Q PLEASE SUMMARIZE YOUR RESPONSIBILITIES AND QUALIFICATIONS.

A In my capacity both with Groundwork Data and Rewiring America, I am responsible for developing analytical tools and models to investigate the future of our energy distribution systems. A key focus of this is the development of the Pipe Segment Analysis tool that aggregates assumptions and datasets related to capital and operational costs, energy consumption, emission rates, and demographic factors, to name a few variables, with the aim of better understanding how investments in energy infrastructure will impact customers, utility managers, policy stakeholders, and the environment. In my capacity at Groundwork Data, I have also served as a researcher and contributor to reports investigating gas utility finances and the connection between pipe investment and customer rates.

I have six years of experience developing analytical models and tools for energy systems. Further details on my qualifications and experience are attached.

Q PLEASE SUMMARIZE THE TESTIMONY YOU ARE PROVIDING TODAY.

Washington Gas Light Company ("Washington Gas" or "WGL") is a decade into PROJECTpipes ("PIPES"), a 40-year pipe replacement program. Reviewed by the Public Service Commission of the District of Columbia ("Commission" or "PSC") every five years, PIPES is currently in its third review period. The Commission rejected WGL's proposal for its third iteration of PIPES (“PIPES 3”) with Order No. 22003, prompting WGL to submit an updated proposal for PIPES 3, now termed “District SAFE,” on September 27, 2024.

Historically accepted as critical for upholding the safety and reliability of the gas distribution system, pipe replacement programs are facing increased scrutiny throughout the United States. There are growing calls for gas companies and public utility commissions to consider non-pipeline alternatives (“NPAs”), such as building electrification, geothermal systems, energy efficiency measures, and advanced leak detection. This testimony highlights concerns with pipeline replacement in the District by analyzing two pipe segments that WGL scheduled for near-term replacement as part of its PIPES 3 proposal. While PIPES 3 was rejected and District SAFE is currently under review, an analysis of these pipe segments nevertheless provides valuable insights. This analysis highlights the need for coordinated planning between the gas system, the electric system, and building investments to reduce costs for customers and reduce greenhouse gas emissions in line with the District’s climate targets. Notably, these goals are not in conflict; this testimony demonstrates how—based on pipe replacement cost data from WGL—a managed transition that coordinates the electrification of D.C. homes with the decommissioning of old, leak-prone pipes can both reduce customer costs and reduce emissions, and reduce the risk of stranded gas assets. In contrast, this testimony also highlights the risks of unmanaged investments. If WGL continues to invest in pipe replacement without regard for the trend of customers opting for electric alternatives because of climate, health, financial, comfort, and other motivations, those investments in pipes are at risk of becoming underutilized, or stranded.

The two illustrative examples provided in this testimony highlight the potential energy futures of segments of the gas distribution system in D.C. based on real-world data. The analysis examines the costs and benefits of a managed transition of these pipe segments that pairs pipe decommissioning with building electrification compared to costly pipe replacement in the face of customer departures, departures that are already occurring in the District and may accelerate in the future. These pipe segments were analyzed using the

Pipe Segment Analysis tool developed by Groundwork Data and supported by Rewiring America. Such an analysis can be applied to many proposed pipe replacement projects to evaluate how NPA strategies can reduce emissions and costs for D.C. residents.

Q HAVE YOU PREVIOUSLY TESTIFIED IN PROCEEDINGS BEFORE THE PUBLIC SERVICE COMMISSION OF THE DISTRICT OF COLUMBIA?

A No.

II. <u>The Importance of Considering Alternatives to Gas Pipeline Replacement</u>

Q WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A The purpose of my testimony is to show that Washington Gas's proposed District SAFE program is not aligned with the District's climate goals and is not the most cost-effective solution for customers, and that there are alternatives to pipe replacement that uphold customer affordability and put the District on track to meet its goal of net-zero economy-wide emissions by 2045. The analysis presented in my testimony shows that District SAFE will not put the District on a path to meeting its requirement to reach net-zero emissions by 2045 and will not reduce costs for the District's residents.[1] Further, I demonstrate the risks of an unmanaged gas transition through a robust analysis of two pipe segments in WGL's service territory.

In its updated proposal to the Commission for District SAFE, WGL proposes to spend $215 million over the next three years on replacing distribution mains and services in the District, including $50 million in 2025.[2] While some amount of investment is necessary to ensure the safe and reliable operation of the gas distribution system, the cost per mile of

[1] D.C. Code § 8-151.09d (2022).
[2] *Formal Case No. 1179, In the Matter of the Investigation Into Washington Gas Light Company's Strategically Targeted Pipe Replacement Plan,* Washington Gas Light Company's Revised Application For Approval Of The District Strategic Accelerated Facility Enhancement Plan, filed Sept. 27, 2024 ("District SAFE Plan"), Exhibit WG(A)-1 at 30.

main replacements in the District is increasing, and will be passed on to WGL customers through rising rates.[3]

With regard to leaks, the pace of replacement is insufficiently addressing emissions from leaking methane. PIPES began in 2014, yet fugitive methane emissions are higher today than they were in 2006.[4] This suggests that WGL is not replacing pipes at the rate that new leaks arise. However, the pace of pipe replacement would actually decrease under District SAFE: through the first two iterations of PIPES, WGL replaced an average of 3-4 miles of main pipe each year; the company is proposing to replace only 2.2 miles in 2025.[5] This is not a phenomenon specific to WGL. A recent study found that despite years of pipe replacement work throughout the US, programs similar to and including PIPES are insufficiently addressing leak emissions. The results of this study suggest there is a significant amount of methane leaking behind-the-meter: "Current efforts to reduce [methane] emissions often target pipeline leaks; however, if a significant portion of [methane] emissions are not from pipelines but from consumption-driven processes, it could require changing the scope of future policy."[6] This suggests that even a dramatic increase in pipe replacement rates—besides being incredibly costly for customers—would not fully address emissions from methane leaks.

At the same time that WGL is replacing pipes, alternatives to household functions traditionally served by piped methane gas are becoming more popular and financially attractive to residents. The share of homes heating with electricity in the District has increased substantially in the past decade, largely cutting into gas's share of the home heating market; between 2010 and 2022, the share of D.C. homes heating with gas fell

[3] *Id*. at 23.
[4] Department of Energy & Environment, *Greenhouse Gas Inventories* (2006-2021) [hereinafter "DOEE GHG Inventory, 2006-2021"], https://doee.dc.gov/service/greenhouse-gas-inventories.
[5] District SAFE Plan, Exhibit WG(A)-1 at 16, 31.
[6] Sargent, et. al., *Majority of US urban natural gas emissions unaccounted for in inventories* (Oct. 2021), https://doi.org/10.1073/pnas.2105804118. The top-down study looked at eight years of methane emissions for the Boston metro region and found that there was no significant decrease in methane emissions, despite years of efforts to address leaking pipes. The study further evaluated multiple U.S. cities—including D.C.—and found that bottom-up GHG inventories, like DOEE's, are likely significantly undercounting leak emissions.

from 64% to 50% of homes, while the share of homes heating with electricity rose from 30% to 45% of homes.[7]

The combination of increasing replacement costs, a replacement pace that does not meaningfully reduce leaks, and alternative household technologies gives rise to a misaligned status quo where there is increasing investment in a gas system that is getting more expensive for customers and does not align with the District's climate targets. This poses a growing threat that pipe replacement investments may become underutilized or, in some areas, stranded as customers exit.

This testimony shows that there are alternatives to pipe replacement that uphold customer affordability and put the District on track to meet its goal of net-zero economy-wide emissions by 2045. I present a study of plausible energy scenarios for homes served by two segments of WGL's system to demonstrate the value of a managed transition of the gas system.

Q COULD YOU PLEASE DESCRIBE THE CONCERNS OF AN UNMANAGED TRANSITION AND THE CONCEPT OF A MANAGED TRANSITION AS IT RELATES TO THE DISTRICT?

A As described in Mr. Zach Pierce's accompanying testimony on behalf of Sierra Club in this docket, a consumer transition to electrification is underway. This has created a paradigm shift for regulated utilities: gas and electric utilities now find themselves in competition for household functions. In an unmanaged transition, investment in the gas system continues to rise, even as increasing competition from electric alternatives and climate policy reduces the number of gas customers and gas consumption. This concentrates the growing system costs on those who remain on the gas system. This population of gas customers is likely to be disproportionately represented by those who are energy burdened today, and thus cannot afford the up-front costs of clean, efficient electric appliances and heating equipment, let alone future rate increases.

[7] U.S. Census Bureau, *Table B25040 ACS 2022 5-year estimate*, https://data.census.gov/table/ACSDT5Y2022.B25040.

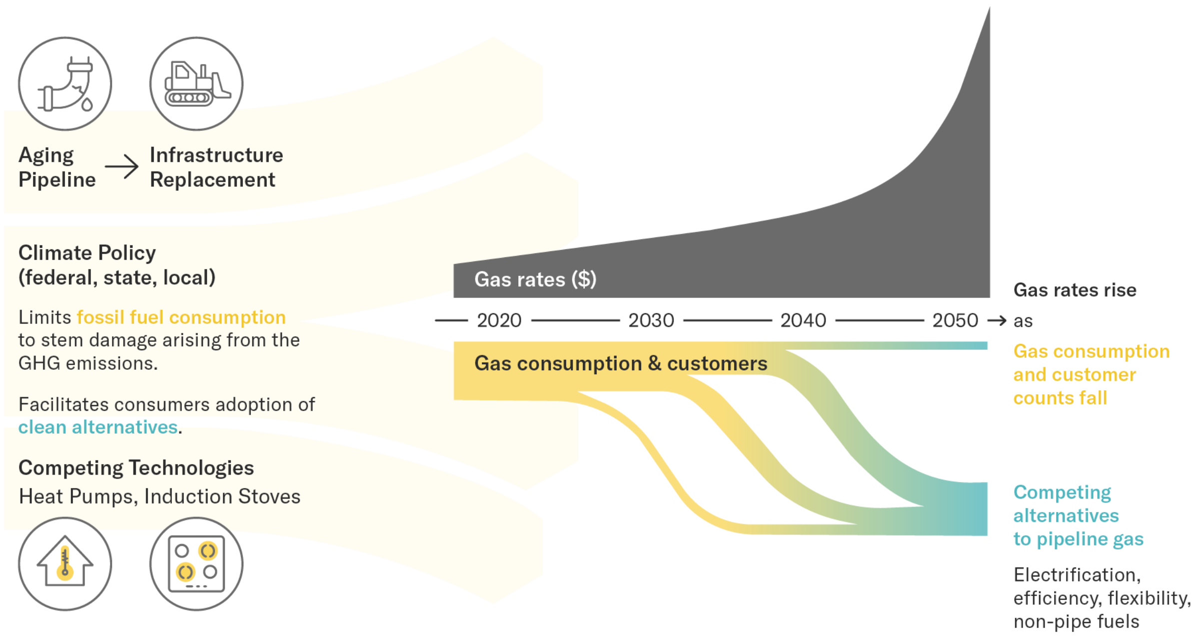

Figure 1: Illustration of the drivers and consequences of an unmanaged transition[8]

With regard to WGL's pipe replacement program, an unmanaged transition manifests itself when investments are made to replace pipes in locations that later experience customer attrition due to electrification. The remaining gas customers are left with ever-growing costs to compensate for the dwindling customer base. This is not an abstract scenario in the District. As I mentioned, the share of households heating with gas is steadily declining as electric heating becomes increasingly popular.[9]

[8] Building Decarbonization Coalition and Groundwork Data, *The Future of Gas in New York* (Mar. 2023), https://buildingdecarb.org/wp-content/uploads/BDC-The-Future-of-Gas-in-NYS.pdf.
[9] U.S. Census Bureau, *Table B25040 ACS 2022 5-year estimate*, https://data.census.gov/table/ACSDT5Y2022.B25040.

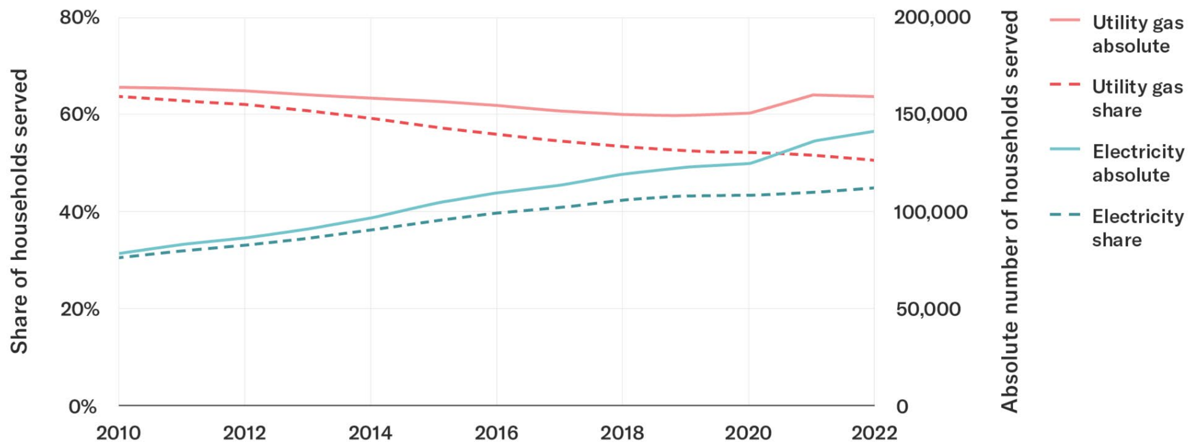

Figure 2: ACS 5-year estimates of D.C. home heating fuel share and absolute households

The alternative to an unmanaged transition is a managed transition. A managed transition is a strategic approach to align customer energy needs with climate goals, while working to preserve and enhance heating affordability.[10] For pipe replacement programs, a managed transition seeks to coordinate building electrification with pipe decommissioning, thus avoiding the high capital costs to replace gas pipe segments, reducing customer costs and emissions, and reducing the risk of underutilized or stranded gas assets.

Q COULD YOU PLEASE DESCRIBE THE STUDY YOU CONDUCTED?

A The study analyzes two segments of WGL's distribution network that were scheduled for near-term replacement in WGL's annual project list filed in tandem with the PIPES 3 proposal. These exact pipes may no longer be scheduled for near-term replacement: an updated project list is expected that aligns with District SAFE following the rejection of PIPES 3. Also, it is likely difficult to intervene on pipe segments that are scheduled for immediate replacement, such as the segments in the project list. However, the study nevertheless highlights the differences between a managed and an unmanaged transition for D.C. residents and the importance of considering non-pipeline alternatives to pipeline

[10] *Rhode Island Pub. Util. Comm'n Docket No. 23-49-NG*, Testimony of Dr. Michael J. Walsh & Dr. Dorie Seavey on Behalf of the Conservation Law Foundation, filed Feb. 9, 2024 [hereinafter "Walsh & Seavey Testimony"], https://ripuc.ri.gov/sites/g/files/xkgbur841/files/2024-02/2349-CLF-Testimony-Walsh-Seavey_2-9-24.pdf.

replacement. Using cost data for actual pipes in WGL's system, I show why a pipe segment analysis is critical for evaluating future pipe replacement proposals.

I used modeling from the Pipe Segment Analysis tool to analyze and compare an unmanaged and a managed transition for two pipe segments. The tool aggregates disparate datasets related to upfront and operating costs, energy consumption, and emissions data to detail the impacts of different scenarios and transition strategies on customers, utility managers, policy stakeholders, and the environment.

Q WHAT ARE THE MAIN FINDINGS OF YOUR STUDY?

A This study shows that a managed transition off gas that coordinates gas system, electric system, and building interventions lowers energy bills for customers, lowers total capital investment, puts the District on a path to meet net-zero carbon emissions by 2045, and reduces stranded asset risks for WGL.

An unmanaged transition is the most expensive option for D.C. It incurs the cost of pipe replacement in addition to the cost of building electrification. It does not achieve D.C.'s climate goals and puts WGL's investments at risk of being stranded. While not explicitly modeled here, the high cost of pipe replacement, combined with a shrinking customer base, will increase gas costs in an unmanaged transition. Only the customers that electrify will see bill reductions.

III. <u>An Analysis of Proposed Pipe Replacement Projects in the District</u>

Q HOW DID YOU SELECT SEGMENTS OF WGL'S SYSTEM TO ANALYZE?

A These pipe segments were chosen from WGL's annual project list, which was submitted following the submission of the PIPES 3 proposal.[11] I selected two isolated pipe segments in WGL's network, making the assumption that isolated pipes—such as dead-ends—can

[11] *Formal Case No. 1175, Washington Gas Light Company's Application for Approval of PROJECT*pipes *3 Plan,* Washington Gas's Final Annual Project List, filed Oct. 31, 2024.

be decommissioned without negatively impacting the safe and reliable operation of the rest of the gas network.

Q PLEASE DESCRIBE THE PIPE SEGMENTS YOU SELECTED.

A Key characteristics of the two pipe segments from WGL's project list are described in Table CL-1. The pipe segments are located at the 2800 block of McKinley Place NW (Segment One) and the 1200 block of Walter Street SE (Segment Two). Both pipeline segments serve single-family homes in the District, with different levels of density. McKinley Place NW is a less-dense neighborhood of larger, detached single-family homes, whereas Walter Street NW is a higher-density neighborhood of rowhouses. Both pipe segments are made up of materials that—in its District SAFE proposal—WGL emphasizes must be replaced to increase the safety and reliability of the system.[12]

	Segment One	Segment Two
Location	McKinley Place NW	Walter Street SE
Ward	4	6
Feet cast iron	0	1,027
Feet bare/unprotected wrapped steel	503	169
Total feet	503	1,196
Total miles	0.10	0.23
Affected services	18	56
Total project cost	$1,063,877	$2,244,289
Cost per foot	$2,115	$1,876
Cost per mile	$11,167,536	$9,907,898
Cost per customer*	$59,104	$40,077

* Uses affected services as a proxy for the number of customers

Table 1: Pipe segment details

[12] District SAFE Plan at 4-5.

Q WHAT ASSUMPTIONS AND DATA SOURCES DID YOU USE FOR THIS STUDY?

A I assumed that, for all scenarios, the pipe segments would be scheduled for replacement in 2030. These segments were originally scheduled for immediate replacement (starting in 2025, rather than 2030), but their status is unknown following the Commission's Order No. 22003 and in anticipation of an updated project list from WGL. Additionally, this is meant to be an illustrative study; a planning horizon of roughly 5 years allows for thoughtful consideration and a deployment of alternatives to pipe replacement.

Additionally, I assumed all homes connected to a pipe segment use piped gas for heating in the baseline case; I did not assume, for example, that a home connected to the gas network heats with electricity and uses piped gas solely for cooking or hot water.

Each scenario analyzes the impact of different pipeline and household interventions on cost (to the customer and the utility), emissions, and energy consumption. The model calculates and quantifies these impacts out to 2050. It's important to note the timing of household interventions in these scenarios. For each home, I assumed all major household appliances (HVAC, domestic hot water heaters, stoves and ranges, and clothes dryers) were installed in the same year for a given home and have a useful life of 18 years.[13] I used data from the District's tax parcel database on when homes were built, renovated, and remodeled to determine their next "natural" appliance replacement year. For example, if a home was renovated in 2010, then I assumed it would naturally replace appliances in 2028. My modeling restricted homes to only replace appliances once during the study period.

The study is built on a number of datasets that model household energy consumption, household appliance costs, utility billing rates, and emission rates. These datasets are described in Table CL-2. My study uses 2024 dollars.

[13] E3's NPA study for the San Francisco Bay area uses a simplified assumption of an 18-year useful life for all appliances, based on previous E3 analyses. *See* E3, *Benefit-Cost Analysis of Targeted Electrification and Gas Decommissioning in California* (Dec. 2023), https://www.ethree.com/wp-content/uploads/2023/12/E3_Benefit-Cost-Analysis-of-Targeted-Electrification-and-Gas-Decommissioning-in-California_u.pdf.

Data	Use	Source
DC tax parcel data	Provides key household characteristics used for modeling home energy consumption and determining appliance replacement schedule	D.C. Computer Assisted Mass Appraisal - Residential (DC CAMA)[14]
Gas-consuming home's energy consumption	Simulates the energy consumption of each home when the home is consuming gas	NREL's ResStock database[15]
Electrified home's energy consumption	Simulates the energy consumption of each home when the home is electrified	Rewiring America's internal household energy consumption profiles, derived from NREL's ResStock database[16]
Household appliance cost	Quantifies the capital investment into homes for new electric or gas appliances	Rewiring America,[17] RMI,[18] and E3[19] cost databases[20]
Electrification incentives	Determines the amount of incentive dollars for each home to electrify	Rewiring America's incentive database[21]
Utility billing rates	Average fixed and volumetric rates for residential electricity	Rewiring America's internal rate database[22]

[14] City of Washington, DC, *Computer Assisted Mass Appraisal - Residential*, https://opendata.dc.gov/datasets/DCGIS::computer-assisted-mass-appraisal-residential/about (accessed Sept. 10, 2024).
[15] Energy consumption for all homes was estimated by matching building characteristics from the tax parcel data to building characteristics in NREL's ResStock database. *See* National Renewable Energy Lab, *End Use Savings Shapes, 2022.1 Release*, https://resstock.nrel.gov/datasets.
[16] Rewiring America has developed an internal dataset of building energy consumption derived from ResStock that simulates energy consumption for a medium-efficiency heat pump, rather than the minimum- and maximum-efficiency heat pumps in the ResStock 2022.1 Release.
[17] Rewiring America, *Report: Upfront cost of home electrification* (Mar. 2024), https://www.rewiringamerica.org/research/home-electrification-cost-estimates.
[18] RMI, *Green Upgrade Calculator*, https://greenup.rmi.org/ (accessed Sept. 12, 2024).
[19] E3, *E3 Releases Technical Analysis Report in the Rhode Island Future of Gas Docket* (June 11, 2024), https://www.ethree.com/rhode-island-future-of-gas-docket/.
[20] The Rewiring America cost modeling comes from an analysis of multiple state-level data sources. The RMI and E3 sources were used to supplement Rewiring America's data and provide cost data for appliances that are not in Rewiring America's dataset.
[21] Rewiring America, *Rewiring America Incentive API*, https://api.rewiringamerica.org/ (accessed Nov. 20, 2024).
[22] The rates were derived by Rewiring America using data from the U.S. Energy Information Administration, NREL's Utility Rate Database, the American Gas Association, and the Homeland Infrastructure Foundation-Level

	and natural gas delivery to determine customer energy bills	
Emission rates	Convert energy consumption to carbon emissions	For natural gas, standard factor sourced from EPA for combustion.[23] For electricity, NREL Cambium marginal emissions factors forecast for PJM East[24]

Table 2: Data sources

Q PLEASE DESCRIBE THE OPTIONS YOU MODELED FOR THESE PIPE SEGMENTS.

A The segment study presented here considers two unmanaged transition scenarios and one managed transition scenario for each pipe segment: Unmanaged Business-as-usual ("BaU") Electrification, Unmanaged Full Electrification, and Managed Electrification. These are described in the following table. The scenarios vary as to what kind of intervention is made on the pipe segment as well as when, and how, individual homes served by that pipe change their energy consumption habits through the adoption of different household appliances. For homes that replace existing gas appliances with new gas appliances, I did not model or assume any changes in their energy consumption.

Scenario	Home electrification	Gas pipe intervention in 2030
Unmanaged Business as Usual (BaU) Electrification	The Business as Usual rate of home electrification in DC continues – 0.5% of homes electrify each year. Non-electrifying homes replace existing gas appliances with	The gas pipe is replaced in 2030.

(HIFLD) Database. Rewiring America calculated utility-average rates (both fixed and volumetric) for both electricity and gas.

[23] U.S. Environmental Protection Agency, *Greenhouse Gas Equivalencies Calculator - Calculations and References*, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-calculations-and-references.

[24] Cambium publishes marginal emissions factors for a number of scenarios; this study assumed the "Mid-case" scenario. *See* National Renewable Energy Lab, *Long-run Marginal Emissions Rates for Electricity* (Feb. 2024), https://data.nrel.gov/submissions/230.

	new gas appliances.	
Unmanaged Full Electrification	All homes electrify at the end-of-life of existing appliances. By 2050, all homes on the pipe segment are electrified.	The gas pipe is replaced in 2030.
Managed Electrification	All homes electrify, either at the end of their appliances' useful lives or when the gas pipe is decommissioned, whichever comes earlier.	The gas pipe is decommissioned in 2030.

Table 3: Study scenarios

As I mentioned, while immediate action may not be possible for the exact pipe segments in my analysis, the principles of this analysis hold true for other segments of WGL's system. The fact that this is an illustrative analysis does not mean that the scenarios presented here are not plausible. As Mr. Pierce and I discuss in both our testimonies, the District is in the midst of a customer shift to electrification that will reduce piped gas consumption.

Q WHAT DID YOU ASSUME TO BE THE NATURAL RATE OF BUILDING ELECTRIFICATION IN THE DISTRICT?

A As I previously mentioned and showed in Figure CL-2, the share of homes heating with electricity in D.C. is increasing, primarily cutting into gas's share of the home heating market. In 2010, the split of homes heating with utility gas versus electricity was roughly two-thirds and one-third, respectively. Today, the gap between utility gas and electricity for home heating is nearly closed: in 2022, 50% of households heated with utility gas, compared to 45% of households that heated with electricity. In terms of absolute customers, the number of households heating with electricity grew by over 81% during this period. The number of households heating with piped gas fell about 3% during the same period, averaging a decline of 0.5% each year. This suggests that most of electricity's gain in the market came from new builds, rather than retrofits of existing homes.[25]

A Given this, I assumed that the natural rate of electrification for existing buildings follows the decline in households heating with utility gas. This means that in the Unmanaged BaU Electrification scenario, I assumed 0.5% of homes on each street segment electrify each year. I randomly assigned homes to electrify or stay on gas to match this departure rate. For the Unmanaged Full Electrification scenario, I modeled a situation where continued changes in consumer preference and increased efforts to encourage electrification electrify all homes by 2050. An accelerated adoption of electrification, like the one modeled in this scenario, is required to meet our emissions targets by 2050.[26] The number of homes electrifying under each scenario is summarized in Table CL-4.

Segment	Scenario	Total Households	Households that electrify by 2050
Segment One	Unmanaged BaU Electrification	18	2
	Unmanaged Full Electrification		18
	Managed Electrification		18
Segment Two	Unmanaged BaU Electrification	56	7
	Unmanaged Full Electrification		56
	Managed Electrification		56

Table 4: Number of households that electrify in each scenario

A higher rate of electrification and gas customer exits is not outside the realm of possibility. Mr. Pierce's testimony highlights how increasing heat pump sales, NPA

[25] U.S. Census Bureau, *Table B25040 ACS 2022 5-year estimate*, https://data.census.gov/table/ACSDT5Y2022.B25040.

[26] Rewiring America, *Pace of Progress* (2023), https://a-us.storyblok.com/f/1021068/x/1c5bfb0365/pace_of_progress_2024.pdf.

investments from other gas utilities, new all-electric building codes in the District, and the uptake of electrification incentives are all putting upward pressure on the rate of electrification.

Another factor examined by Mr. Pierce related to gas system departure is WGL's proposed Customer Choice Pilot Program. This program is a step in the right direction in managing the energy transition; however, as I will later show, lack of coordination between customer exits and pipe replacement or pipe decommissioning could dramatically increase costs for remaining gas customers and presents a financial risk to WGL in the form of underutilized or stranded gas assets.

Q HOW DO THESE SCENARIOS DIFFER WITH REGARD TO CAPITAL INVESTMENT?

A The capital costs in this analysis include the cost to replace building appliances (with gas or electric appliances, depending on the scenario), the cost of pipeline intervention (replacement or decommissioning), and the cost of upgrading the local electric grid, if needed, to serve higher peak loads.

Building appliance costs include the upfront (gross) cost of the appliances, the incentive amount for electrification, and the resulting net cost. D.C. does not have incentive programs for gas appliances. I considered the costs to replace HVAC, domestic hot water, cooking, and clothes drying appliances. With regards to HVAC, I modeled the cost of installing a medium-efficiency air-source heat pump for buildings that electrify. I did not model any weatherization upgrades that would reduce the heating or cooling demands of a given home, though incentives for those upgrades are also available to D.C. residents.

As previously stated, the cost of pipe segment replacements came from WGL's project list. In addition to the data sources and assumptions previously mentioned, I made assumptions regarding the cost of gas pipe decommissioning and electric transformer upgrades based on previous segment studies I have conducted for other regions of the country.[27] These assumptions include an assumed cost to decommission a gas pipe segment of $20,000 and an assumed cost to increase the capacity of electric distribution transformers to serve higher peak demand on the street of $20,000 per transformer.

Tables CL-5 and CL-6 describe the total capital investment for each scenario for Segment One and Segment Two, respectively. The costs are broken out by the building sector (building appliances, both gas and electric), the electric network, and the gas network. Building-sector costs are further broken down into the gross upfront costs for appliances, the total incentive amount, and the resulting net costs. Per Rewiring America's Incentives API, these homes are eligible for the federal 25C Energy Efficient Home Improvement Tax Credit.[28] This tax credit is capped at $2,000 annually for heat pumps (including air source heat pumps and heat pump water heaters) and expires in 2032. Some homes in the Unmanaged BaU and Unmanaged Full Electrification scenarios electrify after 2032 and therefore are not eligible for the tax credit. More electrification incentives are available for District residents via the Inflation Reduction Act's Home Energy Rebates, which can further reduce the net cost of building electrification for qualifying households. These additional incentives could apply to homes not eligible for the 25C tax credit or increase the total incentive amount for homes taking advantage of 25C.

	Unmanaged BaU Electrification	Unmanaged Full Electrification	Managed Electrification
Gross appliance costs	$ 386,864	$ 532,800	$ 532,800
25C tax credit	$ (2,000)	$ (10,000)	$ (36,000)
Net building appliance costs	**$384,864**	**$522,800**	**$496,800**

[27] Previous analysis I have conducted based on decommission costs for Peoples Gas in Chicago show an average decommissioning cost of about $190,000 per mile. For information on decommission costs, *see* Illinois Commerce Commission, *Natural Gas Investigations*, https://www.icc.illinois.gov/programs/natural-gas-investigations. Testimony I supported that analyzed Rhode Island Energy's service territory assumed $10,000 for pipe decommissioning (based on cost figures for Liberty Utilities in Massachusetts) and $20,000 for electric distribution transformer upgrades. *See* Walsh & Seavey Testimony, *supra* note 10. These provide estimates for costs in D.C., but costs will vary by region.

[28] Rewiring America, *Incentives API*, https://api.rewiringamerica.org.

Electric network	**$ -**	**$ 80,000**	**$ 80,000**
Gas network	**$ 1,063,877**	**$ 1,063,877**	**$ 20,000**
Grand total	**$ 1,448,741**	**$ 1,666,677**	**$ 596,800**

Table 5: Segment One total capital investment

	Unmanaged BaU Electrification	Unmanaged Full Electrification	Managed Electrification
Gross appliance costs	$ 987,000	$ 1,195,200	$ 1,195,200
25C tax credit	$ (10,000)	$ (36,000)	$ (112,000)
Net building appliance costs	**$ 977,000**	**$ 1,159,200**	**$ 1,083,200**
Electric network	**$ –**	**$ 180,000**	**$ 180,000**
Gas network	**$ 2,244,289**	**$ 2,244,289**	**$ 20,000**
Grand total	**$ 3,221,289**	**$ 3,583,489**	**$ 1,283,200**

Table 6: Segment Two total capital investment

Results for both segments are similar. The results show that the cost to replace the pipeline segment far exceeds the cost to electrify the homes served by that pipe. Total costs for the Unmanaged scenarios are more than double that of the Managed Electrification scenario. **An unmanaged electrification is the most expensive option for both pipe segments, primarily because of the high cost to replace gas pipes. Even if the cost of building electrification was double what is modeled here, the total capital costs of a managed electrification for each street segment would still be lower than the total capital costs for an unmanaged electrification with pipe replacement.** These results do not capture any costs associated with underutilized or stranded gas system investments; however, it is clear that the replaced gas pipe in the Unmanaged scenarios serves a dwindling customer base. I explore the effects of this later in my testimony.

	Unmanaged BaU Electrification	Unmanaged Full Electrification	Managed Electrification
Building net cost	$ 21,381	$ 29,044	$ 27,600
Electric network	$ –	$ 4,444	$ 4,444
Gas network	$ 59,104	$ 59,104	$ 1,111
Total	$ 80,486	$ 92,593	$ 33,156

Table 7: Segment One average cost per building

	Unmanaged BaU Electrification	Unmanaged Full Electrification	Managed Electrification
Building net cost	$ 17,446	$ 20,700	$ 19,343
Electric network	$ –	$ 3,214	$ 3,214
Gas network	$ 40,077	$ 40,077	$ 357
Total	$ 57,523	$ 63,991	$ 22,914

Table 8: Segment Two average cost per building

Tables CL-7 and CL-8 highlight the spending per household in each scenario. This does not mean that this is the amount each individual customer is spending; rather, it provides an understanding of how capital investments are distributed. For example, for Segment One we can see that pipeline replacement costs nearly $60,000 per household served, yet electrifying the entire street and decommissioning the pipe would cost about half as much per household. This perspective is important to understand; a limited view of just building appliance costs shows that electrifying buildings costs more than installing modern-day gas appliances and obscures the fact that high pipe replacement costs are passed on to customers via growing gas bills.

Q DO CUSTOMERS REALIZE SAVINGS DUE TO ELECTRIFICATION?

A Yes. Despite the higher upfront cost to install electric appliances, the modeling projects bill savings for all households that fully electrify. Of course, electricity bills will rise, but the total household energy bill decreases with the elimination of gas bills. The average annual savings are significant: nearly $1,300 for houses on Segment One and nearly $800 for houses on Segment Two. This is because the higher cost of electricity is compensated for by the higher efficiency of heat pumps compared to gas furnaces.

	Pre-electrification	Post-electrification	Savings
Min	$ 2,978	$ 1,752	$ 1,225
Max	$ 4,136	$ 2,559	$ 1,576
Average	$ 3,171	$ 1,887	$ 1,284

Table 9: Segment One range of annual total (electric + natural gas) energy bills

	Pre-electrification	Post-electrification	Savings
Electricity	$ 1,572	$ 1,887	$ (315)
Natural gas	$ 1,599	$ –	$ 1,599
Total average bill	**$ 3,171**	**$ 1,887**	**$ 1,284**

Table 10: Segment One average annual electric and gas bills, pre- and post-electrification

	Pre-electrification	Post-electrification	Savings
Min	$ 1,767	$ 1,188	$ 579
Max	$ 2,963	$ 2,156	$ 807
Average	**$ 2,209**	**$ 1,434**	**$ 775**

Table 11: Segment Two range of annual total (electric + natural gas) energy bills

	Pre-electrification	Post-electrification	Savings
Electricity	$ 853	$ 1,434	$ (581)
Natural gas	$ 1,356	$ –	$ 1,356
Total average bill	**$ 2,209**	**$ 1,434**	**$ 775**

Table 12: Segment Two average annual electric and gas bills, pre- and post-electrification

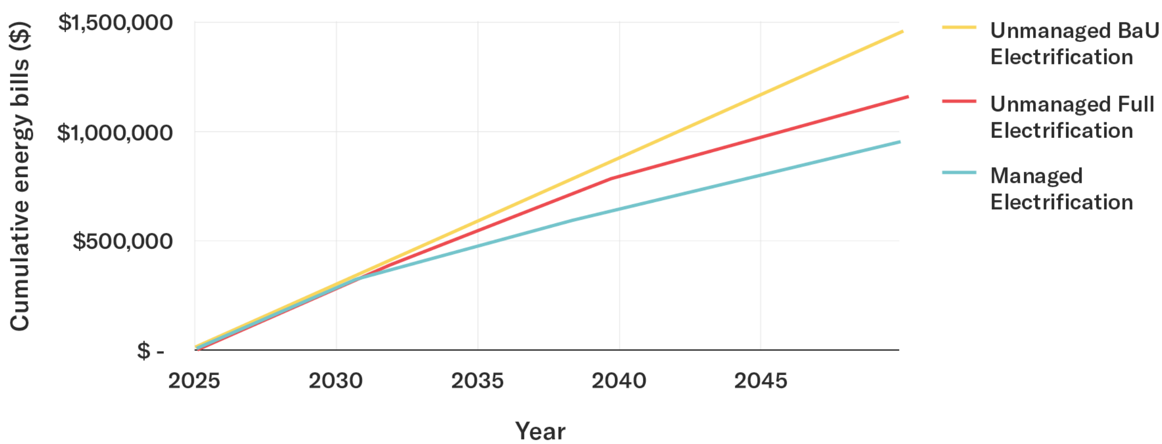

Figure 3: Cumulative energy costs for all buildings for each scenario, Segment One

The modeled energy bills do not assume changes to rates over time, from inflation or otherwise. Note that previous research in other jurisdictions projects gas rates will increase due to pipeline replacement programs similar to WGL's PIPES program.[29] Electric rates may also rise as more homes electrify. An Energy and Environmental Economics ("E3") study of the state of Illinois—a state that is home to some of the largest gas utilities in the country and is, like D.C., evaluating the future of its gas system in the face of vintage, leak-prone pipe—modeled future increases in gas and electric rates and found that monthly energy costs are lower for fully electrified households than for households consuming piped gas. Their modeling found that monthly energy costs for electrified homes are lower because "gas rates escalate more rapidly than electric rates."[30] Lastly,

[29] Dorie Seavey, et al. *The Future of Gas in Illinois* (May 2024), https://buildingdecarb.org/resource/the-future-of-gas-in-illinois.
[30] E3, *Illinois Decarbonization Study* (Dec. 2022), https://www.ethree.com/wp-content/uploads/2022/12/E3-Commonwealth-Edison-Decarbonization-Strategy-Report.-December-2022-1.pdf.

the cost for customers to operate a heat pump may be further reduced if the District adopts so-called "heat pump rates," which would adjust electric rates to encourage electrification and align affordability and policy goals, such as those proposed in Massachusetts.[31]

Q WHAT IMPACTS ON THE GAS SYSTEM WERE OBSERVED IN THIS STUDY?

A This study highlights the risks of underutilized or stranded gas assets. Pipe replacements in the District may face impacts similar to those shown here, as electricity continues to cut into gas's share of household heating. The Unmanaged scenarios for both pipe segments illustrate how customer exits will increase per-customer gas system costs, which puts upward pressure on gas rates and may further motivate customer departures in a negative feedback loop.

Figure CL-4 shows the number of customers in the two Unmanaged scenarios and the depreciated value of the pipe for Segment Two. Using the estimated pipe replacement cost and assumptions on the depreciation rates of the replaced pipe (described below), we can show the risk of stranded asset value from customer attrition. For this modeling exercise, I assumed a depreciation rate of 2.09%, which is a depreciable life of approximately 48 years, based on the depreciation figures provided in WGL's District SAFE proposal.[32] I assumed straight-line depreciation for pipe replacement costs.

[31] *Massachusetts Dep't of Pub. Utils. Docket Nos. 23-80 & 23-81*, Order (June 2024), https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/19281184.
[32] District SAFE Plan, WG(F)-1, Workpaper 2.

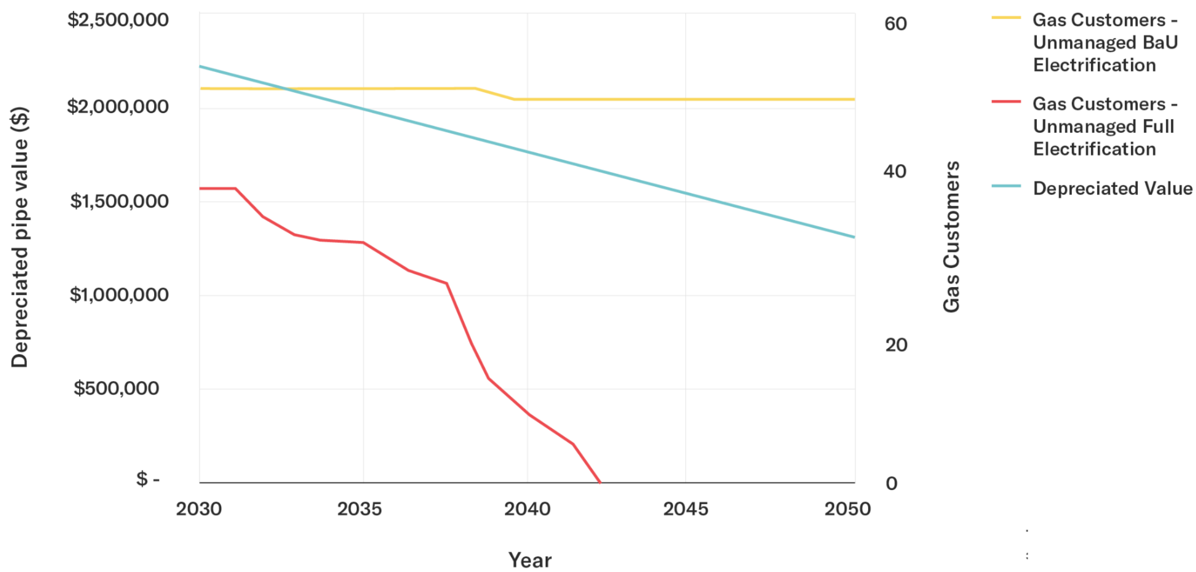

Figure 4: Unrecovered book value (depreciated value) of replaced gas pipe compared to customer counts in an unmanaged transition for Segment Two[33]

As Figure CL-5 illustrates, the depreciation expense per customer of the replaced pipe (annual depreciation divided by the number of customers on the pipe, which we can use as a proxy for the rate burden) grows by 4% in the Unmanaged BaU scenario and 280% in the Unmanaged Full scenario between 2030 (when the pipe is replaced) and 2040. After 2040, all customers have electrified in the Unmanaged Full scenario. The Unmanaged BaU scenario is our most conservative modeling of electrification rates, while the Full scenario is what is required to meet emissions targets. The actual Unmanaged outcome could be somewhere in between, but more likely towards the higher end as D.C. continues striving towards its emissions targets, and in any unmanaged transition, gas costs per customer increase. Customers will not be required to pay off the investment of the exact pipe they are served by; system costs are spread across the entire customer base. However, this provides a discrete understanding of how pipe investments may become underutilized or stranded, and how customer exits will lead to unrecovered values that will put upward pressure on costs for all customers. In an effort to reduce bill impacts, cost recovery for

[33] Please note that the chart starts when the pipe is replaced, in 2030. In the modeling, some customers have already exited by 2030.

pipe investments could be disallowed in the future.[34] The annual depreciation expense per customer for the Unmanaged scenarios for Segment Two are shown in Figure CL-5, below.

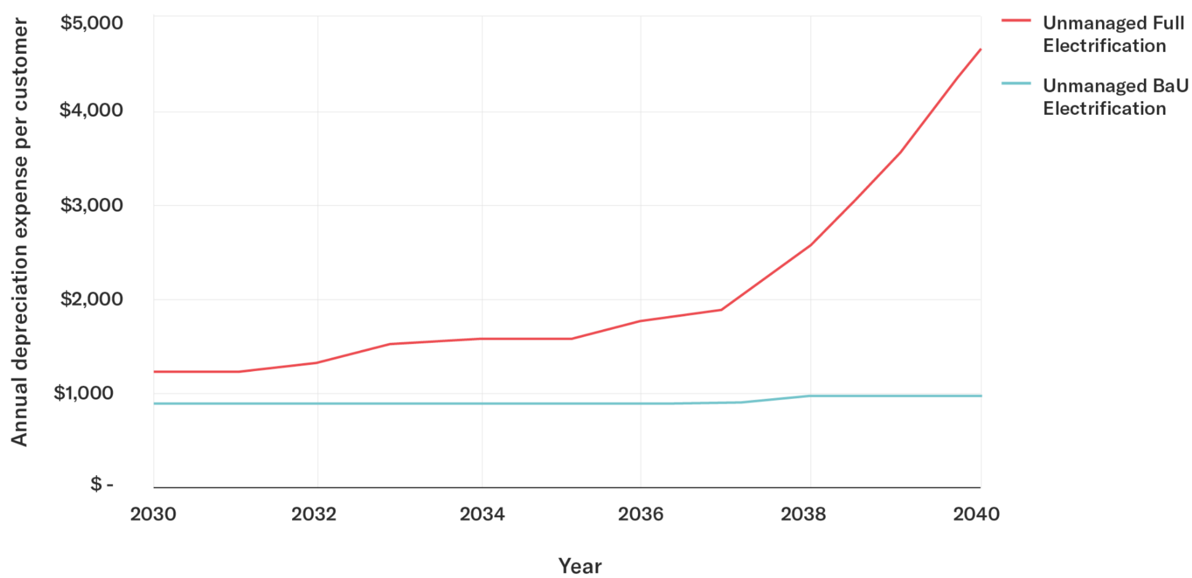

Figure 5: Annual depreciation expense per customer of an unmanaged transition for Segment Two

In the Unmanaged Full Electrification scenario, the unrecovered book value of the pipe is nearly $800,000 for Segment One and over $1.5 million for Segment Two when the last customer electrifies and leaves the system. This means about 75% of the pipe replacement investment would not be recovered by the time all customers exited the system for both pipe segments.

Q DOES TARGETED ELECTRIFICATION HELP THE DISTRICT REACH ITS EMISSIONS GOALS?

A Yes. The modeling shows that managed electrification will put D.C. on track to reach its target of net-zero emissions by 2045. I used the modeled energy consumption for each

[34] For a report exploring the risks of stranded gas assets and concerns with cost recovery of pipe replacement programs in great detail, *see* Dorie Seavey et al., *Peoples Gas: Escalating business risk in a changing energy landscape* (Oct. 2024), www.groundworkdata.org/research/peoplesgas.

scenario and emissions factors for natural gas and electricity consumption to project total CO2e emissions for each scenario.

Natural gas emission rates are standard and published by the U.S. Environmental Protection Agency ("EPA"). For future electricity emissions, I used projected marginal emission rates for PJM East—which includes D.C.—developed by the National Renewable Energy Laboratory ("NREL"). Note that these factors are for a much larger territory than the District; in addition to D.C., PJM East includes Maryland, Virginia, West Virginia, Pennsylvania, New Jersey, Delaware, Ohio, and parts of Kentucky. Therefore, these factors do not capture the specific clean energy targets of D.C. and they may change as more states in PJM establish, update, or make progress on emissions reduction targets.

The District has established economy-wide emissions reduction targets, relative to a 2006 baseline. I used these targets to establish emissions targets for each street segment by determining each street segment's 2006 baseline emissions. For this, I used EPA's Emissions & Generation Resource Integrated Database ("eGRID") to determine the electric-sector emissions rate for 2006.[35] This allowed me to construct an approximation for each street segment's emissions in 2006. While the District does not have sector-specific emissions targets, I applied the economy-wide reduction targets to each street segment. This is represented by orange markers in the following figures, showing the emission reduction target relative to my estimate of 2006 emissions. While imperfect, this provides a proxy to translate economy-wide targets to actions taken at individual pipe segments and in individual households.

Figures CL-6 and CL-7 show the annual emissions for each segment out to 2050. In each, it is clear that electrification puts these homes on a path to meet the District's emissions targets. In 2050, annual emissions in the Unmanaged BaU Electrification scenario are more than double what they are in the Managed Electrification scenario. While emissions from electrification are not zero by

[35] EPA, *Emissions & Generation Resource Integrated Database (eGRID)*, https://www.epa.gov/egrid (accessed Oct. 2024).

D.C.'s target date of 2045—NREL's modeling projects non-zero marginal emissions for PJM East in 2045—the modeling shows that the resulting emissions from a managed electrification would be roughly a quarter what they are today.

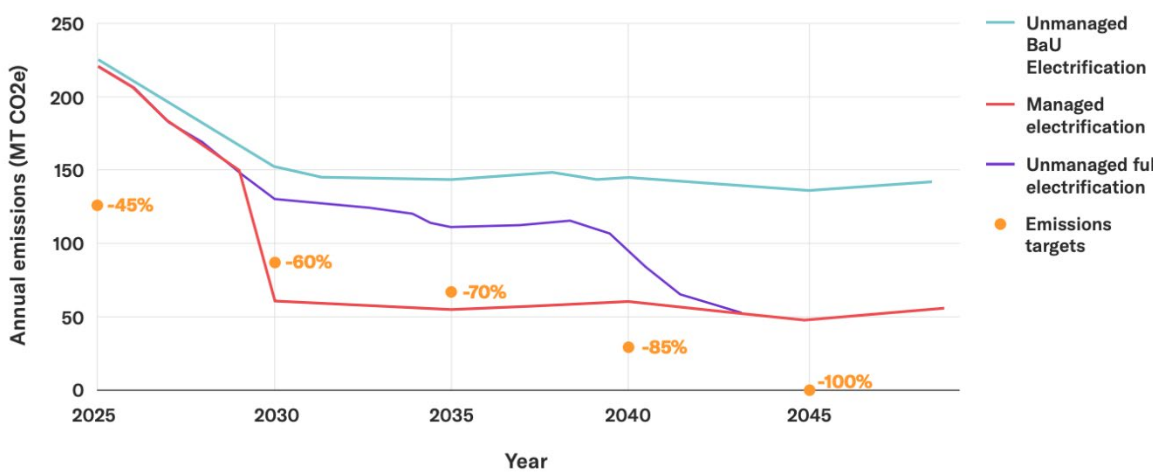

Figure 6: Segment One annual emissions from energy consumption (metric tons CO2e)

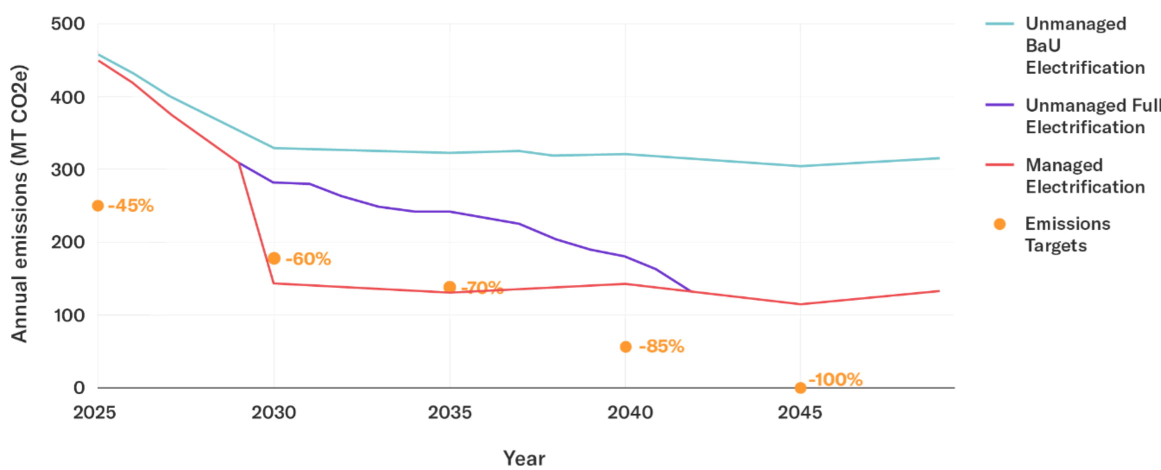

Figure 7: Segment Two annual emissions from energy consumption (metric tons CO2e)

	Unmanaged BaU Electrification	Unmanaged Full Electrification	Managed Electrification
Segment One	3,824	2,663	2,046
Segment Two	8,389	5,593	4,471

Table 13: Cumulative emissions (metric tons CO2e) for each scenario, 2025-2050

As I mentioned, the electric emission rates I used represent a much larger territory than that of Washington, D.C. Electric sector emission rates are not 0 by 2045; however, the Greenhouse Gas ("GHG") Inventory from the D.C. Department of Energy and Environment ("DOEE") shows a consistent decrease in electric sector emission rates since 2006. Using the trend in electric sector emission rates from the GHG Inventory, I constructed a lower bound on street segment emissions (with the NREL projections serving as an upper bound). Figure CL-8 shows the resulting range of possible emissions for Segment One post-electrification (Managed Electrification scenario, only). The original results for the Managed Electrification scenario in Figure CL-6 are shown along with an update to these results if electric sector emission rates follow the decreasing trend found in the GHG Inventory.

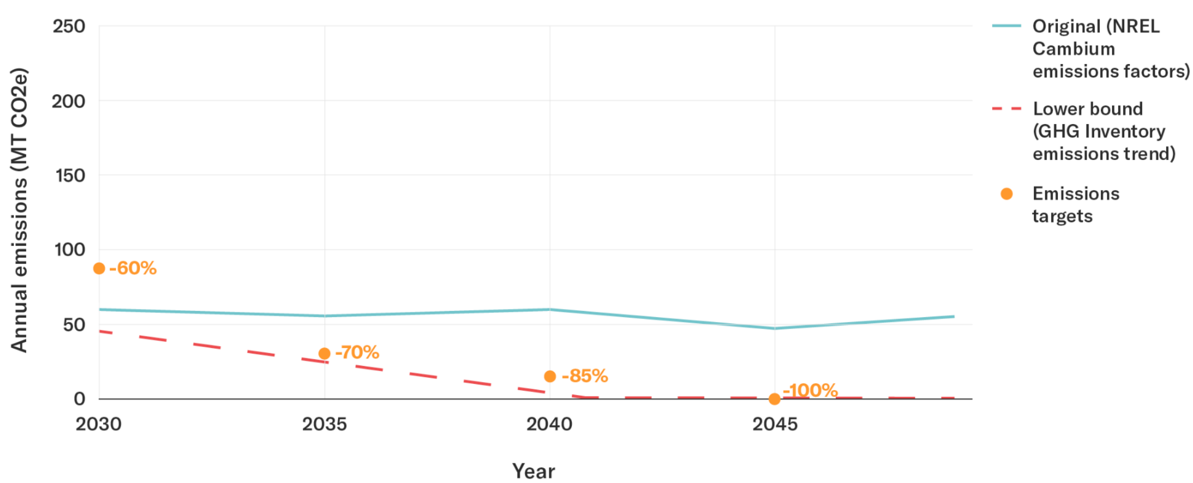

Figure 8: Segment One upper (NREL Cambium projected emissions factors) and lower (GHG Inventory trend) bounds on emissions post-electrification for the Managed Electrification scenario

The results show that electrification puts D.C. on a path to net-zero emissions. Depending on which projection is used, the emissions intensity of electric consumption would be lower than that of piped gas sometime between 2028 (using the GHG Inventory trend) and 2033 (using the NREL Cambium projection).

I did not consider emissions from piped alternative fuels in this analysis. WGL states that pipe replacement would enable it "to safely facilitate the transportation of certain renewable and lower carbon intensity fuel types within the District."[36] However, alternative piped fuels like hydrogen or renewable natural gas ("RNG") are not practical solutions for decarbonizing the District's building stock. Such fuels are expensive and can increase the supply cost of gas multifold, motivating customers to switch away from gas. They also do not follow the same economies of scale found in decarbonization technologies like electrification, rely on limited feedstocks, and are better suited to non-residential sectors that are harder to decarbonize.[37]

Additionally, I did not include emissions from methane leaks. While pipe replacement would reduce leaks, it would not eliminate them completely, as pipe decommissioning would.[38] Per the District SAFE proposal, replacement of all vintage materials would still result in over 5,000 MT CO2e of fugitive leak emissions annually.[39] Regardless, leak emissions are not well quantified and the existing data suggests leaks are a small portion of emissions compared to gas combustion.[40] While the District SAFE plan highlights that replacement of vintage main has the potential to result in "an approximately 92% reduction in fugitive emissions," DOEE's GHG Inventory for 2021 shows that fugitive methane emissions only represented 6% of total emissions from natural gas consumption. Further, if we compare total building emissions in the GHG Inventory to WGL's estimates of annual leak emission reductions, we find that the annual emission savings since 2014 were less than 1% of total building emissions.[41, 42] All of this is happening while data from the GHG Inventory and studies of pipe replacement programs in other parts of the

[36] District SAFE Plan, Exhibit WG(A)-1 at 36.
[37] Building Decarbonization Coalition and Groundwork Data, *The Future of Gas in New York* (Mar. 2023), https://buildingdecarb.org/wp-content/uploads/BDC-The-Future-of-Gas-in-NYS.pdf.
[38] WGL's District SAFE proposal translates emissions factors from the WGL Annual GHG Emissions Report in Formal Case No. 1162 as 4,757 kgCO2e/yr/mile for plastic main and 4 kgCO2e/yr/service for plastic services. *See* District SAFE Plan, Exhibit WG(A)-1 at 34.
[39] *Id*. at 34-35.
[40] See my previous discussion of Sargent, et. al., which found that leaks are likely undercounted in existing methodologies.
[41] *See* Table 6, District SAFE Plan, Exhibit WG(A)-1 at 33.
[42] DOEE GHG Inventory, 2006-2021.

country—including the Sargent study I previously discussed—are showing that pipe replacement programs are not meaningfully reducing leaks.[43]

IV. Conclusion

Q PLEASE SUMMARIZE THIS STUDY.

A This illustrative analysis shows that pipe replacement in the District is not the most prudent solution to reducing customer costs and achieving climate goals. The competitive price of electricity today, combined with the efficiency of electric heat pumps, makes it such that D.C. households can realize energy bill savings today by electrifying. Managed electrification of District homes may speed up the natural pace of building investments, but it will minimize future financial risks for customers and WGL alike by avoiding reinvestment in pipelines that may become underutilized or stranded. Investments in building electrification, coupled with gas pipe decommissioning, cost less than investment in gas pipe replacements and bring about significantly lower building-sector emissions relative to the status quo.

Q ARE THE FINDINGS OF THIS STUDY UNIQUE TO THE DISTRICT?

A No, the value of a managed transition and the risks of an unmanaged transition are not unique to D.C. This is why—in addition to the District—twelve states are currently investigating the future of their regulated gas utilities.[44] The exact strategies and their associated costs and benefits will vary, both across regions and within a given gas utility's territory. For example, delivered fuels, like propane, can be incorporated as a strategy in less dense regions with a robust delivery system, but are likely not appropriate for D.C.[45]

[43] The GHG Inventory shows that leak emissions were in fact 62% higher in 2021 than they were in 2006. A 2021 study of Massachusetts's gas pipe replacement program found that "leak repair activity, at best, has only managed to keep up with the new leaks emerging each year." *See* Dorie Seavey, *GSEP at the Six-Year Mark: A Review of the Massachusetts Gas System Enhancement Program*, Version 1.0 (Oct. 2021), https://gasleaksallies.org/gsep.
[44] *See* Building Decarbonization Coalition, *DecarbNation, Issue 2: The Future of Gas*, https://buildingdecarb.org/decarbnation-issue-2 (containing a summary and tracker e on future of gas proceedings).
[45] Groundwork Data, *Thermal Transition Strategy Study: Non-Pipeline Gas Alternatives to Gas Pipeline Replacement* (May 2024), https://static1.squarespace.com/static/62e94d16a77e1e191eafe4ae/t/664b5646b24bad05ce98ad9b/1716213320738/Thermal+Transition+Strategy+Study+5.14.24.pdf.

Ground-source heat pumps and thermal energy networks are additional technologies that can serve as alternatives to gas pipe replacement and deserve further study.[46] An analysis similar to the one presented here can be invaluable in assessing the tradeoffs of NPAs. The California Clean Energy Commission's work to develop a framework for evaluating and selecting pipe segments for decommissioning and NPA deployment is the most advanced development by a state entity in this space.[47]

Q DOES THIS CONCLUDE YOUR TESTIMONY?

A Yes.

[46] HEET & BuroHappold Engineering, *Geothermal Networks: 2019 Feasibility Study* (revised 2023), https://cdn.prod.website-files.com/649aeb5aaa8188e00cea66bb/656f8ad67bbc7df081e3fe17_Buro-Happold-Geothermal-Network-Feasibility-Study.pdf.

[47] Aas, et al., *An Analytical Framework for Targeted Electrification and Strategic Gas Decommissioning: Identifying Potential Pilot Sites in Northern California's East Bay Region* (June 2024), https://gridworks.org/wp-content/uploads/2024/07/Targeted-Electrification-and-Strategic-Gas-Decommissioning.pdf.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE DISTRICT OF COLUMBIA

IN THE MATTER OF	**)**	
THE INVESTGIATION INTO	**)**	**Formal Case No. 1179**
WASHINGTON GAS LIGHT COMPANY'S	**)**	
STRATEGICALLY TARGETED PIPE	**)**	
REPLACEMENT PROGRAM	**)**	

DECLARATION

I declare under penalty of perjury that the foregoing testimony was prepared by me or under my direction and is true and correct to the best of my knowledge, information, and belief.

Dated: December 10, 2024

Conor Lyman

QUALIFICATIONS

CONOR LYMAN

PROFESSIONAL EXPERIENCE

Groundwork Data (New York, New York) 2022 – Present

Senior Research Scientist

- Lead design and development of tool suite for energy infrastructure and gas transition planning
- Simulate and investigate gas transition scenarios and utility finances for research studies in multiple US states and cities in collaboration with universities, national labs, tool developers, non-profits, and government agencies

Blueprint Power (New York, New York) 2019 – 2023

Modeling and Simulation Engineering Manager, Modeling Engineer, Consultant

- Led team of engineers developing energy modeling and simulation tools for distributed energy resources (DERs)
- Designed and implemented Python-based models for DER projects that forecast long-term project economics and optimized DER dispatch in response to market signals

Lockheed Martin Skunk Works (Palmdale, California) 2017 – 2019

Research Scientist

- Developed Python code for signature management trade studies that programmatically develops parametric CAD designs

EDUCATION

Cornell Tech 2023

Jacobs Technion-Cornell Dual Master of Science Degrees – Urban Tech Concentration

The George Washington University 2017

Bachelor of Science, Mechanical Engineering