Before the
New York Public Service Commission

Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service.	))))	Case 22-E-0064
Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Gas Service.	))))	Case 22-G-0065

DIRECT TESTIMONY OF
ALICE NAPOLEON
AND
ASA HOPKINS PHD

ON BEHALF OF
NATURAL RESOURCES DEFENSE COUNCIL

May 20, 2022

Table of Contents

1. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, title, and employer.

A. **Ms. Napoleon:** My name is Alice Napoleon. I am a Principal Associate at Synapse Energy Economics, Inc. ("Synapse Energy Economics") located at 485 Massachusetts Avenue, Suite 3, Cambridge, MA 02139.

A. **Dr. Hopkins:** My name is Asa Hopkins. I am a Vice President at Synapse Energy Economics, located at 485 Massachusetts Avenue, Suite 3, Cambridge, MA 02139.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics is a research and consulting firm specializing in electricity and gas industry regulation, planning, and analysis. Our work covers a range of issues, including economic and technical assessments of demand-side and supply-side energy resources, energy efficiency policies and programs, integrated resource planning, electricity market modeling and assessment, renewable resource technologies and policies, and climate change strategies. Synapse works for a wide range of clients, including state attorneys general, offices of consumer advocates, trade associations, public utility commissions, environmental advocates, the U.S. Environmental Protection Agency, U.S. Department of Energy, U.S. Department of Justice, the Federal Trade Commission, and the National Association of Regulatory Utility Commissioners. Synapse has over 30 professional staff with extensive experience in the electricity industry.

Q. Please summarize your professional and educational experience.

A. **Ms. Napoleon:** Since joining Synapse in 2005, I have provided economic and policy analysis of electric systems and emissions regulations, with a focus on energy efficiency policies and programs, on behalf of a diverse set of clients throughout the United States and in Canada. On the national level, I led a team that developed tools that help utilities integrate the U.S. Department of Energy's Superior Energy Performance and 50001 Ready strategic energy management platforms into their energy efficiency portfolios. I also co-authored a manual for regulators on designing performance incentive mechanisms, which has been highly utilized by many states.

I was co-author of several reports and comments on the role of energy efficiency in New York State in meeting its Reforming the Energy Vision ("REV") objectives, as well as a white paper on natural gas regulatory reforms needed if New York is to meet its decarbonization targets. In Colorado, Maryland, and South Carolina, I facilitated and provided expert analysis on program costs and benefits for demand-side resource policy working groups.

Since 2009, I have provided extensive and ongoing expert analysis and support for the State of New Jersey regarding its state- and utility-administered energy efficiency and combined heat and power programs. In over a dozen dockets regarding utility-administered efficiency programs, I have conducted expert analysis, provided litigation support, and drafted testimony when appropriate on behalf of the State with respect to a number of issues, including energy efficiency program implementation, cost-effectiveness, design, and overlap between utility- and state-administered programs. I

have also provided expert advice on demand-side management programs in Nova Scotia regarding a range of issues including incentive-setting methodologies, cost-benefit analysis, incentive setting, avoided costs, load forecasting, and locational demand-side management.

Before joining Synapse, I worked at Resource Insight, Inc., where I supported investigations of electric, gas, steam, and water resource issues, primarily in the context of reviews by state utility regulatory commissions.

I hold a Master's in Public Administration from the University of Massachusetts at Amherst and a Bachelor's in Economics from Rutgers University. My resume is attached as Exhibit AN/AH-1.

A. **Dr. Hopkins:** At Synapse Energy Economics, I lead projects related to decarbonization planning and policy, with particular focus on the building sector and gas utilities. I have led or advised projects or testified on these issues in New England, Maryland, Washington, DC, Wisconsin, Nevada, Oregon, California, and Quebec. Before joining Synapse Energy Economics in 2017, I was the Director of Energy Policy and Planning at the Vermont Public Service Department from 2011 to 2016. In that role, I was the director of regulated utility planning for the state's public advocate office, and the director of the state energy office. I served on the Board of Directors of the National Association of State Energy Officials. Prior to my work in Vermont, I was an AAAS Science and Technology Policy Fellow at the U.S. Department of Energy, where I worked in the Office of the Undersecretary for Science to develop the first DOE Quadrennial Technology Review. Prior to my time at the U.S. DOE, I was a postdoctoral

fellow at Lawrence Berkeley National Laboratory, working on appliance energy efficiency standards. I earned my PhD and Master's degrees in Physics from the California Institute of Technology and my Bachelor of Science degree in physics from Haverford College. My resume is attached as Exhibit AN/AH-2.

Q. On whose behalf are you testifying in this case?

A. We are testifying on behalf of the Natural Resources Defense Council ("NRDC").

Q. Have you previously testified before a state or provincial commission?

A. **Ms. Napoleon:** Yes. I have testified before the California Public Utilities Commission, the New York Public Service Commission ("PSC" or "Commission"), the Pennsylvania Public Utility Commission, and the Public Service Commission of South Carolina in the United States, and the New Brunswick Energy and Utilities Board and the Nova Scotia Utility and Review Board in Canada.

A. **Dr. Hopkins:** Yes. I have testified before the Vermont Public Utility Commission, Washington DC Public Service Commission, Public Service Commission of Wisconsin, and Régie de l'énergie du Québec.

Q. Have you testified before the New York PSC?

A. **Ms. Napoleon:** Yes, I testified in rate cases of Con Edison (Cases 19-E-0065 and 19-G-0066) and Niagara Mohawk Power Corporation (Cases 20-E-0380 and 20-G-0381) on behalf of NRDC.

A. **Dr. Hopkins:** No.

Q. What is the purpose of your testimony?

A. The purpose of our testimony is to review and critique several of Consolidated Edison's ("Company" or "Con Edison") proposed gas-side investments as greenhouse gas ("GHG") mitigation strategies and gas extension allowance rule changes. Further, we address the need for long-term planning for the gas system and the adequacy of Con Edison's non-pipe alternatives framework. The testimony also addresses aspects of electric and gas rate design.

Q. Are you sponsoring any exhibits with your testimony?

A. Yes. We are sponsoring the following exhibits:

- Resume of Alice Napoleon: Exhibit AN/AH-1
- Resume of Asa Hopkins: Exhibit AN/AH-2

Q. How is the remainder of the testimony organized?

A. In Section 2, we provide a summary of our conclusions and recommendations. Section 3 describes the policy background for this rate case. Section 4 describes proposals on the gas side that are likely to jeopardize achievement of the GHG emission reductions required by the *Climate Leadership and Community Protection Act* ("CLCPA"). In Section 5 we consider Con Edison's non-pipeline alternative ("NPA") process. Section 6 addresses the need for a plan for the gas system under declining sales conditions. Section 7 addresses Con Edison's proposal regarding extension allowances. Finally, in Section 8, we discuss Con Edison's rate design proposals.

2. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

2.1. Summary of Conclusions

Q. Please summarize your conclusions.

A. Our conclusions are summarized as follows:

- Several of Con Edison's gas proposals and programs may be inconsistent with the CLCPA. Con Edison's proposals with respect to the Main Replacement Program (MRP), renewable natural gas (RNG), and certified natural gas (certified gas) as CLCPA compliance strategies could extend reliance on and create large undepreciated balances for the gas system, even as sales will need to decline to meet CLCPA targets. Con Edison may set itself up for rapid defection from the gas system as gas sales decline and gas rates rise.

- Continuing Con Edison's proposed MRP approach at equivalent inflation-adjusted costs until all of its leak-prone pipe is replaced (in 2040) would result in a very large undepreciated plant balance in 2050 of $5.1 billion. This approach would result in $52 billion in total revenue requirement associated with MRP program investments from 2023 to 2040, which would exacerbate the gas rate increases expected as a result of declines in sales.

- MRP is not a cost-effective way to reduce GHG emissions, relative to electrification and pipeline retirement. Specifically, we show that an approach based on building retrofits, electrification, and pipeline retirement could reduce emissions at a cost per ton that is 77 percent less expensive than the cost per ton

of the MRP, while delivering co-benefits of lower energy bills and increased public health and comfort for building residents.

- Because Con Edison is not retaining or purchasing the environmental attributes associated with the RNG from the Mount Vernon facility, neither Con Edison nor its customers can claim credit towards compliance with state climate policy.
- Certified gas is not regulated. Any environmental benefits from this fuel could be soon eliminated when federal regulations of emissions from the oil and gas industry are promulgated. While Con Edison's certified gas proposal is a only a pilot, we have concerns about the prudence of this as a GHG abatement option.
- Con Edison's proposal to waive gas extension allowance rules represents an important step toward achieving CLCPA objectives.
- It is not appropriate to treat the Mount Vernon RNG interconnection facility as an NPA, since (1) it relies on traditional infrastructure and (2) the RNG will not benefit customers in general, because Con Edison does not propose to retain or purchase the environmental attributes of the RNG.
- The Company has not provided a comprehensive, long-term plan for the orderly downsizing of the gas system. The recent Order Adopting Gas System Planning Process in Case No. 20-G-0131 ("Gas Planning Order")[1] requires both a long-term gas system plan and a full depreciation study that consider scenarios with

[1] New York Public Service Commission. Order Adopting Gas System Planning Process. Case Nos. 20-G-0131 and 12-G-0297. Issued May 12, 2022.

high levels of customer defection from the gas system by 2050, full depreciation of new gas plant by 2050, and full depreciation of all gas plant by 2050. In the absence of such a comprehensive, long-term plan, the MRP approach has not been demonstrated to be a prudent course of action and shortening the depreciation lives of gas assets is not appropriate.

- Electricity tariffs with lower volumetric charges can encourage beneficial electrification because customers who adopt technologies such as electric vehicles (EV) and heat pumps will typically increase their electricity consumption substantially. However, high fixed charges and demand charges can have unintended consequences if not implemented in a strategic manner. Tariffs that shift cost recovery away from volumetric rates, such as demand charges and higher fixed charges, can be harmful to low-income customers, who tend to have lower-than-average usage and can discourage energy efficiency.

- The Company's proposal to reduce the price differential between gas usage blocks by 17 percent will have a very mild impact on the final rates and bill impacts and will result in both high-usage and moderate-usage customers experiencing nearly the same overall bill increase on a percentage basis. Bolder action is needed to move away from carbon-intensive fuels.

2.2. Summary of Recommendations

Q. Please summarize your recommendations.

A. We recommend the following:

- The Commission should not take action on the Company's depreciation request in this case, since the Gas Planning Order requires Con Edison to develop a long-term plan and conduct a depreciation study, both of which should be done by next rate case.

- The Commission should direct Con Edison to fully and carefully scrutinize any proposed investments and expenditures that will further increase cost burdens on future customers, including but not limited to the Main Replacement Program, the Mount Vernon RNG project, and the certified gas pilot, within the context of the comprehensive long-term plan.

- Specifically with respect to the MRP, the Commission should direct Con Edison to (1) separately budget for emergent issues with cast iron and bare steel pipe from the planned MRP budgets; (2) optimize MRP investments by limiting pipeline replacement under the MRP to pipe that is identified as "high risk" (and file for Commission review the methods used to determine if a pipe is "high risk"), with particular focus on such pipe that serves multiple neighborhoods or otherwise has identified opportunity for a longer useful life; and (3) expand the electrification and retirement approach to a neighborhood scale, going beyond the 5 miles of proposed radial feeders and network simplification.

- With respect to RNG, the Commission should deny cost recovery for the Mount Vernon infrastructure project as a GHG reduction strategy. Before any such proposal is considered for approval, Con Edison should (1) provide analysis of CLCPA compliance pathways, in keeping with the requirements of the Gas

Planning Order and the Order on Implementation of the CLCPA, issued on May 12, 2022 ("CLCPA Implementation Order"),[2] and show that this proposal is consistent with such pathways analysis; (2) demonstrate that this RNG investment is reasonable and a cost-effective alternative, given the potential strategies for managing gas system constraints such as NPAs, consistent with the recent Gas Planning and CLCPA Implementation Orders; and (3) retain the environmental characteristics of the RNG for the benefit of its customers. If Con Edison chooses to propose the Mount Vernon infrastructure project strictly on the basis of a resource to relieve supply constraints (i.e., not for environmental policy compliance), the Commission should direct Con Edison to demonstrate that this option compares favorably to all other supply- and demand—side options, including NPAs and conventional supply. Also, leading up to the aforementioned pathways analysis, Con Edison should investigate the serious concerns we raise about the fuel's cost, GHG footprint, supply, and air quality impacts, in an open and transparent stakeholder process. If the outcome of that investigation shows that RNG is likely to perform unfavorably in these areas relative to other alternatives, Con Edison should reduce or eliminate the role of RNG in its strategy to mitigate GHG emissions from its gas system.

- The Mount Vernon project should not be treated as an NPA, and thus there should be no incentive for Con Edison shareholders. Further, Con Edison's proposed

[2] New York Public Service Commission. Order on Implementation of the Climate Leadership and Community Protection Act. Case No. 22-M-0149. Issued May 12, 2022.

NPA process should be reviewed and brought into line with the requirements set forth in the CLCPA Implementation Order and the Gas Planning Order. In addition, we recommend that all infrastructure projects be screened for NPAs, with very limited exceptions.

- The Commission should direct Con Edison to minimize capital investments for the rate plan so that, consistent with the NPA requirements in the Gas Planning Order, all infrastructure investments can benefit from the planning process and can be screened for NPAs.

- Consistent with the Gas Planning Order's call for utilities to pursue innovative rate designs, the Company should continue and expand the innovative pricing pilot ("IPP") to provide important information regarding customer behavior and acceptance of various rate design options, which can inform the development of a future electrification rate.

- Electrification rates should be available to master-metered multi-family dwellings.

- If used for residential customers, high fixed charges and demand charges should be targeted to those customers who invest in beneficial electrification technologies, rather than to all customers universally.

- The Company should reduce the price differential between gas usage blocks by 50 percent to strike a balance between mitigating rate impacts for the highest usage

customers and more quickly moving away from rates that promote greater gas consumption.

- As part of its next rate case application, the Company should commit to the following:
  - Eliminating the declining block rate structure for gas
  - Consider implementing an inclining block rate structure for gas
  - Developing a proposal for mitigating bill impacts for large usage gas customers who would be adversely impacted by the elimination of the declining block rate. Such mitigation measures could include electrification programs targeted to these customers, or a proposal to move these customers into a separate rate class.

3. BACKGROUND

Q. Please describe New York's energy and climate policies relating to electric and gas utilities.

A. The CLCPA calls for ambitious, economy-wide clean energy and climate targets. It requires all sectors of the state's economy to collectively achieve 40 percent emissions reductions from 1990 levels by 2030 and 85 percent emissions reductions by 2050, as well as achieve net zero GHGs by 2050 (meaning sectors must offset any remaining

emissions). The CLCPA also requires 70 percent renewable electricity by 2030 and 100 percent carbon-free electricity by 2040.[3]

On January 16, 2020, the PSC issued its *Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025* ("*Energy Efficiency Implementation Order*") in Case 18-M-0084. This order puts the state on a path to saving 3 percent of electricity sales and 1.3 percent of natural gas sales by 2025. The *Energy Efficiency Implementation Order's* incremental energy savings targets for the investor-owned utilities and the New York State Energy Research and Development Authority ("NYSERDA") amount to 35.8 TBtu for 2021 to 2025, including 7.2 TBtu in electric savings and 4.4 TBtu in gas savings by Con Edison.[4] The *Energy Efficiency Implementation Order* also adopted a heat pump savings target of 3.6 TBtu, 1.0 TBtu of which was allocated to Con Edison. The separate heat pump target, one of the few such goals in the country, represents a firm commitment to reducing carbon emissions through building electrification and is expected to increase residential heat pump penetration to roughly 5 percent of homes by 2025.[5]

In 2018 and 2019, gas utilities in downstate New York (including Con Edison) made claims that gas infrastructure constraints prevented them from offering new firm service. Con Edison's January 17, 2019 notice to the Commission on its intent to institute a

[3] S 6599/A 8429. Available at https://www.nysenate.gov/legislation/bills/2019/s6599.

[4] Energy Efficiency Implementation Order, Appendix A – Table A1 and A2.

[5] Alice Napoleon, Jenn Kallay, and Kenji Takahashi. 2020. Utility Energy Efficiency and Building Electrification Portfolios Through 2025: A Brief on the New York Public Service Commission's Recent Order. Synapse Energy Economics for the Natural Resources Defense Council. Available at, https://www.synapse-energy.com/sites/default/files/NY-EE-Brief-19-082.pdf.

moratorium in most of Westchester County starting on March 15, 2019 provided little advance notice to and caused considerable difficulties and inconveniences for customers seeking firm service. Responding to the situation in Westchester and a moratorium by National Grid, the PSC opened a proceeding in 2020 (Case 20-G-0131) to improve the transparency and inclusiveness of the gas utilities' planning processes, supply and demand analysis, potential moratoria on new connections, and use of demand-reducing measures (e.g., energy efficiency, electrification, demand response, non-pipe solutions) to address supply constraints. In early 2021, the PSC filed two proposals in this proceeding: one on modernizing the gas planning framework for the state, and another on managing gas moratoria.[6] This month, the Commission issued orders on these proposals, as well as on implementation of the CLCPA.

Q. Please describe the order on the gas planning framework.

A. The Gas Planning Order creates and defines a process for long-term gas planning, which requires the gas utilities to file long-term plans every three years and file annual reports in interim years. Analyses underlying each long-term plan include geographically granular 20-year demand and supply forecasts. These analyses must consider energy efficiency and NPAs, and the utility must include an NPA-only scenario unless it presents sufficient evidence that an NPA-only scenario is not feasible. Alternatives are to be compared based on benefit-cost analysis, bill impact analysis, and emissions impacts.

[6] DPS Staff. Staff Gas System Planning Process Proposal. Case 20-G-0131. Filed February 12, 2021; DPS Staff. Staff Moratorium Management Proposal. Case 20-G-0131. Filed February 12, 2021.

This order also calls for the long-term plan to identify and ensure that a portion of NPA benefits accrue to low- and moderate-income ("LMI") and disadvantaged communities.

In addition, the order requires annual reports to provide information necessary to allow clean heat developers to target programs at areas that have leak-prone pipes or need infrastructure improvements to maintain reliability.

In the near term, the Gas Planning Order requires gas utilities to report the costs and number of customers receiving allowances for the cost of connecting to the gas system. Also, gas utilities are required to file full depreciation studies, to include the following scenarios:

- Full depreciation of all new gas plants installed beginning 2022 by 2050
- Full depreciation of all gas plants by 2050
- 50 percent of customers leave the gas system by 2040 and only 10 percent remain by 2050

Q. Please describe the order on gas moratoria.

A. The May 12, 2022 Order Adopting Moratorium Management Procedures requires processes and practices to ensure moratoria are invoked, managed, and released in a fair, equitable, and transparent manner. It also calls for clear communications regarding when, where, and how a natural gas moratorium may be imposed.

Q. Please describe the order on CLCPA implementation.

A. Among other directives, the CLCPA Implementation Order directs the gas utilities to propose a GHG study to analyze the scale, timing, costs, risks, uncertainties, and bill

impacts associated with significant reduction in GHG emissions. This pathways analysis will include (1) a coordinated long-term gas sector decarbonization pathway analysis through 2050, (2) coordinated near-term plans to address actions needed to achieve statewide decarbonization targets through 2030, and (3) individual utility plans to achieve each utility's share of emissions reductions through 2050. (CLCPA Implementation Order, p. 26-27). The pathways analysis will consider how to avoid disproportional burdens on disadvantaged communities.

The CLCPA Implementation Order also addresses disadvantaged communities by measuring and tracking compliance with, and developing and considering proposals to implement, the provisions of the CLCPA that impact these communities. DPS Staff is also assessing whether current clean energy and energy efficiency programs comply with the requirement that no less than 35 percent, with a goal of at least 40 percent, of the overall benefits of such programs are directed to these communities.

The order also directs the utilities to develop detailed rules for applying the GHG accounting required under the CLCPA and to use that consistent method going forward. It requires use of a 20-year global warming potential ("GWP") for GHGs and for emissions inventories to include both GHG emissions produced in the state, as well as upstream emissions (i.e., emissions produced outside of the state but associated with electricity or fuels imported into the state). The order directs the utilities to develop a proposal for a GHG Emissions Inventory Report, including an inventory of gas system-wide emissions.

4. SEVERAL OF CON EDISON'S GAS PROPOSALS AND PROGRAMS MAY BE INCONSISTENT WITH THE CLCPA.

Q. Do you have concerns with Con Edison's proposals for investments in the gas system?

A. Yes. Some of Con Edison's proposals could extend reliance on and create large undepreciated balances for the gas system, even as sales will need to decline to meet CLCPA targets. These include the Main Replacement Program and efforts regarding RNG and certified gas.

4.1. Main Replacement Program

Q. Please describe Con Edison's Leak-Prone Main Replacement Program (MRP) proposal in this proceeding.

A. The proposed program is described on pages 7 to 12 of Exhibit GIOSP-1; we provide a summary here. Con Edison proposes to replace an average of 80 miles per year of small diameter cast iron, wrought iron, and unprotected steel mains with plastic mains. The utility estimates the cost of this program at $965 per foot. The utility also states that it will identify five miles per year of main that can be decommissioned either due to abandonment of redundant facilities or pursuing customer electrification opportunities on radial portions of the system. Con Edison plans to target the program to areas such as the Bronx and Manhattan where it claims that electrification is not a viable short-term decarbonization strategy.

Q. What are the utility's purposes in conducting the MRP?

A. Cast iron, wrought iron, and unprotected steel mains are more leak-prone than plastic or protected steel pipes. Reducing leaks reduces the risk of fire or explosions, thereby increasing safety. Because methane is a potent greenhouse gas, reducing leaks also lowers GHG emissions from the gas distribution system.

Q. Does the MRP consist only of planned replacement of gas mains?

A. No, it also includes responding to "emergent" events, such as third-party damage to leak-prone pipe.

Q. What portion of the cost of the MRP does Con Edison claim is driven by activities that reduce emissions?

A. The utility claims that about 58 percent of the program's costs are attributed to emission reduction and adaptation.[7] Of the remainder, about half is associated with either replacing non-leak-prone pipe that is adjacent to the leak-prone pipe or site restoration.[8] This implies that about one-fifth of the MRP cost (the other half of the remainder) is driven by safety, such as efforts associated with emergent situations, rather than climate or ancillary concerns.

[7] Exhibit GIOSP-1, page 7. $236 million out of $407 million.
[8] Exhibit GIOSP-1, page 10, "Basis for Estimate" states that about 20 percent of overall costs relate to these purposes.

Q. Is all leak-prone pipe equally risky?

A. No. Con Edison states that cast iron pipe has greater leakage than bare steel (Exhibit GIOSP-1, page 9). The utility has historically identified about 10 miles per year of the MRP as "high risk," and proposes to increase that amount going forward (Exhibit GIOSP-1, page 8). The utility's filing does not, however, state a target for the increased amount.

MRP and Stranded Asset Risk

Q. What would be the utility's assumed useful lifetime for MRP assets installed during the next three years?

A. Con Edison proposes using an 80-year average lifetime for depreciation of mains, which we understand to be a five-year reduction from its previous assumption of 85 years.

Q. If depreciation rates are not changed, how much of the MRP investments from the next three years will remain undepreciated plant balance in 2050?

A. We used a modified version of a spreadsheet tool published by Con Edison in Case No. 14-E-0302 (regarding the Brooklyn/Queens Demand Management Program) to model the depreciation, taxes, and return to investors associated with MRP pipeline investments. Of the $1.272 billion that Con Edison proposes to spend on MRP in 2023 through 2025, we estimate that there will be an undepreciated balance of more than $470 million in 2050 (approximately 37 percent). Depreciation rates are greater than the lifetime alone would suggest, due to salvage costs. Con Edison assumes that 90 percent of upfront capital costs for mains will be required for end-of-life salvage (Exhibit DP-1, page 66). As a result, in

2050, alongside an undepreciated plant balance of more than $470 million, Con Edison would have an estimated salvage obligation of about $1.145 billion. (State or local policy on abandoning retired gas pipes in place could substantially reduce this salvage cost. Federal safety regulations do not require pipes to be removed after they are retired.[9])

Q. What will the revenue requirement impact of the MRP investments from the next three years be?

A. Immediately after the investments from 2023 through 2025 are in rate base, we estimate that the annual revenue requirement from these investments alone would be more than $200 million. This represents about 7 percent of the utility's projected total cost of delivery service in 2025 (not counting volatile commodity costs). In 2050, we estimate that the revenue requirement associated with these investments will still be more than $120 million per year. We estimate that the cumulative revenue requirement for these $1.27 billion in investments over their lifetime totals about $7.35 billion, of which almost $3.2 billion (about 44 percent) would not yet have been received as of 2050.

Q. If Con Edison were to continue its proposed MRP approach at equivalent inflation-adjusted costs until all of its leak-prone pipe is replaced (in 2040), what would the resulting undepreciated plant balance be in 2050?

A. We estimate that in 2050 Con Edison would have an undepreciated balance associated with these assets of almost $5.1 billion, with a salvage obligation of more than $8.1 billion. The assets would comprise more than $3.5 billion of rate base (after accounting

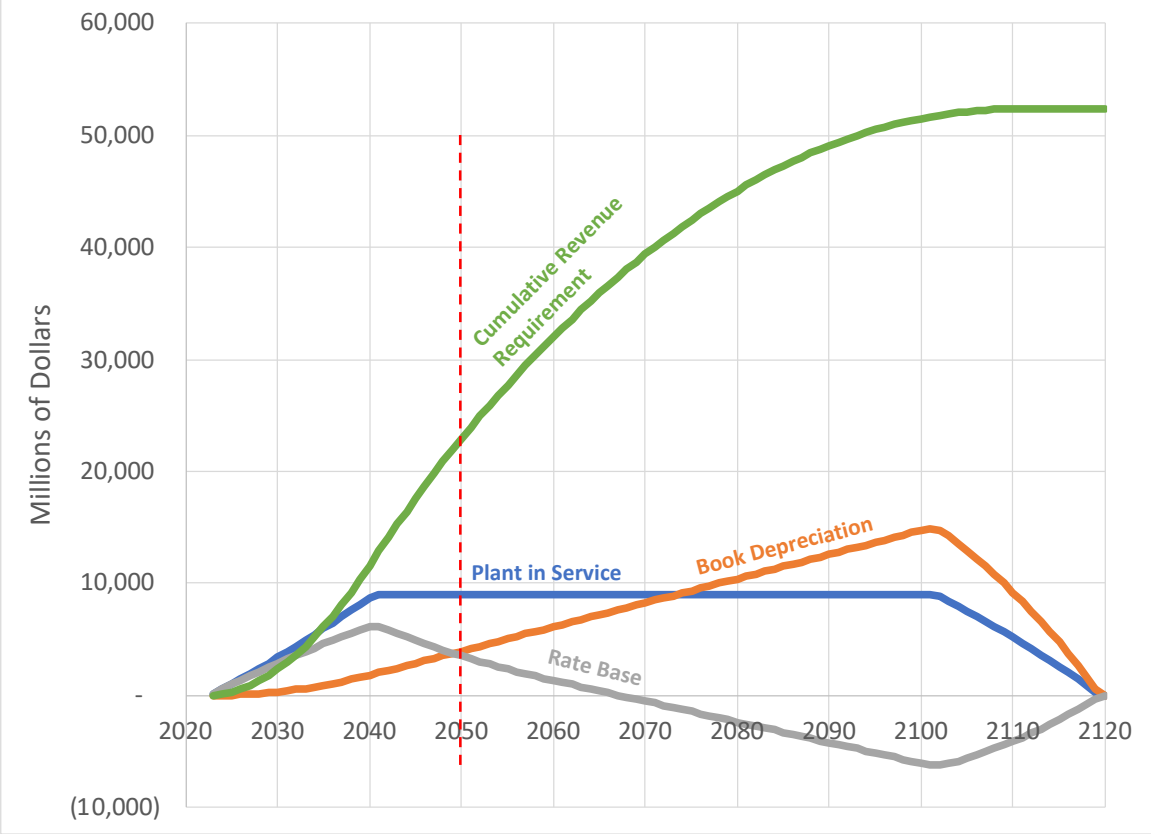
[9] 49 CFR Part 192.727

for accumulated deferred income taxes) in 2050. If the MRP approach continues on its present course, Con Edison will have billions of dollars of assets at risk of stranding in 2050, when pipeline throughput will be much lower to meet CLCPA emissions requirements. This risk can be mitigated, and costs avoided, by reducing the scope and scale of the MRP or by shortening depreciation lifetimes for new assets to align with their expected utilization.

Q. And what would be the resulting impact on revenue requirement?

A. We estimate that Con Edison's customers would be asked to pay more than $1 billion in 2050 as that year's revenue requirement associated with the MRP investments from 2023 to 2040. Of the $52.4 billion in total revenue requirement associated with these 18 years of MRP program investments, $30.5 billion (58 percent) is required in the year 2050 and after. Figure 1 illustrates the trajectory of plant in service, depreciation, rate base, and cumulative revenue requirement for the extended 2023–2040 MRP program under Con Edison's currently proposed approaches.

Figure 1. Financial effects for the next 100 years of extending Con Edison Main Replacement Program through 2040, showing plant in service, depreciation, rate base, and cumulative revenue requirement



Q. How would the revenue requirement in 2040 and 2050 resulting from MRP investments contribute to customer bills?

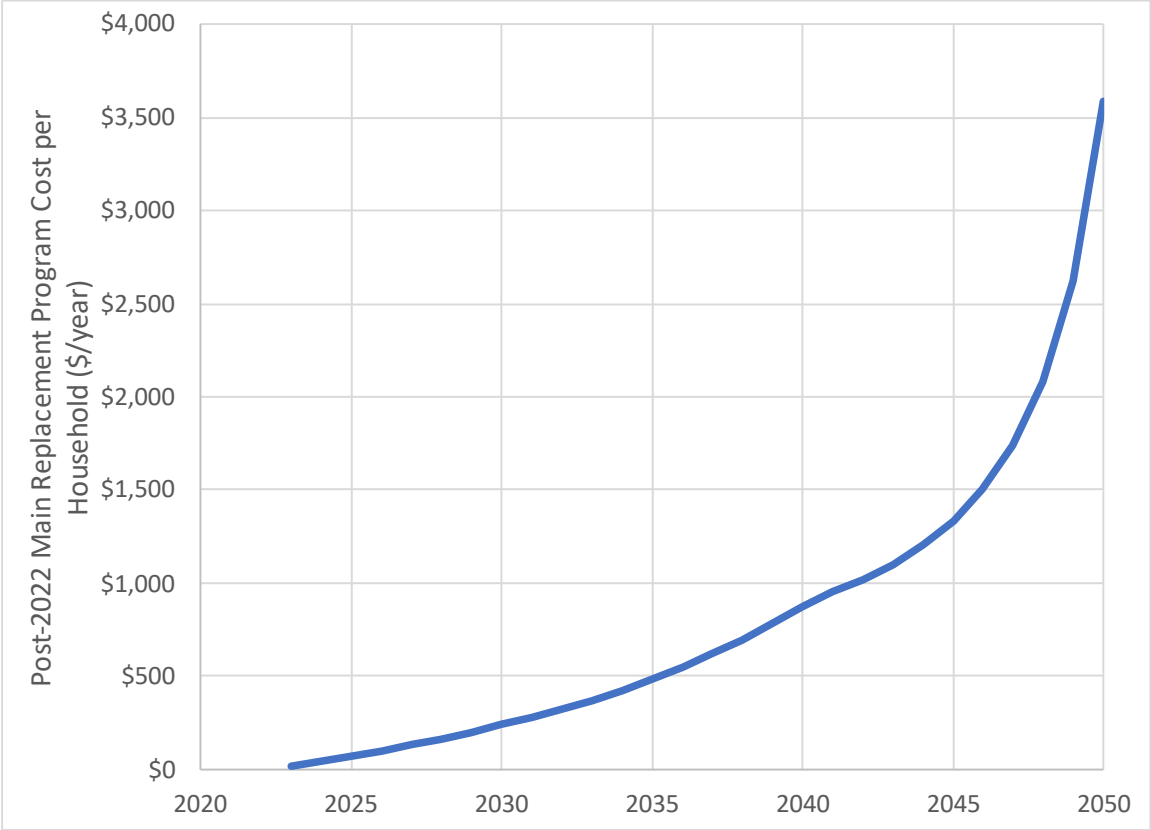
A. The three years of MRP spending proposed in this case, from 2023 to 2025, would result in a revenue requirement of about $149 million in 2040 and $120 million in 2050. In the face of state policy for decarbonization and electrification, the number of households served by Con Edison gas is unlikely to stay the same, so these costs will fall on a shrinking number of customers. If we assume that about two-thirds of the revenue requirement falls on the residential rate classes (as it does today), and customers are

departing from the gas system at the rate contemplated by the Commission in the gas planning order (a reduction of 50 percent by 2040 and 90 percent by 2050[10]), costs per household from just these three years of MRP investment are $105/year in 2040 and $424/year in 2050. While these are nominal, not inflation-adjusted, results for 2040 and 2050, they are nonetheless substantial on the scale of average annual gas delivery bills today of about $730.[11]

If the MRP continues at the scale contemplated by Con Edison, so that all leak-prone pipe is replaced by 2040, the 2040 revenue requirement for post-2022 MRP expenses alone is $1.25 billion, which falls to $1.02 billion in 2050. In the Commission's customer departure scenario,[12] the per-household cost of the completed MRP program rises to $877/year in 2040 and $3,587/year per household in 2050, well more than tripling customer bills in real terms (assuming 2 percent long-term inflation). Figure 2 shows the annual bill impact for an average household, estimated by linearly interpolating between the Commission's fixed points for customer counts today, 2040, and 2050.

[10] Gas Planning Order, page 61.
[11] Derived from residential revenue of about $1.4 billion for the 12 months ended September 30, 2021 (Exhibit AP-G1), paid by 1.9 million households.
[12] Gas Planning Order, page 61.

Figure 2. Annual per-household cost of the Con Edison MRP program assuming continued installations from 2023 through 2040 and gas household numbers in line with the departure scenario from the Commission's May 12, 2022, Gas System Planning Process order



Q. Do these bill impacts increase the risk of rapid or unmanaged customer departure from the gas system?

A. Yes. As gas rates increase, the customer economics of electrification become more favorable. Each additional household that fully electrifies or otherwise substantially reduces their use of pipeline gas creates more rate pressure on other customers, thus exacerbating a potential vicious cycle. Even with only 50 percent of current customers departing by 2040, the bill impacts of the MRP program are considerable. Customers that have the least control over their building systems, such as renters and low-income

households without the financial assets to make investments in their building systems, are the most likely to be left carrying an unsustainable cost. While some kind of regulatory asset treatment may be able to be developed to mitigate or shift this risk, a root cause of the risk is the size of the MRP investment and its impact on revenue requirements.

Q. Under standard regulatory practice, how do regulators determine whether customers should bear the cost for the return *of* investors' capital (e.g., through depreciation), and return *on* that capital (e.g. through return on equity and interest on debt)?

A. The critical concepts here are whether the investments are "prudent" and are "used and useful." These concepts provide the discipline for utility management that the competitive market would otherwise provide. It is just and reasonable for utility investors to recover from customers the cost of investments that are used and useful (that is, providing service to customers) and which were prudently incurred (that is, the investment was a reasonable decision using information available at the time). This includes both the return of capital and return on that capital. Customers should not pay for any cost (including return of capital) for investments that were not prudent. Utilities have an obligation to demonstrate that an investment is prudent, such as by justifying investment with a benefit-cost analysis. If the expected costs exceed the expected benefits, the investment should be presumed to be imprudent (unless there are other explicitly identified mitigating factors). For investments that were prudently decided but are no longer used and useful, regulatory discretion is used to determine what portion of the investment to recover.

Q. Can Con Edison be assured that all investments in the MRP today will be determined to be prudently incurred when the utility seeks recovery in the future?

A. No. The passage of the CLCPA created a bright line for a change in utility asset planning. The CLCPA set emission reduction requirements, changed the accounting for emissions from RNG in a way that makes clear that such fuel cannot be a wholesale replacement for fossil gas, and set clear public policy to reduce co-pollutants in disadvantaged communities. The best information available to Con Edison at this time is that the path forward is unlikely to require a gas distribution system of the same extent as today. The utility has responded to this by shifting its approach in positive directions (e.g., by slightly shortening depreciation lifetimes and targeting electrification instead of pipeline replacement on a limited basis), but future regulators may see that the utility's actions are not commensurate with the pace and scale of change in approach necessitated by the CLCPA. The company's own depreciation expert suggests shorter depreciation lifetimes (Depreciation Panel, page 9) and that the utility act promptly to recover its full existing reserve deficiency (Depreciation Panel, page 31) to account for the CLCPA. In the Gas Planning Order the Commission requires all gas utilities to conduct depreciation studies[13] and long-term infrastructure planning studies[14] that examine different approaches to CLCPA-compliant scenarios, while in the CLCPA Implementation Order, the Commission requires a GHG Emissions Reduction Pathways Study that should provide greater clarity.[15] However, the need for these studies has been clear since the passage of

[13] Gas Planning Order, page 61
[14] Gas Planning Order, pages 17-40
[15] CLCPA Implementation order, page 26.

the CLCPA and the utility should not rest assured that investments and other financial decisions undertaken between the adoption of the CLCPA and the completion of these studies will be immune from prudence review.

Q. What concerns do you have about a large undepreciated plant balance for Con Edison in 2050?

A. Undepreciated assets that are no longer used and useful can become stranded assets. This poses a substantial risk for Con Edison shareholders. MRP costs incurred today are incurred in full knowledge of the CLCPA and its implications for the changes in gas demand over the lifetime of these assets. Con Edison has not accompanied its MRP proposal in this proceeding with a benefit-cost analysis that shows that the MRP is the prudent course of action to address leak-prone pipe. The utility is therefore at risk of not being able to recover its investment.

Even so, customers could see a cost even if shareholders are asked to bear this cost: A large loss to Con Edison shareholders could threaten the financial stability of the company and result in a higher cost of capital that might be passed on to customers. Even if the investment is determined to be prudent, shareholder returns may be lower if the assets become stranded. In many jurisdictions, where large prudently invested assets have been at risk of stranding, regulators or other policymakers have agreed to create regulatory assets or use securitization to recover the costs from customers, with zero or bond-like rates of return.

Q. What concerns do you have about the revenue requirement impact of the MRP approach?

A. If Con Edison's sales do not rise at a rate commensurate with the increased revenue requirement, then per-unit rates will need to rise to cover the utility's cost of service. However, Con Edison's CLCPA panel states that sales will not increase: "We expect to see a decline in gas sales and in usage of our gas delivery system because of energy efficiency and electrification undertaken to help the State meet the CLCPA's clean energy and emissions reduction requirements" (CLCPA Panel, page 30). Adding billions of dollars of additional revenue to be collected from a smaller amount of sales will only make gas rates increase more. If depreciation rates are increased to reflect shorter useful asset lives, it will be even more essential for the size of the capital investment to be limited as much as possible to avoid greater rate increases. Faced with higher gas rates, customers with the ability to invest in electrification will accelerate those investments to free themselves from the higher gas costs, thus exacerbating a potential vicious cycle and risking uncontrolled customer exit from the gas system. Customers without the means to switch away from gas, either due to limited financial means or lack of control of their building systems (e.g., as renters) will be left paying a greater and greater cost. Such an outcome could lead to gross inequities among customers and between generations, and the customers bearing the brunt of the inequity would likely be those customers that are already vulnerable or disadvantaged relative to others.

Q. Could a smaller MRP mitigate your concerns about stranded asset risk and rate impacts from infrastructure investment?

A. Yes. If MRP were scaled back by some factor, for example by focusing only on the highest risk pipes and emergent issues or focusing on retiring rather than replacing leak-prone pipes, the resulting stranded asset and rate impact risks would be reduced by a corresponding factor.

MRP and Greenhouse Gas Emissions

Q. Does the MRP reduce greenhouse gas emissions?

A. Yes. Methane is a potent greenhouse gas. By replacing leak-prone cast iron and bare steel pipe with plastic pipe, the MRP results in reduced GHG emissions.

Q. How much does GHG emission reduction from the MRP cost, on a basis of dollars per ton of CO_2-equivalent emissions?

A. To answer this question, we used Con Edison's stated cost of pipeline replacement and estimated the metric ton of emissions reduction achieved by replacing leak-prone pipe with plastic pipe. Con Edison states that MRP costs $965 per foot of mains replaced (Exhibit GIOSP-1, page 7), or about $5.1 million per mile. The U.S. Environmental Protection Agency ("EPA") estimates emission rates for methane leaks from different materials, which allows us to quantify the emission reductions from the proposed MRP investment. EPA estimates that methane leaks from unprotected steel at a rate of 861 kg/mile/year, from cast iron at 1158 kg/mile/year, and from plastic at 29 kg/mile/year. Using a global warming potential of 84, for the 20-year equivalent emissions of methane

used in the most recent New York state emissions inventory,[16] this implies that replacing cast iron with plastic reduces annual emissions by about 95 metric tons of CO_2-equivalent emissions per mile of replacement per year; and replacing unprotected steel with plastic reduces annual emissions by about 70 metric tons per mile per year. Con Edison's leak-prone pipe inventory is almost exactly split evenly between unprotected steel and iron pipes (adding cast and wrought iron together) (Exhibit GIOSP-1, page 7). Therefore, the MRP should be expected to reduce annual emissions by about 82.5 metric tons per mile on average. This means that a capital investment of $5.1 million for a mile of new pipe reduces ongoing annual emissions by 82.5 metric tons, for a ratio of about $62,000 of capital investment per recurring annual metric ton of CO_2e reduction.

Q. Is the MRP a cost-effective way to reduce GHG emissions, relative to electrification and pipeline retirement?

A. No, the MRP is a very expensive way to reduce GHG emissions, relative to electrification and pipeline retirement. We analyzed this and found that emission reductions from investment in pipeline replacement cost more than 4.5 times as much as emissions reductions from investment in a combination of efficient electrification and pipeline retirement.

Q. How did you determine that MRP is not a cost-effective way to reduce GHG emissions, relative to electrification and pipeline retirement?

[16] See ERG. 2021. *Technical Documentation: Estimating Energy Sector Greenhouse Gas Emissions Under New York State's Climate Leadership and Community Protection Act*, Appendix E. Prepared for NYSERDA. Available at https://www.dec.ny.gov/docs/administration_pdf/energyghgerg.pdf.

A. We estimated the ongoing emissions reductions from electrification and pipeline retirement, per upfront dollar spent, and compared this ratio to the equivalent ratio from the MRP. Put another way, with a budget of $5.1 million to spend on electrification and pipeline retirement, how much annual recurring emissions reduction could Con Edison achieve, and how does that compare with one mile of MRP? The following questions and answers walk through this calculation.

Q. How did you estimate the cost of pipeline retirement on a per-household basis?

A. For simplicity, we assumed that retired pipe is removed and that removing a pipe costs the same as replacing it, per foot. This is a conservative assumption, because there are no material costs for new pipe in the retirement case, but the task likely involves a comparable amount of labor and equipment. If pipelines were cleared of gas and abandoned in place, the cost would be substantially lower. Con Edison serves about 430 households per mile of pipe (1.9 million households[17] and about 4400 miles of pipe), or one household every 12.2 feet. At $965 per foot and 12.2 feet per household, this implies a replacement (and thus retirement) just under $12,000 per household.

[17] We have to approximate the number of households, because many of the households Con Edison serves live in master-metered multi-family buildings. As a result, the number of residential customers and number of residential households are not equal. We approximated the number of households based on Census data for each county the utility serves.

Q. How did you estimate the cost of efficient electrification on a per-household basis?

A. NYSERDA developed cost estimates of retrofits to create efficient all-electric buildings for its Carbon Neutral Buildings Roadmap.[18] We have used the Roadmap's cost estimates for the all-electric retrofit of a gas-heated seven-story, pre-1980 building, in climate zone 4A (New York City) with upgrade to distributed cold climate air source heat pumps, code compliant shell, LED lighting, smart appliances, heat pump water heater, and induction range. While the exact dollar figure is not available in the presentation, it appears the total cost of the retrofit is about $48,000. We use the total cost, rather than incremental cost ($21,000), because in the pipeline-replacement scenario we cannot assume that the building would be retrofit at that time and the work may cause early replacement costs not accounted for in the incremental cost figure. NYSERDA identifies that this approach has substantial benefits, in addition to emissions reduction:

- "Improved health for occupants due to better indoor air quality and better pest control
- Improved comfort and acoustics due to better shell
- Improved passive survivability and resilience due to better shell
- Reduced fire and/or burn risk with induction stove tops

[18] NYSERDA. 2021. "Carbon Neutral Buildings Roadmap: Public Webinars – Day 2." Page 20. Available at https://www.nyserda.ny.gov/-/media/Files/Programs/Carbon-Neutral-Buildings/Day-2-Carbon-Neutral-Roadmap-Presentation.pdf.

- Significant grid benefits due to higher levels of efficiency and smaller HVAC equipment
- Improved net operating income for owners"[19]

As buildings with no on-site emissions powered by a rapidly decarbonizing grid, these buildings would find it straightforward to comply with the requirements of New York City's Local Law 97.[20] NYSERDA estimates that all-electric efficient retrofits of single-family homes cost substantially less than multi-family: less than $30,000 per unit.[21] We do not use this lower cost of electrification because Con Edison's plan is to focus the MRP on the Bronx and Manhattan, where single-family homes are less common. However, to the extent that Con Edison considers MRP investments in areas of its territory that are single-family, the economics of all-electric retrofits are even more favorable than the results we show below.

Q. How much would electrification reduce emissions?

A. Con Edison sells about 980 million therms to residential customers, [22] to serve about 1.9 million households. This implies consumption of about 515 therms per household per year. We used CLCPA-consistent emissions factors. These include the effect of methane leakage in the gas production and transportation process, as well as combustion

[19] Id. p. 24.
[20] Energy and Environmental Economics, Inc. *Independent Consultant Report, Docket 20-80: The Role of Gas Distribution Companies in Achieving the Commonwealth's Climate Goals: Appendix 4: Input Assumptions Workbook*. March 2022. Accessed at https://thefutureofgas.com/content/downloads/2022-03-21/3.18.22%20-%20Independent%20Consultant%20Report%20-%20Appendix%204%20(Input%20Assumptions).xlsx.
[21] Id. p. 27.
[22] Based on U.S. Energy Information Administration. *Form 176 Natural Gas Deliveries*. Accessed via https://www.eia.gov/naturalgas/ngqs/#?year1=2017&year2=2020&company=Name.

emissions; but they do not include in-state pipeline leakage (which we account for separately below). [23] Together, these factors correspond to CO_2e emissions of about 4.5 metric tons per household per year. Electrifying all end-uses corresponding to this gas consumption would increase electric use and associated emissions. We estimate that if current gas equipment is about 80 percent efficient (reflecting a typical gas boiler or furnace efficiency) and the replacement electric equipment is 200 percent efficient (reflecting a conservative estimate of heat pump efficiency for space and water heating, blended with cooking and laundry uses), then it would take about 6,040 kWh to provide the same level of service to the household. Using New York's average electric sector emissions from 2019,[24] this electric use would result in about 1.24 metric tons of CO_2e emissions per year. However, New York's electricity portfolio is set to rapidly become cleaner, with net zero emissions by 2040. If emissions fall linearly from 2019 to zero in 2040 and then remain there, average additional emissions from electricity between now and 2050 would be less than 30 percent of the 2019 emissions rate, or about 0.35 metric tons per year per household. The emissions would be lower if we accounted for the increase in the efficiency of building shells associated with the retrofit. After adjusting for this, the net average annual emissions impact of electrification would be about 4.2 metric tons per year. Adding the eliminated leakage from 12.2 feet of pipe (about 0.2 metric tons/year based on 84.8 metric tons/mile/year—the average of the U.S. EPA leak

[23] Derived from ERG. December 2021. *Technical Documentation: Estimating Energy Sector Greenhouse Gas Emissions Under New York State's Climate Leadership and Community Protection Act.* Table 36, page 63. Prepared for NYSERDA. Available at https://www.dec.ny.gov/docs/administration_pdf/energyghgerg.pdf.

[24] Calculated based on NYSERDA. 2021. Energy: 2021 NYS Greenhouse Gas Emissions Report: Sectoral Report #1. Available at https://www.dec.ny.gov/docs/administration_pdf/ghgenergy21.pdf.

rates for cast iron and unprotected steel pipe) we get an average reduction of about 4.4 metric tons per year per household from electrification and pipeline retirement. [25]

Q. What is the cost per recurring annual ton of emission reductions from the electrification and retirement approach?

A. At a total cost of $60,000 per household (combining retrofit and pipeline removal costs), an upfront capital investment of $5.1 million would allow electrification and pipeline retirement of an average of 85 households. At an average of 4.4 metric tons of annual emissions reduction per household, this implies that this approach would reduce ongoing annual emissions by about 370 metric tons of CO_2e, for a ratio of about $13,800 per ongoing annual metric ton of CO_2e reduction. This ratio is lower than the cost for emissions reduction using the MRP approach, which is $62,000 per ongoing annual metric ton of CO_2e reduction, by a factor of 4.5. While this analysis is conservative and necessarily high-level (and does not account for gas system operational factors, the topology of the gas pipeline system, or building stock diversity), it strongly indicates that an alternate approach could eliminate leaks and their associated environmental and safety risks—a retired pipe does not leak—while reducing emissions at a faster rate, reducing stranded cost risk, lowering energy bills, and improving public health, comfort and air quality.

[25] This assessment does not include the reduction in leakage from service lines and meters, because the number of service lines and meters per household is highly variable. However, including the elimination of these additional sources of leakage would further reduce emissions.

Q. Customers do not pay only the upfront capital cost of pipeline investments. How have you accounted for the cost of capital, taxes, and other similar factors in your assessment of the cost per ton of different approaches?

A. We have not accounted for these effects. If we did, the cost per ton of the MRP approach would be higher. If the electrification-and-retirement approach were also funded as a utility capital expense, then its costs would also be higher, and the overall result of the comparison would be relatively unchanged. If some of the costs of electrification and retirement were covered in another way (e.g., through customer contributions, taxpayer-funded programs, or operations and maintenance costs that do not have an associated cost of capital), then the net effect would be to make the non-MRP approach even more cost-effective. Given the need to reduce gas system emissions to meet CLCPA requirements, meeting that goal in more cost-effective ways will enable lower system-wide costs, and therefore lower gas rates.

Q. Under the electrification and retirement approach, the same overall budget would eliminate less leak-prone pipe, because the money would primarily go to building improvements. How do you think about this tradeoff?

A. We think about this tradeoff from the perspective of the two objectives of the MRP: safety and GHG emissions.

Q. What is the implication of the tradeoff for GHG emissions?

A. From a GHG perspective, the electrification that we contemplate here is more effective than pipeline replacement, so it makes sense to focus on the buildings. The building-

based approach also improves resident health and comfort, reduces toxic air pollution, and lowers bills—none of which the proposed MRP approach achieves.

Q. What is the implication of the tradeoff for gas system safety?

A. Pipeline safety is advanced by the removal or replacement of leak-prone pipe, as well as by addressing emergent situations. This means that the complete elimination of all aspects of the MRP proposal, including the portion that responds to emergent issues, would not be wise. (When a third party causes a leak, it does not make sense to immediately retire the gas pipe and electrify all affected buildings.) However, it also means that preemptively replacing cast iron or bare steel pipe should be avoided where a planned neighborhood approach to electrification and retirement can be pursued, even if this means there remain more miles of leak-prone pipe on the system. "High risk" pipe that serves multiple neighborhoods could be replaced; since the building systems implications of its retirement may be large, there is more likelihood that it will be used for some purpose in the longer term, and the risk assessment shows greater return for such a replacement from a safety perspective. In addition, the overall budget and ambition of policy and programs could be scaled up to retire more miles of pipe than the current proposed budget could support when coupled with electrification. We believe that this blended approach is suitable for now, and it is aligned with the Commission's recent order that gas utilities be required to identify "locations of specific segments of [leak prone pipe] that could be abandoned in favor of [non-pipeline alternatives] and where

infrastructure projects may be needed in the near future to maintain reliability."[26] We also agree with the Commission's encouragement to "take a 'neighborhood approach' and work with local groups and State agencies on a comprehensive program that simultaneously removes leaking or leak-prone infrastructure and employs programs such as weatherization and demand response along with electrification."[27]

Q. Does the topology of the gas system complicate both MRP and pipeline retirement-based approaches?

A. Yes, although there should still be plenty of areas where retirement with electrification is topologically straightforward. Where Con Edison does propose electrification and retirement in the MRP context, it does so only for radial segments (GIOSP-1, page 8)—effectively, the leaves of the tree. However, more than one-third of Con Edison's pipe network was composed of leak-prone pipe as of the end of 2020. The utility has not published a map of its pipeline assets by type and age, although the utility will be required to make more information available in its annual reports required by the Gas Planning Order. It is likely that leak-prone pipe is not concentrated in particular areas of its network; but given the amount of remaining leak-prone pipe, there are likely to be areas with substantial density of remaining pipe. In these areas, retirement with electrification could be accomplished at a neighborhood scale. In some places, retiring a segment of leak-prone pipe may complicate serving other customers who are "downstream" of the retired segment.

[26] Gas Planning Order, page 42.
[27] Ibid.

Q. Are there particular downsides to a scattered approach to MRP pipeline replacement?

A. Replacing isolated segments under the MRP paradigm could result in new, and relatively undepreciated, pipe being surrounded by segments of pipe that are suitable for electrification and retirement. This could create additional and nearer-term stranded cost risks. Without a comprehensive plan that accounts for system topology and long-term system needs, neither the MRP nor an electrification-based approach can be fully optimized.

Q. What do you suggest that Con Edison change about its approach to leak-prone pipe, given the asset risk, rate impact, and GHG reduction cost results you have detailed?

A. We recommend two changes in Con Edison's approach. First, building on the Gas Planning Order, the Commission should direct Con Edison to develop a comprehensive and detailed plan for its long-term infrastructure needs in order to avoid building or replacing any unnecessary mains. Later in our testimony we describe such a planning approach in greater detail. Second, with respect to the MRP proposal in this proceeding, we recommend that the Commission order Con Edison to: (1) separate budgeting for emergent issues with cast iron and bare steel pipe from the planned MRP budgets, since the alternatives for emergent issues are more constrained; (2) optimize MRP investments by limiting pipeline replacement under the MRP to pipe that is identified as "high risk" (and file for Commission review the methods used to determine if a pipe is "high risk"), with particular focus on such pipe that serves multiple neighborhoods or otherwise has identified opportunity for a longer useful life; and (3) expand the electrification and

retirement approach to a neighborhood scale, going beyond the 5 miles per year of proposed radial feeders and network simplification.

4.2. Renewable Natural Gas

Q. What is RNG?

A. RNG is pipeline-quality gas derived from biomass or other organic sources. Once processed, it is interchangeable with conventional fossil gas—that is, it can be delivered in the same pipes and combusted in the same appliances.[28]

Q. What does Con Edison propose with respect to RNG?

A. The Company proposes to install equipment to support a third-party RNG facility's interconnection to Con Edison's gas system in Mount Vernon. The equipment consists of metering, gas quality measurement, odorant measurement, and remote shutdown. The projects is projected to cost $1.5 million in rate year 1. (Gas Infrastructure Operations and Supply Panel Testimony, p. 50.)

Q. Why is the Company making this proposal?

A. According to the testimony of the Gas Infrastructure Operations and Supply Panel, Con Edison has "adopted the objective of decreasing the emissions associated with the gas flowing through the system, through the purchase of certified gas and the interconnection of RNG facilities" (GIOSP testimony, p. 113). In response to DPS set 13 question 415,

[28] ICF for the American Gas Foundation 2019. Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment.

the Company describes its RNG interconnection initiative as providing customers with "clean alternative heating options" and "low-to-zero carbon gaseous fuels." This discovery response also speaks of the Mount Vernon RNG Interconnection project as one that will "hopefully open the door for future additional interconnections."

Q. Will Con Edison's proposal deliver GHG emission reductions to its customers?

A. No, the proposal will not deliver emission reduction benefits associated with the environmental attributes of the RNG to Con Edison's customers. Con Edison is not proposing to retain or purchase any renewable energy credits or other environmental attributes associated with the methane from the RNG facility (Response to WE ACT/AGREE Set 2, question 21). Because Con Edison is not retaining or purchasing these attributes, neither Con Edison nor its customers can claim credit towards compliance with state climate policy. If out-of-state entities purchase these attributes, these buyers can claim the emissions reductions towards their obligations, and New York would not benefit. However, Con Edison's customers would still be on the hook for the cost of the interconnection facility, and if it is treated like an NPA, customers would also pay shareholder incentives.

Q. How effective is RNG as a strategy for reducing GHG emissions that would otherwise be released into the atmosphere?

A. The carbon intensity of RNG varies substantially with several factors, including feedstock, production methods, location of production, and how the fuel is transported to

the point of injection into the distribution system.[29] Some types of RNG are able to produce lifecycle carbon reductions under some accounting frameworks (and, as discussed below, still raise other serious concerns). For example, in a study conducted for the American Gas Foundation, ICF found that RNG from food waste will produce moderate emissions savings in the Mid-Atlantic region, accounting for emissions prior to injection into the distribution system.[30]

Critically, however, the CLCPA calls for using the 20-year global warming potential (GWP) of GHGs, rather than the 100-year GWP used by other states and by the federal government, and accounting for gross (rather than net) emissions. Taking this into account, the New York Department of Environmental Conservation (DEC) is developing emissions factors for fossil and renewable fuels that take into account the 20-year GWP.[31] The draft CLCPA emissions factors are shown in Figure 3. These factors assume no net emissions from upstream production and transport of the RNG and account for the total carbon dioxide created by methane combustion from any source.

[29] ICF 2019, Appendix B.
[30] ICF 2019.
[31] New York State Climate Action Council, July 22, 2021 meeting presentation. Available at https://climate.ny.gov/CAC-Meetings-and-Materials.

Figure 3. Greenhouse Gas accounting: Climate Action Council existing guidance and draft, CLCPA-compliant factors

	June 2020 Accounting [1]	Draft CLCPA Accounting [2]
	Emission factor, lbs/mmbtu CO2e (100-yr GWP, combustion emissions only)	Emission factor, lbs/mmbtu CO2e (20-yr GWP, upstream emissions included)
Natural Gas	117	182-**215** *
Renewable Natural Gas	*~0*	*117*
Distillate Fuel	163	219
Renewable Diesel	*~0*	*163*
Gasoline	160	227
Renewable Gasoline	*~0*	*160*
Jet Fuel	161	204
Renewable Jet Fuel	*~0*	*161*

Q. Do the emission factors in Figure 3 take into account all emissions from RNG?

A. No. Importantly, the estimate of lifecycle emissions for RNG above does not take leakage from the distribution system and at the customer site into account. If such emissions are taken into account, the emission factor would increase to around 134 lbs/mmbtu CO_2e, assuming the in-state emissions calculated for NYSERDA's CLCPA-compliant GHG inventory.[32]

Q. Is the Mount Vernon project expected to capture substantial GHG emissions that would otherwise be released into the atmosphere?

A. That is not known. The facility in question will produce RNG from food waste digestion, which Con Edison suggests may have a negative lifecycle carbon intensity (Response to WE ACT/AGREE Set 2, question 21). Con Edison's expectation is consistent with the

[32] ERG. 2021. *Technical Documentation: Estimating Energy Sector Greenhouse Gas Emissions Under New York State's Climate Leadership and Community Protection Act*. Appendix D. Prepared for NYSERDA. Available at https://www.dec.ny.gov/docs/administration_pdf/energyghgerg.pdf.

carbon intensity that ICF projects for food waste digestion for the MidAtlantic region.[33] However, neither a project-specific nor a CLCPA-accounting-compliant analysis for the proposed facility is available (Response to WE ACT/AGREE Set 2, question 21).

Q. Do you have other concerns with proposals to integrate RNG?

A. Yes. As noted above, Con Edison appears to view the Mount Vernon proposal as a first step in a larger strategy that uses RNG, certified gas, and potentially hydrogen to mitigate GHG emissions from its system. However, this investment, and the larger strategy, puts Con Edison on a path that appears to be inconsistent with the CLCPA. This is particularly true if the draft CAC emissions factors are adopted. Efforts to better integrate and to promote RNG fuels may send customers the message that they are compliant and consistent with state policy objectives, despite questions about RNG's carbon footprint, cost, availability, and air quality impacts (as discussed below). If customers expect that RNG provides an environmentally preferable alternative to fossil gas, customers may opt to stay on the gas system, at least in the short term. However, such short-term decisions will come with renewed customer investment in gas end-use equipment and Company investment in pipes, dragging out and making more costly the transition to the options consistent with CLCPA targets (including electrification). The situation will also become less equitable, since those facing the highest barriers to electrification—renters and LMI customers—will remain on the gas system longer than those with the means to disconnect from it.

[33] ICF 2019.

Q. Do all RNG sources have equal impacts on emissions?

A. No, the GHG footprint of RNG varies considerably. A report from ICF and the American Gas Foundation found that RNG produced from food waste and dairy and swine manure feedstocks are likely to result in emissions reductions using ICF's methodology, when netting out the emissions reductions from the agriculture source, relative to combustion of fossil methane.[34] However, some of the more plentiful feedstocks—including landfill gas, beef/poultry manure, water resource recovery facilities, agricultural residue, forestry residue, energy crops, and municipal solid waste—all have positive lifecycle emissions factors using ICF's methodology.[35] In addition, there are other environmental and health concerns associated with various feedstocks; as such, it is also important to carefully consider the range of possible environmental and health impacts, beyond GHG emissions.

Q. Is RNG available in sufficient volume to play a meaningful role in CLCPA compliance for Con Edison's customers?

A. The supply of RNG with a favorable GHG footprint is limited, and there is risk that supplies will not develop in the quantities needed to meaningfully contribute to a CLCPA compliance strategy. In its High Resource Potential Scenario, AGF estimates a GHG-negative RNG resource of 13.223 tBtu/year in 2040 for all of New York state.[36] Compared with Con Edison's projected annual sales of 171.445 tBtu in 2025, this

[34] RNG will still produce toxic air pollution and carbon dioxide when combusted, even if it is estimated to decrease GHG emissions.
[35] ICF 2019, p. 72.
[36] ICF 2019, p. 66.

statewide RNG potential could at most displace roughly 13 percent of current sales. It is clear that GHG-negative RNG cannot displace a large portion of gas demand, even assuming declining sales in future years (Gas Forecasting Panel, p. 6). Given that there are competing uses for the RNG from other utilities, industry, and transportation sectors in New York and elsewhere, it is not reasonable to assume that GHG-negative RNG from sustainable feedstocks could serve any substantial portion of the supply for Con Edison's customers. Some of these competing sectors have end-uses that are difficult to electrify. This is true for some industrial processes and long-distance transportation, for example. Thus, if RNG is found to be a reasonable part of a GHG compliance strategy, it would be better used in those sectors, rather than being integrated into the overall gas system to be used for applications that have commercially available alternatives (e.g., heat pumps for space and water heating).

Q. Is RNG a cost-effective way to reduce emissions, compared with other alternatives?

A. To assess the cost of RNG as a compliance strategy, we compare the cost of RNG with the cost of electrification and pipe retirement. Two recent studies conducted on behalf of gas utilities have estimated the long-term cost of non-fossil gases. In Massachusetts, Energy and Environmental Economics estimated that in 2050 synthetic natural gas ("SNG"), which the firm assumed would be required to meet marginal supply in cases with net zero emissions and continued pipeline gas use, could cost more than $37 per

MMBTU.[37] For Washington Gas Light, ICF estimated that the supply curve for non-fossil gases in 2040 would flatten out at around $20 per MMBTU.[38] Taking these values as bookends, and using the GHG emissions factors from Figure 3 alongside the U.S. Energy Information Administration's *Annual Energy Outlook* estimates of fossil gas prices in 2050, we estimate that non-fossil gas reduces emissions at a cost of between $448 per ton (ICF cost of RNG combined with high fossil gas emissions rate) and almost $1,600 per ton (Energy and Environmental Economics' conservative SNG cost combined with low fossil gas emissions rate). In comparison, using the logic described under the section on the MRP above, the upfront cost of electrification retrofits and pipeline retirement is $13,800 per ton for a continued annual reduction for the lifetime of the change. If we assume that the buildings that are electrified will last for 75 years, the annual cost of emissions reduction from electrification would be about $184 per ton—well below the estimated range of emission reduction costs from RNG. In addition to substantially lower emission reduction costs, electrification retrofits and pipe retirement provide other benefits. These benefits include lower energy bills for residents, improved occupant comfort, elimination of toxic air pollution, consistency with compliance obligations under Local Law 97, and lower stranded cost risk. RNG will produce none of these benefits.

[37] Energy and Environmental Economics, Inc. *The Role of Gas Distribution Companies in Achieving the Commonwealth's Climate Goals Independent Consultant Report: Technical Analysis of Decarbonization Pathways*. Appendix 4 at https://thefutureofgas.com/content/downloads/2022-03-21/3.18.22%20-%20Independent%20Consultant%20Report%20-%20Appendix%204%20(Input%20Assumptions).xlsx

[38] ICF, Inc. "Study on the Use of Biofuels (Renewable Natural Gas) in the Greater Washington, D.C. Metropolitan Area." ICF Resources Inc. March 2020. Available as Appendix D at https://edocket.dcpsc.org/apis/api/filing/download?attachId=101994&guidFileName=e69b6cb2-963c-4122-aca3-3b45e838b2b7.pdf. See page 79.

Q. Do you have other comments about the RNG proposal?

A. Yes. We note that RNG and certified gas (discussed below), like fossil gas (and all combustion fuels), create toxic air pollution when burned. This raises concerns about indoor and outdoor air quality impacts. The air quality impacts associated with these fuels should be assessed and factored into the analysis of whether to proceed with related investments.

Q. Please summarize your recommendations regarding RNG.

A. First, the Commission should deny cost recovery for the Mount Vernon infrastructure project as a GHG reduction strategy. Before any such proposal is considered for approval, Con Edison should (1) provide analysis of CLCPA compliance pathways, in keeping with the requirements of the Gas Planning Order and the CLCPA Implementation Order, and show that this proposal is consistent with such pathways analysis; (2) demonstrate that this RNG investment is a reasonable and cost-effective alternative, given the potential strategies for managing gas system constraints; and (3) retain the environmental characteristics of the RNG for the benefit of its customers. If Con Edison chooses to propose the Mount Vernon infrastructure project strictly on the basis of a resource to relieve supply constraints (i.e., not for environmental policy compliance), the Commission should direct Con Edison to demonstrate that this option compares favorably to all other supply- and demand-side options, including NPAs and conventional supply.

Second, leading up to the aforementioned pathways analysis, Con Edison should investigate the serious concerns we raise about the fuel's cost, GHG footprint, supply and unsustainable feedstocks, and air quality impacts in an open and transparent stakeholder process, consistent with the requirement of the CLCPA Implementation Order. If the outcome of that investigation shows that RNG is likely to perform unfavorably in these areas relative to other alternatives, Con Edison should reduce or eliminate the role of RNG in its strategy to mitigate GHG emissions from its gas system.

4.3. Certified Natural Gas

Q. What is certified natural gas?

A. According to the Company, certified gas is "natural gas originating from producing sites that have undergone third–party certification to verify that the operator has met high environmental standards and best practices for methane emissions reduction in their operations" (GIOSP testimony, p. 137).

Q. What is the Company proposing for certified gas?

A. Con Edison is proposing a pilot program for the procurement of certified gas. The pilot is limited to an annual cost above traditional, fossil supplies of $800,000 per year (GIOSP testimony, p. 137).

Q. **Do you have concerns with this proposal?**

A. Yes. As with RNG, Con Edison seems to be relying on certified gas as a decarbonization strategy. In response to DPS set 13 question no. 415, Con Edison described the Certified

Gas Pilot as "a quick and effective way to reduce the Company's contribution to GHG emissions and to encourage natural gas producers to implement technology and operations measures that reduce their wellhead methane emissions." But efforts to promote certified gas are problematic. As with RNG, customers may invest in long-lived gas consuming equipment because they believe that certified gas is sufficient to comply with state policy. In this way, promotion of certified gas is likely to work at cross purposes with the CLCPA, despite Con Edison's claims to the contrary (GIOSP testimony, p. 137).

Q. If we assume that customers do not continue to invest in gas-consuming equipment because of misplaced perceptions about the environmental properties of certified gas, will use of certified gas reduce emissions?

A. Not necessarily. Con Edison has not yet set the requirements for certified gas. The Company states that the natural gas certification process "will vary based on the third-party certification entity being used by the producer. Typically, [requirements] include requiring producers to meet specific commitments related to environmental impact, such as provide specific reporting, commitments to real time monitoring, and/or adhering to emission maximums" (Response to City Set 5, Question No. 54). Since the requirements for the program have not been set, the GHG emission reductions associated with the program are unknown (Response to EDF Set 3, Question No. 19, and Response to WE ACT/AGREE Set 2 Question No. 31). Also, the Environmental Protection Agency is currently considering regulations to reduce air emissions from equipment and activities

used for the onshore oil and gas industry.[39] If and when such regulations are promulgated, the claimed benefits of certified gas will be reduced or eliminated.

Q. Is certified gas regulated?

A. No. There are no official standards to verify that certified gas provides incremental benefits above what is already occurring in the industry.

Q. Do you have other concerns with certified gas?

A. Yes. As with RNG, certified gas will leak from the distribution system and from customer end-use equipment just the same as "uncertified" fossil gas, and it will cause indoor and outdoor air quality problems when combusted.

Q. What do you conclude about the proposed certified gas pilot?

A. We have serious concerns about the proposed certified gas pilot as a GHG abatement option. Given the possibility of federal regulations, emissions reductions are tenuous at best. To achieve emissions reductions over time, customers would need to continue to pay higher rates for certified gas. Also, the potential for emissions reductions from certified gas is limited, since the fuel will still release GHGs during combustion. Given the likelihood that significant investment in certified gas could prolong dependence on the gas system, any strategy that assumes a large role for certified gas is inconsistent with the emissions reductions required by the CLCPA. While Con Edison's certified gas

[39] https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry

proposal is only a pilot, certified gas in general appears to be a costly and risky gamble as a GHG abatement strategy.

Q. Is Con Edison proposing investments in other alternative fuels?

A. No, although the Con Edison testimony does mention hydrogen. If Con Edison were proposing any specific investment in hydrogen, many of the same concerns as we have with RNG and certified gas would arise. And similarly, it should be deployed in hard-to-electrify sectors. Whether hydrogen results in reductions in GHG emissions depends on how it is produced; hydrogen with a zero GHG footprint is not currently cost competitive[40] and would use vast amounts of renewable electricity that could be better used directly for the end-uses that are currently served by fossil gas. Also, hydrogen can be mixed with methane, but only to up to 20 percent hydrogen by volume. Above that point, hydrogen poses safety, cost, and feasibility concerns for distribution within the existing pipeline network and for consumption by existing customer-owned natural gas end-use equipment.[41]

[40] Howarth, R., Jacobson, M. 2021. "How green is blue hydrogen?" *Energy Science & Engineering:* 12. August. Available at https://onlinelibrary.wiley.com/doi/full/10.1002/ese3.956.

[41] Melaina, M., Antonia, O., Penev, M. 2013. *Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues*. National Renewable Energy Laboratory Technical Report NREL/TP-5600-51995. Available at: https://www.nrel.gov/docs/fy13osti/51995.pdf.

5. CON EDISON'S NPA PROCESS SHOULD BE SHORED UP

Q. What are Non-Pipeline Alternatives?

A. NPAs are collections of distributed energy resources and other measures, often at the premises of end-use customers, that can meet the reliability need without new gas infrastructure investments.

Q. What guidance has the Commission provided regarding the use of NPAs?

A. According to the March 19, 2020 Order Instituting Proceeding in Case 20-G-0131, NPAs[42] "include temporary supply, energy efficiency, electrification, and clean demand response" to "reduce or eliminate the need for gas infrastructure and investments."[43] The recent Gas Planning Order calls for long-term plans that consider energy efficiency and NPAs, and the utility must include an NPA-only scenario unless the it presents sufficient evidence that an NPA-only scenario is not feasible. Alternatives (including NPAs) are to be compared based on benefit-cost analysis, bill impact analysis, and emissions impacts.

Q. Has Con Edison proposed a framework for consideration of NPAs?

A. Yes. In September 2020, Con Edison proposed a framework for consideration of NPAs that involves the following steps:

1) identifying system needs;

[42] NPAs were called Non-Pipeline Solutions in this Order.
[43] State of New York Public Service Commission. Order Instituting Proceeding, March 19, 2020. Case 20-G-0131, p. 7.

2) screening system needs for suitable NPA candidates, considering the costs, size of the load relief needed, location, and available timeline for addressing the need;

3) assessing NPA measures and developing diverse NPA portfolios based on cost-effectiveness, execution risks, peak reduction, timeliness, community impacts, alignment with state policy, and other factors;

4) procuring and implementing the NPA;

5) recovering NPA costs over a 20-year amortization period; and

6) providing performance incentives equivalent to 30 percent of the net benefits of a project, as determined by the benefit-cost analysis.[44]

Q. How does Con Edison propose to assess the cost-effectiveness of NPAs?

A. The benefit-cost analysis will use the Societal Cost Test and include:

- avoided natural gas distribution and transmission investment associated with specific projects developed to mitigate the identified need,
- avoided purchases of natural gas,
- costs associated with the NPA investments, and
- avoided GHG emissions associated with reduction in gas usage in buildings.

[44] Con Edison 2020. Case 19-G-0066.

Con Edison's Gas Benefit-Cost Analysis Handbook, attached to the 2020 NPA framework proposal, calls for using the Weighted Average Cost of Capital ("WACC") for the discount rate.

Q. Do you have any comments on the Company's NPA assessment approach?

A. Yes. Con Edison's Gas BCA Handbook indicates that avoided GHG emissions are based on the GHG emission rate of 117 lbs./MMBtu for demand-side measures, which is the GHG content of gas used in the building.[45] This indicates that avoided fugitive emissions are not included as benefits of the NPA. Methane leakage should be taken into account at the 20-year global warming potential of methane as discussed above, consistent with the CLCPA's requirement that pollutants be measured on a 20-year lifetime.

In addition, we find that NPAs should be considered for all infrastructure investments, with limited exceptions. Electrification technologies are readily available and technically able to displace fuel consumption for residential and many commercial end-uses, including almost all space and water heating. This means that, with adequate lead time, most or nearly all growth-related gas pipeline investment could be avoided with electrification and other demand-side resources. Considering NPAs for all infrastructure investments is consistent with the Commission's directive in the Gas Planning Order that gas utilities include a "no infrastructure" scenario in their long-term plans. While the gas utilities can claim that a "no infrastructure scenario" is not feasible for a particular project

[45] Con Edison. Gas Benefit-Cost Analysis Handbook. Sept. 14, 2020. Case No. 19-G-0066.

or for portion of its long-term plan, such claims must include sufficient documentation to support that assertion.[46]

Consistent with the requirements of the Gas Planning Order,[47] location-specific, long-range demand forecasts are needed to support development of NPAs, so that there is sufficient time to implement them. However, with this rate filing the Company has presented only a short-term load forecast going out to 2025.[48]

We also recommend that the company estimate rate and bill impacts from proposed investments, using a lifetime consistent with the CLCPA timeframe. That is, the lifetime for new gas plant should assume it will be fully depreciated by 2050, in line with the Commission's requirement for scenarios with full plant depreciation by that year.

Q. What does Con Edison consider as exceptions for consideration of NPAs?

A. In Case 19-G-0066, Con Edison stated that NPAs are not suitable for addressing non-distribution infrastructure (such as information technology), emergent safety issues, and regulatory requirements.[49] These exceptions are reasonable on their face. However, unless it involves an imminent safety issue, NPAs should be considered for all infrastructure investments before any exceptions are applied. The emphasis on NPAs will help mitigate the considerable risk of stranded assets in the future. In practice, there may be opportunities to resize or avoid traditional investments of the types Con Edison proposes to exclude. For example, if there is enough lead time, investments for

[46] Ibid.
[47] Gas Planning Order at p. 36.
[48] See Gas Forecasting Panel Testimony and Exh GFP-1 to GFP-4.
[49] Con Edison 2020. Case 19-G-0066.

compliance with regulations regarding minimum pressures or the like might be avoided by NPAs that retire the asset rather than increase pressure.

Q. Is Con Edison proposing any NPAs in the rate case?

A. The Company is seeking cost recovery for some NPA proposals initially made in Case No. 19-G-0066 in December 2021. These NPAs include:

1. Main Replacement NPA Program
2. Soundview in the Bronx
3. Port Chester in Westchester
4. Bayside in Queens

Q. What is the Main Replacement NPA Program?

A. This program involves identifying mains where the elimination of the segment will have no detrimental impacts on system safety or reliability, and procuring NPAs by converting gas uses for customers currently connected to the main to electricity. This approach eliminates the need to replace the main and has the potential to demonstrate the effectiveness of the approach that we described earlier in our testimony.

Q. What are the Soundview, Port Chester, and Bayside NPAs?

A. Con Edison is exploring use of NPAs in Soundview, Port Chester, and Bayside to mitigate projected system constraints in these areas.

In the Soundview neighborhood of the Bronx, Con Edison identified potential future capacity constraints with two regulator stations and developed a traditional solution to

rebuild them to be in service by 2024. Similarly, the Company forecasts constraints on two regulator stations in Port Chester in Westchester. In this case, the traditional infrastructure solution would involve a new regulator, upgrades to the existing regulators stations, and a new supply main that would need to be in service by 2025.[50] In December 2021, Con Edison issued a request for NPA proposals for Soundview and Port Chester. In Bayside, the Company forecasts a need to replace 8,000 feet of low-pressure gas mains with new high-pressure mains by 2025. As of December, the Company was in the process of determining the viability of an NPA solution by constructing a preliminary indicative solution portfolio.[51]

Q. Is Con Edison proposing any other NPAs?

A. Yes. The Company is also proposing the Mount Vernon RNG interconnection facility as an NPA. In response to a request for proposals for non-pipeline solutions, Con Edison selected the Mount Vernon RNG project, which would produce RNG from food waste (GIOSP-1, p. 117). Con Edison plans to install equipment, including metering, gas quality measurement, odorant measurement and remote shutdown, to support the interconnection to this RNG facility. The project is forecast to cost $1.5 million.

Q. Do you have concerns with any of these NPA proposals?

A. Yes. It is not appropriate to treat the Mount Vernon RNG interconnection facility as an NPA, since (1) it relies on traditional infrastructure and (2) the RNG will not benefit

[50] Con Edison 2021. Case 19-G-0066.
[51] Con Edison 2021. Case 19-G-0066.

customers in general. As discussed in Section 4.2, Con Edison will not retain the environmental attributes of the RNG, which means that the project is justified solely on its ability to relieve system constraints and not on the grounds of environmental compliance. However, the CLCPA Implementation Order clarifies that projects to address pipeline capacity issues do not displace traditional utility capital expenditures and do not fit the definition of an NPA.[52] Thus, this project is not eligible for earnings incentives.

Q. **What do you recommend?**

A. The Mount Vernon project should not be treated as an NPA, and thus there should be no incentive for Con Edison shareholders. Further, Con Edison's proposed NPA process should be reviewed and brought into line with the requirements set forth in the CLCPA Implementation Order and the Gas Planning Order. In addition, we recommend that all infrastructure projects be screened for NPAs, with very limited exceptions.

6. CON EDISON SHOULD DEVELOP AND COMMIT TO A COMPREHENSIVE LONG-TERM PLAN FOR DOWNSIZING THE GAS SYSTEM

Q. Please describe Con Edison's proposal for depreciation of gas plant.

A. Relative to historical depreciation treatment, Con Edison proposes to shorten the book lives for structures and improvements, mains, services, meters, meter installations, house regulators and house regulator installations (Depreciation Panel testimony, p. 31). While

[52] CLCPA Implementation Order, p. 41.

the Depreciation panel recommends shortening the average service lives for these long-lived assets by ten years, the Company proposes to reduce gas service lives by only five years in order to mitigate rate impacts (Depreciation Panel testimony, p. 31 - 41).

Q. Why is the Company making this proposal?

A. The Depreciation Panel states that this proposal is to account for potential impacts of the CLCPA (Depreciation Panel testimony, p. 31).

Q. Has Con Edison provided a long-term plan for how it will address the CLCPA?

A. Yes, although it is not a comprehensive, stakeholder-vetted plan. In response to DPS Set 13, question 415, Con Edison points to its Gas Long Range Plan (GLRP)[53] as its outline for achieving 2050 goals. But this plan has not been the subject of a stakeholder process, and the underlying modeling has not been provided. Review of the plan and the underlying modeling, including associated inputs, assumptions, and methodologies, is important for ensuring a robust plan that is reasonably likely to achieve its goals. The planning processes ordered by the Commission's Gas Planning Order and CLCPA Implementation Order will result in more robust planning in the next few years, between now and Con Edison's next rate case.

[53] Con Edison 2022. Long-Range Plan: A Comprehensive View of Our Gas System through 2050. Available at https://www.coned.com/en/our-energy-future/our-energy-vision/long-range-plans.

Q. What should a plan for meeting the requirements of the CLCPA include?

A. As we described in our report filed in the gas planning docket and titled, "Long-Term Planning to Support the Transition of New York's Gas Utility Industry," plans should include the following:

- The long-range vision for the industry as a whole
- Load forecasts
- Supply resource forecasts
- Resource and capacity gap analysis for system constraints and meeting the long-term GHG targets
- Assessment of impacts of switching to electricity on electric load, in conjunction with electric utilities
- Options for meeting system capacity constraints
- Long-term scenario analysis
    - Options for achieving the long-term vision, including gas supply options, gas alternative options, electricity alternative options, and demand-side options (including NPAs and the MRP)
    - Scenarios for using the options to achieve the long-term vision, including scenarios with fossil gas completely replaced by non-fossil gas alternatives (grounded in realistic assumptions about potential feedstock

constraints and CLCPA-compliant methane emissions accounting) or electricity

- Description of how the different scenarios are evaluated and optimized
- A preferred scenario
- An assessment of customer impacts, including bill impacts, customer fuel-switching, and customer equity

- An action plan for meeting system capacity constraints and the long-term state GHG targets

Notably, these recommendations are echoed in the requirements of the Gas Planning Order and the CLCPA Implementation Order.

Q. What is the purpose of this long-range plan?

A. In addition to providing options and a plan for meeting the requirements of the CLCPA, the long-term gas plan should form the basis of demonstrating that specific investments in GHG abatement options are cost-effective. For this assessment, the long-range plan should use a societal discount rate. A societal discount rate is consistent with the goals of the long-term gas plans and reflects the regulatory perspective, which is more appropriate in this context than the utility investor perspective represented by the WACC.[54]

[54] See National Energy Screening Project, *The National Standard Practice Manual for Assessing the Cost-Effectiveness of Distributed Energy Resources*, Appendix G, 2020 for more detail.

If the Company chooses to invest in GHG abatement options that are not demonstrated to be cost-effective in the long-term gas plan, these investments could be considered to be imprudent and thus not eligible for cost recovery or for a return.

Q. Does Con Edison's GLRP include these elements?

A. The GLRP provides a start for these elements, but it is only just a start. For example, the plan does not contemplate a range of options, and it does not provide analysis to understand the trade-offs associated with these choices. Further, it lacks any details on supporting analysis, including but not limited to load forecasts, supply resource forecasts, assessment of risks and capacity gaps, and customer impacts associated with different options.

Q. Do you have other concerns about the GLRP?

A. Yes. This plan contemplates that gas capital expenditures will remain at near business-as-usual levels through 2030. Such spending levels are problematic, as they increase investments that may be stranded in the future. Also, supplies of alternative fuels are currently limited, and there is a substantial risk that they may not materialize, may not be cost-effective, or may have higher greenhouse gas and air pollution emissions than the Company anticipates.

Q. Once Con Edison has developed and committed to such a plan, would it be appropriate to consider reducing the depreciation lives of gas assets?

A. Yes. Some mechanism for addressing undepreciated balances should be allowed to mitigate the intergenerational inequities that would result if future customers or taxpayers

are left to pay for a large balance on a gas system with many assets that are no longer used and useful. Con Edison is required to complete updated CLCPA-compliance depreciation studies by the Gas Planning Order. But before an alternative mechanism such as faster depreciation is put into place, Con Edison, in consultation with the Commission and stakeholders, should develop a plan and goals for downsizing the distribution system. Allowing faster depreciation without such a plan leaves open the possibility that current customers will shoulder higher rates for faster depreciation, future customers (including the most vulnerable ones who are unable to electrify their end-uses) will be left with an oversized gas system, and CLCPA targets will not be attained.

Development of the plan we describe should commence immediately since each year that passes means that depreciation lifetimes will need to be shortened that much more, and rates will be higher as a result. Shifting costs to the future will only compound problems. As explained in the Depreciation Panel Testimony, depreciation deferrals increase costs to customers over time in three ways: (1) depreciation or amortization of reserve deficiencies incur additional costs; (2) customers pay a return on reserve deficiencies; and (3) customers departing the gas system would leave remaining customers to shoulder the entire reserve deficiency (Depreciation Panel Testimony, p. 55). Failure to reconcile deprecation book lives with likely actual lives, which might be shorter due to market changes and regulation, would exacerbate the effect of depreciation deferrals. The resulting eventual increases in rates could speed up customer defection from the gas system, further compounding the problem. This possibility underscores the importance of developing a comprehensive, long-term plan for downsizing the system, to guide utility

decision-making and serve as a yardstick for determining prudence of investments. To the extent that Con Edison delays development of the plan, there may be cause to shift risk to shareholders.

Q. What mechanisms can be used to address undepreciated balances?

A. Once the Company has developed and committed to a robust, comprehensive plan, the utility and Commission should consider other depreciation methodologies, such as shortening asset lives or basing depreciation on units of energy delivered. Also, alternative financial mechanisms such as securitization[55] could be explored.

7. CON EDISON'S PROPOSAL TO WAIVE GAS EXTENSION ALLOWANCE RULES REPRESENTS AN IMPORTANT STEP TOWARD ACHIEVING CLCPA OBJECTIVES.

Q. Please describe the regulations governing new customer payments in order to connect to the gas system.

A. Under Public Service Law § 31, customers connecting to the gas system are provided up to 100-feet of main and/or service at no charge (GIOSP testimony p. 56).

Beyond the requirements of the Public Service Law, Section 230.2 of the Commission's regulations requires the gas utilities to provide residential gas heating customers with 100 feet of main and 100 feet of service. For residential non-heating customers and nonresidential customers, Commission regulations require gas utilities to provide a total

[55] Securitization refers to an approach in which undepreciated assets are separated from the rate base and recovered, while earning a bond-like rate of return, from ratepayers or taxpayers. In this approach, overall costs are reduced because of the lower rate of return and potential tax savings due to the deductibility of interest, and the recovery timeframe can be shorter or longer than the asset lifetime in order to meet equity and affordability concerns.

of 100 feet of main and/or service, plus the length of service line necessary to reach the edge of the public right-of way. (GIOSP testimony p. 56)

Notably, the Gas Planning Order requires utilities to report on the cost of the 100 foot rule within 90 days. It also directs DPS Staff to file rulemaking to amend current rules 60 days thereafter.[56]

Q. Please describe Con Edison's proposals regarding interconnection.

A. Con Edison is requesting a waiver from the Commission regulations (16 NYCRR §230.2) that require gas utilities to provide additional piping to new residential heating customers. Con Edison proposes to provide an allowance for a combined total of 100 feet of main and/or service, plus the length of service line necessary to reach the edge of the public right-of-way. The Company's proposal would set the allowance consistently across customer types and usage types. (GIOSP p. 58)

In addition, Con Edison is proposing several changes to its tariff language regarding gas extension allowances. These include:

- removing language in its gas tariff that allows multiple customers seeking to connect to the gas distribution system to pool their installation allowances and avoid connection costs. (GIOSP testimony, p. 55-56)

[56] Gas Planning Order, p. 59.

- eliminating the current provision that reimburses a customer who chooses to pay for a main extension if other customers subsequently connect to that section of main within five years. (GIOSP testimony, p. 56)

- eliminating the "revenue test," which currently allows the connecting customer to avoid costs of connection above the 100 feet allowance if that customer's gas usage is expected to generate revenues above a specified threshold. (GIOSP testimony, p. 56)

- requiring that customers seeking gas service connection acknowledge that they have been provided information on non-fossil alternatives and that they are aware of climate protection laws and regulations. (GIOSP testimony, p. 56)

Q. Is Con Edison proposing to change or deviate from the requirements of the Public Service Law?

A. No.

Q. Do you support these proposals?

A. Yes, we strongly urge the Commission to approve Con Edison's request for a waiver of gas extension allowance rules and to modify tariff language. The phase-out of GHG-emitting fuels required by the CLCPA and other policies means that all policies that enable or encourage new gas connections, investment, and consumption should be scrutinized for their GHG implications. Currently, installation and materials costs covered by the allowance is socialized across all customers in the short term, with the expectation that over time revenues from the new customer will cover these costs. The

current connection allowance policy potentially burdens customers with the risk that some portion of the costs of new main and service lines will not be recovered from new customers, if the new customer exits the gas system before these costs are recovered due to policy or other influence.

Further, once installed these new assets have a large share of value yet to be depreciated, and thus the utility has an incentive for these new main and service lines to be among the last assets to be retired—potentially putting the state's attainment of CLCPA targets in jeopardy.

8. CON EDISON SHOULD MODIFY ITS RATES TO FURTHER ADVANCE ELECTRIFICATION AND DECARBONIZATION GOALS.

Q. What types of electric rate designs can be used to promote beneficial electrification?

A. Electric tariffs with lower volumetric charges can encourage beneficial electrification because customers who adopt technologies such as EVs and heat pumps will typically increase their electricity consumption substantially. Volumetric rates can be reduced by increasing the fixed charge or by implementing demand charges. However, such tariffs should be implemented carefully, as fixed charges and demand charges can work to undermine beneficial price signals in other respects, which we discuss more below.

Q. Is the Company proposing rate designs that could support electrification?

A. Yes. The Company is proposing to continue and expand its innovative pricing pilot (IPP) (Customer Energy Solutions Panel, p. 75-78). These rates feature time-variant demand charges, which recover costs through a combination of volumetric rates (based on

kilowatt-hour consumption) and demand charges (based on maximum kilowatt usage). The demand charges are substantially higher during on-peak periods (non-holiday weekday afternoons and evenings) than off-peak hours, which provides an incentive to customers to shift their usage away from on-peak periods.

Q. Should the Company develop a permanent rate offering to promote electrification?

A. Yes. Continuing and expanding the Company's IPP will provide important information regarding customer behavior and acceptance of various rate design options, which can inform the development of a future electrification rate. Although we do not endorse any particular rate design proposed or piloted by the Company at this time, we support the Company's proposal to test rate designs that could be beneficial to customers who electrify. We also note that such innovative rate designs are called for in the Gas Planning Order.

Q. What principles should the Commission consider when reviewing rate designs intended to promote electrification?

A. Rate designs intended to promote electrification should:

1) Encourage customers to invest in controllable technologies or otherwise shift usage to lower-cost and lower-emissions hours.[57] Examples of such rates include time-of-use rates and critical peak pricing.

[57] For example, heat pump water heaters with advanced settings can respond to time-varying rates by heating during off-peak hours and storing the energy in the form of hot water for future use.

2) Avoid perverse incentives. For example, non-coincident demand charges could discourage customers from using beneficial electrification technologies during off-peak hours, even though there may be excess renewable energy on the grid at that time. Likewise, rates that are overly reliant on fixed charges may result in inefficient consumption of electricity.

3) Provide customers who adopt beneficial electrification technologies with operational cost savings relative to using technologies with higher GHG emissions.

Q. Please explain your statement that rates with higher fixed charges and demand charges should be implemented with care.

A. High fixed charges and demand charges can have unintended consequences if not implemented in a strategic manner for the following reasons:

- By shifting recovery of costs away from volumetric rates, higher fixed charges and demand charges can encourage customers to consume more electricity. Greater electricity consumption is in the public interest when it replaces more carbon-intensive fuels through beneficial electrification, but not when it is merely a result of less efficient energy use. Lower volumetric rates also reduce incentives for traditional energy efficiency and conservation measures, potentially reducing the effectiveness of these programs.

- For residential customers, most of the distribution system is sized based on the combined demand of multiple customers, rather than an individual customer's maximum demand. Thus, demand charges during off-peak periods may not be

cost reflective and, if large enough, could even discourage adoption of certain technologies (such as electric vehicles).

- Finally, demand charges and higher fixed charges can have detrimental impacts on residential customers, and thus should never be mandatory. In particular, low-income customers tend to have lower-than-average usage and could be harmed by tariffs that shift cost recovery away from volumetric rates. Demand charges can also be difficult for customers to understand, resulting in customer confusion.

For the reasons listed above, it is important that such rate structures be targeted to customers who invest in beneficial electrification technologies, rather than to all customers universally.

Q. Should electrification rates be available to master-metered multi-family dwellings?

A. Yes. Not all heat pump systems lend themselves to submetering – particularly those that use centralized systems to serve multiple units with a single outdoor unit. Further, even when central boilers are replaced with unitary heat pumps, the submetering process is complex and may be a deterrent to landlords since petitions to submeter must be accompanied by monthly reductions to rental charges.[58] Given that rental units comprise an estimated two-thirds of New York City's housing stock,[59] it is vital to ensure that

[58] N.Y. Comp. Codes R. & Regs. tit. 16 § 96.5 (e)(1), available at https://casetext.com/regulation/new-york-codes-rules-and-regulations/title-16-department-of-public-service/chapter-ii-electric-utilities/subchapter-a-service/part-96-residential-electric-submetering/section-965-notice-of-intent-to-submeter-and-petition-to-submeter-contents

[59] Urban Green Council. Going Electric: Retrofitting NYC's Multifamily Buildings. April 2020. Available at https://www.urbangreencouncil.org/sites/default/files/urban_green_going_electric_4.22.2020.pdf.

landlords are provided with sufficient price signals, in combination with available Clean Heat program incentives, to overcome the high up-front costs associated with converting to heat pumps.

Q. Do the natural gas tariffs proposed by the Company support decarbonization objectives?

A. Yes, to some extent. For SC 2 and SC 3, the Company is beginning to flatten the declining block rate structure (Gas Panel, p. 29). Reduction of the rate discount for higher usage blocks will encourage customers to use less gas and improve incentives to invest in beneficial electrification technologies. However, the Company's proposal does not go far enough.

Q. Why do you maintain that the Company's proposal to begin to flatten the declining block gas rate does not go far enough?

A. The Company's proposal reduces the price differential between usage blocks by 17 percent, which has a very mild impact on the final rates and bill impacts and results in both high-usage and moderate-usage customers experiencing nearly the same overall bill increase on a percentage basis.[60]

Although the Company appears to be taking this gradual approach in an effort to mitigate bill impacts for higher-usage customers, bolder action is needed to move away from carbon-intensive fuels. Further, the Company's proposal mitigates bill impacts for a tiny

[60] For example, an SC 3 customer consuming 100 therms would experience a 19% bill increase, while a customer consuming 10,000 therms would experience a 20% bill increase, as shown in Workpaper for Ex (GRP-3), sheet "FS BT-SC3."

fraction of extremely high usage natural gas customers at the expense of the multitude of low- and moderate-usage customers.

Q. How many customers benefit from the Company's declining block rates?

A. According to the data we analyzed, less than 3 percent of customers on SC 2 and SC 3 actually benefit from the Company's declining block rates.[61] Median January usage is less than 300 therms on rate schedule SC 2 and less than 200 therms on rate schedule SC 3,[62] yet the Company's proposal to maintain the declining block rate only benefits customers who use more than 3,000 therms.[63]

Q. What do you propose with respect to the declining block rate structure for gas rates?

A. We recommend that:

- In the instant proceeding, the Company reduce the price differential between blocks by 50 percent. This would strike a balance between mitigating rate impacts for the highest usage customers and moving more quickly away from rates that promote greater gas consumption.
- As part of its next rate case application, the Company commit to the following:
    - Eliminating the declining block rate structure

[61] Calculated based on January 2019 consumption levels and number of customers reported in response to UIU 2-52, Attachment 3 Gas, and rate impacts calculated using Workpaper for Ex (GRP-3).
[62] Based on number of customers and therm use over 30 days in January 2019 provided in response to UIU 2-52.
[63] Calculated based on Workpaper for Ex (GRP-3).

- Consider implementing an inclining block rate structure
- Develop a proposal for mitigating bill impacts for large usage customers who would be adversely impacted by the elimination of the declining block rate. Such mitigation measures could include electrification programs targeted to these customers, or a proposal to move these customers into a separate rate class.

Q. Does this conclude your direct testimony?

A. Yes, it does.

EXHIBITS

Alice Napoleon, Principal Associate

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Inc., Cambridge, MA. *Principal Associate*, June 2021 – Present; *Senior Associate*, June 2013 – June 2021; *Associate*, July 2008 – June 2013; *Research Associate*, April 2005 – July 2008.

- Provides expert analysis, ongoing stakeholder support, and consulting services in regulatory proceedings regarding energy efficiency program design and performance, funding and incentive mechanisms, cost-effectiveness screening, potential studies, and plans. Develops and sponsors testimony on electric and natural gas energy efficiency plans, advanced metering infrastructure (AMI) proposals, innovative programs, and regulatory structures.
- Researches policies and practices regarding ratemaking for energy efficiency, power procurement, risk management, and fuel diversity.
- Managed efforts by Synapse and subcontractors to conduct a sweeping study of the disparate impacts of electric and natural gas infrastructure on economic, social, and health outcomes, and options for improving energy equity. Conducted interviews and oversaw research, including a literature review, web meetings, and several case studies.
- Conducted extensive research on low-income energy efficiency efforts in U.S. states. Analyzed energy burden differences by income level and across factors that can impact participation in and efficacy of energy efficiency programs in order to inform program design and targeting efforts. Provided consulting services and testimony on low-income energy efficiency programs and proposals.
- Led development of a cost-effectiveness tool, program designs, and case studies to facilitate incorporating strategic energy management programs into energy efficiency program portfolios for commercial and industrial customers.
- Designed research approach and managed team that conducted a sweeping analysis of energy efficiency potential studies from utilities, states, and regions across the U.S.
- Conducted research and co-authored reports on efforts to increase resilience of the electric system, including emerging regulatory mechanisms. Designed survey instrument and oversaw interviews.
- Facilitated residential, commercial, and industrial policy working groups and managed technical analysis of working group recommendations to reduce greenhouse gas (GHG) emissions in Colorado, South Carolina, and Maryland.

Resource Insight, Inc., Arlington, MA. *Research Assistant*, 2003-2005.

Responsible for conducting research and analysis of electric, gas, steam, and water resource issues. Conducted discounted cash flow analysis for asset valuation. Developed market-price benchmarks for analysis of power-supply bids including energy, capacity, ancillary services, transmission, ISO services, losses, and adjustment for load shape. Prepared discovery responses, formal objections, comments, and testimony; collaboratively wrote and edited reports; created and formatted exhibits. Participated in drafting an Energy Plan for New York City. Edited solicitation for competitive power supply to serve aggregated municipal load.

University of Massachusetts, Amherst, MA. *Teaching Assistant*, 2001-2002.

Developed and taught lessons on applied math to a diverse group of incoming graduates; tutored students in microeconomic theory and cost benefit analysis; graded problem sets and memoranda.

International Council for Local Environmental Initiatives, Berkeley, CA. *Cities for Climate Protection Intern for the City of Northampton, MA*, 2001.

Compiled primary and secondary source data on energy consumption and solid waste generation by the municipal government, city residents, and businesses; applied emissions coefficients to calculate total GHG emissions; identified current and planned municipal policies that impact GHG emissions; researched the predicted local effects of global warming; gathered public feedback to provide acceptable and proactive policy alternatives. Composed a GHG emissions inventory describing research findings; wrote and distributed a policy report and press releases; gave newspaper and radio interviews; addressed public officials and the public during a televised meeting.

University of Massachusetts, Amherst, MA. *Research Assistant*, 2000-2001.

Located federal data sources, identified changes, and updated a research database to evaluate the Habitat Conservation Program; proofread articles and white papers; composed a literature review on land use modelling. Collaboratively administered, tested, and proposed interface enhancements for a web-based data warehouse of regional habitat change research; formally presented the system to an independent research group.

Court Square Data Group, Inc., Springfield, MA. *Administration Manager*, 1998-2000; *Project Administrator*, 1996-1998.

As Administration Manager, analysed profitability and diversity of income sources; managed cash flow, expense, and income data; created budgets; devised and implemented procedures to increase administrative efficiency; implemented new accounting system with minimal disruption to workflow.

As Project Administrator, coordinated implementation of software features; identified opportunities for future development; monitored problem resolution; wrote and coordinated production of a user's manual and questionnaires; edited technical proposals and a business plan.

EDUCATION

University of Massachusetts, Amherst, MA
Master of Public Administration, 2002

Rutgers University, New Brunswick, NJ
Bachelor of Arts in Economics, 1995

Syracuse University, Syracuse, NY, 1994

PUBLICATIONS

Hopkins, A. S., A. Napoleon, K. Takahashi. 2021. *A Framework for Long-Term Gas Utility Planning in Colorado*. Synapse Energy Economics for the Colorado Energy Office.

Kallay, J., A. Napoleon, K. Takahashi, E. Sinclair, T. Woolf. 2021. *Opportunities for Evergy Kansas to Address Energy Equity Within its Integrated Resource Plan and Other Planning Processes*. Synapse Energy Economics for Union of Concerned Scientists.

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Steinhurst, W., A. Napoleon, K. Takahashi. 2006. *Energy in the Northern Forest Region: A Situation Analysis*. Synapse Energy Economics for Northern Forest Center and The North Country Council.

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Fagan, R., A. Napoleon, A. Rochelle, A. Sommer, W. Steinhurst, D. White. K. Takahashi. 2006. *Mohave Alternatives and Complements Study: Assessment of Carbon Sequestration Feasibility and Markets.* Sargent & Lundy and Synapse Energy Economics, Inc. for Southern California Edison.

TESTIMONY

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Pennsylvania Public Utility Commission (Docket No. M-2020-3020830): Direct testimony of Alice Napoleon and Courtney Lane regarding PECO Energy Company's proposed Act 129 Phase IV Energy Efficiency and Conservation Plan. On behalf of the natural Resources Defense Council. January 14, 2021.

Nova Scotia Utility and Review Board (Matter No. M09519): Evidence of Alice Napoleon regarding Nova Scotia Power's Smart Grid Nova Scotia Project proposal. On behalf of Counsel to the Nova Scotia Utility and Review Board. February 19, 2020.

New York Public Service Commission (Cases 20-E-0380 and 20-G-0381): Direct testimony of Alice Napoleon and Kenji Takahashi regarding proposed earnings adjustment mechanisms in a proceeding on Rates, Charges, Rules, and Regulations related to Niagara Mohawk Power Corporation d/b/a National Grid for Electric Service and National Grid for Gas Service. On behalf of the Natural Resources Defense Council. November 25, 2020.

California Public Utilities Commission (Application Nos. 19-11-003, 19-11-004, 19-11-005, 19-11-006): Prepared Testimony of Alice Napoleon addressing proposals of Pacific Gas and Electric Company, San Diego Gas & Electric Company, Southern California Edison Company, and Southern California Gas

Company related to the Energy Savings Assistance (ESA) Program and Budgets for Program Years 2021-2026. On behalf of The Utility Reform Network. September 4, 2020.

California Public Utilities Commission (Application Nos. 19-11-003, 19-11-004, 19-11-005, 19-11-006, 19-11-007): Comments of The Utility Reform Network on the Energy Division Staff Proposal and Utility Applications. On behalf of The Utility Reform Network. July 24, 2020.

Nova Scotia Utility and Review Board (Matter No. M09096): Evidence of Alice Napoleon regarding EfficiencyOne's 2020-2022 DSM Plan. On behalf of Counsel to the Nova Scotia Utility and Review Board. May 28, 2019.

New York Public Service Commission (Cases 19-E-0065 and 19-G-0066): Direct testimony of Tim Woolf and Alice Napoleon regarding energy efficiency targets and incentives in Con Edison rate case. On behalf of the Natural Resources Defense Council. May 24, 2019.

Nova Scotia Utility and Review Board (Matter No. M08604): Evidence of Alice Napoleon regarding the 2019 Demand Side Management Resource Plan. On behalf of Counsel to the Nova Scotia Utility and Review Board. June 13, 2018.

Nova Scotia Utility and Review Board (Matter No. M08349): Evidence of Alice Napoleon regarding Nova Scotia Power's Advanced Meter Infrastructure Proposal. On behalf of Counsel to the Nova Scotia Utility and Review Board. January 18, 2018.

Nova Scotia Utility and Review Board (Case No. M07767): Direct evidence in the matter of the Nova Scotia Power Advanced Meter Infrastructure Pilot. On behalf of Counsel to the Nova Scotia Utility and Review Board. February 16, 2017.

Public Service Commission of South Carolina (Docket No. 2016-223-E): Direct Testimony of Alice Napoleon regarding South Carolina Electric and Gas Energy Efficiency Efforts. On behalf of South Carolina Coastal Conservation League. September 1, 2016.

Nova Scotia Utility and Review Board (Case No. M06247): Direct evidence in the matter of an application by Efficiency Nova Scotia Corporation for approval of its electricity demand-side management plan for 2015. On behalf of Counsel to the Nova Scotia Utility and Review Board. July 14, 2014.

TESTIMONY ASSISTANCE

Public Service Commission of South Carolina (Docket No. 2017-2-E): Direct Testimony of Thomas Vitolo, PhD regarding Avoided Cost Calculations and the Costs and Benefits of Solar Net Energy Metering for South Carolina Electric & Gas Company. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. March 22, 2017.

State of New Jersey Board of Public Utilities (Docket No. ER16060524): Direct testimony of Tim Woolf regarding the Petition of Rockland Electric Company for Approval of an Advanced Metering Program, and for Other Relief. On behalf of New Jersey Division of the Ratepayer Advocate. September 9, 2016.

Nova Scotia Utility and Review Board (Matter No. M06733): Direct testimony of Tim Woolf regarding EfficiencyOne's 2016-2018 demand-side management plan. On behalf of the Nova Scotia Utility and Review Board. June 2, 2015.

Missouri Public Service Commission (File No. EO-2015-0055): Rebuttal and surrebuttal of Tim Woof on the topic of Ameren Missouri's 2016-2018 Energy Efficiency Plan. On behalf of Sierra Club. March 20, 2015 and April 27, 2015.

State of New Jersey Board of Public Utilities (Docket No. EO14080897): Direct testimony of Kenji Takahashi regarding the Petition of Public Service Electric & Gas Company to continue its Energy Efficiency Economic Extension Program on a Regulated Basis (EEE Extension II). On behalf of New Jersey Division of the Ratepayer Advocate. November 7, 2014.

Kentucky Public Service Commission (Case No. 2014-00003): Direct testimony of Tim Woof regarding Louisville Gas and Electric Company and Kentucky Utilities Company's proposed 2015-2018 demand-side management and energy efficiency program plan. On behalf of Wallace McMullen and the Sierra Club. April 14, 2014.

State of New Jersey Board of Public Utilities (Docket No. GO12050363): Direct testimony of Maximilian Chang regarding South Jersey Gas Company's proposal to extend and modify its energy-efficiency programs. On behalf of New Jersey Division of the Ratepayer Advocate. November 9, 2012.

State of New Jersey Board of Public Utilities (Docket No. GO12070640): Direct testimony of Robert Fagan regarding New Jersey Natural Gas Company's petition for approval of the extension of the SAVEGREEN energy efficiency programs. On behalf of the New Jersey Division of the Ratepayer Advocate. October 26, 2012.

State of New Jersey Board of Public Utilities (Docket No. GO11070399): Direct testimony of Robert Fagan regarding Elizabethtown Gas Company's Proposed Energy Efficiency Program. On behalf of New Jersey Division of the Ratepayer Advocate. December 16, 2011.

State of New Jersey Board of Public Utilities (Docket No. GR11070425): Direct testimony of Robert Fagan regarding New Jersey Natural Gas Company's petition for approval of the extension of the SAVEGREEN energy efficiency programs. On behalf of the New Jersey Division of the Ratepayer Advocate. November 16, 2011.

State of New Jersey Board of Public Utilities (Docket No. GR10030225): Direct testimony of David Nichols regarding New Jersey Natural Gas Company's Proposed Energy Efficiency Program. On behalf of New Jersey Division of the Ratepayer Advocate. July 9, 2010.

Virginia State Corporation Commission (Case No. PUE-2009-00097): Direct testimony of William Steinhurst regarding Appalachian Power Company's Integrated Resource Plan filing pursuant to Va. Code

§ 56-597 et seq. On behalf of the Southern Environmental Law Center, Chesapeake Climate Action Network, Appalachian Voices, and the Virginia Chapter of The Sierra Club. March 23, 2010.

Delaware Public Service Commission (Docket No. 07-20): Jointly authored an expert report, with Robert Fagan, William Steinhurst, David White, and Kenji Takahashi, In the Matter of Integrated Resource Planning for the Provision of Standard Offer Service by Delmarva Power & Light Company Under 26 DEL. C. §1007 (c) & (d). On behalf of the Staff of Delaware Public Service Commission. April 2, 2009.

State of New Jersey Board of Public Utilities (BPU Docket EM05020106): Direct and surrebuttal testimony of Bruce Biewald, Robert Fagan, and David Schlissel regarding the Joint Petition Of Public Service Electric and Gas Company And Exelon Corporation For Approval of a Change in Control Of Public Service Electric and Gas Company And Related Authorizations. On behalf of New Jersey Division of the Ratepayer Advocate. November 14, 2005 and December 27, 2005.

Illinois Commerce Commission (Dockets 05-0160, 05-0161, 05-0162): Direct testimony of William Steinhurst regarding Ameren's proposed competitive procurement auction (CPA). On behalf of Illinois Citizens Utility Board. June 15, 2005 and August 10, 2005.

Illinois Commerce Commission (Docket 05-0159): Direct testimony of William Steinhurst regarding Commonwealth Edison's Proposal to implement a competitive procurement process. On behalf of Illinois Citizens Utility Board and Cook County State's Attorney's Office. June 8, 2005 and August 3, 2005.

Resume updated January 2022.

Asa S. Hopkins, **Ph.D.,** Vice President

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Vice President*, April 2019 – present, *Principal Associate*, January 2017 – March 2019.

Conducts research and writes expert testimony and reports related to state energy policy and planning, energy efficiency, strategic electrification, deep decarbonization, and the present and future of electric and gas utility regulatory and business models.

Vermont Public Service Department, Montpelier, VT. *Director of Energy Policy and Planning,* October 2011 – December 2016

State energy planning and utility regulation

- Directed the year-long development of the 2016 Vermont Comprehensive Energy Plan, including stakeholder meetings, public forums, and coordination of contributions from other departments and the Governor's office. Primary author of the executive summary and five chapters.
- Led the Department's approach to establishing budgets and performance targets for energy efficiency utilities. Oversaw staff conducting program evaluation and savings verification.
- Submitted testimony and conducted analysis in support of public advocacy and negotiation in prominent litigated regulatory proceedings.

Policy development, analysis, and advocacy

- Developed the structure of Vermont's 2015 Renewable Energy Standard, including its novel "energy transformation" requirement. Worked with stakeholders to develop support for the policy and with the legislature to shepherd it to passage. This policy will result in more reduction of Vermont's GHG emissions than any others passed in the last 15 years.
- Led execution of Vermont's Total Energy Study, which examined technology and policy pathways for Vermont to meet GHG emission and renewable energy goals.
- Led cost-benefit analysis of Vermont's existing net metering structure and led the development of departmental proposals for a new structure.
- Prepared and delivered public, stakeholder, and interagency presentations, including to agency and business leaders, legislative committees, and the governor.
- Oversaw programs providing financing, technical, and process assistance to clean energy projects.

During tenure, Vermont rose in the rankings on national clean energy state scorecards: ACEEE State Energy Efficiency Scorecard from 5th to 3rd and U.S. Clean Tech Leadership Index from 10th to 3rd.

U.S. Department of Energy, Washington, DC. *Special Advisor to the Under Secretary for Science / AAAS Science and Technology Policy Fellow,* September 2010 – August 2011

Dr. Hopkins served as the assistant project director for the Department of Energy's first Quadrennial Technology Review. In this role, he coordinated a team that solicited input from Department of Energy and National Laboratory staff and scientists, ran a series of public workshops, facilitated coordination with the White House, developed a set of technology assessments, and ultimately drafted the Report on the First QTR, published Sept. 27, 2011.

Lawrence Berkeley National Laboratory, Berkeley, CA. *Environmental Energy Policy Postdoctoral Fellow*, January 2009 – August 2010

Conducted technical and economic analysis to support the Department of Energy in setting the energy efficiency standards that appliances must meet in order to be sold in the United States.

California Institute of Technology, Pasadena, CA. *Graduate Research Fellow,* 2002 – 2008

Los Alamos National Laboratory, Los Alamos, NM. *Post-Baccalaureate Researcher, Theoretical Division,* June 2001 – June 2002

EDUCATION

California Institute of Technology, Pasadena, CA
Doctor of Philosophy in Physics, 2008

Haverford College, Haverford, PA
Bachelor of Science in Physics with minors in Computer Science, Growth and Structure of Cities, 2001

SELECTED PROJECTS

The Future of Gas Utilities – Synapse is assisting a number of clients to understand the future of gas utilities in the context of deep building decarbonization objectives. This work includes assisting Conservation Law Foundation in Massachusetts Department of Public Utilities Docket 20-80 (an investigation into "the role of gas local distribution companies as the Commonwealth achieves its target 2050 climate goals"); Natural Resources Defense Council in New York and Nevada's regulatory proceedings regarding the future of gas; the Colorado Energy Office regarding approaches to decision-making in the face of uncertainty, in the context of Colorado's regulatory proceedings regarding gas utility Clean Heat plans and building decarbonization; the Maryland Office of People's Counsel in modeling the impact of the state's decarbonization objectives on utility sales and finances; and the District of Columbia Department of Energy and Environment in assessing Washington Gas Light's Climate Business Plan.

Massachusetts Comprehensive Energy Plan – On behalf of the Massachusetts Department of Energy Resources (the state energy office), Synapse and Sustainable Energy Advantage assisted DOER and its

sister agencies in the development of Massachusetts's first Comprehensive Energy Plan. Dr. Hopkins assisted DOER leadership in defining the scope and approach for the CEP, to distinguish it from other state planning processes. He worked with Pat Knight to develop an approach to modeling energy transformations toward low-carbon alternatives in electricity, buildings, and transportation that are consistent with state policy and approaches while being grounded in stock turnover rates and feasible policies and programs.

Northeastern Regional Assessment of Strategic Electrification – On behalf of the Northeast Energy Efficiency Partnerships, Synapse and Meister Consultants Group identified the opportunity, costs, and benefits available if strategic electrification is adopted as a key strategy for decarbonization in New York and New England. Dr. Hopkins, Kenji Takahashi, and Pat Knight are primary authors of the resulting report, published in July 2017, which characterizes the current markets for efficiency electrification technologies (such as heat pumps and electric vehicles), identifies policies to overcome market barriers, assesses the state of electrification technologies, and models the extent of electrification both possible given market dynamics and required to meet regional greenhouse gas emission goals.

2016 Vermont Comprehensive Energy Plan – Directed the year-long development of the 2016 plan, including setting its strategic approach to current Vermont energy planning challenges and grounding it in quantitative analysis. Developed the public engagement process, then hosted expert stakeholder meetings and public forums. Adapted the results of the 2014 Total Energy Study to produce scenarios that illustrate the proposed pathways identified in the plan. Coordinated contributions from staff and leaders in other departments, and from the Governor's office. Wrote the executive summary and 5 of the 14 chapters.

Total Energy Study – Scoped and led a legislatively-mandated report on policy and technology pathways to meet Vermont's renewable energy and greenhouse gas emission goals. Designed and facilitated a focus-group-based stakeholder engagement process to identify technology and policy visions for analysis. Retained outside modeling consultant, then worked closely with them to build credible business-as-usual and policy case models of Vermont's energy economy to the year 2050 using the TIMES/FACETS integrated assessment model. Translated those model results to make REMI PI+ calculations of impact on Vermont GDP and jobs. Synthesized qualitative and quantitative results into intermediate and final reports identifying key outcomes for policy design.

Demand Resources Plan Proceedings – In each of three, three-year cycles, led the development of the Department of Public Service's positions regarding appropriate budgets, rate and bill impacts, and performance targets for Vermont's energy efficiency utilities. Analyzed current efficiency utility performance to calibrate expected future performance. Negotiated performance metrics that reflect policy priorities. Developed new regulatory and budget treatment of research and development for behavioral energy efficiency programs.

Quadrennial Technology Review – As Assistant Project Director, managed the project activities of the eight-person core team for the U.S. Department of Energy's first Quadrennial Technology Review. This

review of DOE's energy technology activities established a robust framework and codified principles used to build DOE's energy technology portfolio (including identifying the appropriate and highest-leverage activities for DOE relative to the private sector and other government actors). Extensive collaboration and discussions within DOE, as well the public through a series of workshops with industry, government, national laboratory, and academic participation, culminated in the publication of the first DOE-QTR report in September 2011. Coordinated successful stakeholder workshops; facilitated focus groups. Drafted discussion papers that served as the basis for extensive intra- and inter-agency and White House coordination and negotiation. Primary author of the final report's section on building and industrial energy efficiency. Project was completed on schedule and on budget, and met its critical milestones.

REPORTS

Hopkins, A. S., A. Napoleon, K. Takahashi. 2021. A Framework for Long-Term Gas Utility Planning in Colorado. Synapse Energy Economics for the Colorado Energy Office.

Hopkins, A. S., A. Napoleon, K. Takahashi. 2021. *A Framework for Long-Term Gas Utility Planning in Colorado.* Synapse Energy Economics for the Colorado Energy Office.

Woolf, T. A, Napoleon, A. Hopkins, K. Takahashi. 2021. *Long-Term Planning to Support the Transition of New York's Gas Utility Industry*. Synapse Energy Economics for Natural Resources Defense Council.

Frost, J., J. Litynski, S. Letendre, A. S. Hopkins. 2021. *Economic Impacts of Climate Change on Cape Cod*. Synapse Energy Economics for Eastern Research Group and the Cape Cod Commission.

Hopkins, A.S., P. Knight, J. Frost. 2021. *Rhode Island Carbon Pricing Study.* Synapse Energy Economics and the Cadmus Group for the Rhode Island Office of Energy Resources.

Hopkins, A.S., S. Letendre, J. Litynski. 2021. *Economic Impacts of Climate Change on Cape Cod*. Synapse Energy Economics and Eastern Research Group for the Cape Cod Commission.

Kallay, J., A.S. Hopkins, C. Odom, J. Ramey, J. Stevenson. R. Broderick, R. Jeffers, B. Garcia. 2021. *The Quest for Public Purpose Microgrids for Resilience: Considerations for Regulatory Approval.* Synapse Energy Economics for Sandia National Labs.

Takahashi, K., E. Sinclair, A. Napoleon, A. S. Hopkins, D. Goldberg. 2021. *Evaluation of EnergyWise Low-Income Energy Efficiency Program in Mississippi – Program Performance, Design, and Implications for Low-Income Efficiency Programs*. Synapse Energy Economics for Sierra Club and Gulf Coast Community Foundation.

Kallay, J., A. Napoleon, J. Hall, B. Havumaki, A. S. Hopkins, M. Whited, T. Woolf, J. Stevenson, R. Broderick, R. Jeffers, B. Garcia. 2021. *Regulatory Mechanisms to Enable Investments in Electric Utility Resilience.* Synapse Energy Economics for Sandia National Laboratories.

Kallay, J., A. Napoleon, B. Havumaki, J. Hall, C. Odom, A. S. Hopkins, M. Whited, T. Woolf, M. Chang, R. Broderick, R. Jeffers, B. Garcia. 2021. *Performance Metrics to Evaluate Utility Resilience Investments.* Synapse Energy Economics for Sandia National Laboratories.

Kallay, J., S. Letendre, T. Woolf, B. Havumaki, S. Kwok, A. S. Hopkins, R. Broderick, R. Jeffers, K. Jones, M. DeMenno. 2021. *Application of a Standard Approach to Benefit-Cost Analysis for Electric Grid Resilience Investments*. Synapse Energy Economics for Sandia National Laboratories.

Hopkins, A. S., S. Kwok, A. Napoleon, C. Roberto, K. Takahashi. 2021. *Scoping a Future of Gas Study.* Synapse Energy Economics for Conservation Law Foundation.

Kallay, J., A. S. Hopkins, A. Napoleon, B. Havumaki, J. Hall, M. Whited, M. Chang., R. Broderick, R. Jeffers, K. Jones, M. DeMenno. 2021. *The Resilience Planning Landscape for Communities and Electric Utilities.* Synapse Energy Economics for Sandia National Laboratories.

Shipley, J., A. S Hopkins, K. Takahashi, D. Farnsworth, 2021. *Renovating Regulation to Electrify Buildings: A Guide for the Handy Regulator*. Regulatory Assistance Project.

Letendre, S., E. Camp, J. Hall, B. Havumaki, A. S. Hopkins, C. Odom, S. Hackel, M. Koolbeck, M. Lord, L. Shaver, X. Zhou. 2020. *Energy Storage in Iowa: Market Analysis and Potential Economic Impact.* Prepared by Synapse Energy Economics and Slipstream for Iowa Economic Development Authority.

Eash-Gates, P., K. Takahashi, D. Goldberg, A. S. Hopkins, S. Kwok. 2021. *Boston Building Emissions Performance Standard: Technical Methods Overview.* Synapse Energy Economics for the City of Boston.

Camp, E., C. Odom, A. S. Hopkins. 2020. *Cost-Effectiveness of Proposed New Mexico Environment Department Oil and Gas Emissions Reduction Rules: Impacts and Co-Benefits of Reduced Volatile Organic Compound Emissions from the Oil and Gas Industry.* Synapse Energy Economics for Environmental Defense Fund.

Takahashi, K., J. Frost, D. Goldberg, A. S. Hopkins, K. Nishio, K. Nakano. 2020. *Survey of U.S. State and Local Building Decarbonization Policies and Programs*. Presented at the 2020 ACEEE Summer Study of Energy Efficiency in Buildings.

Hopkins, A. S., A. Napoleon, K. Takahashi. 2020. *Gas Regulation for a Decarbonized New York: Recommendations for Updating New York Gas Utility Regulation.* Synapse Energy Economics for Natural Resources Defense Council.

Takahashi, K., A. S. Hopkins, J. Rosenkrantz, D. White, S. Kwok, N. Garner. 2020. *Assessment of National Grid's Long-Term Capacity Report*. Synapse Energy Economics for the Eastern Environmental Law Center.

Camp, E., N. Garner, A. S. Hopkins. 2019. *Cost-Effectiveness of Comprehensive Oil and Gas Emissions Reduction Rules in New Mexico: Impacts of Reduced Methane and Volatile Organic Compound Emissions from the Oil and Gas Industry.* Synapse Energy Economics for the Environmental Defense Fund.

Camp, E., A. S. Hopkins, D. Bhandari, N. Garner, A. Allison, N. Peluso, B. Havumaki, D. Glick. 2019. *The Future of Energy Storage in Colorado: Opportunities, Barriers, Analysis, and Policy Recommendations.* Synapse Energy Office for the Colorado Energy Office.

Kallay, J., A. S. Hopkins, J. Frost, A. Napoleon, K. Takahashi, J. Slason, G. Freeman, D. Grover, B. Swanson. 2019. *Net Zero Energy Roadmap for the City of Burlington, Vermont*. Synapse Energy Economics and Resource Systems Group for Burlington Electric Department.

Camp, E., B. Fagan, J. Frost, D. Glick, A. S. Hopkins, A. Napoleon, N. Peluso, K. Takahashi, D. White, R. Wilson, T. Woolf. 2018. *Phase 1 Findings on Muskrat Falls Project Rate Mitigation.* Synapse Energy Economics for Board of Commissioners of Public Utilities, Province of Newfoundland and Labrador.

Hopkins, A. S., P. Knight, N. Peluso. 2018. *Massachusetts Comprehensive Energy Plan: Commonwealth and Regional Demand Analysis.* Synapse Energy Economics, Sustainable Energy Advantage, and MA DOER for the Massachusetts Department of Energy Resources.

Knight, P., D. Goldberg, E. Malone, A. S. Hopkins, D. Hurley. 2018. *Getting SMART: Making sense of the Solar Massachusetts Renewable Target (SMART) program*. Synapse Energy Economics for Cape Light Compact.

Hopkins, A. S., K. Takahashi, D. Glick, M. Whited. 2018. *Decarbonization of Heating Energy Use in California Buildings: Technology, Markets, Impacts, and Policy Solutions*. Synapse Energy Economics for the Natural Resources Defense Council.

Woolf, T., A. S. Hopkins, M. Whited, K. Takahashi, A. Napoleon. 2018. *Review of New Brunswick Power's 2018/2019 Rate Case Application.* In the Matter of the New Brunswick Power Corporation and Section 103(1) of the Electricity Act Matter No. 375. Prepared by Synapse Energy Economics for the New Brunswick Energy and Utilities Board Staff.

Hopkins, A. S., K. Takahashi. 2017. *Alternatives to Building a New Mt. Vernon Substation in Washington, DC*. Synapse Energy Economics for the District of Columbia Department of Energy and Environment.

Hopkins, A. S., S. Fields, T. Vitolo. 2017. *Policies to Cost-Effectively Retain Existing Renewables in New York*. Synapse Energy Economics for the Alliance for Clean Energy New York.

Vitolo, T., A. S. Hopkins. 2017. *The Mounting Losses at CWLP's Dallman Station: A Study of the Relative Costs of Operating Each of the Four Dallman Units*. Synapse Energy Economics for the Sierra Club.

Hopkins, A. S., A. Horowitz, P. Knight, K. Takahashi, T. Comings, P. Kreycik, N. Veilleux, J. Koo. 2017. *Northeast Regional Assessment of Strategic Electrification*. Synapse Energy Economics and Meister Consultants Group for the Northeast Energy Efficiency Partnerships.

Vermont Public Service Department. 2016. *Vermont Comprehensive Energy Plan*.

Vermont Public Service Department. 2016. *Act 199 Study on Manufacturing Competitiveness and Energy*.

Vermont Public Service Department. 2014. *Total Energy Study: Final Report on a Total Energy Approach to Meeting the State's Greenhouse Gas and Renewable Energy Goals*.

Vermont Public Service Department. 2014. *Evaluation of Net Metering in Vermont Conducted Pursuant to Act 99 of 2014*.

Vermont Public Service Department. 2013. *Total Energy Study: Report to the Vermont General Assembly on Progress Toward a Total Energy Approach to Meeting the State's Greenhouse Gas and Renewable Energy Goals.*

Vermont Public Service Department. 2013. *Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012*.

U.S. Department of Energy. 2011. *Report on the First Quadrennial Technology Review*. DOE/S-0001.

ARTICLES

Hopkins, A. S., K. Takahashi, S. Nadel. 2020. "Keep warm and carry on: Electrification and efficiency meet the 'polar vortex'." Proceedings of the 2020 ACEEE Summer Study of Energy Efficiency in Buildings.

Hopkins, A. S., K. Takahashi, L. David. 2018. "Challenges and Opportunities for Deep Decarbonization through Strategic Electrification under the Utility Regulatory Structures of the Northeast". Proceedings of the 2018 ACEEE Summer Study on Energy Efficiency in Buildings, August 2018.

Hopkins, A. S. Review of *Burn Out*, by Dieter Helm, *Science* 356, Issue 6339 (May 2017): 709, https://doi.org/10.1126/science.aam8696

Dunsky, P., A. S. Hopkins, K. Vaillancourt, M. Fabbri. 2016. "Achieving an Ultra-Low Carbon Future: Technology and Policy Pathways to Meet Vermont's GHG Goals," *ACEEE Summer Study on Energy Efficiency in Buildings.*

Greenblatt, J., A. S. Hopkins, V. Letchert, M. Blasnik. 2012. "Energy Use of U.S. Residential Refrigerators and Freezers: Function Derivation Based on Household and Climate Characteristics," *Energy Efficiency.* 10.1007/s12053-012-9158-6.

Hopkins, A. S., L. Gu, A. Lekov, J. Lutz, G. Rosenquist. 2011. "Simulating a Nationally Representative Housing Sample Using EnergyPlus," Lawrence Berkeley National Laboratory Report, LBNL-4420E.

Lutz, J.D., A. S. Hopkins, V. Letschert, V.H. Franco, A. Sturges. 2011. "Using National Survey Data to Estimate Lifetimes of Residential Appliances," *HVAC&R Research*.

Alvarez, R.M., A. S. Hopkins, B. Sinclair. 2010. "Mobilizing Pasadena Democrats: Measuring the Effects of Partisan Campaign Contacts," *The Journal of Politics* 72, 31.

Nielsen, A.E.B., A. S. Hopkins, H. Mabuchi. 2009. "Quantum Filter Reduction for Measurement-Feedback Control Via Unsupervised Manifold Learning," *New Journal of Physics* 11, 105043.

Hopkins, A. S., B. Lev, H. Mabuchi. 2004. “Proposed Magnetoelectrostatic Ring Trap for Neutral Atoms,” *Physical Review A* 70, 053616.

Hopkins, A. S., K. Jacobs, S. Habib, K. Schwab. 2003. “Feedback Cooling of a Nanomechanical Resonator,” *Physical Review B* 68, 235328.

TESTIMONY

Public Service Commission of Wisconsin (Docket No. 5-CG-106): Addressed the need for a pair of liquified natural gas facilities in light of the fossil fuel use reductions required to meet state and federal goals for mitigating climate change and the potential for cost-effective demand-side alternatives. On behalf of the Sierra Club, June 2021.

Vermont Senate Finance Committee: Provided expert testimony in the form of a presentation entitled “Updating Vermont’s Renewable Energy Standard” to the Vermont Senate Finance Committee in January of 2020. Dr. Hopkins presented on the history of the standard, what has changed since 2015, and future potential.

Vermont Public Utility Commission (Docket No. 17-1247-NMP): Addressed the consistency of a proposed solar generation facility with the Vermont Comprehensive Energy Plan. On behalf of Derby GLC Solar LLC, January 2018.

Washington DC Public Service Commission (FC 1142): Provided expert testimony regarding the merits of the proposed merger of Washington Gas and AltaGas, Ltd. with respect to the impact on environmental quality, with particular emphasis on the impact of utility management and its approach to climate change on the ability of the District to achieve its climate change mitigation goals. On behalf of the District of Columbia Government.

Régie de l’énergie du Québec (R-3986-2016): Provided an expert report and testimony regarding best practices in utility demand response programs, in the context of Hydro Québec Distribution’s ten-year Supply Plan. On behalf of the Regroupment national des conseils régionaux de l’environment du Québec (RNCREQ).

Vermont Public Service Board (Dockets No. 8586 and 8685): Addressed the need for a proposed solar PV generator and its associated contract under PURPA rates, its economic impact on the state, and its consistency with the Vermont Electric Plan. On behalf of the Vermont Department of Public Service, July 2016.

Vermont Public Service Board (Docket No. 8684): Proposed avoided energy and capacity cost rates for use in Rule 4.100, Vermont’s implementation of PURPA. On behalf of the Vermont Department of Public Service, October 2015 and May 2016.

Vermont Public Service Board (Docket No. 8600): Addressed the need for a proposed solar PV generator, its economic impact on the state, and its consistency with the Vermont Electric Plan. On behalf of the Vermont Department of Public Service, March 2016.

Vermont Public Service Board (Docket No. 8525): Introduced a memorandum of understanding between the DPS and Green Mountain Power regarding a proposed rate design, with particular focus on new critical peak price rates to be available and marketed. On behalf of the Vermont Department of Public Service, November 2015.

Vermont Public Service Board (Docket No. 7970): Addressed whether increases in the expected cost of a gas pipeline expansion project were sufficient to warrant reopening the underlying proceeding, particularly with respect to the need for the project, the economic impact on the state, and consistency with the general good of the state and the Vermont Comprehensive Energy Plan. On behalf of the Vermont Department of Public Service, May 2015.

Vermont Public Service Board (Docket No. 8311): Addressed how statutory criteria for the use of electric energy efficiency funds for electrification measures (such as heat pumps) might be met. On behalf of the Vermont Department of Public Service, January 2015.

Vermont Public Service Board (Docket No. 7862): Presented the Department's positions regarding whether Entergy Vermont Yankee should be granted a continued certificate of public good, with particular focus on the need for the plant, the economic benefit of continued operation, consistency with the Vermont Electric Plan, and whether continued operation by Entergy was in the general good of the state. On behalf of the Vermont Department of Public Service, October 2012 and April 2013.

Vermont Public Service Board (Docket No. 7833): Addressed the need for a proposed biomass electric generator and its consistency with the Vermont Electric Plan. On behalf of the Vermont Department of Public Service, October and November 2012; February and September 2013.

Vermont Public Service Board (Docket No. 7770): Addressed a number of topics related to the merger of Green Mountain Power and Central Vermont Public Service, most particularly the disposition of a windfall repayment due to ratepayers. On behalf of the Vermont Department of Public Service, January and March 2012.

Vermont Public Service Board (Docket No. 7815): Addressed consistency of a proposed long-term PPA with the Vermont Electric Plan and the utility's integrated resource plan. On behalf of the Vermont Department of Public Service, January 2012.

SELECTED PRESENTATIONS

Shipley, J., Hopkins, A. S., Takahashi, K., & Farnsworth, D. "Renovating regulation to electrify buildings: A guide for the handy regulator," presented with Regulatory Assistance Project, January 2021.

Hopkins, A. S. 2019. "Efficiency, Electrification, and Renewables in New England and Puerto Rico" at 2019 ACEEE Energy Efficiency as a Resource Conference, October 2019.

Hopkins, A. S. 2019. "Strategic electrification and winter cold snaps: A resource and a challenge" at 2019 ACEEE Energy Efficiency as a Resource Conference, October 2019.

Panelist on “Deep Dive Session on State and Local Electrification Roadmaps” at Electric Power Research Institute (EPRI)/Northeast Energy Efficiency Partnerships (NEEP) Electrification Summit, August 2019.

Hopkins. A. S., K. Takahashi, D. Lis. 2018. “Decarbonization through Strategic Electrification Meets Utilities and Regulation in the Northeast” at the 2018 ACEEE Summer Study on Energy Efficiency in Buildings, August 2018.

Hopkins, A. S. 2019. “Strategic Electrification: Impacts and approaches to meeting decarbonization goals in the northeastern states (and elsewhere)” at Lawrence Berkeley National Laboratory, Energy Technologies Area, August 2018.

Hopkins, A. S. 2017. “Utility Performance Regulation” at the Western States Regional Meeting of the National Association of State Energy Officials, April 2017.

Panelist on “A Regulatory Perspective of Grid Transformation” at the IEEE Innovative Smart Grid Technologies Conference, September 2016.

Panelist on the “Comprehensive Energy Plan Update” at the Renewable Energy Vermont Conference, October 2015.

Hopkins, A. S. 2015. “Vermont’s Total Energy Study.” Presentation at the National Association of State Energy Officials Energy Policy Outlook Conference, February 2015.

Panelist on “The Role of Energy Efficiency in Mitigating Winter Peak Issues” at the Association of Energy Services Professionals (Northeast Chapter) & Northeast Energy Efficiency Council, November 2014.

Hopkins, A. S. 2014. “Total Energy Study.” Presentation at the Renewable Energy Vermont Conference, October 2014.

Panelist on “State Energy & Economic Policy Impacts on Industry Transformation” at the Power Industry Transformation Summit, April 2014.

Hopkins, A. S. 2008. “Mobilizing Pasadena Democrats: Measuring the Effects of Partisan Campaign Contacts.” Presentation at the American Political Science Association Annual Meeting, August 2008.

HONORS, AWARDS, AND FELLOWSHIPS

Certified Public Manager, 2014

AAAS Science and Technology Policy Fellowship, 2010 – 2011

Dean’s Award for Community Service, 2009

Delegate to the 2004 Democratic National Convention

NSF Graduate Research Fellow, 2002 – 2005

Los Alamos National Laboratory Student Distinguished Performance Award, 2002

Two-time first-team Academic All American, 2000 and 2001

Barry M. Goldwater Scholar, 1999 – 2001

OTHER ACTIVITIES

NASEO - Electricity Committee: Affiliate Co-Chair, 2020-present

Newton, MA Citizens Commission on Energy, Member 2017-present

Guest on Synapse Energy Economics, Inc.'s *Energy Nerd Show,* Aug 6, 2020

Board Member, National Association of State Energy Officials, 2015-16

Industrial Advisory Board for ARPA-E-funded project "Packetized Energy Management," 2016

Burlington, VT Public Works Commission: Member 2012 –2014, Chair 2015

Resume updated January 2022.