BEFORE THE NEW YORK STATE
PUBLIC SERVICE COMMISSION

Proceeding on Motion of the Commission
as to the Rates, Charges, Rules and Regulations
of Niagara Mohawk Power Corporation
d/b/a National Grid for Electric Service

Proceeding on Motion of the Commission
as to the Rates, Charges, Rules and Regulations
of Niagara Mohawk Power Corporation
d/b/a National Grid for Gas Service

DIRECT TESTIMONY OF THOMAS G. (JERRY) ACTON
ON BEHALF OF PACE ENERGY AND CLIMATE CENTER AND ALLIANCE FOR A GREEN ECONOMY

November 25, 2020
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I. INTRODUCTION AND OVERVIEW

Q. Please state your name and business address.
A. Thomas G. (Jerry) Acton; 2299 Shirley Road Berkshire, NY 13736.

Q. Please describe your organization.
A. Physicians, Scientists and Engineers (“PSE”) for Healthy Energy is a non-profit multidisciplinary research and policy institute focused on the adoption of evidence-based energy policy. PSE is dedicated to supplying evidence-based scientific and technical information on the public health, environmental, and climate dimensions of energy production and use.

Q. Please summarize your background and experience.
A. I earned my B.S. in Aeronautical Engineering from the U.S. Naval Academy and my M.S. in Mechanical Engineering at North Carolina State University. My military service in the Navy spanned 10 years, culminating in the roles of Tactical Coordinator and Mission Commander of a P3-C submarine and surface ship surveillance aircraft. I then worked for IBM and then Lockheed Martin for 31 years as a Systems Engineer, System Architect, and Senior Technical Staff member. I worked in technical leadership roles on a wide variety of military, government, and commercial complex systems programs ranging in contract value from $10 million to $2 billion. My responsibilities included system requirements, system architecture and design, and operational performance analysis. I now serve as a Senior Fellow with PSE Healthy Energy and as a Complex Systems Architect with The GreyEdge Group, LLC. A detailed CV is attached as Exhibit TGA-1.

Q. Have you previously testified before the New York Public Service Commission (“the Commission”)?
A. Yes. I submitted expert testimony on behalf of Alliance for a Green Economy in the National Grid Upstate rate case in 2017 (Case Nos: 17-E-0238 and 17-G-0239) and the Orange and Rockland rate case in 2018 (Case Nos: 18-E-0067 and 18-G-0068).
Q. On whose behalf are you testifying in this proceeding?
A. I am testifying on behalf of the Alliance for a Green Economy and Pace Energy and Climate Center.

Q. What is the purpose of your testimony?
A. The purpose of this testimony is to analyze the new gas rate proposal filed by Niagara Mohawk Power Corporation d/b/a National Grid (“the Company” or “National Grid”) as it relates to New York’s Climate Leadership and Protection Act (“CLCPA”), and to compare the likely emissions impacts of the Company’s gas filling with what is necessary to meet the 2030 and 2050 mandates enshrined in the law. I will make recommendations for how the Commission can ensure that National Grid’s Upstate investments and proposals contribute to New York’s ability to meet its legally binding greenhouse gas emissions reductions mandates.

Q. What information did you review in preparing this testimony?
A. I reviewed the Company’s gas rate filing, the Company’s direct testimony, various interrogatory responses from the Company, the CLCPA, U.S. Energy Information Administration (“EIA”) Emissions Reports, EIA Energy Consumption Reports, and the American Community Survey of the U.S. Census Bureau.

Q. Are you sponsoring any exhibits with this testimony?
A. Yes.

II. SUMMARY OF FINDINGS AND RECOMMENDATIONS

Q. Please summarize your findings and conclusions based on your review of this case.
A. The Company plans to expand gas infrastructure and invest in serving increasing numbers of gas customers, a plan that is fundamentally incompatible with achieving the 2030 and 2050 greenhouse gas reduction requirements established in the CLCPA: 40% reduction in greenhouse gas (“GHG”) emissions from 1990 levels by 2030 and an 85% reduction by 2050.
The establishment of aggressive binding mandates for greenhouse gas emissions reductions require a dramatic shift in the business-as-usual operations of the utilities in this state. National Grid’s approach, which largely continues and expands natural gas space and water heating systems for new construction and conversion of existing residential petroleum space and water heating systems to gas will not meet any of the CLCPA mandates.

Further, the Company’s gas efficiency and heat pump incentive proposals will help reduce greenhouse gases, but these proposals will fall drastically short of the reductions necessitated by the CLCPA. Together, the emissions reductions that could be achieved from these programs represent only about 13.9% progress over a three-year period toward the 2030 CO₂ reduction targets for the Company’s territory.

Unfortunately, some of this potential progress will be undone by the Company’s projected annual 2,400 new gas connections, which over a three-year period will reduce the progress to 10.6% of the CO₂ reductions needed to meet the 2030 GHG reduction mandates. Meanwhile, the Company’s other “Future of Heat” proposals (Carbon Capture Utilization System, Renewable Natural Gas and Hydrogen Proposals, Demand Response, and Fuel-Switching Calculator) will do little to help make progress on the requirement, while collectively costing customers $20.96 million through 2025 in capital investments.¹

The most effective way to meet the state’s aggressive 40% and 85% GHG emissions reduction mandates is through aggressive application of a process called Environmentally Beneficial Electrification. As I will describe in my testimony, this process involves converting low efficiency, emissions intensive oil and natural gas combustion heating systems to high efficiency, non-combustion thermal energy systems powered by electricity.

Q. Please summarize your recommendations to the Commission.

¹ See Company Direct Testimony of the Future of Heat Panel ("FOH Testimony") at 9 ($2.89 million for RNG interconnection and $18.07 million for everything else).
A. The Commission must require the Company to plan its investments around meeting the greenhouse gas reduction mandates of the CLCPA. This will require the Company to implement the following:

1. Develop a plan for an orderly phase out and retirement schedule for all its gas assets and their replacement with individual or shared renewable thermal energy systems through the process of Environmentally Beneficial Electrification.

2. Invest in renewable thermal energy (heat pumps, a beneficial electrification technology) and energy efficiency at a scale that brings down emissions associated with the Company’s gas system by 40% by 2030 and 85% by 2050 and plan for the near total decommissioning of its gas infrastructure system by 2050. This includes scaling up the Geothermal Network concept with a business model that makes access to renewable thermal energy affordable and accessible to all customers.

3. The Company should cease marketing fuel oil to natural gas conversions (which nearly double residential housing unit CO₂e emissions) and should cease marketing gas as a clean or beneficial technology.² ³ it is not either.

4. Avoid further investments in the gas infrastructure beyond what is essential to maintain reliability and safety for current gas customers.

5. The Company should design a business model that supports more affordable energy rates for its Geothermal Network proposal by leveraging long term CAPEX financing, volume equipment purchase agreements, and any other financial mechanisms that make heating and cooling more affordable than it is today. Further, the Company should spread the

² See National Grid, Convert to Natural Gas, https://www.nationalgrid.com/Upstate-NY-Home/Convert-to-Natural-Gas/ (last visited Nov. 23, 2020) (“It’s clean and green. Natural gas is the cleanest-burning fossil fuel and a highly efficient form of energy. It has fewer impurities and reduces CO2 emissions by 27 percent, so you’ll feel good about helping the environment.”).

³ See National Grid, Convert to Natural Gas, https://www.nationalgrid.com/Upstate-NY-Home/Convert-to-Natural-Gas/ (last visited Nov. 23, 2020) (“It’s clean and green. Natural gas is the cleanest-burning fossil fuel and a highly efficient form of energy. It has fewer impurities and reduces CO2 emissions by 27 percent, so you’ll feel good about helping the environment.”).
costs of the proposed Geothermal Network across all gas customers, such as any other gas capital project.

III. CLCPA MANDATES AND APPLICATION TO NATIONAL GRID UPSTATE SERVICE TERRITORY.

Q. Are you familiar with the CLCPA?
A. Yes

Q. Please summarize the greenhouse gas reduction mandates required by the CLCPA.
A. The CLCPA requires economy-wide greenhouse gas emissions reductions of 40% from 1990 levels by 2030 and 85% reductions from 1990 levels by 2050. The law requires electric power greenhouse gas emissions reductions of 100% by 2040. The law also requires 70% renewable electricity by 2030 and statewide energy efficiency gains of 185 trillion British thermal units (“tBtu”) from the 2025 forecast. The greenhouse gases covered by the law are not just carbon dioxide, but also methane and other greenhouse gases. The emissions reduction requirements cover not just emissions coming from electricity generation, but also combustion heating and transportation. The CLCPA does not specify GHG reduction sub-targets for different sectors.

Q. When you refer to “combustion heating” what exactly are you talking about?
A. I am talking about the burning of any carbon fuels directly in buildings to heat a space, to heat water, to cook, to dry clothes, and to run a gas fireplace that results in GHG emissions directly from the buildings. Combustion heating does not include electricity used for space heating, hot water, stoves or clothes dryers.

Q. What combustion fuels are used in for combustion heating in New York?

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4 See N.Y. Environmental Conservation Laws (“NYECL”) § 75-0107.
5 See N.Y. Public Service Law § 66-P(2).
6 See NEYECL § 75-0103.
A. Natural gas, petroleum (distillate and residual fuel oil, propane, kerosene, gasoline), coal, and wood.

Q. Please characterize the greenhouse gases that are emitted by the combustion heating sector in New York.

A. When fossil fuels used for heat are burned for thermal energy, those fuels emit carbon dioxide ("CO₂"), which is one of the two major contributors to global climate change. The other major contributor to global climate change is methane, which is a greenhouse gas with a global warming potential 86 times higher than CO₂ over a 20-year period.

Importantly, there are fugitive greenhouse gas emissions associated with the fossil fuels used for combustion heating, which are released during their extraction, transportation, and distribution to buildings before they are burned for energy. In the case of natural gas, a main component of these fugitive emissions is methane. The most recent Proposed Part 496, Statewide Emissions Limits by the New York Department of Environmental Conservation (“DEC”) Emissions Inventory identified 3.14% as the likely methane leakage rate along the gas distribution system for New York. As shown in Exhibit 4, this leakage rate represents a CO₂ equivalent (CO₂e) greenhouse gas emissions level that is 98% higher than the CO₂ level (see Exhibit 4 for calculations), thereby nearly doubling the emissions footprint of the natural gas used in buildings. As an example, a natural gas building that emits 5 metric tons of CO₂ per year from burning the gas for heat has a CO₂e footprint of 9.9 metric tons per year (5 times 1.98) once fugitive methane is accounted for.

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10 Id.
Q. What portion of New York greenhouse gas emissions comes from combustion heating, meaning: heating spaces, heating water, cooking, and drying clothes in New York?

A. When accounting for both CO₂ emissions and the CO₂e emissions from methane leakage, combustion heating accounts for 109.4 million metric tons (“mmT”) of the 228.9 total mmT, which is 47.8% of greenhouse gas emissions from energy in New York State. See the chart below (Figure 1) for mmT of greenhouse gas emitted from different energy sectors in New York. Figure 1 includes both CO₂ from combustion and CO₂e from the methane leakage.

Figure 1: New York Energy-Related Greenhouse Gas Emissions by Service 2018
228.9 Million Metric Tons (mmT) per Year

Q. Can you please explain the sources and methodology behind the chart above?

A. Please see Exhibit 2.

Q. How many tons of CO₂e by fuel type are emitted by combustion heating in New York?

A. See the table below, Figure 2, where I have calculated the CO₂ and CO₂e associated with each type of fossil fuel used for combustion heating in New York. Petroleum is
predominantly distillate fuel oil but also includes small amounts of propane and kerosene in the residential sector and residual oil and gasoline in the commercial and industrial sectors. Natural gas CO$_2$ and the associated methane CO$_{2e}$ generate 84.1% of greenhouse gas emissions from combustion heating.

<table>
<thead>
<tr>
<th>Fuel Type Emissions 2018</th>
<th>mmTons / Year</th>
<th>% of Total CO$_{2e}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal CO$_2$</td>
<td>1.25</td>
<td>1.1%</td>
</tr>
<tr>
<td>Petroleum CO$_2$</td>
<td>16.8</td>
<td>14.8%</td>
</tr>
<tr>
<td>Natural Gas CO$_2$</td>
<td>48.1</td>
<td>84.1%</td>
</tr>
<tr>
<td>Methane Leakage CO$_{2e}$</td>
<td>47.1</td>
<td></td>
</tr>
<tr>
<td>Total CO$_2$</td>
<td>66.1</td>
<td>58.4%</td>
</tr>
<tr>
<td>Total CO$_{2e}$</td>
<td>113.2</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 2:** Million Metric Tons (mmT) Emission from Fuels Used for Combustion Heating in NY 2018

**Q.** Can you please explain the sources and methodology behind the chart above?

A. Please see Exhibit 2.

**Q.** Have you performed an analysis of how many tons of CO$_{2e}$ New York needs to reduce from the combustion heating sector in order to meet the 2030 and 2050 greenhouse gas reduction targets required by the CLCPA?

A. Yes. The first step is to figure out an appropriate greenhouse gas reduction target for the heating sector in the context of the other energy sectors that produce greenhouse gases: electricity and transportation. Each energy sector contributes differently to today’s greenhouse gas emissions (as illustrated in Figure 1). Each sector has performed differently since 1990, and each sector faces different challenges for de-carbonization based on the particular fuels and technologies used. Together, these sectors must work together to reach 40% greenhouse gas reductions from 1990 levels by 2030 and 85% reductions by 2050.

The CLCPA does not prescribe detailed emissions reductions by sector, but instead sets economy-wide greenhouse gas reduction targets for 2030 and 2050. Therefore, in order to recommend a 2030 target for any given sector, I had to make some assumptions based on where we are today for each sector and overall compared to 1990 levels, the different
challenges that each sector faces, and what is most likely achievable. I concluded that
based on the data, the 2030 GHG reduction targets for each sector should be as follows:

- **Electricity:** decrease from 1990 levels by 79.9% CO₂ and decrease by 67.5% CO₂ plus
  methane CO₂e.

- **Combustion heating:** decrease from 1990 levels by 41.3% CO₂, decrease by 7.4% CO₂
  plus methane CO₂e.

- **Transportation:** decrease from 1990 levels by 1.9% CO₂.

Taken together, the sub-goals I developed for electricity, transportation, and heating
amount to a 40% decrease in greenhouse gas emissions from 1990 levels by 2030 as
required by the CLCPA.

Q. **How did you come to this conclusion?**

A. Please refer to Exhibit 3.

Q. **Above, you said that to reach the 2030 mandate, the heating sector should reduce
41.3% CO₂, and 7.4% CO₂ plus methane CO₂e. How many total tons of CO₂e does
this equate to?**

A. 24.16 million metric tons CO₂e required to be reduced between 2018 and 2030: 12.2 CO₂
times 198% = 24.16 Total CO₂e.

Q. **How did you calculate that number?**

A. It is the summation of the CO₂ and methane leakage CO₂e reductions between 2018 and
2030 for the residential, commercial and industrial sectors required to meet the 2030
greenhouse gas reduction target.

Q. **What does your analysis assume in terms of how the needed CO₂e reductions should
be distributed among the fuels used for combustion heating in New York?**

A. I assumed all fuel types should be reduced at rates comparable to their percentage of total
fuels consumed (as shown in Figure 2).
Q. Based on the 2030 and 2050 mandates, can you recommend year over year targets for annual statewide CO$_2$e reductions in combustion heating?

A. Yes. I developed an exponential reduction curve that achieves the 2030 and 2050 CLCPA mandates starting from the 2018 emissions levels. Since there are only 10 years left to achieve it, the 2030 mandate is much more challenging to meet than the 2050 mandate. See Figure 3 below.

**Figure 3:** Year over Year Strategy to Reduce Emissions in the Heating Sector by Fuel Type

Q. Have you calculated what National Grid’s proportion of CO$_2$e from combustion heating is today?

A. Yes. National Grid’s combustion heating CO$_2$ plus methane leakage CO$_2$e emissions in 2020 are 9.094 mmT as shown in Figure 4 below.
Figure 4: National Grid Heating Emissions 2020

Q. What methodology did you use to calculate this?
A. Please see Exhibit 2.

Q. How many tons of CO₂e need to be eliminated from National Grid’s gas customers in order to contribute proportionately to the 2030 and the 2050 greenhouse gas reduction targets required by the CLCPA?
A. Each utility should contribute equally to achieving the 2030 state-wide CO₂e reduction targets for combustion heating. National Grid’s portion of natural gas combustion heating reduction should be proportional to the state-wide targets per customer segment as shown in the table below. The total emissions reductions should be 2.45 million metric tons CO₂e by 2030.
Figure 5: Combustion Heat Emissions Targets for National Grid’s Upstate Natural Gas Contribution to the CLCPA Emissions Reduction Mandates (Total CO$_2$e values in this chart refer to CO$_2$ + 3.14% methane leakage associated with natural gas. Total CO$_2$e = CO$_2$ times 198%).

Q. Please explain your sources and methods for creating the table above.
A. Please see Exhibit 2.

Q. In order to meet the annual greenhouse gas emissions targets you have assigned to National Grid Upstate service territory for the combustion heating sector, how many customers in National Grid Upstate service territory need to be removed from the gas system and converted to heat pumps or other beneficially electric systems by 2030 and 2050?
A. The table below, Figure 6, shows how many National Grid customers can still be on gas and how many customers must be converted from gas to a zero-emissions heating source in order to meet the 2030 and 2050 CLCPA mandates. By 2030, 154,333 customers total need to be converted off of gas.
Case Nos. 20-E-0380 & 20-G-0381

Figure 6: National Grid Conversions from Gas to Heat Pumps Needed to Meet CLCPA Mandates

Q. Please explain your methodology for the figure above.
A. To determine the number of customer conversions, the average emissions per customer per year as of FY200 must be calculated for each customer type as shown in Figure 7. The CO₂ numbers are used because they are the direct emissions from buildings. Reductions in direct building CO₂ will result in proportional reductions in 3.14% methane leakage CO₂e emissions. Please see Exhibit 2 for a more detailed explanation as to how I calculated the data.

Q. Please explain your methodology for calculating average emissions per customer.
A. To determine the average total CO₂ and total GHG emissions per customer for each customer category, the total GHG and CO₂ emissions per year are divided by the number of customers for each customer category as shown in Figure 7.

Figure 7: National Grid Average Yearly Emissions per Customer

Q. Can you please explain your methodology for the data found in Figure 7?
A. Yes, please refer to Exhibit 2.
Q. How many tons of CO₂ need to be eliminated from customers in National Grid’s Upstate service territory that use petroleum for heat in order to contribute proportionately to the 2030 and the 2050 greenhouse gas reduction targets required by the CLCPA?

A. To perform this calculation, I start by estimating how many petroleum customers exist in National Grid’s Upstate service territory because the company could not provide that information. As shown in Figure 8, I estimate that within National Grid’s Upstate service territory there are 188,696 fuel oil customers, which is the primary petroleum-based heating fuel in New York. Please refer to Exhibit 2, which explains my methodology.

![Figure 8: Estimated National Grid Upstate Conversions Fuel Oil Customers and Average Yearly CO₂ Emissions Per Customer](image)

Next, I determined the necessary greenhouse gas reductions from fuel oil customers in National Grid’s Upstate service territory. See Figure 9 below, which shows emissions levels and required reductions to meet the CLCPA mandates for 2030 and 2050 allocated to fuel oil statewide and for National Grid Upstate territory. This proposed CO₂ emissions reduction schedule will eliminate residential fuel oil heating by 2050.

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11 Company Response to PACE_AGREE-162 (attached as Exhibit TGA-6).
Q. Please explain the sources and methods to create the table above.
A. Please refer to Exhibit 2.

Q. What does that mean for how many customers in National Grid’s Upstate service territory need to be converted from fuel oil-based heating systems to heat pumps and other beneficially electric systems?
A. As shown in Figure 10 below, the numbers of fuel oil customers that must be reduced are then calculated by dividing the million metric tons per year for fuel oil combustion heating from Figure 9 by the average fuel oil customer metric tons per year 5.4 from Figure 8.

IV. STRATEGIES FOR ACHIEVING CLCPA TARGETS

Q. What are the technologies and programs available to achieve these recommended CO\textsubscript{2}e reduction targets for the combustion heating sector?
A. The only viable strategy to achieve such aggressive greenhouse gas emissions reductions in a short period of time is through energy efficiency and environmentally beneficial electrification of the combustion heating sector. This beneficial electrification must be
accompanied by increases in renewable electricity so that emissions from combustion heating can be mostly eliminated.

Q. Can you please explain environmentally beneficial electrification?

A. Environmentally beneficial electrification is a term to describe the process of transitioning the energy source for our vehicles, space and water heaters, stoves, dryers, fireplaces, and grills from emissions intensive combustion of fossil fuels (gasoline, diesel, propane, fuel oil, natural gas) to clean, renewable off-site and on-site electricity. This process is also known simply as “beneficial electrification” or “strategic electrification.”

In practice, environmentally beneficial electrification means transitioning low efficiency combustion engine vehicles to high efficiency, zero emissions battery electric vehicles; low efficiency, emissions intensive fossil fuel space and hot water heaters to high efficiency zero emissions electric powered heat pumps; lower efficiency air conditioners to higher efficiency heat pumps; and lower efficiency fossil fuel powered appliances to higher efficiency, electric powered appliances.

Q. If heat pumps and other environmentally beneficial electric technologies need electricity to operate, don’t they simply shift emissions from the on-site combustion in the building to the electricity generating sector?

A. When these technologies are coupled with zero emissions electricity (such as solar or wind), the fossil fuels used to power them are eliminated, thus eliminating the greenhouse gas emissions entirely. When beneficial electrification occurs in a scenario where the electric power generation technology makes use of an electric grid still powered by some fossil fuels, there are still greenhouse gas reduction benefits due to the significantly higher efficiency of the technology. Fewer fossil fuels are needed through the electricity grid to get the same heating or transportation output than if the heater or vehicle were directly burning fossil fuels on site. In the case of National Grid’s Upstate service territory, there is a very low percentage of fossil fuels powering the electricity grid, so the
greenhouse gas reductions realized through beneficial electrification are dramatic.13 As New York works toward its renewable electricity goals of 70% by 2030 and 100% by 2040, these environmentally beneficial technologies will get cleaner along with the electricity grid.

Q. Can you please describe the technologies available for beneficial electrification of space heating?

A. Thermal energy technologies that use electricity have improved dramatically over the past two decades. Air source heat pumps are 200+% efficient for both heating and cooling14 compared to 65% to 97%15 efficient combustion heating and even less efficient conventional air conditioning. However, air source heat pumps will sometimes need a supplemental heating source for the coldest days of the year since their efficiency drops off in very cold weather.

Ground source heat pumps are 400+% efficient16 when coupled to a ground heat exchanger loop that supports both heating and cooling. This means that for every input unit of electricity used, you get four units of output heat, three coming from the ground, which stores heat from the sun.

When ground source heat pumps are connected to a network of ambient temperature ground loops, the system efficiency can approach 600+%.17 So, for every input unit of electricity into the thermal network system, you get six units of output thermal energy, five coming from the ambient temperature loops network. This is possible because in addition to ground heat exchangers, a number of additional thermal energy sources can be

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16 “GSHPs [Ground Source Heat Pumps] can effectively reach a COP [Coefficient of Performance] in the heating mode of between 3.0 to 6.0, which represents efficiencies between 300% to 600%.” Company Ex. FOH-2 at 8; see also NYSERDA 2019, supra note 14, at tbl. 6-1.
17 Id.
connected to the ambient temperature loops network and shared by all connected building heat pumps. These additional thermal energy sources that vary by geographic area can include any combination of solar thermal heat exchangers, surface water heat exchangers, wastewater heat exchangers, captured industrial waste heat, and recycled thermal energy using thermal load diversity among buildings. For instance, one can move the rejected heat from a cooling dominant building or space to a heating dominant building or space; basically just moving free energy from one place to another. The higher the system efficiency, the lower the electric needs of the system, and the easier it will be to meet the greenhouse gas reduction targets in the electric sector.

Q. Can you please describe the technologies available for beneficial electrification of water heaters?
A. Ground source and air source heat pump water heaters are available and are a very efficient way to heat water. An additional option is a solar assisted high efficiency electric hot water heater system.

Q. Can you please describe the technologies available for beneficial electrification of cooking?
A. Electric stoves, including induction stoves, provide a way to eliminate direct fossil fuel use for cooking and supply energy for heating through renewable electricity. The elimination of fossil fuel combustion from the kitchen has added health benefits. A recent analysis published by the Rocky Mountain Institute found that indoor air pollution from the carbon monoxide and nitrogen dioxide emitted from gas stoves exceeds outdoor air quality standards and contributes to significantly higher rates of childhood asthma. Living in a home with a gas stove increases children's risk of having asthma by 42%.

Q. Can you please describe the technologies available for beneficial electrification of clothes drying?

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A. Electric clothes dryers or heat pump clothes dryers.

Q. What role does building energy efficiency play in the de-carbonization of combustion heating?

A. Building energy efficiency is an important complement to beneficial electrification. Improving the building envelope through air sealing and insulation to retain heat and reduce the total energy needed for space conditioning can help reduce gas used by customers who have not yet converted to heat pumps. It can also help those who are converting to heat pumps save money on operating costs as well as reduce heat pump demand on the electric grid. Electric efficiency programs can also help reduce demand on the electricity grid to reduce the total amount of renewable electricity that will need to be constructed to power all our energy uses.

Q. The Company states that converting customers from oil to gas is a strategy to reduce emissions. Do you agree?

A. Not at all. This is a fundamentally flawed strategy.

The Company claims that converting customers from oil to gas will “reduce CO\textsubscript{2} emissions by 14,841 tons per year while displacing 2.9 million gallons of oil per year.”

First, this conversion strategy is based on a cleaner burning rationale which assumes that cleaner burning equates to fewer overall building level emissions, which is not true. Second, this strategy fails to take into account the emissions from methane leakage. Natural gas has the highest emissions level of all heating fuels including coal, as depicted in the graph below.

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20 Company Ex. GIOP-4 at 2.
Q. Please describe your sources and methodology from the graph above.
A. Please see Exhibit 2.

Q. Are there other reasons why converting from oil to gas is not a good greenhouse gas reduction strategy?
A. Yes. It turns out that households that use natural gas produce comparable CO₂ emissions to those using oil, even if you do not account for methane leakage. In National Grid Upstate territory, the average housing unit using natural gas emits 5.34 million metric tons CO₂ per year based on consumption data provided by the Company, as shown in Figure 7. The average house on fuel oil emits 5.4 million metric tons of CO₂ per year as shown in Figure 8.

Q. This seems counterintuitive if natural gas is cleaner burning than oil. Can you explain why you see higher CO₂ emissions levels from buildings that use gas?
A. The average household using gas for heat also uses gas for their stoves and clothes dryers which accounts for the 1.29 difference between 5.34 and 4.05. When households use gas appliances rather than electric, their emissions rise. This increased consumption and associated CO₂ emissions are depicted in Figure 12 below. This happens because, as I
discussed above, converting appliances to electricity through beneficial electrification achieves emissions reductions. Converting from electric to gas reverses the emissions benefit.

When you add in the methane CO$_2$e from leakage, the emissions then *double* for housing units using natural gas. The Company’s plans to continue converting from fuel oil (5.4 metric tons from Figure 8) to natural gas (10.57 metric tons per year) contribute to a 5.17 (10.57 minus 5.4) million metric tons per year increase per housing unit, double that of the fuel oil building they are converting. Even if CCUS were to be implemented on every converted building and it were to achieve the reductions claimed by the Company, the CO$_2$ emissions would still increase from 5.4 to 8.68, a 62% increase.$^{21}$

![Figure 12: Average Combustion Heating Emissions per Housing Unit NY](image)

**Q.** Can you please explain the sources and methodologies for the chart above?

**A.** See Exhibit 2.

**Q.** So, what should we do with customers currently using fuel oil and other petroleum-based fuels for combustion heating?

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$^{21}$ Company Response to PACE_AGREE-009 (attached as Exhibit TGA-7); Company Response to SC-004 (attached as Exhibit TGA-8).
A. We must move customers from fuel oil, but the strategy to move them to gas is not in line with the CLCPA. A better conversion strategy would be to convert customers on oil to heat pumps powered by an increasingly cleaner electricity grid.

The Commission should end support for conversions from fuel oil to natural gas and implement a strategy that requires utilities to support the transition from fuel oil to heat pumps instead. The basic physics of the CLCPA mandates that converting approximately 40% and 85% of the emissions intensive fuel oil and natural gas heating systems to zero emissions systems (e.g. heat pumps) is absolutely necessary.

Q. The Company is proposing various other greenhouse gas reduction strategies, such as renewable natural gas (“RNG”), hydrogen blending, carbon capture, and power to gas. Do you agree that these are viable greenhouse gas reduction strategies?

A. I am not an RNG, hydrogen, or carbon capture expert, so I defer to other experts on the details of these plans. However, it is clear from reading the Company’s testimony and their responses to discovery, that the Company has provided no data to quantify how these strategies can result in significant greenhouse gas reductions that can be achieved to meet the 2030 or 2050 CLCPA mandates.22

V. NATIONAL GRID’S UPSTATE PROPOSAL COMPARED TO CLCPA REQUIREMENTS

Q. Please explain your understanding of the Company's plan to comply with the CLCPA.

A. The Company believes that the gas network can enable the emission reductions required by the CLCPA.23 The Company intends to transform the gas network by introducing and integrating RNG and hydrogen into the gas system.24

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22 Company Response to PACE_AGREE-170 (attached as Exhibit TGA-9).
23 Company Response to SC-017 (attached as Exhibit TGA-10).
24 Id.
As discussed in its Future of Heat testimony, the Company plans to pursue various “de-carbonization” initiatives in order to reduce its reliance on pipeline capacity and to comply with the CLCPA.\textsuperscript{25}

Unfortunately, three of the Company’s proposals—Carbon Capture Utilization System, the Direct RNG Interconnection Program, and the Centralized RNG Interconnection Program will unlikely impact reliance on pipeline capacity.\textsuperscript{26} The Company has been unable to quantify the projected greenhouse gas reductions it expects from those strategies.\textsuperscript{27}

Meanwhile, the Company is projecting that it will connect an additional 2,400 residential and commercial customers each year to its gas system\textsuperscript{28} and is planning tens of millions of dollars in infrastructure investments to support that customer growth.\textsuperscript{29,30} Of those 2,400 new customers each year, 675 will be converted to gas annually as a result of the oil to gas conversion program, and approximately 1,725 new customers will be the result of new construction.\textsuperscript{31}

On the positive side, the Company’s activities under the Commission’s January 2020 New Efficiency New York Order include gas efficiency programs that have the potential to reduce emissions and heat pump incentives that will help some customers overcome the upfront costs of heat pumps.\textsuperscript{32} The Company is additionally showing some innovation that might help beneficial electrification of heating scale up in its Geothermal Network program.

\textsuperscript{25} FOH Testimony at 16; Company Response to PACE_AGREE-081 (attached as Exhibit TGA-11).
\textsuperscript{26} Id.
\textsuperscript{27} Company Response to Pace_AGREE_170 (Ex. TGA-9).
\textsuperscript{28} See Company Ex. GIOP-4 at 2–3.
\textsuperscript{29} Company Response to PACE_AGREE-170 (Ex. TGA-9).
\textsuperscript{30} Company Direct Testimony of the Gas Infrastructure and Operations Panel (“GIOP Testimony”) at 55.
\textsuperscript{31} See Company Response to PACE_AGEEE-045 (attached as Exhibit TGA-12); Company’s Response to PACE_AGREE-068 (attached as Exhibit TGA-13).
Q. Have you reviewed the Company’s proposals for heat pump incentives and geothermal network?
A. Yes. The Company is proposing to incentivize 172,203 mmBtus of heat pumps as part of its compliance with the New Efficiency New York Order in 2022. For the years 2023 and 2024, the numbers are 210,694 mmBtu and 245,889 mmBtu respectively. Additionally, the Company is proposing a Geothermal Network that, if successful, would make it easier to reach those targets by providing better access to geothermal loops for customers that cannot install their own privately owned loop.

Q. What are the emissions impacts of the Company’s heat pump incentives and Geothermal Network?
A. CO₂ emissions will be reduced by 33,370 metric tons over three years. GHG emissions including CO₂ and Methane leakage CO₂e will be reduced by 66,073 metric tons over three years.

<table>
<thead>
<tr>
<th>Heat Pump Incentives Program</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dekatherms Reduced per Year</td>
<td>172,203</td>
<td>210,694</td>
<td>245,889</td>
<td>628,786</td>
</tr>
<tr>
<td>Metric Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂</td>
<td>9,139</td>
<td>11,182</td>
<td>13,050</td>
<td>33,370</td>
</tr>
<tr>
<td>Total CO₂e</td>
<td>18,095</td>
<td>22,140</td>
<td>25,838</td>
<td>66,073</td>
</tr>
<tr>
<td>Number Customers Converted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Residential</td>
<td>1,710</td>
<td>2,092</td>
<td>2,442</td>
<td>6,244</td>
</tr>
<tr>
<td>All Commercial</td>
<td>274</td>
<td>335</td>
<td>391</td>
<td>1,001</td>
</tr>
<tr>
<td>20%R/80%C Mix</td>
<td>561</td>
<td>687</td>
<td>801</td>
<td>2,049</td>
</tr>
</tbody>
</table>

Figure 13: Projected Emissions Reductions Due to Heat Pump Adoption, National Grid Upstate Service Territory Heat Pump Adoption, National Grid Upstate Service Territory

Q. Please explain the sources and methods used to create the chart above.
A. I used the same equations as for Figure 4, please see Exhibit 2.

Q. Do you consider the Geothermal Network Proposal to be viable?

33 See Id. at Appendix C.
34 See FOH Testimony at 24.
A. Yes. As I mentioned above, a networked thermal energy system approach using heat pumps and the optimal mix of free, non-combustion thermal energy sources will dramatically increase energy efficiency, eliminate wasted combustion energy, recycle rejected thermal energy from cooling dominant buildings, and access free thermal energy from solar, water, and ground heat exchangers using zero emissions technologies.

This proposal will help set the foundation to offer geothermal networks as an alternative to the replacement of leak prone gas pipe and a legitimate replacement for gas expansion expenditures going forward. It holds the promise of being a new choice for customers, especially for customers using petroleum for heating (e.g., oil or propane heating customers in National Grid’s Upstate electric territory) to switch to a lower-cost, non-combustion energy source. There are additional benefits relative to other electric-based heating technologies including electric demand reduction in the summer while minimizing the projected winter peak, hence reducing the need for some portion of future clean electric capacity investments.

Above, I demonstrated that by 2030, 154,333 natural gas customers (see Figure 6) and 88,377 fuel oil customers (see Figure 10) in National Grid’s Upstate territory need to be converted to a zero-emissions heating technology in order to keep the state on track to meet its climate requirements.

Technologically, geothermal networks are viable. In fact, many geothermal networks already exist and have been proven to function and provide benefits, including National Grid’s own pilot geothermal network in Long Island.

As I have demonstrated above, de-carbonization of the heating sector in line with CLCPA mandates will require a dramatic ramp up of zero-emission heating technologies. Utility-scale networked geothermal solutions – such as that proposed by National Grid – will allow the Company to scale the solutions to reach the thousands of customers that must

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35 NY ISO, supra note 13, at 42.
36 See Company Ex. FOH-2.
be converted off of fossil fuel heat each year. The Company should not just pilot this concept but should be planning to implement it at a much greater scale.

That said, I am concerned that the proposed $22.69/ton/month\textsuperscript{37} charge for customers proposed by the Company will not induce the market transformation needed. The average residential customer in National Grid’s Upstate service territory would need 4.5 tons of heat pump capacity,\textsuperscript{38} meaning the average household would need a 5-ton heat pump system. Under the Company’s current proposal, the average household would be charged a flat monthly rate of $113.45 per month to connect to the Company’s Geothermal Network.\textsuperscript{39} Additionally, the customer would need to pay for the unsubsidized portion of their above ground heating equipment plus for the additional electricity to run the heat pump system. Netted against these costs would be a reduction or possible elimination of the customer’s gas bill.

This monthly cost is nowhere near competitive with gas. The Company’s proposed rates would raise the average monthly residential gas bill to $79.94 per month.\textsuperscript{40} This is much cheaper than the geothermal network from a customer perspective. Further, when compared with the current costs of installing and owning your own geothermal system, it is unclear whether the Company’s proposal provides any financial benefit on a monthly basis.\textsuperscript{41} On a lifetime system cost basis, the Company’s proposal is not competitive at all because whereas privately-owned systems can be paid off over time, the Company intends to charge the monthly rate to customers indefinitely.\textsuperscript{42}

A fundamental flaw in the Company’s proposal is that unlike gas capital investments, which are spread out over all of the thousands of National Grid’s Upstate customers, the

\textsuperscript{37} See FOH Testimony at 37.

\textsuperscript{38} Calculated as follows: Average Therms per residential customer per year = 1,007 (per Company Gas Forecast testimony. Convert to Average Dekatherms (DT or mmBtu) per customer per year = 1,007 / 10 =100.7 Convert to Tons = 100.7 divided by 22.2 (mmBtu per Ton) = 4.54 22.2 mmBtu per ton = 12,000 times 1850 ton hours per year divided by 1,000,000

\textsuperscript{39} Company Response to PACE_AGREE-135 and Attachment (attached as Exhibit TGA-14).

\textsuperscript{40} See Company Ex. G-RDP-4 at Schedule 4, Page 1.

\textsuperscript{41} Company Response PACE_AGREE-137 (attached as Exhibit TGA-15).

\textsuperscript{42} See Company Response PACE_AGREE-136 (attached as Exhibit TGA-16).
Company is proposing to recover the costs of the Geothermal Network only from participants.\textsuperscript{43} The only rationale for this provided by the Company is that it wishes to pilot whether customers will pay for geothermal under these circumstances.\textsuperscript{44}

Charging only geothermal customers for this program raises the cost per customer considerably, and does not put geothermal on a level playing field with gas. Comparatively, the Company is not similarly constraining any of its proposed other Future of Heat investments, which have a much more ambiguous ability to reduce greenhouse gas emissions by making only customers participating in those programs bear the full costs.

While the proposal to charge only geothermal customers for the Network project may be viewed initially as admirable to those looking to avoid any cost impacts on existing gas or electric ratepayers, it is shortsighted and will slow the adoption of this critical solution. The gas ratepayers need to contribute to the next generation of solutions as New York pulls back on gas expansion and with the increasingly prohibitive cost of replacing leak prone pipe with a projected service life of only 30 years. Existing gas distribution assets with depreciation schedules beyond 2050 are also threatening the gas ratepayers, as evidenced by the CFO of Corning Gas requesting “accelerated depreciation” charges be applied in their ongoing rate case to meet CLCPA mandates.\textsuperscript{45}

It is also notable that National Grid’s first demonstration project in Riverhead was funded from gas ratepayers, resulting in a low monthly charge to the customers receiving the shared geothermal service. “Homeowners paid a fixed monthly access fee of $21.66, which is the minimum charge of a KEDLI residential heating customer (Rate Code

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\textsuperscript{43} See FOH Testimony at 30.
\textsuperscript{44} See Company’s Response PACE_AGREE-129 (attached as Exhibit TGA-17).
Page FS-6
1. The majority of the homes received a 3-ton system, which would have translated to a monthly charge of $7.22/ton, which is 3 times less expensive than the current proposal of $22.69/ton/month.

Additionally, the per ton per month cost is set at a rate that allows the Company to recover the upfront capital costs of the program after about 18-20 years while charging customers for using the system for at least 50 years. This makes the long-term costs of participating in the pilot much higher than what customers can get through private financing of their own system, and it fails to take advantage of the utility’s ability to spread costs over long-time frames.

To make this project successful, accessible, and scalable, the Company needs a different business model than what they are proposing. Some options to consider for lowering the rates related to the Geothermal Network would be to spread the costs over the entire gas customer base, like any other capital investment, and/or lengthening the Company’s payback period beyond 20 years to something closer to the expected life of the system.

Q. Have you calculated the emissions impacts of adding 2,400 new residential and commercial customers each year to the gas system, with 675 converted from oil and the rest new construction?

A. Yes. Figure 14 shows that from 2022 to 2024 CO₂ emissions will increase 41,395 metric tons over three years (.041mmT), and total CO₂e emissions including methane leakage will increase 81,963 (.082 mmT). This growth is 25% more than the amount projected to be saved by the Company’s heat pump incentive and geothermal network program, Figure 13.

46 Company Ex. FOH-2 at 10.
47 Company Ex. FOH-2 at 122.
48 Company Response to PACE_AGREE-182 (attached as Exhibit TGA-18).
Q. Please explain your sources and methodology to compile the chart above.
A. The number of dekatherms per year added by the new customer connections was obtained from the company.\(^\text{49}\) The calculations are the same as for Figure 4.

Q. Have you reviewed the emissions impact of the Company’s gas efficiency targets?
A. The Customer Energy Panel Exhibit 1 states that the 2022 gas efficiency targets are a reduction of 870,798 dekatherms. The 2023 and 2024 targets are the same, for a total of 2,612,394 over three years.\(^\text{50}\) The table below shows that the gas efficiency program impacts over those three years will be 138,642 metric tons CO\(_2\) and 274,511 metric tons total CO\(_2\)e.

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\(^{49}\) Company Response to PACE_AGREE-169 (attached as Exhibit TGA-19).

\(^{50}\) See Company Ex. CEP-1.
Q. What about the Company’s leak prone pipe replacement (“LPP”) proposal?

A. The Company plans to retire approximately 50 miles of LPP per year on average for the term of the rate plan. The Company says that replacing 195 miles of leak prone pipe will reduce emissions by 63,000 dekatherms.

Between 2022 and 2025, the total yearly amount of CO\textsubscript{2}e emissions from that amount of natural gas leakage that would be saved is 5,123 metric tons (.005 mmT) as shown in Figure 16 below.

![Figure 16: Emissions Reductions from Leak Prone Pipe Replacement 2022-2025](image)

Q. When you review the Company’s proposed strategies for reducing emissions in its entirety, how do the Company’s proposals compare to what is needed to stay on track to the CLCPA targets?

A. As I have demonstrated above, aggressive conversions from gas and petroleum are needed to meet the greenhouse gas reduction mandates required by the CLCPA. The combustion heating sector contributes 47.8% of greenhouse gas emissions from energy in New York State when methane is accounted for in accordance with the CLCPA.

After taking into account progress made in all three energy sectors (electricity, transportation, and combustion heating), I have recommended that by 2030, the combustion heating sector should reduce greenhouse gas emissions by 41.3% CO\textsubscript{2} and...

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51 Company Responses to PACE_AGREE-061 (attached as Exhibit TGA-20) and PACE_AGREE-062 (attached as Exhibit TGA-21).
52 Company Response to DPS-727 at 4 (attached as Exhibit TGA-22).
7.4% CO$_2$e in order to do its part to meet the CLCPA mandates. This translates to a statewide reduction of 24.16 mmT CO$_2$e between 2018 and 2030.

When I apportion these mandates to National Grid’s Upstate service territory, I conclude that by 2030, 1.24 mmT CO$_2$ must be reduced from National Grid Upstate customers in the combustion heating sector, the equivalent of removing 154,333 natural gas customers (including residential, commercial and industrial as shown in Figure 6 above) and 88,377 fuel oil customers off of fossil fuel heat (as shown in Figure 10 above).

Figure 17 below summarizes the combustion heating emissions reductions potential for the Company’s quantifiable programs compared to the 2030 CO$_2$ target of 1.24 mmt and CO$_2$e target of 2.45 mmT. On the positive side, the gas efficiency program contributes significantly, advancing the company 11.2% toward the 2030 targets. The heat pump incentive program also contributes 2.7%. The leak prone pipes program impact to emissions reduction is insignificant at 0.2%. These three programs contribute 14% to reaching the Company’s statewide share of the CLCPA 2030 mandates.

**Figure 17:** Program Emissions Reductions Summary 2022–2024

National Grid’s Upstate gas efficiency programs will help the Company reduce direct building level CO$_2$ gas emissions by 138,642 metric tons CO$_2$ (.139 mmT) and 274,511 metric tons CO$_2$e (.275 mmT) over the next few years, the equivalent of removing 25,942 gas customers from the system, see Figure 15.
The Company’s heat pump incentive program will further reduce direct building level CO\textsubscript{2} emissions by 33,370 metric tons (.033 mmT) over three years, the equivalent of removing 6,244 residential gas customers from the gas system (see Figure 13). In order to achieve the 2030 CLCPA mandate, having a heavy mix of commercial conversions networked with nearby residential conversions would be the most cost and time effective approach for the next 10 years. This would allow time for the Gas Efficiency Program upgrades that might reduce the required heating capacity of subsequent residential heat pump conversions to take place.

The Company’s Leak Prone Pipe investments result in very little greenhouse gas reductions (.005 mmT CO\textsubscript{2}e over three years) when compared with other options, such as efficiency and heat pumps.

These three programs together represent about 13.9\% CO\textsubscript{2} progress and 14.1\% total CO\textsubscript{2}e of the progress needed to meet the 2030 GHG reduction mandates.

Unfortunately, 3.3\% of this potential progress will be undone by the Company’s projected 2,400 new gas connections, which will result in increases of 41,395 metric tons CO\textsubscript{2} and (or .041 million metric tons) per year and 81,963 metric tons per year GHG (or .082 million metric tons) and will cost customers precious money that could and should be redirected to a beneficial electrification project.

This reduces the progress to 10.6 \% CO\textsubscript{2} and 10.8\% of total CO\textsubscript{2}e needed to meet the 2030 GHG reduction mandates.

Meanwhile, the Company proposes to spend a collective $20.96 million through 2025 on other capital investments it describes as “Future of Heat”—investments that further extend the life of the gas system, but which provide speculative and unquantified greenhouse gas reduction prospects. Even more, the Company indicated that the proposed

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53 See FOH Testimony at 9. ($2.89 million for RNG interconnection and $18.07 million for everything else).
gas demand response, fuel switching calculator, RNG interconnection, and carbon capture “may result in emissions reductions but the magnitude is unknown.”\textsuperscript{54} The Company has not developed a specific estimated emissions reduction contribution from each of the individual initiatives listed above. The Company has stated that “[o]ne of the purposes of the demonstrations is to assess potential reductions.”\textsuperscript{55} 

Taken together, the Company’s proposed investments related to reducing emissions do not make adequate progress toward the State’s greenhouse gas reduction requirements. Furthermore, the Company has provided no forecast of reduction of GHG emissions on a volumetric and or percentage basis that will be achieved by the years 2025, 2030, and 2035\textsuperscript{56}, nor does it have a comprehensive plan demonstrating how it will achieve the targets.

Therefore, the only possible conclusion is that if the Commission were to adopt National Grid’s proposal as written, National Grid’s Upstate portion of New York’s first legally mandated 2030 emissions reduction level is unlikely to be met.

The Company has acknowledged that the heating sector is challenging to decarbonize.\textsuperscript{57} The Company explains that customers have made significant investments in heating systems and other equipment to utilize natural gas for heating applications and that “[r]eplacing all this equipment and retrofitting buildings, especially older buildings, is an enormous technical and economic challenge.”\textsuperscript{58}

Continuing with this line of thought will not enable New York State nor the customers within the Company’s service territory to achieve the CLCPA mandates. The thought process needs to be shifted to “how CAN the CLCPA mandates be met?” The technologies exist to meet the mandates. What is missing is the will to creatively apply

\textsuperscript{54} Company Response to PACE_AGREE-170 (Ex. TGA-9).
\textsuperscript{55} Company Response to PACE_AGREE-170 (Ex. TGA-9).
\textsuperscript{56} See Company Response to SC-018 (attached as Exhibit TGA-23).
\textsuperscript{57} See FOH Testimony at 42.
\textsuperscript{58} See Company Response to SC-009 (attached as Exhibit TGA-24).
them and formulate a utility scale business model to make the solutions much more affordable and eliminate the need for subsidies.

VI. RECOMMENDATIONS

Q. Based on all of your analysis of the CLCPA targets, the application of those targets to National Grid’s Upstate service territory, and National Grid’s proposals, what are your recommendations?

A. The Commission should require the Company to plan its investments around specifically meeting the CLCPA greenhouse gas reduction mandates.

1. This will require the Company to invest in heat pumps and energy efficiency at a scale that brings down emissions associated with the Company’s gas system by 40% by 2030 and 85% by 2050 and plan for the near total phase out of its gas infrastructure system by 2050.

2. The Company should cease marketing fuel oil to natural gas conversions and should cease marketing gas as a clean or beneficial technology.

3. The Company should be required to find every opportunity to avoid investments in gas infrastructure beyond what is absolutely necessary to maintain reliability and safety for current gas customers.

4. The Company should be required to develop a plan for an orderly phase out and retirement schedule for a minimum of 85% of its gas assets and their replacement with individual or shared renewable thermal energy systems.

5. The Commission should require National Grid to adopt annual targets in CO$_2$e emissions reductions to be achieved with specific targets for energy efficiency and heat pumps, as these provide the most effective methods for reducing emissions.

6. The Commission should address the 100-foot rule$^{59}$ and other policies that encourage and subsidize oil-to-gas conversions, as they would continue to nearly double residential housing unit CO$_2$e emissions.

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$^{59}$ The 100-foot rule is a policy that requires gas companies to provide prospective gas customers with 100 ft. of infrastructure at no cost to the new customer.
7. The Commission should mandate that the 100 ft. rule (16 NYCRR Part 230) apply to
closures to an ambient temperature thermal loop just as it applies to the natural gas
distribution system today.

8. The Company should convert the focus of the current LPP plans to replace leak prone
pipes with ambient temperature thermal loop installations which will cost less because
they do not need to have long distance supply runs, but rather locally concentrated inter-
connected ambient temperature thermal loops that provide both heating and cooling by
connecting to any combination of residential, commercial, and industrial buildings in a
given area. This can be accomplished by attaching locally available non-combustion
thermal energy resources to the loop network (a tailored combination of ground source
heat exchangers, solar thermal heat exchangers, surface water heat exchangers, waste
water heat exchangers, captured industrial waste heat, and recycled thermal energy using
heating and cooling diversity among buildings, and thermal energy storage).

9. The Company should work with a thermal energy company that has years of experience
with ambient temperature thermal loop installations to collectively design a business
model that supports more affordable energy rates by leveraging long term CAPEX
financing, volume equipment purchase agreements, and any other financial mechanisms
that make heating and cooling more affordable than it is today. Further, the Company
should spread the costs of the proposed Geothermal Network across all gas customers,
just as with any other gas capital project.

Q. Does this conclude your testimony?
A. Yes.