Critical Elements in Short Supply:

Assessing the Shortcomings of National Grid's Long-Term Capacity Report

Conducted by:

David G. Hill, Ph.D., Energy Futures Group

Chelsea Hotaling, Energy Futures Group

Gabrielle Stebbins, Energy Futures Group

Prepared for:

350.org and 350Brooklyn

Original March 9, 2020

With Addendum:

April 17, 2020

This whitepaper was prepared by David Hill, Chelsea Hotaling and Gabrielle Stebbins of Energy Futures Group with support and review or comment from Suzanne Mattei of Lookout Hill Public Policy Associates, Robert Wood and Sara Gronim of 350Brooklyn, and Richard Brooks of 350.org. Any omissions or errors are the responsibility of the primary authors. Questions for the authors should be directed to dhill@energyfuturesgroup.com

Table of Contents

EXECUTIVE SUMMARY

The Settlement Agreement between the New York State Public Service Commission ("PSC") and National Grid regarding National Grid's recent self-imposed moratorium on new natural gas connections included a requirement for National Grid to conduct a long-term needs assessment. This paper presents an alternative analysis that casts doubt on National Grid's claim to need new gas infrastructure by analyzing National Grid's findings from three perspectives:

Questions on Whether the Predicted Need is Inflated: The U.S. Energy Information Administration's forecasted demand is significantly lower than National Grid's. **An adjustment based on EIA's data would reduce National Grid's projection of future energy needs by nearly 85%.** Furthermore, National Grid's own analysis shows that the historical growth in Design Day Gas Demand has slowed between 2014 and 2020 compared to 2010 to 2014. Transparency is critical when forecasting future demand. A meaningful debate regarding the need for new gas infrastructure requires National Grid to present the underlying assumptions and methodology used to develop the demand forecast.

Better Ways to Meet Demand: Comprehensively incorporating non-pipeline alternatives such as energy efficiency, demand response, flexible load management, strategic electrification through cold climate air source heat pumps as well as geothermal heat pumps, and sealing gas leaks in existing pipelines can greatly reduce future demand. This paper shows that aggressive implementation of **non-pipeline alternatives can reasonably be expected to meet 88% of National Grid's projected need** – and would more than address future demand if National Grid's projection is inflated.

Meeting our Climate Goals: Construction of new gas infrastructure is inconsistent with State climate policy, goals, and initiatives. **Consistency with State climate policy requires that National Grid's high projections be reduced by more than 95%**; the non-pipeline option is the appropriate route for our energy future.

Careful, critical assessment of new gas infrastructure is necessary. Investment in new gas infrastructure with a decades-long lifespan can lead to stranded costs, under-utilized assets, and emissions that are incompatible with climate targets. Ratepayers may end up bearing undue costs, and investment in new pipeline capacity may discourage investments in energy efficiency, peak demand reduction programs, electrification of space heating and decarbonization of the grid, all of which are critical to a sustainable energy future.

National Grid must play a constructive role in meeting New York State and local energy goals by vigorously promoting a comprehensive and integrated strategy that relies on energy efficiency, demand response, flexible load management, strategic electrification, reduction of gas leaks and renewable solutions.

Introduction

Under a settlement agreement with the New York State Public Service Commission ("PSC") in November 2019, which lifted National Grid's self-imposed moratorium on new gas service connections, the company agreed to investigate a range of options to address long term supply needs for its downstate New York territory - the Keyspan Gas East (KEDLI) and Brooklyn Union Gas (KEDNY) service areas. National Grid had asserted in May 2019 that its refusal to process applications for new or expanded gas service in most of its downstate New York territory was due to concerns over sufficient firm gas supplies during periods of peak demand.[1] The settlement agreement requires National Grid to produce a report assessing long-term need and options to address it, and to present its analysis for public input.[2]

National Grid's proposed report, released on February 24, 2020,[3] emphasizes the Williams Northeast Supply Enhancement Project (NESE) pipeline as a key element of the solution set that it intends to submit to the PSC—a costly, questionable and problematic option. The NESE proposed by the Williams corporation and Transcontinental Gas – and supported by National Grid as its sole named customer – would allow the burning of up to 400,000 Dekatherms more per day (400 MDth/day[4]) of gas, which would be a 14% increase to National Grid's existing 2,888 MDth/day of total system firm peak day capacity for the KEDLI and KEDNY systems combined.[5]

Careful, critical assessment of new gas infrastructure is necessary. Investment in new gas infrastructure with a decades-long lifespan can lead to stranded costs,[6] under-utilized assets, and emissions that are incompatible with climate targets. Ratepayers may end up bearing undue costs,[7] and investment in new pipeline capacity may discourage investments in energy

[1] Implementation and Contingency Plan, Oct 21, 2019, NYS PSC Case 19-G-0678. p. 2.

[2] New York Public Service Commission, "*PSC Approves Settlement to Lift National Grid Gas Moratorium*", 19101/19-G-0678, 11/26/2019. The long-term options to be considered, among others, include a new pipeline, liquified gas (LNG) facilities, compressed gas (CNG) facilities, renewable energy sources, conservation strategies and interoperable systems. *Id.*

[3] National Grid, Natural Gas Long-Term Capacity Report for Brooklyn, Queens, Staten Island and Long Island (Feb. 2020) (hereafter, National Grid Report.)

[4] One MDth = 1,000 Dekatherms (one million Dekatherms, in contrast, is designated as 1 MMDth). National Grid's report uses the MDth unit of measurement, and this report does the same, for ease of comparison.

[5] New York Public Service Commission, Case 19-M-0382, Winter Supply 2019-2020 forms, Table 1a. See National Grid Report, p. 9.

[6] Pipelines such as NESE are typically expected to be in service for ~50 years (or, 2070), while state climate targets net zero emissions by 2050.

[7] https://www.edf.org/sites/default/files/documents/Managing_the_Transition_new.pdf

efficiency, peak demand reduction programs, electrification of space heating and decarbonization of the grid, all of which are critical to a sustainable energy future.
This paper provides a framework for critiquing the National Grid report on long-term supply needs and options. Our work is preliminary; we present three elements and parameters, together with guidelines and suggestions, that should inform the public review and assessment of National Grid's pending plan:

- Transparency: What are National Grid's underlying assumptions regarding future demand, and are these reasonable? Is the predicted need inflated?
- Comprehensiveness: Has National Grid truly incorporated the savings achievable through non-pipeline alternatives? We identify better ways to meet demand.
- Consistency: National Grid's report is incompatible with greenhouse gas reduction targets set to meet our climate goals.

Based on these parameters, we provide a qualitative and semi-quantitative overview of factors to be considered when reviewing and assessing the validity of National Grid's report.

Figure 1 compares the results of our preliminary analysis of the key parameters listed above with the proposed capacity of the pipeline option presented in National Grid's report.

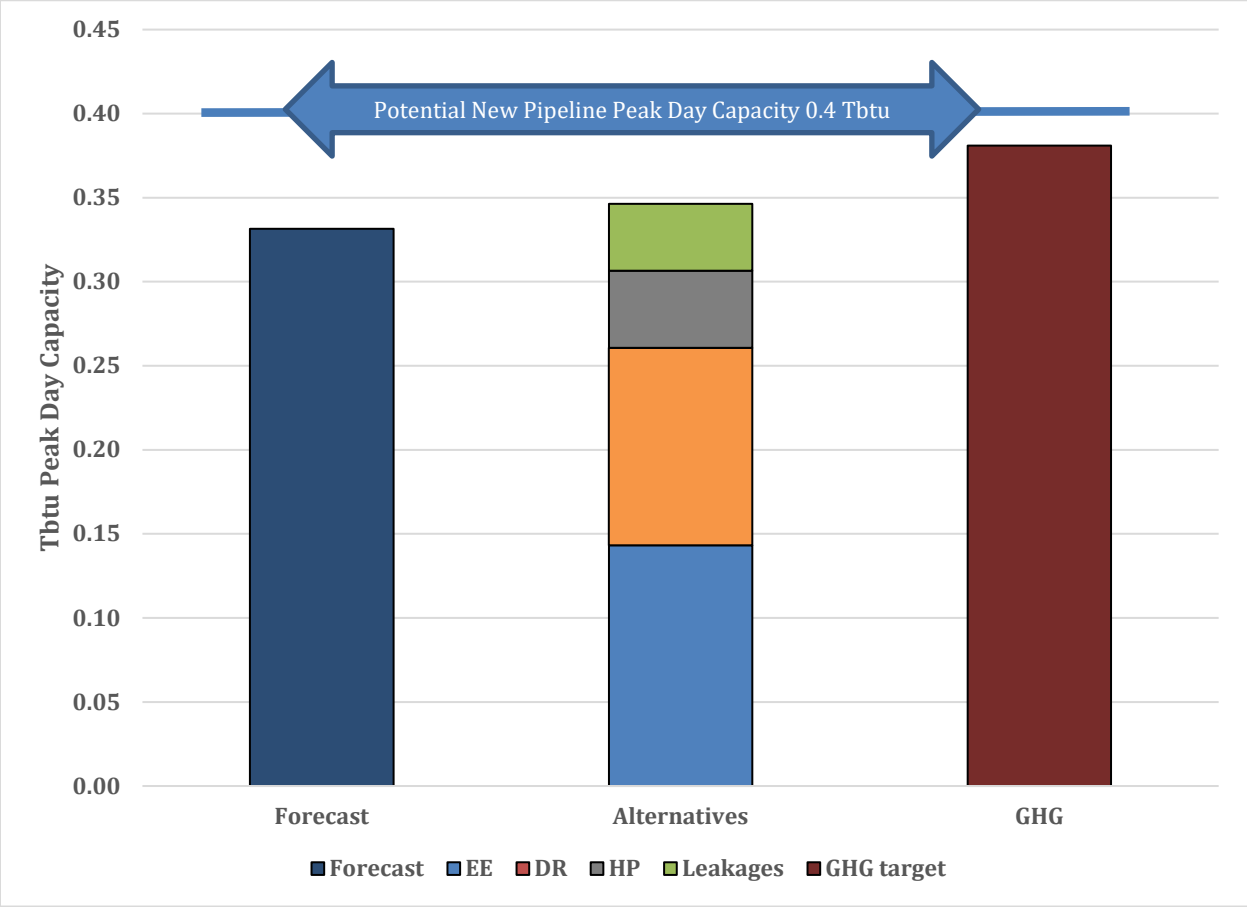

Figure 1: Proposed Pipeline Capacity Compared with Adjusted Needs Forecast, Non-Pipeline Solutions and New York Goal to Reduce Greenhouse Gases

The first stacked bar indicates that adjusting the demand forecast to be consistent with both historic trends and long-term energy outlook forecasts by the Energy Information Administration from 2019 to 2030 off-sets nearly 85% of the new peak day capacity that the proposed NESE pipeline would provide, leaving just slightly more than 15% capacity that would need to be met – and certainly could be met by non-pipeline solutions. This is discussed in Section 2 of this paper.

The second stacked bar in Figure 1 represents how a combination of non-pipeline alternative can be expected to off-set 88% of the peak day capacity that the proposed NESE pipeline would provide, not even taking into consideration any adjustment to National Grid's forecast of peak day demand. This is discussed in Section 3 of this paper.

Note that the first and second bars show a significantly lower demand than National Grid's forecast, each unto themselves. Scrutinizing the proposed forecast (the first bar) *in combination*

with an aggressive non-pipeline alternatives plan (the second bar) would reduce demand even further, raising even more doubt as to the need for new gas infrastructure.

Finally, the third bar indicates the amount of new gas capacity that must be avoided (more than 95%) if National Grid's pending long-term plans are to be consistent with statewide greenhouse gas reduction targets, presented in Section 4 of this paper.

The following sections of this paper explain the analysis that led to these results.

1 Background: National Grid's Downstate Customer Base

National Grid provides gas services to roughly 1.8 million customers in downstate New York through the Keyspan Gas East (KEDLI) and Brooklyn Union Gas (KEDNY) service territories. Figures 2 and 3 illustrate deliveries of gas by customer class in 2018 as reported by Energy Information Administration Form 176.

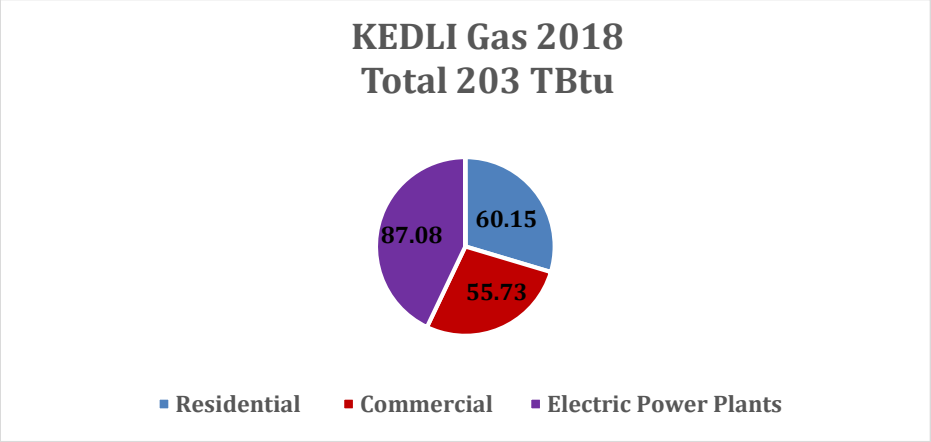

Figure 2: Keyspan Gas East Gas Deliveries by Customer Segment.[8]

The Brooklyn Union Gas KEDNY territory has slightly higher annual volume, with the notable difference of less delivery for electric power generation than KEDLI. Figure 3 provides the 2018 data for KEDNY.

[8] EIA. Form 176 Custom Report (User-defined). Natural Gas Annual Respondent Query System

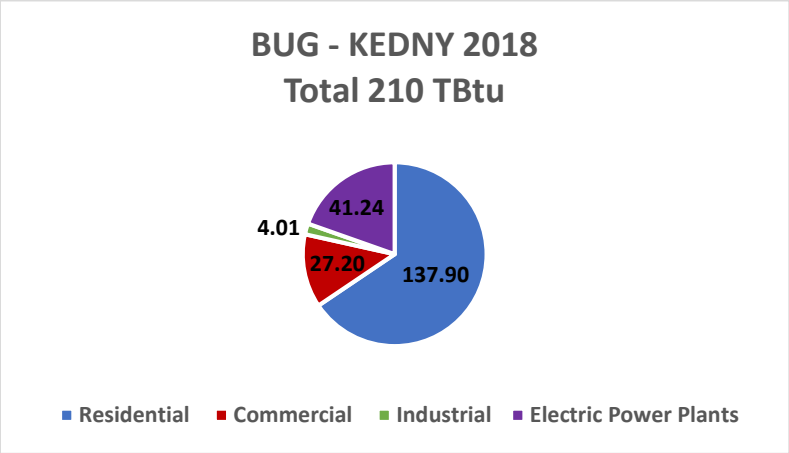

Figure 3: Brooklyn Union Gas KEDNY 2018 Deliveries by Customer Segment.[9]

2 Transparency: Forecasting Baseline Need

While National Grid presents a variety of data in the February 2020 report, the underpinning data sets, assumptions, and modeling methodology remain a "black box." As a result, it is impossible to analyze and verify the validity of National Grid's final forecasted demand. However, it is possible to compare historical demand to the estimates used by National Grid.[10]

National Grid's most recent report from February 24, 2020 asserts that the Downstate New York area will experience a Design Day[11] demand growth at a rate of 1.8% between 2020 and 2035, with a range of 0.8% to 1.1% to represent low and high demand scenarios.[12]

[9] EIA. Form 176 Custom Report (User-defined). Natural Gas Annual Respondent Query System.

[10] Note that the analysis in this paper was based on an August 29, 2018 presentation submitted to the U.S. Army Corps of Engineers, in which National Grid had originally projected gas demand growth of 10% over the next ten years.

[11] A "design day" is a 24-hour period of demand which is used as a basis for planning gas capacity requirements.

[12] National Grid Report, p.8. National Grid's projection for their baseline demand forecast is a CAGR of 1.8% between 2020 and 2035. National Grid then provides a range of 0.8% for a low demand scenario and 1.1% for a high demand scenario that take into consideration ranges of energy efficiency, demand response, and electrification.

While National Grid is projecting growth in its Design Day Gas Demand between 2020 and 2035, the continued growth in demand may not be as strong as it is projecting. This same pattern of slower growth appears in National Grid's report where it provides the historical Design Day Gas Demand compared to its projections for the future. Figure 4 illustrates National Grid's comparison between historical and projected Design Day Gas Demand. The historical growth in Design Day Gas Demand has slowed between 2014 and 2020 compared to 2010 to 2014. This slowing pace of growth calls into question the reasonableness of National Grid's assumption that the higher pace of growth from 2010 to 2014 would continue in the future.[13]

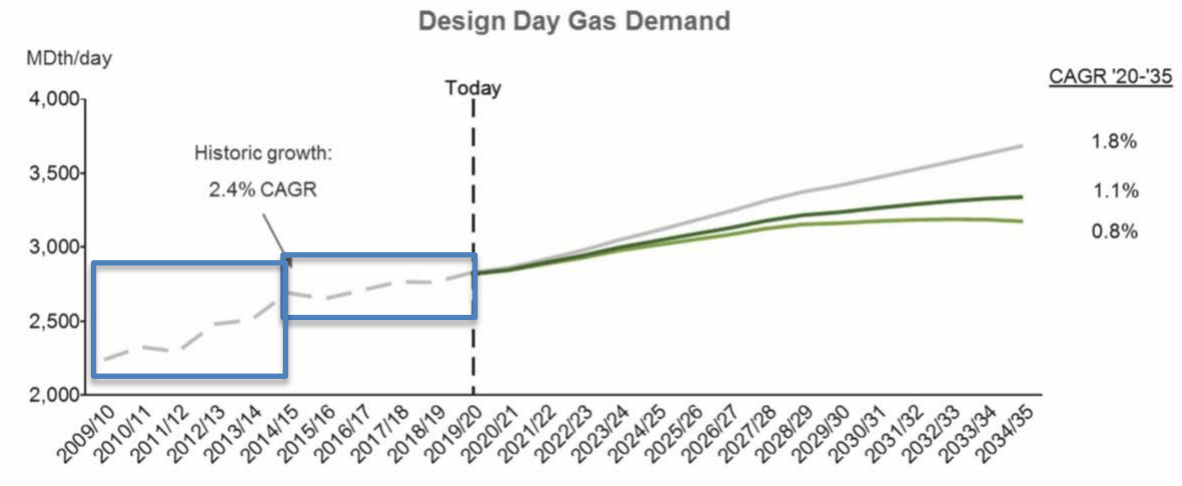

Figure 4: National Grid's Historical and Projected Design Day Gas Demand[14]

In its discussion on the key drivers for Design Day Demand growth, National Grid lists numerous drivers, which include: population growth, business and economic growth, increased gas usage per customer, and continued conversions from oil to gas. For stakeholders to understand what is driving the projected growth in Design Day Demand, National Grid needs to provide the sources for the underlying data. Without these citations, there are questions about the assumptions National Grid is making for these drivers.

Not only does historical demand not align with National Grid's demand forecast - other forecasts do not align either. The Annual Energy Outlook for 2020 produced by the U.S. Energy

[13] In order to fully understand National Grid's forecast, the report must discuss the forecasting methodology used, including whether National Grid used regression analysis focusing on key variables explaining growth in demand, or whether they applied extrapolation methods. If National Grid did use regression analysis, it would be helpful to understand what variables they chose to include in their model. In addition, it would be beneficial for stakeholders to see what the demand breakdown by customer class has been historically and what National Grid is forecasting for 2020 to 2035. Stakeholders will not be able to truly understand the derivation of National Grid's forecast without this key information.

[14] National Grid Report, Figure 1, p.8.

Information Administration (EIA),[15] in contrast to National Grid, projects that gas consumption will increase from 31.03 trillion cubic feet in 2019 to 31.54 trillion cubic feet in 2030.[16] This represents only 1.6% growth over the next ten years—which may itself be a conservative estimate given increased commitments to energy efficiency and renewable energy.

As represented in Figure 1 above, adjusting National Grid's 1.8% annual forecast[17] load growth downward, to be more consistent with the EIA's outlook, would offset almost 85% of the asserted need for a 400 MDth/day pipeline expansion for peak day purposes (not counting any potential adjustment to carbon output from changes in pipeline fuel[18]).

Decarbonization of our power grid is another issue that has not been included in National Grid's analysis or in this paper. However, it should be incorporated into future analyses and deliberations. Figures 2 and 3 above show that electric power plants constitute 31% of the current customer load base. With a State target of 70% renewable electric generation by 2030, and the addition of new offshore wind capacity, National Grid's downstate service territory can reasonably expect to see significant declines in demand for gas for electric generation. Additionally, Figure 5 below shows the results of a Long Island Power Authority's (LIPA) Integrated Resource Plan (IRP) presentation demonstrating that the run time for gas and other fossil generation stations is expected to be reduced due to the addition of off-shore wind.

[15] The U.S. Energy Information Administration (EIA) is a federal entity that collects, analyzes and disseminates detailed energy-related information. See Department of Energy (DOE) Organization Act of 1977 (P.L. 95-91, 42 USC 7135).

[16] Energy Information Administration, Annual Energy Outlook 2020. Table: Table 13. Natural Gas Supply, Disposition, and Prices. The 1.6% growth is for national gas consumption. The EIA Annual Energy Outlook projects that gas consumption in New England will decrease from 0.885 quadrillion Btu in 2019 to 0.729 quadrillion Btu in 2030.

[17] Taking National Grid's assumed baseline annual growth rate from 2020 to 2025 represents 9.33% growth between 2020 and 2025.

[18] This paper does not evaluate the passages of National Grid's report that describe pilot studies of blending hydrogen with gas.

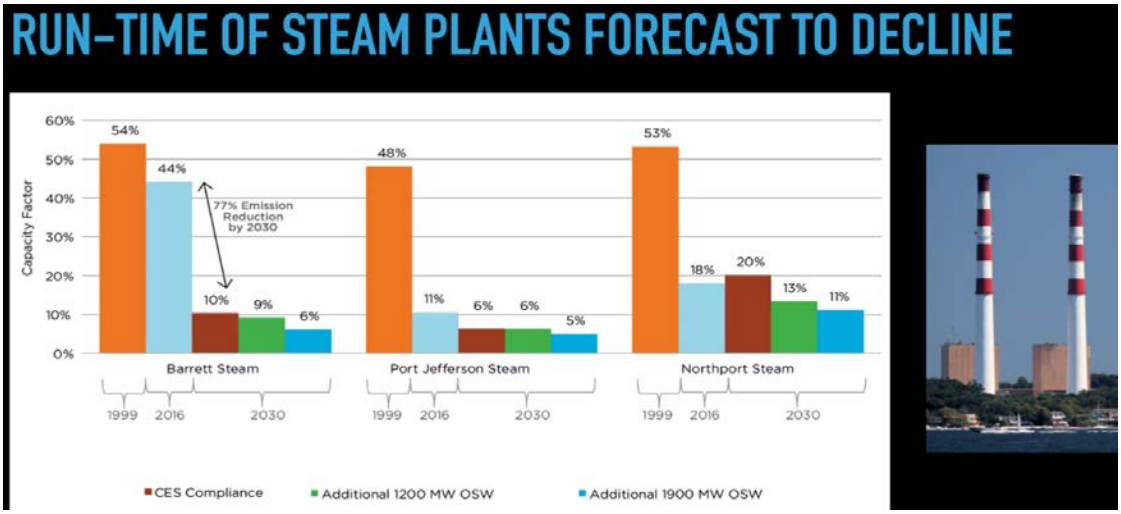

Figure 5: LIPA Anticipated Reductions in Non-Renewable Station Run Times.

Moreover, while strategic electrification and increasing variable renewable generation will require more coordination and planning for peak electric and gas demand loads during winter periods, the decisions to not build new gas fired electric generation must be explicitly recognized and included in National Grid's long-term gas needs assessment. In the KEDLI territory, the Long Island Power Authority's (LIPA) most recent Integrated Resource Plan has led to decisions to not build new gas fired capacity and to not repower existing gas generation stations.[19]

We are unable to assess the role of a decarbonizing grid in National Grid's forecasting. Its report should provide key information to allow such an assessment. It should disclose the highest level of capacity used by interruptible-service power plants in National Grid's Downstate New York territory during a non-peak period. It should also discuss how LIPA's recent and projected reduction in gas consumption by power plants affect the frequency of need for peak capacity or peak demand reduction.

We recognize that power plants running on interruptible service are taken off the pipeline system during periods of peak demand, operating instead temporarily on an alternate fuel. Nevertheless, if such power plants reduce the use of gas on average-to-increasingly colder days, that reduction does improve to some extent the capacity of the transmission pipelines to accommodate the increasingly higher gas usage by other customers that occurs as the temperature drops toward severe cold (*before* reaching peak capacity). Therefore, a significant reduction in gas use by power plants could affect how often the system reaches the point at which peak demand strategies are triggered. This should be quantified.

[19] Long Island Power Authority, DPS Public Statement Hearings. https://www.lipower.org/wp-content/uploads/2016/10/Irp20Presention20BEST1.pdf

3 Comprehensiveness: Non-Pipeline Alternatives

A major policy in New York State that should drive non-pipeline alternatives in National Grid's plan is Governor Cuomo's Reforming the Energy Vision (REV) energy strategy. National Grid has proposed gas initiatives as part of the REV strategy and includes them in its current proposed plan. National Grid's REV strategy discusses its commercial gas demand projects to address gas constraints on the customer side and a green gas tariff program.[20] National Grid reports that it is looking into exploring solutions that include smart thermostats, building management systems, and solutions for thermal storage.[21]

While National Grid discusses an array of non-pipeline approaches in its proposed long-term needs assessment, a more aggressive program is possible. Indeed, when implemented in a comprehensive, integrated, strategic manner, non-pipeline alternatives result in considerable savings.

Table 1 summarizes our findings and estimate of peak day savings (in MDth) from non-pipeline alternatives that a comprehensive analysis should incorporate.

Table 1: Non-Pipeline Alternatives

Alternative	Peak Day MDth	Notes
Gas Energy Efficiency	140	Annual incremental efficiency savings of 1%, consistent with leading initiatives, with 5% cumulative annual savings by 2025.
Demand Response	120	Annual average savings of 20%, which is relatively conservative compared to pilot results. Based on saturation of 20% of residential and commercial customers by 2025.
Heat Pumps	50	Based on 1% of residential customers switching per year, a total of 80,000 customers by 2025.

[20] National Grid. Reforming the Energy Vision for Gas. Retrieved from https://www.nationalgridus.com/new-energy-solutions/Community-Projects/New-York/Gas-Rev

[21] National Grid. Gas Demand Response. Retrieved from https://nyrevconnect.com/gas-demand-response-national-grid/

Reduced Gas System Leakage	40	Based on reducing National Grid's current 2.32% leakage rate by 60%, down to a 0.93% reduction rate.
Total	**350**	**88% of potential 400 MDth/day pipeline expansion**

In its report, National Grid considers energy efficiency, demand response, and heat pumps for strategic electrification as a suite of options for its "No-Infrastructure Solution." Table 2 below highlights the Design Day Demand impact National Grid is projecting for these resources for two points in time in its forecast. Our preliminary analysis indicates a higher potential for savings by 2025 compared to what National Grid is projecting in its report.

Table 2: National Grid's Design Day Impact From No-Infrastructure Solution[22]

	Required Impact 2026/2027 (MDth/Day)	**Required Impact 2034/2035 (MDth/Day)**
No Infrastructure Solution	148 - 199	230 - 400

Our preliminary analysis includes one alternative that National Grid did not consider in its needs assessment: addressing leaks in the distribution system. Additional, critical information is missing from National Grid's presentation of the assumptions it made regarding its no-infrastructure solution options. For stakeholders to assess whether National Grid is harnessing all possible savings, National Grid must provide the annual impacts assumed for each year of the needs assessment, as well as additional information regarding the impact of specific energy efficiency and demand response programs.

3.1 Incremental Energy Efficiency

On January 16, 2020, the PSC released its Order on a Comprehensive Energy Efficiency Initiative, which establishes targets for increased use of heat pumps and calls for annual levels of efficiency savings of 3% for electricity and 1.3% for gas by 2025.[23]

[22] National Grid Report, Table 38, p. 97.

[23] Case 18-M-0084. January 16, 2020. State of New York Public Service Commission. In the Matter of a Comprehensive Energy Efficiency Initiative. Note that the "3,600 MDth" cited in the Case did not have a unit associated with it, hence none is provided here.

But if National Grid only achieves the minimum level of incremental energy efficiency required by this Order, the cumulative percentage of incremental savings for National Grid's downstate New York territory would be only 1.5% of its 2018 deliveries.[24] For our analysis, we assume that National Grid would achieve cumulative savings of 5% by 2025 and a reduction in demand of 140 MDth/day.

While higher than National Grid's current energy efficiency achievement of 0.4% of gas sales, this level of savings is comparable to what utilities elsewhere have achieved. Figure 6 presents the energy efficiency achievements of several utilities, as a percentage of retail gas sales, in 2015. National Grid's service territory in Massachusetts is one of the leaders in savings as a percent of sales. It is not unreasonable to assume that National Grid would be able to replicate that success in its downstate New York service territories.

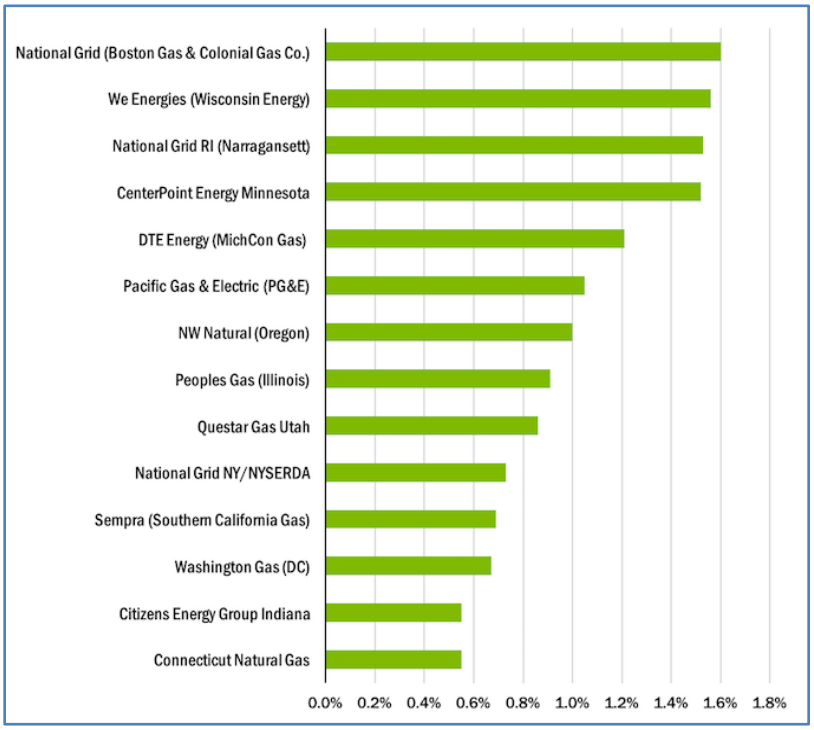

Figure 6: Incremental 2015 Energy Efficiency Savings as a Percent of Retail Gas Sales[25]

[24] Case 18-M-0084. Appendix A, Table A4. Total savings for KEDLI and KEDNY between 2021 and 2025 are 6.10 Tbtu. The cumulative incremental savings between 2021 and 2025 only amount to 1.5% of National Grid's 2018 sales.

[25] ACEEE. March 31, 2017. Leading states and utilities achieve substantial gas energy efficiency savings. Retrieved from https://www.aceee.org/blog/2017/03/leading-states-and-utilities-achieve

3.2 Demand Response

More aggressive demand response programs present another opportunity to reduce future need. Demand response programs for gas would work essentially in the same way as demand response electricity programs. During periods of high demand and/or low supply, utilities provide an incentive to customers to lower their usage during the peak demand period. National Grid has an existing pilot demand response program for commercial and industrial customers. Since National Grid does not have an existing demand response program for residential customers in KEDNY or KEDLI, we used the savings results from a residential demand response program used by Southern California Gas Company ("SoCalGas"). When customers enroll in the program, they agree to allow SoCalGas to adjust[26] their smart thermostat remotely when an event is called.

During the 2017-2018 winter season, SoCalGas enrolled 9,267 customers and 10,798 smart thermostats. On average, each participant reduced their usage between 16-25%, which translated to 0.03-0.05 therms during the morning event period and between 10.7-15.6% or 0.012-0.019 therms during the evening event period.[27]

For the savings estimate in our analysis, we assumed a conservative level of 16% from a residential program similar to that of SoCalGas, and a 25% savings from a commercial and industrial program.[28] The weighted average savings across both programs is 20.5%. We assume that National Grid is able to reach 20% saturation for demand response programs by 2025.

[26] Up to four degrees.

[27] Case U 904 G. Direct testimony of Darren Hanway. Public Utilities Commission of the State of California. November 6, 2018. Retrieved from https://www.socalgas.com/regulatory/documents/a-18-11-005/Demand_Response_Testimony_Chapter%201_Final.pdf

[28] National Grid has not released results on peak impacts from their commercial and industrial demand response pilot.

Table 3 shows the breakdown of customers across National Grid's downstate service territories for 2018.

Table 3: Customers by National Grid Service Territory[29]

Company	Customers	2018
KEYSPAN ENERGY	Residential	505,303
	Commercial	46,695
THE BROOKLYN UNION GAS CO	Residential	1,025,428
	Commercial	32,101
	Industrial	3,652

Based on this saturation level, National Grid could achieve 120 MDth savings from implementing demand response programs. This is a reasonable assumption given the penetration SoCalGas has been able to achieve for its smart thermostat program, in addition to the penetration level from a smart thermostat program launched in Massachusetts.[30]

Our assumptions for National Grid's ability to scale its demand response programs is based on progress with its existing demand response program and results from other pilot studies. National Grid won the Utility Industry Innovation in Gas Award for its demand response program powered by AutoGrid software,[31] and it cited "greater than previously anticipated"

[29] EIA. Form 176 Custom Report (User-defined). Natural Gas Annual Respondent Query System.

[30] In a pilot program launched between December 2014 and January 2015, 20,104 nest thermostats enrolled, which translated to 54% of all eligible thermostats in Massachusetts. Information from Nest Seasonal Savings: MA DOER Heating Season Impact Evaluation. 2015. Retrieved from https://www.mcecleanenergy.org/wp-content/uploads/2016/08/MCE-AL-17-E-Seasonal-Savings-Pilot.pdf

[31] Autogrid. November 20, 2017. National Grid Recognized by NARUC for Natural Gas Flexibility Program Power by Autogrid. Retrieved from https://www.auto-grid.com/awards/national-grid-recognized-by-naruc-for-natural-gas-flexibility-program-powered-by-autogrid/

savings from demand-reduction programs and energy efficiency initiatives as one of the ways that it achieved compliance with the order to end its self-imposed moratorium on gas.[32]

National Grid has seen some demonstrated savings with the commercial customers participating in its pilot program. It was able to engage 16 large customers in its demand response pilot in New York. Based on information included in a presentation at the AEE East Energy Conference, the pilot in New York was able to see reduction in account-level gas consumption.[33] Figure 7 below illustrates how a university was able to achieve its fixed service level[34] targets during a gas demand event.

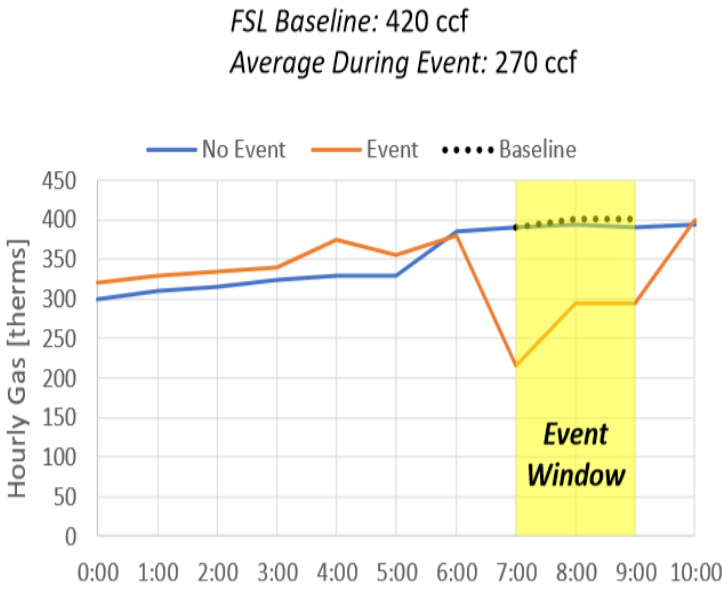

Figure 7: Reproduction from presentation at AEE East Energy Conference

The demand reduction potential and actual load reduction potential in National Grid's downstate commercial demand response pilot program exceeded its initial target. Table 4

[32] Harrington, M. and McDermott, M. November 26, 2019. National Grid Finds Gas to Resolve Short-Term Supply Problem. Retrieved from https://www.newsday.com/long-island/politics/national-grid-moratorium-gas-1.38936730

[33] Kurt Roth. March 21, 2019. Gas Demand Response: The Next Frontier. Presented at AEE East Energy Conference.Retrieved from https://cdn2.hubspot.net/hubfs/55819/Fraunhofer-GasDR-GlobalCon-FINAL-updated.pdf

[34] Fixed service level is when the customer manages their gas consumption to achieve a target gas consumption level relative to a pre-determined baseline.

shows the targets National Grid set for the pilot program compared to the results it has seen from the program.

Table 4: National Grid Pilot DR Program[35]

	National Grid Target	Results
Customer Enrollment	30 customers	15 facilities
Demand Reduction Potential	.14 MDth/hr	.19 MDth/hr
Actual Load Reduction Potential	Average of 25% process and 10% heating loads	Average of 63% and median of 50%

Even though National Grid had lower enrollment from customers, it was able to realize greater demand reduction potential than it originally anticipated from 30 customers. Considering the number of customers enrolled in the program to date, National Grid has the potential to scale this program to reach more of its commercial and industrial customers. With 15 customers enrolled across National Grid's downstate service territory, that represents a small percentage of the market, as illustrated in Table 5 below. Calculations were based on the number of customers National Grid reported for 2018 as shown in 3.

Table 5: National Grid Pilot DR Program Market Penetration

Territory	Customers Enrolled	% of C&I Customers
KEDLI / KeySpan	4	0.01%
KEDNY / Brooklyn Union Gas	11	0.03%

In its 2019 REV update on the pilot program, National Grid reported on a new customer that submitted demand response applications for 41 of its facilities. Due to project constraints, the project team worked with this company to select one facility that would provide the maximum level of value to the participant and the Project.[36] Nevertheless, the customer's willingness to include all of its facilities in a demand response pilot is a positive indication of the ability of this concept to be scaled. Based on this update provided by National Grid, significant potential exists to scale the program to reach more customers.

[35] National Grid Gas Demand Response REV Demonstration Project in New York City and Long Island. January 31, 2018. Q4 2017 Report.

[36] National Grid Gas Demand Response REV Demonstration Project in New York City and Long Island. January 31, 2019. Q4 2018 Report, p.2.

SoCalGas's recent proposal for its demand response plan includes additional pilot programs. Table 6 below illustrates the four pilot programs SoCalGas plans to explore for demand response offerings to customers. National Grid should look to some of the programs SoCalGas is implementing to expand upon its pilot program to reach a higher penetration for demand response.

Table 6: SoCalGas Gas Demand Response Pilot Programs[37]

Pilot Programs	Description	Pilot Goals
Space Heating Load Control	Smart Thermostat Load Control program that offers customers incentives to lower gas use during an event	● 50,000 thermostats by the end of 2018-2019 winter season ● 7,000 new enrollments every year
Water Heating Load Control	Controlling water heating equipment to lower gas usage during an event	Participants: ● 500 for 2019-2020 ● 1,000 for 2020-2021 ● 1,500 for 2021-2022
Load Reduction	Targeted for commercial and industrial customers to lower gas consumption	With 1% enrollment of customers, the program has the potential to reduce 22,172 therms per day with an average savings of 20%
Behavioral Messaging Pilot	Using messaging strategies to encourage customers to reduce their gas usage during peak demand periods	Sending energy reports to customers that provides information on peak demand events and the impact that customers had during the event

[37] Case U 904 G. Direct testimony of Darren Hanway. Public Utilities Commission of the State of California. November 6, 2018. Retrieved from https://www.socalgas.com/regulatory/documents/a-18-11-005/Demand_Response_Testimony_Chapter%201_Final.pdf

Another demand response program with smart thermostats also saw similar savings from heating use. The Massachusetts Department of Energy Resources partnered with Nest[38] to deploy a pilot program launched between December 2014 and January 2015. The program saw a high penetration of thermostats, as 20,104 nest thermostats enrolled, which translated to 54%[39] of all eligible thermostats in Massachusetts. The program saw a reduction in heating usage by an average of 3.5%.[40]

Achieving New York State's climate goals will require a substantial reduction in the reliance on gas. Demand response programs can address peak demand concerns while also reducing gas consumption. National Grid identified higher than expected savings from its pilot program, and it should replicate those savings by introducing other demand response programs similar to SoCalGas. These savings will be key to addressing its reported capacity need.

3.3 Flexible Load Management

Flexible load management—which includes coordination of loads through smart devices across multiple end users, and the ability to pre-heat and stagger loads such as water and space heating—further expands the potential beyond the conventional approach to demand response. A recent report by the Brattle Group found that a portfolio of load-flexibility programs, especially targeting the residential sector, could triple existing demand response capability by 2030.[41] It noted that, "For reasons entirely unrelated to demand response, customers are increasingly adopting technologies with load flexibility capabilities," and it predicts that while the commercial and industry sector has provided 70% of retail demand response capacity up to now, residential load flexibility additions ultimately will exceed those of the commercial and industry sector.[42]

3.4 Strategic Electrification

New York State's Order on Energy Efficiency identified a heat pump target of 88,000 buildings throughout the entire State.[43] Our analysis assumes that National Grid can target 1% of residential customers each year for installation of heat pumps in the Downstate area. This

[38] Nest is one of the companies that have developed smart thermostats. Smart thermostats are electronic thermostats that optimize heating and cooling.

[39] Nest identified 37,586 thermostats in Massachusetts for the program.

[40] Nest Seasonal Savings: MA DOER Heating Season Impact Evaluation. 2015. Retrieved from https://www.mcecleanenergy.org/wp-content/uploads/2016/08/MCE-AL-17-E-Seasonal-Savings-Pilot.pdf

[41] The Brattle Group, The National Potential for Load Flexibility: Value and Market Potential Through 2030. June 2019., p. 18. Retrieved from https://brattlefiles.blob.core.windows.net/files/16639_national_potential_for_load_flexibility_-_final.pdf.

[42] *Id.*, p. 25.

[43] Case 18-M-0084. January 16, 2020. State of New York Public Service Commission. In the Matter of a Comprehensive Energy Efficiency Initiative.

results in 5% of residential customers, or 80,000 households in Downstate New York alone, switching to heat pumps between 2020 and 2025. Our analysis indicates that installing heat pumps in 80,000 homes in the targeted area translates into savings of 50 MDth/day for National Grid by 2025. NYSERDA's report on its heat pump analysis indicates that more technical potential exists for use of heat pumps across the state. Table 7 outlines the technical potential identified by NYSERDA in its analysis of potential savings from heat pumps across existing and new buildings in New York State. This considers households switching from gas and fuel oil to heat pumps. Table 8 demonstrates the potential for National Grid's downstate service territory.

Table 7: Technical Potential Annual Thermal Load Served by Small-Scale Residential Heat Pumps for Existing and New Buildings to 2025 (MDth)[44]

Fuel	Area	ASHP	Minisplit	GSHP	Total
Gas	Long Island	16,300	10,100	16,800	43,200
	NYC	10,505	6,600	8,690	25,795
Fuel Oil	Long Island	18,300	11,700	18,800	48,800
	NYC	1,705	1,100	1,430	4,235

Table 8: Heat Pump Technical Potential for Existing and New Buildings for National Grid's Service Territory (MDth)[45]

Geography	ASHP	GSHP
Long Island	34,600	35,600
New York City	12,210	10,120
Total	**46,810**	**45,720**

National Grid should capture this potential for significant savings from the installation of heat pumps to mitigate the impact of peak demand events on its system.

[44] NYSERDA. New Efficiency: New York Analysis of Residential Heat Pump Potential and Economics. January 2019. Table 4-9, p. 18.

[45] Assume that National Grid's share of residential customers if 55% for New York City. ICF 2012 Assessment of NYC Natural Gas Market and Emissions, p. 26.

3.5 Gas Leakage

Leakage from gas pipeline systems results in emissions of methane, a greenhouse gas that is 86 times more powerful than carbon dioxide in the first 20 years. Our savings calculation for reducing the problem of leakages within National Grid's system is based on the weighted average of the current leakage rate for KEDLI and KEDNY, which is 2.32%.[46] Our assumption of the impact of reducing leakage on gas savings is based on a MIT study[47] finding that a 30% to 90% reduction in leakages would be needed to meet climate targets. From this range, we then targeted a reduction rate of 60% as a midpoint. This means that National Grid would need to lower its leakage rate down to 0.93%, which translates into a savings of 40 MDth/day.

4 Consistency: Greenhouse Gas Reduction Targets

Building a new gas pipeline is not consistent with the recent legislation passed in New York State to address climate change. Table 9 below highlights some of the policy enacted in New York State to address emissions and move toward a carbon free energy system. A new gas pipeline goes against the goals identified by New York State climate policies. Under these initiatives, the gas pipeline would become a stranded asset since New York will not be able to continue to rely on gas if the state wants to meet its emission reduction goals. In addition, it would not be prudent for National Grid to invest in the pipeline before evaluating and considering all other non-pipeline options to address the gas supply.

[46] EIA. Form 176 Custom Report (User-defined). Natural Gas Annual Respondent Query System. We took the weighted average of 2018 reported leakage volume for KEDLI and KEDNY service territories.

[47] Chandler, David. December 16, 2019. MIT News. The uncertain role of natural gas in the transition to clean energy. Retrieved from http://news.mit.edu/2019/role-natural-gas-transition-electricity-1216

Table 9: New York State and Local Policies on Emissions

Policy	Goals
Governor Cuomo's budget initiatives and the Climate Leadership and Community Protection Act of 2019	• Electricity grid must be 100% carbon-free by 2040
Climate Mobilization Act	• Buildings over 25,000 square feet in New York City must lower than emissions footprint by 40% by 2030 • Explore feasibility study on retiring 21 gas fired power plants and replacing them with renewable energy and storage
One City	• Reduce GHG emissions by 80% by 2050 in New York City • Reduce GHG emissions from energy used to heat, cool, and power buildings by 30% from 2005 levels

New York State has joined many other states and local and international jurisdictions that are now defining and embarking on a path leading toward a less risky climate future. It has made the commitment to reduce greenhouse gas emissions by 85% by 2050 with offsets for the remaining 15%, to achieve a net zero increase. It has also established a 70% renewable electricity goal by 2030, and a goal to achieve 100% carbon free electricity by 2040.[48]

The State is making progress in reducing emissions; 2016 levels—the latest available—are 13% lower than the 1990 base year, and 2016 emissions are 21% lower than New York's highest year of emissions, which was 2005.[49] ***Reducing emissions by 85% from 1990 requires that total annual statewide emissions be no more than 35 million metric tonnes of CO_2 equivalent (MMTCO2e) by 2050.***

Gas combustion in New York State created more than 70 MMTCO2e of emissions in 2016, representing 43% of the State's combustion related emissions, and more than a third of the total statewide greenhouse gas emissions.[50] Leakage from the gas system accounted for another 2 million metric tonnes. ***Therefore, gas emissions in the latest inventory, taken by***

[48] Climate Leadership and Community Protection Act, 2019.

[49] New York State Greenhouse Gas Inventory: 1990–2016 Final Report, July 2019. Table S-2.

[50] Ibid. Table S-1, and Figure S-4.

themselves, were more than two times greater than the eventual target for statewide total emissions.

These numbers provide context for consideration of National Grid's pending plan for long-term gas supply needs. Major new investments in pipeline infrastructure that would increase the combustion of gas in the downstate service territories is not a strategy consistent with state energy and policy goals.

The combined gas consumption by buildings in the KEDLI and KEDNY territories was 281,000 MDth in 2018.[51] To be consistent with New York's target of 40% greenhouse gas reduction by 2030, this consumption would need to be reduced by 20%, or 56,000 MDth by 2025. As represented in Figure ES 1, this level of reduction off-sets 95% of a potential new pipeline capacity expansion.

National Grid's report also sends confusing messages to stakeholders about how it is accounting for the emissions from the proposed NESE pipeline. MJ Bradley released a report[52] on CO2 emissions from the pipeline that was riddled with concerns, and National Grid is using that study in its long-term needs assessment.[53] National Grid asserts that the NESE pipeline would produce fewer emissions than non-pipeline alternatives in part by relying on this report. But the Bradley report relied on the Department of Energy's outdated statistics on methane leakage rates and focused on methane's 100-year warming potential rather than its far more potent 20-year impact. While it briefly mentions the correct methane data in passing, it consigns its discussion of it to an appendix.

Conclusions and Recommendations

The PSC's enforcement action agreement requiring National Grid to conduct a comprehensive long-term needs assessment presents an important opportunity to scrutinize our future energy options. The analysis and findings above lead us to the following conclusions and recommendations:

- Transparency: National Grid's data assumptions and methodologies must be scrutinized, as National Grid's projection is not consonant with the EIA's Annual Energy Outlook national and regional projection for gas consumption nor with recent historic demand. National Grid must provide full transparency to the assumptions and approach utilized in order for stakeholders to assess the validity of its needs assessment.
- Comprehensiveness: A far more aggressive plan embracing non-pipeline alternatives can reasonably be expected to meet future needs even if National Grid's high projections

[51] Energy Information Administration, form 176.
[52] MJ Bradley. June 11, 2019. Life Cycle Analysis of the Northeast Supply Enhancement Project. Retrieved from https://www.mjbradley.com/sites/default/files/MJBA_NESE_LCA_06112019.pdf
[53] National Grid Report, p. 51.

are correct – and would more than address future growth needs if National Grid's projection is inflated.

- Consistency: Construction of new gas infrastructure is not consistent with State climate policy, goals, and initiatives. National Grid should play a constructive role in meeting New York State and local energy goals by promoting vigorous non-pipeline alternatives such as energy efficiency, demand response initiatives and deployment of renewable technologies.

Critical Elements in Short Supply: April 17th Addendum

On February 24, 2020 National Grid released the "Natural Gas Long-Term Capacity Report for Brooklyn, Queens, Staten Island and Long Island ("Downstate NY")". Energy Futures Group (EFG) issued a critical assessment of National Grid's report on March 9, 2020. EFG's work examined National Grid's approach and findings to projecting long term capacity needs, from several perspectives:

- The basis and component factors driving demand forecast projections;
- The characterization and consideration of non-pipeline alternatives; and
- Consistency of the long-term capacity report with state policy and targets related to reducing greenhouse gas emissions.

National Grid has subsequently released a revised Summary Report (March 11, 2020), a single page spreadsheet with further detail on Demand Scenario assumptions (March 23, 2020), A Customer Cost Impact Supplement (March 23, 2020), and a Technical Appendix (latest revision April 1, 2020). National Grid has also conducted six remote public information sessions and solicited feedback via survey and direct comments.

This Addendum to EFG's original report further highlights several topics with additional research and analysis. The sections presented below on gas demand response programs and natural gas leakage mitigation complement, rather than replace the material presented in our original assessment.

To date, National Grid's Long-Term Capacity Report and the supporting documents and presentations have not identified a preferred solution; they have been intended to inform the public, regulatory and policy decision makers about the range of options under consideration. Based on their analyses and feedback to the report and public sessions, National Grid is expected to bring forward preferred option(s) and investments in the coming months. The final section of this addendum to EFG's original report outlines an important set of questions to assist in the critical review and assessment of National Grid's pending proposal for a preferred solution to meeting the long-term capacity needs for the downstate New York service territory and customers.

Demand Response

Natural gas demand response efforts have traditionally focused on interruptible service rates where customers (typically large users) have flexibility to curtail usage either by operating changes or fuel switching during high peak demand periods. National Grid has a temperature control tariff in place and includes an enhancement to this tariff as an option for the low demand scenario, as discussed further below.

Natural gas demand response initiatives can also include device-based (direct load control) and behavioral strategies. These are relatively newer approaches for natural gas system planning offering additional means to reduce peak day demands and offset the need for supply side infrastructure investments.

Both National Grid[54] and Con Edison[55] have reported favorably on gas demand reduction pilot initiatives, with encouraging results on savings per participating customer, lower than anticipated costs, and high levels of potential customer interest.

As Grid takes next steps in identifying its preferred options for meeting long term needs, taking full advantage, and building upon, the pilot experience is essential. The market is also evolving rapidly and taking advantage of new connected device control and communication strategies. Looking forward capturing the industry's emerging innovation and ability to deliver gas demand response savings will be critical.

In our review of the Grid's Technical Appendix materials and the initial Long-Term Needs Assessment report we have the following additional comments and questions on the demand response elements of the plan.

Enhanced Temperature Control Tariff

National Grid's assumptions around potential savings from an enhanced Temperature Control demand response program call into question why they only applied this assumption to one of the demand scenarios. In the Technical Appendix, it states:

> *In the High demand scenario, we assumed that Commercial & Industrial and Residential (C&I/R) demand response programs will take place, and that the existing Temperature Controlled program would remain in place. In the Low demand scenario, we assumed that on top of the C&I/R programs there will be an additional demand reduction due to an enhanced Temperature Controlled tariff.*[56]

Table 1 outlines the differences that National Grid assumed around the Temperature Control DR program under the Low and High Demand scenarios. Given National Grid's success with their pilot program, savings from a new enhanced Temperature Control Tariff should be considered under both demand scenarios evaluated and not just the Low Demand scenario. In the Long-Term Needs Assessment Report, National Grid stated, "We have proposed new incentives for this program and believe this could reduce TC conversions to firm service by

[54] Gas Demand Response REV Demonstration Project in New York City and Long Island Q4 2018 Report, Table 3.1.2 Checkpoints, p. 9.
[55] Gas Demand Response Report on Pilot Performance – 2018/19, Consolidated Edison Company of New York, Inc. July 1, 2019 Case 17-G-0606 Case 14-E-0423.
[56] National Grid Natural Gas Long-Term Capacity Report Technical Appendix, p.3. April 1, 2020. Retrieved from https://millawesome.s3.amazonaws.com/Downstate_NY_Long-Term_Natural_Gas_Capacity_Report_Technical%2BAppendix%2B04-01-20.pdfNational Grid Technical Appendix. Hereafter referred to as the National Grid Technical Appendix.

25%."[57] If the program can be redesigned with new incentives, then this should be the assumption used to gauge the savings from the Temperature Control program. It does not make sense for National Grid to assume that the new Enhanced Tariff can be made available in only the Low Demand scenario.

National Grid reports its assumption for Temperature Control customers to be 50 Dth on the design day.[58] Not including potential savings from an enhanced tariff across both demand scenarios distorts the savings and downplays the role demand response can play in helping to address National Grid's identified supply and demand gap.

Table 1. Temperature Control Assumptions Under Demand Scenarios[59]

Temperature Control	**Low Demand**	**High Demand**
Conversion Rate	25% slower than historic	Historic rates
New Enhanced Tariff	Yes	No

Commercial/Industrial and Residential Heat Programs

It appears that savings for the Commercial and Industrial (C&I) and residential heat demand response programs are considered for both the Low Demand and High Demand scenarios, but some of the language used in National Grid's Technical Appendix is misleading. For example, in one section it mentions that the savings are in both scenarios,[60] but another section states "The thermostat direct load control (DLC) program participation was assumed to increase linearly over 4 years to reach 40% of residential heating customers by 2024 in the high gap scenario. This program was assumed to not be necessary in the low gap scenario."[61] Similar to the use of different assumptions for the enhanced Temperature Control tariff, it seems like National Grid is presenting misleading information on savings that can be achieved from a C&I and residential heat demand response program. As was discussed in our initial report, other thermostat control programs have achieved success in helping to lower demand during peak events. It is disingenuous for National Grid to not consider this program under both of their demand scenarios.

[57] National Grid Long-Term Needs Assessment, p. 35.
[58] National Grid Technical Appendix, p.11.
[59] National Grid Technical Appendix, p. 36.
[60] Please see Footnote 2.
[61] National Grid Technical Appendix, p. 11.

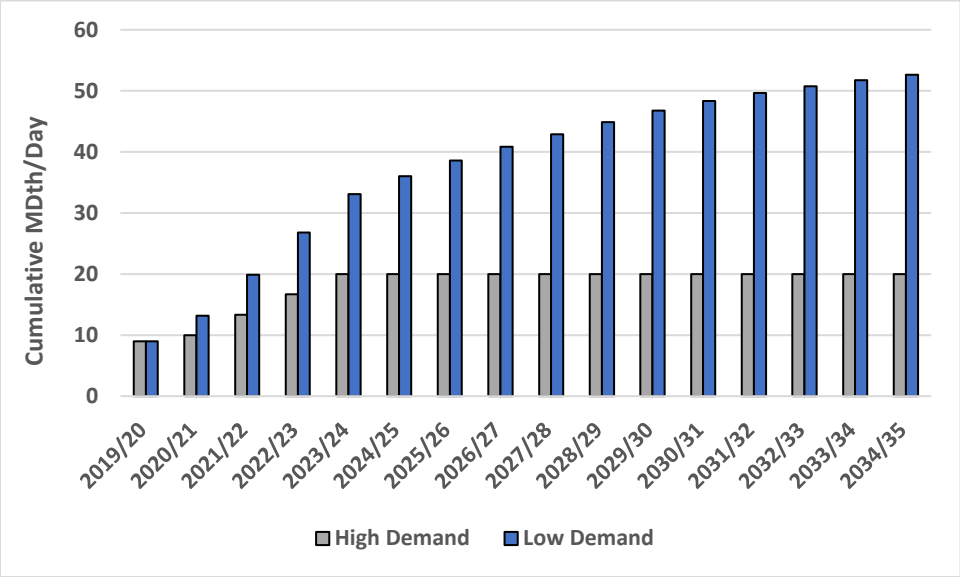

Figure 1. Cumulative Savings from Demand Response (MDth/Day)[62]

Under the high demand scenario, the graph illustrates how the design day savings for demand response programs remains flat at 20 MDth/day by the 2023/2024 winter season with no potential for additional savings thereafter. National Grid assumes a ramp up of savings from 9MDth/day to 20 MDth/day by 2024/2025. Since National Grid's projections cap at 20 MDth/day, this leads to questions around the assumptions made for technical or market adoption limits and why there is no further potential savings beyond the 20MDth/day.

These savings contrast with the analysis we performed for our initial report as Illustrated in Table 2. The demand response savings analysis included in our initial report assumed savings level similar to what Southern California Gas has seen with their demand response pilot programs. We assumed that National Grid is able to reach 20% saturation for demand response by 2025.

[62] National Grid Detailed Demand Scenario Assumptions for Natural Gas Long-Term Capacity Report. Retrieved from https://ngridlongtermsolutions.com/docs/Long_Term_Capacity_Report_Technical_Appendix_Demand_Assumptions_Year_by_year_03-20-20_vF.pdf.

Table 2. Comparison of Per Customer Demand Response Design Day Reductions:

	National Grid[63]	SoCalGas[64]	EFG Assumption[65]
Savings/Customer	2%	16-25%	20.5%

National Grid specifies the assumption that the demand response program reaches 40% penetration for residential customers, but there is no information included in the Technical Appendix about the assumption for commercial and industrial customer participation. The January 2019 REV Gas Demand Response pilot program indicates average space heating savings of 10% and average process savings of 25%.[66] Given the results from the pilot program, it is unclear why those savings would not be incorporated into the estimated savings rate for an expanded program.

National Grid's Demand Response savings also do not consider the potential to expand their program offerings to include controlled devices, such as hot water heaters, or behavioral messaging programs for the residential sector. Behavioral demand response programs, which may or may not include financial incentives for participation. As discussed in EFG's initial report, Southern California Gas is expanding their Demand Response program offerings to include hot water heaters. They are also exploring pilot Behavioral Messaging Programs to help lower use during peak demand periods.[67] If National Grid considered the potential for expanding their Demand Response program offerings, they could achieve even more savings from Demand Response on the Design Day. Not exploring additional Demand Response program options fails to characterize the full potential of Demand Response programs to help address the supply and demand gap reported by National Grid.

In the Table 1 of the Long-Term Capacity Report, Demand Response is ranked attractive or highly attractive on all criteria, except for reliability. National Grid includes a footnote that "reliability could improve over time as programs mature."[68] The REV Gas DR pilot report

[63] National Grid Technical Appendix, p. 12.
[64] Case U 904 G. Direct testimony of Darren Hanway. Public Utilities Commission of the State of California. November 6, 2018. Retrieved from https://www.socalgas.com/regulatory/documents/a-18-11-005/Demand_Response_Testimony_Chapter%201_Final.pdf.
[65] Weighted average of 16% and 25% savings.
[66] Gas Demand Response REV Demonstration Project in New York City and Long Island Q4 2018 Report, Table 3.1.2 Checkpoints, p. 9.
[67] Case U 904 G. Direct testimony of Darren Hanway. Public Utilities Commission of the State of California. November 6, 2018. Retrieved from https://www.socalgas.com/regulatory/documents/a-18-11-005/Demand_Response_Testimony_Chapter%201_Final.pdf
[68] National Grid Long-Term Needs Assessment, p. 12.

includes the observation that for large commercial firm gas customers the interest in the pilots indicates the "concept could be scaled relatively easily if the need presented itself".[69]

Natural Gas Leakage Reductions

Natural gas system leakage, across the entire system from production, processing, long distance transmission, and local distribution reduces the overall system efficiency. Because methane has a higher global warming potential than carbon dioxide, particularly over shorter time horizons, leakages also have disproportionate environmental impact. Leakages can also create health and safety risks.

While efforts to identify and reduce system leakages have a relatively small impact on total annual consumption, and on peak day demand, they should be considered as foundational, with opportunities identified and addressed as part of any long-term needs assessment.

The estimation of leakage rates and mitigation opportunities is complicated, and complex as the system and equipment operation vary seasonally and with pipeline pressure and across a wide range of older and newer infrastructure. Our initial assessment included an estimate of the design day demand impact of reducing gas leakage by 60% to 0.93% down from 2.32% that has been reported. Figure 2 provides a further indicator that gas leakage reduction may present an important opportunity for National Grid's KEDLI and KEDNY territories. While the number of backlog leaks reported is trending downwards, it remains well above the values reported for other gas utilities in the state.

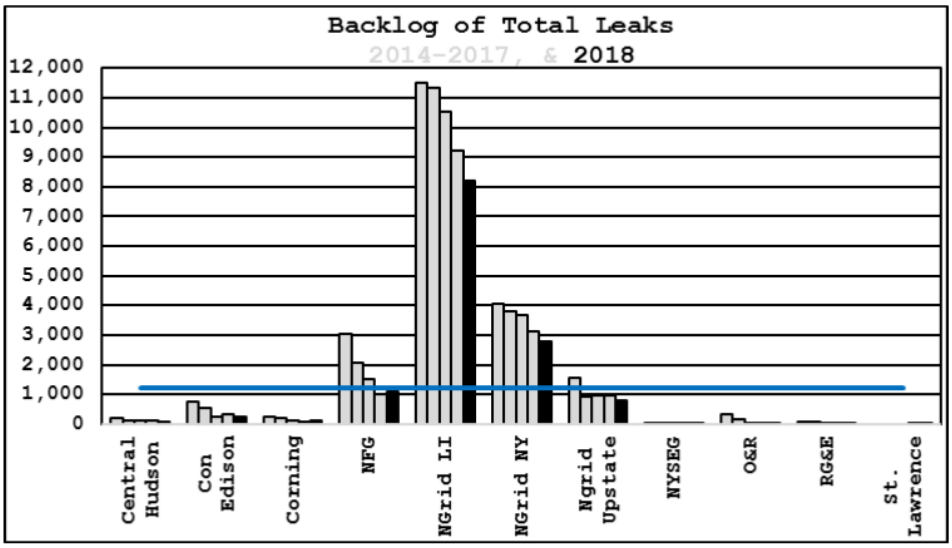

Figure 2. KEDNY and KEDLI Territories Have Relatively High Backlog of Known Leaks[70]

[69] Gas Demand Response REV Demonstration Project in New York City and Long Island Q4 2018 Report, Table 3.1.2 Checkpoints, p. 2.

[70] State of New York Department of Public Service, 2018 Pipeline Safety Performance Measures Report, Pipeline Safety Section Office of Electric, Gas & Water June 13, 2019, p. 30.

Studies of Natural Gas leakage in other eastern cities include Washington D.C.,[71] and New Jersey. The Environmental Defense Fund is partnering with Google Earth and gas utilities to promote new approaches to leak detection, mitigation and prioritization. In January 2019, People's Gas in Pittsburgh committed to using the new approaches to reduce leakages from their distribution system by 50%,[72] which is slightly less, but in the same range that EFG recommended as 2025 reduction for National Grid in our assessment.

We emphasize that investments and initiatives to reduce gas system leakage are complements, not replacements for, the demand side options under consideration by National Grid.

Framework Questions for Evaluating Preferred Option(s)

Based on the initial Long-term Needs Assessment, additional research, and feedback from stakeholder including the public sessions, National Grid is expected to propose preferred options in the coming months.

Below we list critical questions and observations that will deserve careful attention as the preferred options are developed and proposed.

Review of Grid's Options Ranking

National Grid identifies five criteria for assessing the attractiveness of options for meeting long term capacity needs, providing a summary in Table 1 of their report.[73]

Though the table is presented without providing a summary ranking on either a qualitative or quantitative basis, we note the no infrastructure options score at or near the top in three of the five categories (safety, environment and community). The only category where no infrastructure options are consistently low scorers is reliability. However, the score is foot-noted with a caveat indicating that a reliability ranking can improve as programs mature. The presumptive lack of reliability, based on low participation, runs counter to experience, for example from the documented interest and potential over subscription to the demand response pilot.

On the cost criteria, we note that Grid scores the NESE pipeline as attractive, yet as illustrated in the Technical Appendix Figure 5, in the low demand scenario NESE is more expensive than the combined "no infrastructure" package, and that seven of the nine options including demand resources are less expensive than NESE solution. The scoring of the NESE pipeline as "attractive" on the cost criteria in Table 1, is therefore questionable.

We also note that the term *"no infrastructure"* may introduce some bias as it potentially suggests lack of specific assets to address system needs. Energy efficiency, demand response, strategic electrification, and leakage reduction all include investment and deployment of real

[71] Natural Gas Pipeline Leaks Across Washington DC. *Environ. Sci. Technol.* 2014, 48, 3, 2051-2058.
[72] https://www.edf.org/media/peoples-gas-edf-unveil-new-commitment-help-protect-climate-cutting-methane-emissions
[73] National Grid, Long-Term Capacity Report, Table 1, page 12.

assets and infrastructure that can cost effectively and measurably reduce peak and annual demand. It may be more balanced and accurate to distinguish between the demand and supply side resources and infrastructure deployed to help reduce peak demand and assure long term needs are met.

Continued Scrutiny of Forecast Necessary

Our initial assessment identified the need for greater transparency on Grid's demand forecast and the underlying assumptions and drivers. The Technical Appendix provides additional detail, but questions remain.

For example, we would expect to see further rationale and explanation for the predicted growth rates in multi-family sector number of accounts and per customer usage across all three scenarios. The annual and cumulative growth rates for peak day demand for the multi-family sector are illustrated in Table 3.

Table 3: National Grid's Multifamily Design Day Demand Forecasts[74]

Scenario	Compound Annual Growth Rate	Cumulative Growth (2020-2035)
Baseline	3.68%	72%
Hi-Demand	3%	55%
Lo-Demand	2.15%	38%

New or renovated multi-family units can and should be expected to have more efficient shells and mechanical equipment than existing units, even in the absence of energy efficiency and demand response initiatives. If this market segment is growing rapidly with forecast compound annual growth rates for customer accounts ranging from 1.69% in the low scenario to 2.4% in the baseline, then it represents a key opportunity for targeted efficiency, strategic electrification and demand response. As noted further below, contrary to this, the adoption of heat pumps in the multi-family sector does not start until after 2025, and the forecast of increasing per customer gas demand is inconsistent with targeted efficiency or demand response.

Low Heat Pump Adoptions by 2025

As presented in Table 3 of the Technical Appendix, National Grid's forecast of the adoption of air source heat pumps in the residential market through 2025 represent very modest growth, and it is reasonable to anticipate more rapid expansion.

EFG's Critical Assessment projected 80,000 total residential heat pump installs in Grid's downstate territory by 2025. This would require roughly 1% of the residential customers each year to adopt heat pumps either at the time of a natural replacement or as an early retirement

[74] Grid Technical Appendix, Tables 1, 4, and 5.

retrofit. Grid's projections are much more conservative projecting totals of 8,300 (Hi Gas Demand) and 10,400 (Lo Gas Demand) total installations by 2025.

Table 4 compares the market shares of annual natural replacements and total market share for the residential sector, between EFG's critical assessment and Grid's market projections as presented in the Technical Appendix and the supporting participation spreadsheet.

Table 4: Comparative Residential Heat Pump Market Adoptions by 2025[75]

	Share of Annual Natural Replacement Market	**Total Residential Market Saturation**
EFG Critical Assessment	23.5%	6.8%
Grid Hi Gas Demand	2.4%	0.7%
Grid Lo Gas Demand	3.1%	0.9%

A 2016 HVAC market report prepared for NYSERDA documented 43,418 air source heat pump installations statewide, representing roughly 0.5% saturation of annual installations.[76] National Grid's projected rates for 2025 therefore barely surpass what statewide data from several years ago indicate. For further contrast, and to put the EFG estimate of 80,000 total residential installations for National Grid downstate territory by 2025 in perspective, an assessment of rapid heat pump market expansion conducted by VEIC for NRDC projected that annual statewide installations of 60,000 to more than 500,000 units could be attainable by 2025.[77]

Furthermore, National Grid projects zero incremental adoptions of air source heat pumps in the commercial and multi-family sectors by 2025.[78] This is particularly concerning given Grid's forecast of the increasing number of customer accounts in the multi-family sector. New multi-family accounts and major renovations provide excellent opportunities for the installation of heat pumps, and multiple options and good applications including variable refrigerant flow (VRF) heat pump technologies are available for commercial sector customers. Whether the result of already occurring market transformation, or accelerated utility and statewide efforts to expand these markets, the projections by Grid, of no growth through 2025 in the multifamily and commercial market are not credible.

[75] Grid Technical Appendix, Tables 1, 4, and 5.
[76] D+R International, 2017. 2016 HVAC Market Report, prepared for NYSERDA.
[77] "Ramping Up Heat Pump Adoption in New York State Targets and Programs to Accelerate Savings", prepared by VEIC for NRDC, September 2018.
[78] National Grid Technical Appendix Table 3, Commercial & Multifamily gas to electric conversions, p.4.