COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Petition of Boston Gas Company d/b/a National Grid for Approval of Firm Transportation Agreements with Tennessee Gas Pipeline Company, LLC and Portland Natural Gas Transmission Systems, pursuant to G.L. c. 164, § 94A.	)	D.P.U. 17-174

Direct Testimony of Elizabeth A. Stanton

On Behalf of Conservation Law Foundation

Regarding Consistency of Petition with Company Portfolio Objectives, Adequacy of Alternatives Considered, and Consistency with State Environmental Policies

February 14, 2018

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1. INTRODUCTION AND QUALIFICATIONS

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

A. My name is Elizabeth A. Stanton, and I am the Director and Senior Economist of the Applied Economics Clinic of the Global Development and Environment Institute at Tufts University, 44 Teele Avenue, Somerville, MA 02144.

Q. Please describe the Applied Economics Clinic.

A. The Applied Economics Clinic is a 501(c)(3) non-profit consulting group housed at Tufts University's Global Development and Environment Institute. Founded in February 2017, the Clinic provides expert testimony, analysis, modeling, policy briefs, and reports for public interest groups on the topics of energy, environment, consumer protection, and equity, while providing on-the-job training to a new generation of technical experts. The Applied Economics Clinic's mission is: (1) To provide low cost and (when we receive foundation grants) pro bono expert services to public interest groups on the topics of energy, environment, consumer protection, and equity; (2) To train the next generation of expert technical witnesses and analysts by providing applied, on-the-job learning experiences to graduate students in related fields; and (3) To work proactively to support and promote diversity in the fields of economics, engineering, math and sciences.

Q. Please summarize your professional and educational experience.

A. I have more than 17 years of professional experience as an environmental economist. I have submitted expert testimony in Massachusetts, Vermont, New Hampshire, Illinois, Minnesota, Indiana, and several federal dockets; and I have authored more than 140 reports, policy studies, white papers, journal articles, and book chapters on topics related to energy, the economy, and the environment.

Before founding the Applied Economics Clinic, I was a Senior Economist at Synapse Energy Economics where I led studies examining environmental

regulation, cost-benefit analyses, and the economics of energy efficiency and renewable energy.

Prior to joining Synapse, I was a Senior Economist with the Stockholm Environment Institute's (SEI's) Climate Economics Group, where I was responsible for leading the organization's work on the Consumption-Based Emissions Inventory (CBEI) model and on water issues and climate change in the western United States. While at SEI, I led domestic and international studies commissioned by the United Nations Development Programme, Friends of the Earth-U.K., and Environmental Defense.

My articles have been published in *Ecological Economics*, *Renewable Resources Journal*, *Environmental Science & Technology*, and other journals. I have also published books, including *Climate Economics: The State of the Art* (Routledge, 2013), which I co-wrote with my colleague at Synapse, Dr. Frank Ackerman. I am also coauthor of *Environment for the People* (Political Economy Research Institute, 2005, with James K. Boyce) and coeditor of *Reclaiming Nature: Worldwide Strategies for Building Natural Assets* (Anthem Press, 2007, with Boyce and Sunita Narain).

I earned my Ph.D. in economics at the University of Massachusetts-Amherst, and have taught economics at Tufts University, the University of Massachusetts-Amherst, and the College of New Rochelle, among others. My curriculum vitae is attached as Exhibit CLF-EAS-2.

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

A. I am testifying on behalf of the Conservation Law Foundation.

Q. Have you testified previously in this docket?

A. No, I have not.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide an independent, third-party review of the Petition filed by Boston Gas Company d/b/a National Grid (National Grid or the Company) to assess its consistency with the Company's portfolio objectives, the adequacy of alternatives considered, and its compliance with the Massachusetts Global Warming Solutions Act (GWSA).

Q. How is your testimony organized?

A. My testimony is organized as follows:

1. Introduction and Qualifications.
2. Consistency with the Portfolio Objectives Established in the Company's Supply Plan.
3. Comparison to the Range of Alternatives Reasonably Available to the Company and its Customers.
4. Compliance with the Global Warming Solutions Act.

2. CONSISTENCY WITH THE PORTFOLIO OBJECTIVES ESTABLISHED IN THE COMPANY'S SUPPLY PLAN

Q. Have you reviewed the most recently approved FSP for National Grid?

A. Yes, I have reviewed DPU 16-181, National Grid's FSP filed in November 2016 and approved by the Department in October of 2017.

Q. Please describe the portfolio objectives established in National Grid's 2016 FSP.

A. In its 2016 FSP, National Grid describes its "obligation to provide safe, reliable and least-cost gas service to its customers."(DPU 16-181 Initial Filing at p.3)

Q. Have you reviewed National Grid's most recently approved Initial Filing in this docket (DPU 17-174)?

A. Yes.

Q. Please describe the portfolio objectives established in National Grid's 2017 Initial Filing.

A. The testimony of National Grid witness Theodore Poe, Jr. describes National Grid's portfolio objectives as follows:

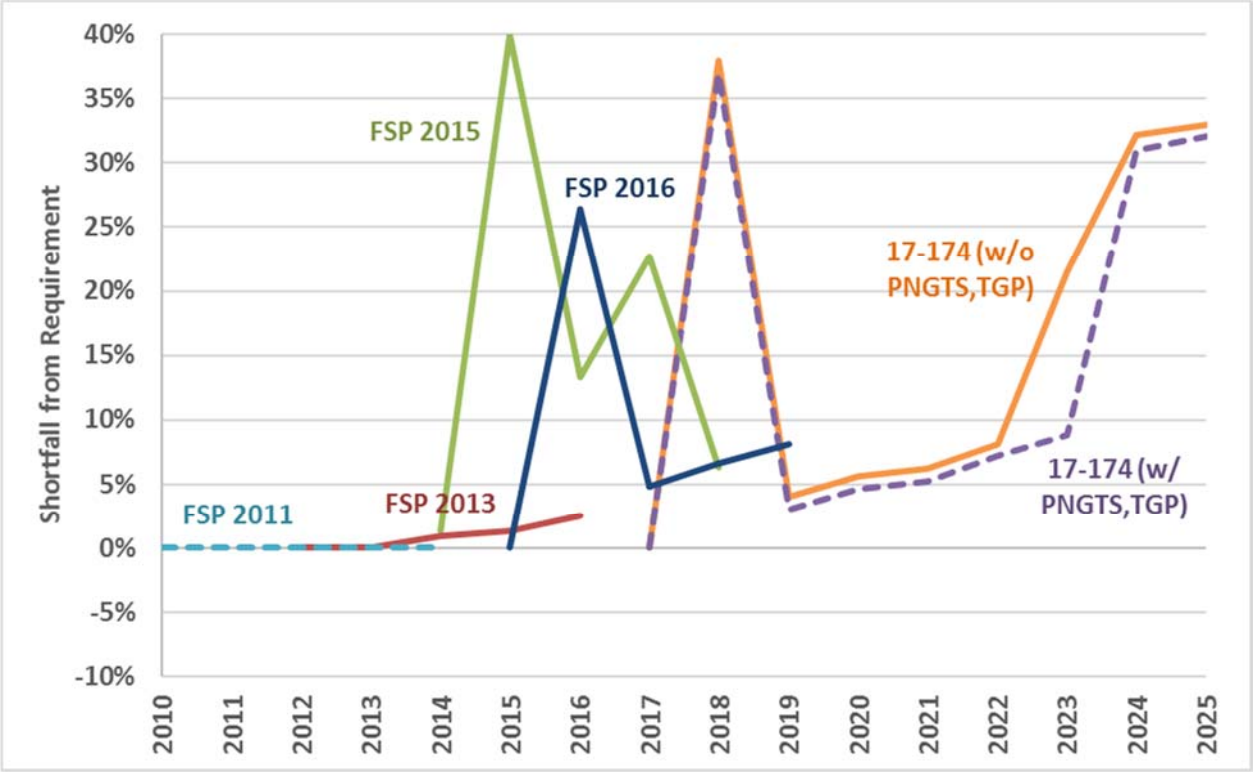
> *The principal objective of the Company's gas-resource planning process is the development and utilization of a resource portfolio composed of gas supply, interstate-pipeline transportation, and underground storage and supplemental resources that can be used to meet firm requirements in a cost-effective and reliable manner*. (Ex. NGRID-TEP-1 at p.5)

Q. Do National Grid's portfolio objectives depend on increased supply capacity?

A. National Grid's portfolio objectives do not necessarily depend increased supply capacity. National Grid's portfolio objectives depend on selection of the most cost-effective set of supply and demand resources that together are sufficient to meet natural gas demand. Whether or not this optimal set of resources includes higher supply capacity is a matter to be established through modeling and demonstrated in the Company's filings to the Department.

Figure 1 presents National Grid's expected "shortfall" as predicted in its past filings to the Department. The Company's "shortfall" is the difference between its expected natural gas requirements or needs in a given year and its expected gas supply. The shortfalls shown in Figure 1 are for the "design day" and are given as a percentage of the same year's expected gas requirements.

Figure 1. National Grid's Expected Design Day Shortfalls as Predicted in Past Filings



In reviewing Figure 1, two important observations regarding National Grid's expectations regarding meeting natural gas needs with its selected set of supply and demand resources are evident. First, contracts with PNGTS and TGP for new supply do very little to address the Company's expected shortfall. Second, the Company's expected shortfall varies greatly from year to year and filing to filing, and includes expected shortfalls reaching 40 percent of expected gas requirements.

Q. Does National Grid expect its proposed contracts with PNGTS and TGP for new supply to resolve its shortfall?

A. No. Based on the information presented by the Company in its initial filing in 17-174, National Grid does not expect its proposed contracts with PNGTS and TGP for new supply to resolve its shortfall (see Figure 1 in which the Company's shortfall without the proposed PNGTS and TGP contracts is shown in orange and its shortfall with these contracts is shown in dotted purple).

Q. How, then, does this increased supply impact on National Grid's portfolio objectives?

A. Recall that National Grid's portfolio objectives depend on selection of the most cost-effective set of supply and demand resources that together are sufficient to meet natural gas demand. National Grid's proposed contracts with PNGTS and TGP for new supply do not resolve its shortfall (thus increasing the resources needed to meet natural gas demand). Instead, the Company appears to contend that its proposed contracts with PNGTS and TGP for new supply will reduce costs, rendering the set of supply and demand resources that includes these contracts the most cost-effective choice:

> *In addition, the Proposed Agreements are expected to provide commodity cost savings from (a) the incremental capacity provided at the Company's citygate by the Tennessee Agreement, and (b) the Company's ability to access supplies at Dawn, Ontario for all capacity on Tennessee originating at Dracut, MA that will be provided by the PNGTS Agreement. If the Company did not enter into the Proposed Agreements it could not be certain that it will be able to access competitively priced gas supply that is necessary to meet its near-term and long-term forecast requirements in a least-cost and reliable manner. (17-174 Initial Filing, at p.5)*

Q. Are National Grid's proposed contracts with PNGTS and TGP for new supply necessary to meet the Company's forecast of customer needs in future years?

A. The materials filed by the Company in 17-174 do not provide information sufficient to determine whether or not National Grid's proposed contracts with PNGTS and TGP for new supply are necessary to meet the Company's forecast of customer needs in future years.

Q. Does National Grid demonstrate that its proposed contracts with PNGTS and TGP for new supply result in the least-cost supply and demand resource mix?

A. No. National Grid does not provide sufficient evidence to demonstrate that its proposed contracts with PNGTS and TGP for new supply result in the least-cost supply and demand resource mix.

Q. What additional evidence would National Grid need to present to demonstrate that its contracts with PNGTS and TGP for new supply result in the least-cost supply and demand resource mix?

A. National Grid uses the SENDOUT model to identify the least-cost portfolio of supply and demand resources for its customers:

> *Since 1996, the Company has been using the SENDOUT® model developed by New Energy Associates, now Ventyx, as its primary analytical tool in the portfolio design process. The SENDOUT® model is a linear-programming optimization software tool used to assist in evaluating, selecting and explaining long-term portfolio strategies. SENDOUT® has several advantages over previous models. For instance, there is no limit to the number of resources that can be defined. This allows the Company to model its resources more realistically and to receive more meaningful output. Second, the model allows the Company to examine the effect of various contracts on the total portfolio cost.*
>
> *In that regard, the SENDOUT® model can be used in one of two ways. First, the model can be used to determine the best use of a given portfolio of supply, capacity and storage contracts to meet a specified demand. That is, it can solve for the dispatch of resources that minimizes the cost of serving the specified demand given the existing resource and system-operating constraints. The model dispatches resources based on*

> *the lowest variable cost to meet demand, assuming that demand charges are fixed. Second, the SENDOUT® model can be used to determine the optimal portfolio to meet a given demand. To do this, the model uses a linear programming algorithm to analyze the combination of contracts and the size of each contract (i.e., MDQ) to determine the combination that results in the lowest total cost, taking into account both variable and fixed costs. (FSP 2016, p.126)*

Put simply, SENDOUT allows National Grid to input (1) its expected future demand for natural gas and (2) its potential supply resources, and from these inputs determine a least-cost supply portfolio for its customers. Essentially, SENDOUT performs a "cost effectiveness" analysis, answering the question: Given a set amount of natural gas requirement what is the least expensive way to provide reliable supply?

Gas requirements are treated as fixed, as a given. And the expected prices of natural gas supply resources (including transportation and storage) are examined in various combinations to find the cheapest combination of resources that will meet customers demand.

Three obstacles exist that may prevent this type of cost-effectiveness modeling from achieving National Grid's portfolio objective (selection of the most cost-effective set of supply and demand resources that together are sufficient to meet natural gas demand):

(1) **Missing resources:** Many potential resources are not included in modeling and are therefore not available for the SENDOUT model to choose as it assembles its least-cost portfolio. For National Grid, potential resources that are left out of modeling appear to include additional energy efficiency measures (beyond current and planned measures) that reduce annual gas usage, efficiency measures targeted at peak day usage, incentives to adopt electric and/or renewable space and water heating, additional LNG and

natural gas storage, thermal storage, and load management (demand response). More demand-side measures may exist with benefit-cost ratios higher than 1.00 (or even measures with negative benefit-cost ratios that, when combined with the rest of National Grid's efficiency portfolio, result in an average benefit-cost ratio that is lower than 1.71 but greater than 1.00); these measures are not including in the SENDOUT modeling of the least-cost supply portfolio.

(2) **Uneven playing field:** While energy efficiency from current and planned programs are included in the Company's expected gas requirements, these critical demand-side resources are not treated the same as supply-side resources. Like supply-side resources, energy efficiency measures have a net cost or benefit associated with them that should be considered in a cost-effectiveness analysis of a least-cost resource portfolio for National Grid's customers. National Grid's benefit-cost ratio for the last three-year gas efficiency planning period (2016-2018) was expected to be 1.71. [1] That is, the benefit of the Company's gas efficiency savings is $1.71 for every $1 of cost (or, stated another way, every therm of energy efficiency savings makes the Company's supply and demand portfolio less expensive). It seems unlikely that any of the supply-side resources included by National Grid in its modeling have negative costs (that is, offer benefits) for every therm. The Company's SENDOUT model is not considering the lowest-cost resource among its alternatives.

(3) **Treatment of supply disruption as a resource:** While energy efficiency and non-pipeline alterative resources are not included in National Grid's assessment of the least-cost resource portfolio, supply disruption is. The Company includes unserved customers as a supply resource with two

[1] DPU 15-161, Initial Filing, Exhibit NG-GAS-4, p. 35 of 52. http://170.63.40.34/DPU/FileRoomAPI/api/Attachments/Get/?path=15-161%2fExhibitNGGAS4CompanySpecificEn.pdf.

important consequences. First, the SENDOUT model is selecting the resource "unserved customers" in preference to available pipelines supply (see Ex. NGRID-DMW); it would appear that supply disruption is assumed to be cheaper than gas supply in some hours of the year. Second, SENDOUT's choice to select leaving customers unserved over purchasing gas depends on an implied price of supply disruption that does not appear to have been provided either in FSP 2016 or 17-174. National Grid does, however, estimate the cost of supply disruption for a separate purpose in its modeling (in its estimation of the design day and design year). For that separate purpose it limits the cost of supply disruption to the cost to relight heating equipment, the cost of damages in buildings that have had pipes freeze, and commercial and industrial lost revenue. While the Company notes that there are additional costs associated with supply disruption, these costs are not included in modeling:

> *If the Company were to have a shortfall in supply during the winter season, the amount of supply in deficit can be translated into an equivalent number of customers whose service would be disrupted for more than one day. For a supply disruption of a multi-day duration, service would be curtailed on a priority basis and would likely fall on commercial and industrial establishments before affecting the residential sector, since supply to the residential sector is more likely to involve health and personal safety.* (FSP 2016, p.121)

3. COMPARISON TO THE RANGE OF ALTERNATIVES REASONABLY AVAILABLE TO THE COMPANY AND ITS CUSTOMERS

Q. Could National Grid's portfolio objectives be served using other resources?

A . National Grid's portfolio objectives depend on selection of the most cost-effective set of supply and demand resources that together are sufficient to meet natural gas demand. Taken in its component parts:

- **Most cost-effective set of supply and demand resources:** National Grid's selected set of resources includes both supply and demand resources. Together, these resources—both supply and demand—determine the overall cost of the portfolio. Least cost resource portfolios include the lowest cost resources regardless of whether these resources are on the supply or demand side. Could National Grid's portfolio objective of providing the most cost-effective set of resources be achieved using resources other than their new supply contracts? The answer depends on cost information not provided in the Company's 17-174 filing.

- **Sufficient resources to meet natural gas demand:** National Grid's contracts with PNGTS and TGP for new supply are not necessary to meet the Company's forecast of customer needs in future years. Could National Grid's portfolio objective of providing sufficient resources to meet natural gas demand be achieved using resources other than their new supply contracts? Yes. National Grid's 17-174 filing does not meet this objective, and alternate resources could certainly help it meet this objective.

Q. What alternatives to additional pipeline contracts are described by National Grid in its 2016 FSP?

A. National Grid's FSP 2016 includes both supply and demand-side alternatives to new pipeline contracts. LNG delivery, storage, and withdrawal are important supply-side alternatives while energy efficiency measures are an important demand-side alternative.

Q. What alternatives to additional pipeline contracts are described by National Grid in this docket (DPU 17-174)?

A. Similarly, in its 17-174 filing, National Grid includes both LNG delivery, storage, and withdrawal and energy efficiency among its resources. With regards to the viability of additional resources other than its contracts with PNGTS and TGP for new supply, National Grid's witnesses Arangio, Whitney, and Jaffe state that:

> *There are no alternatives in the short term to the Tennessee Agreement that utilize existing pipeline infrastructure that would provide incremental capacity to the Company's citygate in Acton, MA that would not require the installation of new compression and/or pipeline facilities. Given the Company's immediate need for this capacity, there were therefore no alternatives.* (Ex. NGRID-EDA/DMW/SAJ-1, at p.30)

Further, when asked "What alternatives did the Company consider before determining there were no viable supply options or comparable alternatives at Dracut?" (Ex. NGRID-EDA/DMW/SAJ-1, at p.32) witnesses Arangio, Whitney, and Jaffe reported that three pipeline-based alternative resources had been considered: Access Northeast, ENGIE, and Repsol.

Q. Are LNG delivery, storage, and withdrawal important to National Grid's ability to meet its portfolio objective of providing sufficient resources to meet natural gas demand?

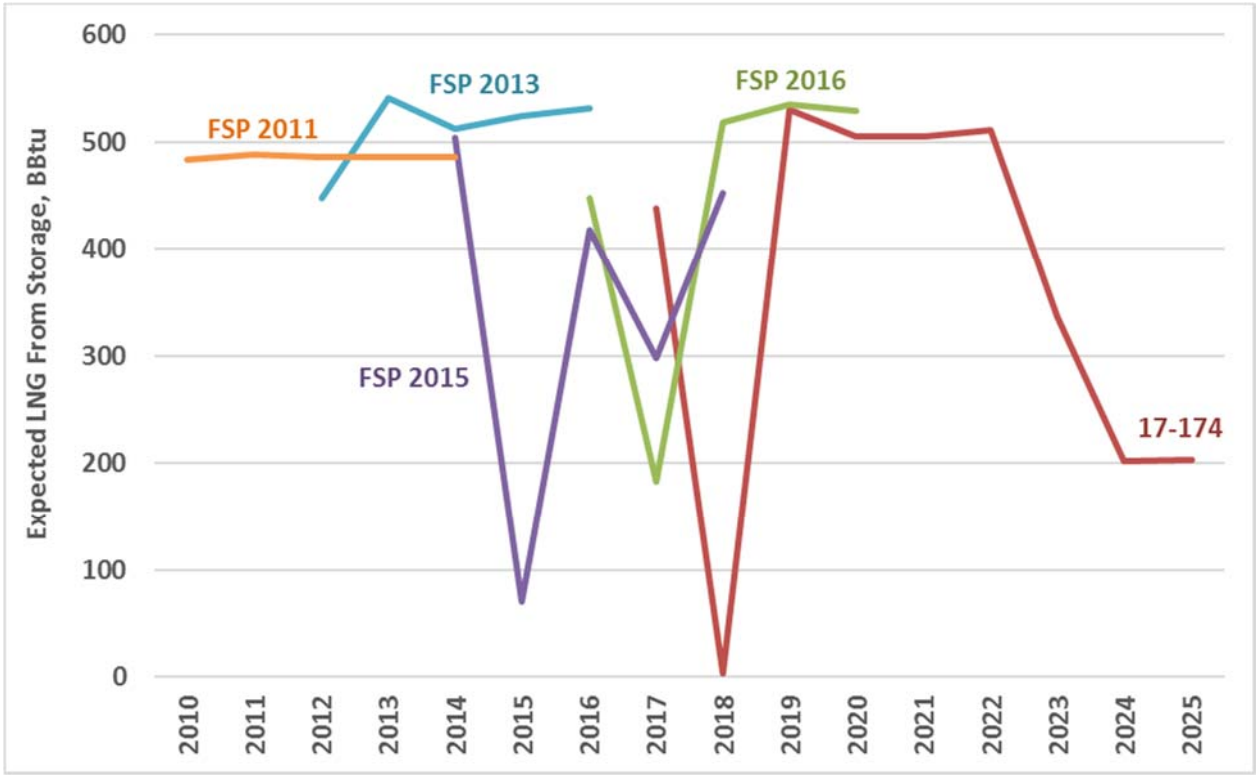
A. Yes. LNG delivery, storage, and withdrawal are important to National Grid's ability to meet its portfolio objective of providing sufficient resources to meet natural gas demand. National Grid's Forecast and Supply Plans (FSP) for 2011 and 2013 show expected shortfalls that are less than 3 percent (see Figure 1 above). In contrast, the more recent FSPs for 2015 and 2016 and the planning information presented in this docket (17-174) show:

- **First planned year:** no shortfall in first year after filing,

- **Second planned year:** a very high shortfall in the second year after filing, and then
- **Third planned year:** shortfalls of 5 to 13 percent in the third year after filing.

This pattern in National Grid's expected natural gas shortfalls is explained by the Company's expectations regarding the availability of LNG, as shown in Figure 2. Confidence regarding the availability of LNG in the first year after filing is followed by doubt in the second year and then confidence in the third year.

Figure 2. National Grid's Expected Design Day LNG From Storage as Predicted in Past Filings



In its initial filing in this docket (17-174), National Grid expects just 4 BBtu of LNG withdrawals from storage in 2018/19. (In the Company's FSP 2015 and FSP 2016, LNG withdrawals from storage for 2018/19 were 453 and 519 BBtu, respectively.) National Grid explains:

> *In year 2018/19, LNG withdrawal is only 4 BBtu for the design day. The design day LNG withdrawal is based on several factors including; total LNG refill volumes, customer requirements, pricing changes and resource availability. For gas year 2018/19, the Company only has 2,320 BBtu of LNG off-peak refill under contract with ENGIE. The LNG off-peak supply agreement from Gaz Metro terminates in November 2018 while the NGLNG and Northeast Energy liquefaction projects are not expected to be in service until the 2020 off-peak season. LNG withdrawal is not being maximized on the peak day because the SENDOUT model is "husbanding" LNG for other cold days within the design season. (Ex. NGRID-EDA/DMW/SAJ-1, at p.23)*

National Grid asserts that it assumes for the purposes of modeling and planning that historical contracts not yet signed will be signed:

> *[T]he Company assumed that all contracts expiring during the forecast period would be renewed with no change in pricing, quantities or operating characteristics. (17-174 Joint Testimony of Elizabeth D. Arangio, Deborah M. Whitney and Samara A. Jaffe, p.23)*

However, the Company instead makes this assumption only for the third year of planning and beyond, and not for the second year of planning, thus creating the pattern of extreme natural gas shortfall seen in second planning year in Figure 1.

Q. What other alternative resources are available to National Grid to meet its portfolio goals?

A. Possible alternative resources available to National Grid include additional energy efficiency measures that reduce annual gas usage, efficiency measures targeted at peak day usage, incentives to adopt electric and/or renewable space and water

heating, additional LNG and natural gas storage, thermal storage, and load management (demand response).

Q. What steps have other natural gas distribution companies taken to secure non-pipeline alternative resources?

A. In December 2017 New York's Con Edison issued a request for proposals (RFP) for "Non-Pipeline Solutions to Provide Peak Period Natural Gas System Relief":[2]

> *Con Edison has identified a need for Non-Pipeline Solutions throughout its natural gas service territory to address a nine percent shortfall in Peak Day pipeline capacity by November 2023, which is equivalent to more than 100,000 Dt on a Peak Day. The traditional solution would be the acquisition of incremental interstate pipeline capacity to address this requirement. The goal of this RFP is to identify a portfolio of opportunities that will reduce customer loads and provide new supply sources without the construction of a new pipeline, or at a minimum will be able to reduce the Company's reliance on Delivered Services. The primary capacity constraint is for daily deliveries of natural gas into Con Edison's service territory from upstream pipelines; the Company's internal distribution capacity is adequate to meet fluctuations in customer Demand throughout the day. As a result, NPS projects must be able to provide Relief for a minimum of 24 consecutive hours on the coldest days of the year to be useful to Con Edison, and are more valuable if deployable for multi-day consecutive periods of cold weather. (Exhibit CLF-EAS-3 at p.7)*

[2] See Exhibit CLF-EAS-3, https://www.coned.com/-/media/files/coned/documents/business-partners/business-opportunities/non-pipes/non-pipeline-solutions-rfp.pdf.

Since as early as 2012 (see Berkshire Gas FSP 2012 and FSP 2014), Berkshire Gas has operated a load management program with the goal of reducing the need for supply resources on peak:

> *[T]he Company has entered into agreements with several large customers (with alternate fuel capabilities) that provide significant load management flexibility in that the Company may curtail service for a designated period of time in order to promote the efficient use of its distribution system (also referred to as "demand-side management"). The Company has been a leader in terms of its load management initiatives. (Berkshire Gas FSP 2016, p.15)*

Q. Did National Grid issue an RFP for non-pipeline alternatives in an attempt to identify and secure least-cost alternative resources?

A. To my knowledge, no.

Q. Does National Grid operate a load management program with the goal of reducing the need for supply resources on peak?

A. To my knowledge, no. National Grid has, however, initiated a small pilot program in gas demand response for which initial findings are expected in 2019.

4. COMPLIANCE WITH THE GLOBAL WARMING SOLUTIONS ACT

Q. Are you familiar with the Commonwealth's Global Warming Solutions Act, and if so, do you have an understanding of its technical requirements?

A. Yes, I am familiar with the Massachusetts Global Warming Solutions Act, and I do have an understanding of its technical requirements. The Global Warming Solutions Act, or "GWSA," is a law passed in 2008 that requires the Commonwealth to reduce its statewide greenhouse gas emissions across all sectors and emissions sources to a level in 2020 that is no greater than 25 percent of 1990 emissions levels, or approximately 70.8 million metric tons of CO_2 equivalent

("$MMCO_2e$"), and a level in 2050 that is no greater than 80 percent of the state's 1990 emissions level, or approximately 18.9 $MMTCO_2e$.[3]

Q. In your understanding, what is required technically for a program, project, or approval to be considered consistent with the GWSA?

A. While the quantitative details will differ from case to case, assessing consistency with the GWSA as a technical matter requires at a minimum an understanding of the volume of greenhouse gas emissions that can be reasonably expected to occur as a result of the program, project or approval as well as the level of statewide greenhouse gas emissions allowed by the GWSA at that time those emissions are expected to occur. It should also normally include evidence of emission reductions that assist that Commonwealth with achieving its GWSA goals, as distinct from simply not actively harming the Commonwealth's achievement of GWSA goals.

Q. In your opinion, does the record in this matter contain adequate evidence to enable someone to assess the greenhouse gas emissions impact of the contracts with TGP and PNGTS for new supply?

A. No.

Q. Please explain.

A. In its Petition, the Company asks for permission to acquire 13,868 dekatherm ("Dth") per day of new gas capacity in the proposed TGP contract and to acquire another 57,068 Dth/day of new gas capacity in the proposed PNGTS contract.[4] All of that capacity, according to the Company, is designed to serve retail customers by enabling the Company to sell them gas for end-use combustion, predominantly for space heating.[5]

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[3] *See, e.g.*, Exec. Office of Energy and Envtl. Affairs, *Massachusetts Clean Energy and Climate Plan* (Dec. 31, 2015) ("2015 CECP"), 1-10.
[4] *See* Ex. NGRID-EDA/DMW/SAJ-1 (Joint Testimony of Elizabeth D. Arangio, Deborah M. Whitney, and Samara A. Jaffe) at 6.
[5] *See, e.g.*, *id.* at 14 ("The Company has entered into the Tennessee Agreement based on the fact that the Company continues to need long-term, incremental pipeline capacity in order to meet customer sendout

According to the U.S. Environmental Protection Agency, "the average heat content of natural gas is 0.1 MMBtu per therm"; "the average carbon coefficient of natural gas is 14.46 kg carbon per mmbtu"; and the "fraction of that carbon oxidized to CO_2 during combustion is 100 percent".[6] Accordingly, the combustion of a dekatherm of gas will result in the release to atmosphere of approximately 0.053 metric tons of CO_2.[7]

As a result, the approval of the Petition would authorize the release into the atmosphere of approximately 3,761 metric tons per day of CO_2, or up to 1.4 $MMTCO_2e$ annually for the next twenty years life of these contracts,[8] until about the year 2038.

Over that same 20-year period, the GWSA requires dramatic annual reductions in the Commonwealth's greenhouse gas emissions, including those from the combustion of gas for end-uses like those served by the Company. Over the life of the proposed supply contracts, statewide greenhouse gas emissions – which include those that will result from the proposed contracts[9] – must decline approximately 2

requirements on a reliable basis."), 15 ("The main reason for entering into the PNGTS Agreement is to address liquidity concerns at Dracut, MA, in order to enhance the overall reliability of the Company's existing and future gas resource portfolio.").

[6] *See* U.S. EPA, *Greenhouse Gases Equivalencies Calculator - Calculations and References* ("Therms and Mcf of natural gas") available at: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

[7] 0.1 MMBtu/1 therm × 14.46 kg C/MMBtu × 44 kg CO2/12 kg C × 1 metric ton/1,000 kg = 0.0053 metric tons CO2/therm

[8] Ex. Ex. NGRID-EDA/DMW/SAJ-1 at 7 ("The Agreements are for 20 and 22-year terms (Tennessee Agreement and PNGTS Agreement, respectively) beginning with anticipated in-service dates of November 2018.").

[9] *See, e.g.*, Dept. of Envtl. Protection, *Statewide Greenhouse Gas Emissions Level: 1990 Baseline and 2020 Business As Usual Projection Update* (July 2016), Appx. C ("Massachusetts Annual Greenhouse Gas (GHG) Emissions Inventory: 1990-2014, with Partial 2015 & 2016 Data - March 2017"), tab "NatGas Systems", https://www.mass.gov/files/documents/2016/11/sv/gwsa-appc.xls (including in "statewide GHG emissions" all emissions resulting from the combustion of gas for building services as well as emissions resulting from gas transportation and distribution leaks).

percent per year to about 36.2 $MMTCO_2e$, or approximately 62 percent below 1990 levels in 2040.[10]

By 2040, then, the proposed agreements would alone authorize and enable the release of greenhouse gases of a volume that will have a significant and direct impact on the ability of the state to meet its GWSA-required emissions levels, as these contracts would be a source of emissions equivalent to approximately 3.8 percent of the total permitted in the Commonwealth as a whole by the GWSA in that timeframe for the entire state economy. Indeed, contrary to the Company's suggestion here that these contracts are necessary to serve a sustained high volume of gas consumption by its customers through 2038, the Commonwealth already anticipates that in the same timeframe, compliance with the GWSA will require the use of less gas as the Commonwealth "electrif[ies] the buildings sector's heating and cooling loads" and develops non-fossil "renewable thermal market."[11]

Q. Does the Petition, or any other document in the record, contain an analysis of either the greenhouse gas emissions that will result from the proposed agreements or their impact on the ability of the Commonwealth to meet its GWSA-required emissions reductions over the life of the contracts?

A. No, I have seen no such analysis in the record as of the date of this testimony. The Petition itself contains no mention whatsoever of either the greenhouse gas emissions that can be reasonably assumed will result from the approval of the proposed contracts, or of the impact of such emissions on the state's ability to meet its GWSA-required emissions reduction. Similarly, there is no mention of either in National Grid's approved 2016 FSP which the Petition references and relies on.

[10] Based on a straight-line decline from the GWSA's 25 percent emissions reduction required by 2020 to the 80 percent reduction required by 2050.
[11] *See, e.g.*, 2015 CECP at 1-10, 50-54 (meeting the GWSA's emissions limits between 2030 and 2050 will require "electrif[ication of] the buildings sector's heating and cooling loads" and the development of non-fossil "renewable thermal market").

Q. Have you seen any mention of greenhouse gas emissions or the GWSA by the Company in the record?

A. Only one, in the Company's February 7, 2018 response to request for information DPU-1-1.[12] However, that response alone does not contain sufficient information or analysis upon which the Department can conclude that approval of the proposed contracts is consistent with the GWSA.

Q. What does that response say?

A. The response argues that the proposed TGP contract and the proposed PNGTS contract will be replacements for already approved gas capacity.

Q. Does the citation to previous approval of pipeline capacity in Ex. DPU-1-1 refer to a prior proceeding before the Department with record evidence that could support a conclusion that some portion of the proposed 20-year supply agreements will not have a significant impact on the ability of the Commonwealth to meet its GWSA-required emissions levels?

A. No. The Department's prior approval of contracts for 151,962 Dth/day of capacity which the Company suggests the proposed TGP and PNGTS contracts will "replace"[13] did not contain record evidence that could be analyzed to test the impact of the 151,962 Dth/day on the Commonwealth's ability to meet its GWSA-required emissions levels. I reviewed the Final Order in D.P.U. 15-34 and the record evidence to which it refers in its GWSA-related findings. In the Final Order in D.P.U. 15-34, the Department cites to no quantitative evidence regarding the emissions levels expected as a result of the end-use combustion of that gas, and includes no assessment (and points to no evidence containing any assessment) regarding the levels of greenhouse gas emissions required by the GWSA, or the

[12] Ex. DPU-1-1.
[13] *See* DPU 15-34, Final Order (Aug. 31, 2015) ("D.P.U. 15-34 Final Order") at 5 ("Pursuant to the transportation agreement, Tennessee will deliver a total of 151,962 dekatherms per day ("Dth/day") of interstate pipeline capacity from Wright, New York, to the Company's distribution system[.]").

proposed contract's impact on those levels, at any time during the life of the contracts at issue in D.P.U. 15-34.

Q. Did the Department's Final Order in 15-34 use or describe a reasonable standard for a proposed contract for new gas supply to meet the emissions requirements of the GWSA?

A. No. In the Final Order in 15-34 the Department states only that "the record evidence indicates that the additional capacity will be used, in large part, to serve new customers converting from oil heating to natural gas, and therefore the Department expects that the acquisition of the proposed capacity will further reduce greenhouse gas emissions and contribute towards GWSA goals."[14] The record exhibits from the Company to which the Department cites in support of that statement do not provide quantification of the emissions impact.[15]

Q. What would be a reasonable minimum standard for a proposed contract for new gas supply to meet the emissions requirements of the GWSA?

A. As I indicated previously, assessing consistency with the GWSA requires evidence of emissions reductions that assist that Commonwealth with achieving its GWSA goals (as distinct from simply not actively harming the Commonwealth's achievement of GWSA goals) as well as evidence of emission impacts that is both quantitative and specific. Here, that would require, at minimum, quantitative estimates of the expected number of conversions from a different space heating fuel to natural gas caused by the proposed contract capacity, of the resulting change in

[14] D.P.U. 15-34 Final Order at 41.
[15] *See* Order, D.P.U. 15-34 at 41-42 (citing D.P.U. 15-34 Ex. AG-1-9, Atts. A, B, Tr. 1, at 145-146). The Department also cites CLF's direct testimony, which contains emissions calculations. *See id*. (citing Exhibit CLF-1 at 41). However, that page of the direct testimony of CLF's expert witness in D.P.U. 15-34 only mentions a portion of the pipeline capacity which might be used to convert oil-fired space heat to gas-fired space heat and the resulting emissions changes between 2019 and 2029.

expected greenhouse gas emissions, and of the pace and scope of reductions in greenhouse gas emissions required in the same timeframe by the GWSA.

Q. In addition to expected greenhouse gas emissions from combusting gas, are there any additional sources of greenhouse gas emissions that are reasonably foreseeable from a proposed contract for new gas supply?

A. Yes. Analysis should be presented of the known and reasonably estimable greenhouse gas emissions that can and should be assumed will occur from the transport and distribution of the gas associated with a proposed contract (based on current technology and scientific assessments of existing Commonwealth leak rates). The Department has determined that 0.6 to 1.1 percent of total gas received into the Commonwealth's gas distribution system is lost to the atmosphere as direct methane emissions due to leakage throughout the system.[16] Assuming in the absence here of evidence to the contrary regarding the Company's own leak rates, the Department must assume that at least 0.85 percent (the mid-point of the 0.6 to 1.1 percent range) of 70,936 Dth/day that the proposed TGP contract and the proposed PNGTS contract would authorize would similarly be released into the atmosphere again, with substantial potential impact to the state's ability to comply with GWSA-required emissions limits over the life of these contracts. Such reasonably expected leakage would increase expected greenhouse gas emissions resulting from these contracts by as much as 0.3 $MMTCO_2e$, each year, or about 0.8 percent of the Commonwealth's total permitted greenhouse gas emissions in 2040.[17]

Q. Does this conclude your testimony?

A. Yes, it does.

[16] *See, e.g.*, ICF, *Lost and Unaccounted For Gas* (Dec. 23, 2014) (prepared for the Department) at i.
[17] This estimate assumes a 25-year global warming potential for methane leaks, per U.S. EPA, *Greenhouse Gases Equivalencies Calculator - Calculations and References* ("Therms and Mcf of natural gas") available at: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.