**STATE OF CONNECTICUT**
**CONNECTICUT SITING COUNCIL**

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| IN RE:<br><br>APPLICATION OF NTE CONNECTICUT, LLC FOR A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY AND PUBLIC NEED FOR THE CONSTRUCTION, MAINTENANCE AND OPERATION OF AN ELECTRIC POWER GENERATING FACILITY OFF LAKE ROAD, KILLINGLY, CONNECTICUT | DOCKET NO. 470<br><br>JANUARY 15, 2018 |

# PRE-FILED TESTIMONY OF PAUL J. HIBBARD ON BEHALF OF NTE CONNECTICUT LLC

## I. INTRODUCTION AND SUMMARY OF CONCLUSIONS

**Q. Please state your full name, business address and occupation.**

A. My name is Paul J. Hibbard. I am a Principal at Analysis Group, Inc., an economic, finance and strategy consulting firm headquartered in Boston, Massachusetts, where I work on energy and environmental economic and policy consulting. My business address is 111 Huntington Avenue, 14th Floor, Boston, Massachusetts, 02199.

**Q. Please describe your background and experience that help inform your opinions in this matter.**

A. I have been with AGI for approximately eleven years, first, from 2003 to April 2007, and most recently, from August 2010 to the present. From April 2007 to June 2010 I served as Chairman of the Massachusetts Department of Public Utilities ("MA DPU") and also served as a member of the Massachusetts Energy Facilities Siting Board ("EFSB"), the New England Governors' Conference Power Planning Committee, and the NARUC Electricity Committee and Procurement Work Group. I also served as State Manager for the New England States Committee on Electricity and as Treasurer on the Executive Committee of the 41-state Eastern Interconnect States' Planning Council. My experience as Chairman of the MA DPU and as a Board Member of the EFSB includes considering and deciding on issues relating to the zoning, permitting and siting of major energy infrastructure in the Commonwealth of Massachusetts, including power plants, transmission lines, and fuel transport pipelines.

Before that I worked in energy and environmental consulting and with state energy and environmental agencies. I hold an M.S. in Energy and Resources from the University of California, Berkeley, and a B.S. in Physics from the University of Massachusetts at Amherst. A more detailed description of my relevant background and experience and my curriculum vitae are attached as Exhibit 1.

**Q. After reviewing the application[1] and related information about the proposed Killingly Energy Center ("KEC"), do you have any opinions about the need for KEC to ensure the reliability of the electric power supply and to develop a competitive electricity market in Connecticut and the region?**

A. Yes.

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[1] DOCKET NO. 470 - NTE Connecticut, LLC application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a 550-megawatt dual-fuel combined cycle electric generating facility and associated electrical interconnection switchyard located at 180 and 189 Lake Road, Killingly, Connecticut, Connecticut Siting Council, Opinion, May 11, 2017.

**Q. Please summarize those opinions.**

A. Based on my review of KEC and the regional power system context, I believe the Connecticut Siting Council ("CSC" or the "Council") should find that KEC is necessary for the reliability of electric supply of Connecticut and the New England region, and will contribute to the competitiveness and efficiency of wholesale electricity markets for the following reasons:

- KEC would represent an efficient and dispatchable generating resource connected to the high-voltage system[2] close to load in Connecticut, and with the ability to provide Connecticut and the New England Independent System Operator ("ISO-NE") system with a **full range of essential reliability services**, including frequency response, voltage control, spinning and non-spinning reserves, automatic generation control, fast ramping capability, and flexible operating modes (i.e., baseload, cycling, and peaking generation).
- KEC, with its firm gas contract and dual-fuel capability, would provide exactly the type of **fuel security** needed to address Connecticut's and New England's most pressing system resilience/reliability challenge - the dependence on natural gas, particularly during winter months. The recent cold snap amplifies the reliability value and price-hedging benefits of KEC's "defense-in-depth" approach to fuel management and security.
- KEC contains all of the fast-acting, flexible and dispatchable operating

[2] CSC Findings of Fact, No. 192.

characteristics needed to **fully support the expanded integration of variable renewable resources** at the grid-connected and distributed levels.

- KEC's efficiency means that it will represent a **low-emitting resource** capable of frequently displacing higher-emitting resources, thus reducing greenhouse gas emissions in Connecticut and the region.
- Recent developments highlight the reliability and market value of KEC: lower caps on carbon dioxide ("$CO_2$") proposed by the Northeast states in the Regional Greenhouse Gas Initiative ("RGGI"), and regulations establishing a more stringent cap on $CO_2$ emissions from power plants in Massachusetts, likely will accelerate the retirement of older, less efficient, and higher-emitting power plants in southern New England. Further, suspension of the application for the Access Northeast natural gas pipeline and continued opposition to new natural gas infrastructure make KEC's approach to fuel security and fuel management even more important.
- Obtaining a capacity supply obligation ("CSO") in the ISO-NE forward capacity market ("FCM") is one - but not the only - indication of the reliability value of a resource to Connecticut and the ISO-NE region. Regardless of whether KEC obtains a CSO in the upcoming forward capacity auction ("FCA"), the reliability and competitive market attributes discussed herein (and in KEC's overall application) are sufficient for the Council to find that KEC is necessary for the reliability of electric supply, and contributes to the competitiveness and efficiency of wholesale electricity markets in the region. Nevertheless, KEC is also well positioned to succeed in obtaining CSOs in FCA 12 or subsequent FCM auctions.

## II. WHY KEC IS NEEDED

**Q. Have you reviewed the particular challenges the ISO-NE power system faces relative to the provision of reliable and efficient electric service?**

A. Yes, I have participated in a continuous evaluation of the reliability challenges as both a public utility commissioner and siting board member, as an employee of energy and environmental regulatory agencies representing MA in regional policy deliberations, and as a consultant to ISO-NE and other stakeholders in the New England region.

**Q. Could you please provide an overview of the particular challenges this region faces?**

A. Yes. ISO-NE's unique reliability challenges have been recognized by the system operator, by Connecticut (and other New England states), by the North American Electric Reliability Corporation, and by the Federal Energy Regulatory Commission ("FERC").[3] Particular challenges for our states and region include (1) increasing dependence on non-firm natural gas, particularly during cold winter conditions; (2) the ongoing attrition of aging and less-efficient generating capacity in the region; and (3) an increasing penetration of variable renewable resources (primarily wind and solar photovoltaic ("PV") plants) at both the bulk power system ("BPS") and distribution system levels. These factors present risks and challenges to reliable BPS operations in Connecticut and across the region that should be considered when evaluating the need for new generating resources.

**Q. How would KEC help Connecticut and New England address these reliability**

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[3] For example, see Connecticut Department of Energy and Environmental Protection ("DEEP"), *2017 Comprehensive Energy Strategy*, July 26th, 2017; NERC, *Long-Term Reliability Assessment*, December 2016; and FERC, *Winter 2017-18 Energy Market Assessment*, October 19, 2017.

**challenges?**

A. The KEC facility is precisely what is needed to meet the state's and the region's reliability needs now, and to help address the most pressing reliability, resilience, operating flexibility and environmental challenges that Connecticut and New England will face in the coming years. KEC is uniquely suited to these challenges because it can be configured in any mode - baseload, cycling, or peaking - and represents a dispatchable and flexible resource that (1) addresses the New England region's dependence on natural gas through a redundant and resilient approach to fuel security and management; (2) adds an efficient, low-emitting, and local generating resource to help manage the attrition of aging generation in Southern New England; (3) possesses all of the various resource dispatchability and flexibility attributes to help the region integrate an increasing quantity of variable renewable and demand resources at the grid-connected and distributed levels, and (4) will achieve all of the above while reducing emissions from higher-emitting fossil generating units on the system.

**Q. Please describe in more detail how KEC can help address the challenge of the growing dependence on non-firm natural gas in New England.**

A. KEC meets the fuel security challenge for the state and region with a comprehensive "**defense-in-depth**" approach to fuel supply - a level of fuel security almost certainly unmatched by most, if not all, existing or proposed natural gas-fired generating facilities in the New England region.[4] Specifically, NTE has obtained a contract for year-round firm natural gas transportation for KEC, beginning in 2020, to provide up to 95,000 million Btu of natural gas per day (sufficient to support KEC's operations at maximum output).[5] Unlike most, if not all, natural gas-fired generators in Connecticut, KEC would be able to always burn natural gas, given its firm transportation commitment. Nonetheless, it could switch to ultra-low sulfur diesel oil ("ULSD") should there be an event or emergency natural gas system conditions under which the delivery of electricity and/or heating fuel to Connecticut would benefit from KEC moving to its alternate fuel supply. KEC's ULSD backup would thus provide additional and redundant fuel security to support reliable and resilient Connecticut and New England power system operations in the dead of winter or at any other point in the year when the region faces natural gas system constraints. It would also provide flexibility to support the delivery of natural gas for heating to critical public institutions (such as hospitals and schools) and residents/businesses under emergency conditions. NTE has included more than enough ULSD backup capability for this purpose. When full, the tank will have enough ULSD for at least 50 hours of operation at full load, or at partial load (or only during peak hours) for several days to a week. Further, KEC has the ability to replenish ULSD supplies while operating, if ever needed.[6] This contribution of KEC to the reliability, flexibility and resilience of the state's and region's power supply

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[4] As noted by ISO-NE, "[t]he lack of firm fuel contracts by natural gas generators has limited the availability of natural gas transport to generators and funding for natural gas infrastructure expansion." ISO-NE, *2017 Regional System Plan*, November 2, 2017, p. 98.

[5] CSC Findings of Fact, Nos. 301 - 302

[6] CSC Findings of Fact, No. 314.

and other critical energy needs cannot be overlooked in the current and expected future New England market/reliability context, and should be viewed as both a reliability need and a significant public interest benefit.

**Q. How does the use of natural gas for electricity generation create constraints on natural gas delivery during winter months?**

A. The use of natural gas for electricity generation in New England continues to grow as the dominant source of power supply. At the same time, natural gas is a critically important resource for heating homes, hospitals, schools and businesses during the winter. Consequently, the demand for natural gas, particularly during cold winter periods, has increased significantly in the New England region, while the ability to *transport* natural gas into New England has not kept pace with growth in power sector demand, leading to periods of pipeline delivery constraints and associated power system economic and reliability challenges and risks in the region.

State-regulated local natural gas distribution companies ("LDCs") are required to forecast growth in demand for natural gas (for heating and process needs) in their service territories, and to ensure their ability to meet customer demand at the time of winter peak (i.e., under the coldest winter conditions). This typically involves entering into fixed long-term contracts to support the development and construction of new interstate pipeline transportation capacity and local storage to meet growing peak demand, and/or contracting for the delivery of liquefied natural gas ("LNG"). By entering into long-term contracts for pipeline capacity, the natural gas LDCs are *guaranteed* transportation of natural gas as needed to their systems on a year-round basis, and particularly under cold winter conditions. In effect, the LDCs purchase priority delivery rights on the interstate pipeline system.

Unlike most New England gas-fired plants, KEC has entered into the same type of firm, priority natural gas transportation contract as the LDCs to support its power plant operations. Most, if not nearly all, other natural gas-fired power plant owners in the New England region have not entered into such priority, long-term financial arrangements to guarantee the *transportation* of natural gas to their power plants.[7] In nearly all hours of the year this is not a concern, because there is sufficient transportation capacity not being used by LDCs, allowing for continuous operation of more than enough of the region's natural gas-fired power plants to support reliable and economic power system operations.[8] Given these circumstances, power plant owners have typically chosen to purchase excess pipeline transportation only on an *as-available* basis for power plant operations, also known as "interruptible" or "non-firm" service.

Under these conditions, as our dependence on natural gas for electricity generation grows, the interstate pipeline system has become constrained - that is, filled to at or near

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7 As described by Gordon Van Welie, President and CEO of ISO-NE, "Cost-of-service, state-regulated, Local Distribution Companies (LDCs) enter into firm, long-term contracts with pipelines to guarantee gas delivery for home heating; merchant generators do not make comparable long-term fuel arrangements because they cannot be assured of cost recovery" and "[m]erchant gas generators typically will not sign long-term contracts for firm gas transportation, since it is more economic for them to buy transportation in the secondary market (when it is available), or switch to oil when the pipelines are constrained." Van Welie, Gordon, *Challenges Facing the New England Power System*, ISO-NE Presentation, March 26, 2015, pp. 14, 21.

8 For example, during summer months (when New England electricity demand is at its highest) the LDCs' demand is at its lowest, and there is more than enough unused pipeline capacity to support full operation of the region's power plants.

capacity during certain winter month hours. Given the significant role that natural gas plays in meeting power system reliability needs, this creates risks to the reliable operation of the region's power system, particularly under cold winter conditions.[9] In response, ISO-NE has (1) continuously raised concerns about the risks associated with power plants not contracting for firm winter natural gas transportation capacity; (2) developed market designs focused primarily on establishing incentives for reliable winter performance (such as the "pay-for-performance" component of the FCM); and (3) for six years administered an out-of-market "winter reliability program" to ensure reliable winter operations absent the development of new pipeline capacity into the region.[10] In addition, the concerns raised by ISO-NE are shared by most other entities focused on or responsible for the reliability of power supply in the New England region.[11]

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9 To this point the lack of firm pipeline transportation arrangements has at times created high prices for natural gas delivered to power generators (including, e.g., during the recent cold snap), but has not lead to specific power system outages in winter months. Instead, the region has managed to maintain reliability through the operation of oil- and coal-fired generating assets (many of which are among the resources that have retired or are at risk of doing so), the purchase of LNG on a spot basis, and the administration of ISO-NE's winter reliability program.

10 With respect to firm contracts, ISO-NE has emphasized that "The lack of firm fuel contracts by natural gas generators has limited the availability of natural gas transport to generators and funding for natural gas infrastructure expansion," See ISO-NE, *2017 Regional System Plan*, November 2, 2017, p. 98. With respect to its "pay-for-performance" programs, ISO-NE states "Instituting 'pay for performance' (PFP) enhancements that, starting in 2018, will reward resources that make investments to successfully boost performance during periods of system stress, such as by ensuring adequate fuel, while resources that don't perform will forfeit capacity payments." See ISO-NE, *2017 Regional Electricity Outlook*, January 2017, p. 30. With regard to its Winter Reliability Program, ISO-NE states that it has mitigated fuel risk security over the past six years by "Implementing Winter Reliability Programs that pay demand-response resources to be available and generators to boost winter fuel inventories of oil and LNG or to invest in dual-fuel technology," See ISO-NE, *2017 Regional Electricity Outlook*, January 2017, p. 30.

11 For example, the Connecticut Department of Energy and Environmental Protection has stated that "[i]nadequate natural gas delivery infrastructure is threatening the reliability and affordability of New England's gas-dependent electric system during peak winter periods [and that] [d]ue to market structure, gas-fired generators - who now produce more than half of the region's electricity - are not contracting

In short, New England continues to add new gas-fired resources at a time when (a) most power plant owners are reluctant to establish fuel assurance through long-term firm fuel transportation contracts, or commit to specific quantities of oil storage available at plants with dual-fuel capability, and (b) it is becoming increasingly difficult to develop and site new energy infrastructure in the region, causing older, higher-emitting, and less efficient units to be relied upon to meet reliability challenges. The combination of these factors suggests a particular focus when assessing need and public benefits on the contributions of proposed resources to addressing this fundamental reliability challenge to Connecticut and the New England region.

**Q. Since KEC is intended to be primarily run on natural gas, will it add to the over-reliance on natural gas electric generation in New England?**

A. No; in fact, it helps to alleviate this reliability challenge. This is because KEC has *both* firm transportation of natural gas to the facility *and* back up ULSD-generation capability with a commitment to significant on-site ULSD storage capacity.

**Q. Please describe how the recent cold snap affecting the Northeast U.S. sheds light on the reliability/market value of KEC's unique fuel security attributes.**

A. From December 26, 2017 through January 7, 2018, the New England region faced one of

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directly for the gas capacity they need to run." See Connecticut Department of Energy and Environmental Protection, *2014 Integrated Resources Plan for Connecticut*, March 17, 2015, ii. Similarly, NERC reported that "New England has no storage facilities while relying on natural gas and liquefied natural gas supplies. It has limited infrastructure compared to the demand of natural gas in the area for electric generation. Disruption to any of the major trunk lines or deliveries would likely force generation out of service… Lack of firm transportation by electric generators in this area contribute to its risk profile." See NERC, *Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System,* November 2017, p. 6.

the most severe periods of extended cold weather in recent history ("17/18 Cold Snap"). Throughout the 17/18 Cold Snap, natural gas pipelines entering the region were at or near capacity;[12] demand for natural gas exceeded historical levels;[13] the price of delivered natural gas in short-term markets (that is, for those that did not have long-term firm delivery contracts) spiked to extremely high levels, driving similar increases in the prices offered by generators in the New England power market;[14] the region became heavily dependent on coal- and oil-fired generation;[15] and ISO-NE and state governments took specific actions to reduce the risks to power system reliability.[16]

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12 See, e.g., EIA, *Northeast Winter Alert,* January 5, 2018: "Major pipelines delivering natural gas into New York and New England are constrained again on January 5, with average pipeline utilization ranging from 90%-100% on key segments." … "Many natural gas pipelines have issued operational flow orders and critical notices advising their customers to carefully manage the amount of natural gas transportation capacity they use relative to what they requested or scheduled per contractual rights, or they will be subject to possible penalties. Interruptible transportation service is highly restricted throughout the region."

13 "Estimated U.S. natural gas demand on January 1, 2018 reached 150.7 billion cubic feet, surpassing the previous single-day record set in 2014…" EIA, *Cold weather, higher exports result in record natural gas demand*, January 5, 2018.

14 "This past week, increases in demand led to higher prices in natural gas and electricity markets. Day-ahead natural gas price for delivery for January 1, 2018, neared $30 per million British thermal units at trading locations in the Mid-Atlantic region, New York, and Boston" … "Because the spot price of natural gas affects power prices in many parts of the United States, spot wholesale prices also rose, surpassing $200 per megawatthour (MWh) in New York City and $185/MWh in New England." EIA, *Cold weather, higher exports result in record natural gas demand*, January 5, 2018.

15 See, e.g., SNL Financial, *New England dual-fuel units burning through oil, emissions limits amid cold-snap,* January 2, 2018: "ISO New England spokesperson Marcia Blomberg said … the extreme cold weather is increasing demand for natural gas heating, creating pipeline constraints, driving up natural gas price and causing dual-fuel generators to switch fuels. As a consequence, oil- and coal-fired power plants are generating much more power than usual and wholesale power prices have soared," and "[a]s of 10:30 a.m. on Jan. 2, 34% of New England's electricity was being supplied by oil-fired generation (which over a given year supplies less than 1% of the region's generation), followed by natural gas at 25%, nuclear at 23%, renewables at 9%, coal at 6% and hydro at 4%."

16 On January 3, 2018, ISO New England implemented Master/Local Control Center Procedure No. 2 (M/LCC 2). See ISO-NE, *January 7 Power Systems Update*, January 7, 2018. Actions were also taken by states to ensure fuel delivery. For example, see New Hampshire Declaration of Emergency Notice (Title 49 CFR 390.23), December 26, 2017; Massachusetts Declaration of Emergency Notice (Title 49 CFR §

In short, this past year Connecticut and New England faced exactly the type of winter circumstances that KEC is designed to help address. This is because KEC's firm natural gas delivery contract, at pre-established prices, will provide incentives for increased natural gas infrastructure development, certainty of natural gas supply during critical cold periods, and mitigation of regional electricity price impacts through prices that do not rise with episodic short-term price fluctuations. In addition, the firm contract will allow KEC to operate throughout such a cold snap period on natural gas, avoiding increased emissions associated with oil-fired generation and preserving oil stocks for use in the event that the cold snap deteriorates to emergency conditions. In short, KEC represents precisely the type of generating facility that can reduce the reliability, emission and electricity cost risks and impacts that the New England region faces during cold snap events.

**Q. Please describe in more detail the ongoing attrition of aging and less-efficient generating capacity in the region, and its implications?**

A. In New England, as in other regions, market conditions are causing the retirement of many aging and less-efficient coal and oil-fired generating units on the system. The combination of low-cost gas, decreasing costs (and increased efficiency) of new gas-fired capacity, and the emergence of economically competitive and state-mandated renewable resources is reducing prices, thereby placing financial pressure on the continued operation of older resources. These older resources are more expensive to operate and may require additional

390.23), December 28, 2017; and Vermont Declaration of Emergency Notice (Title 49 CFR 390.23), January 3, 2018.

capital investment to upgrade power plant components. In New England, this primarily includes oil and coal-fired resources, but also some nuclear capacity, mostly located in southern New England.[17] The number of unit retirements that has occurred and is expected to occur is significant from a power system reliability perspective. While expectations around the specific level and timing of retirements will fluctuate from year to year as market conditions vary, the likely retirement of the vast majority of older, less efficient resources has been continuously recognized by ISO-NE, DEEP, and others as a potential reliability challenge.[18]

The continued retirement of the region's resources highlights the need for adding new capacity over time, and, in particular, for adding capacity in southern New England with characteristics that can help integrate variable resources, address the region's growing dependence on natural gas, and otherwise support continued reliable power system operations.

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17 In New England, there are 88 operating generating units that can operate on coal or oil, including 28 with an operating capacity of more than 25 MW. 62 of these units are in Connecticut, Massachusetts, or Rhode Island (SNL Financial).

18 See, e.g., Connecticut DEEP, *2017 Comprehensive Energy Strategy*, July 26, 2017, p. 46: "The [New England] market, as designed, is replacing the retiring units with more natural gas generation, exacerbating the risks as the demand for gas rises and the available capacity remains constant. This occurs because markets are 'fuel neutral' and natural gas units are generally the least expensive units to build and operate". See also, ISO-NE, *Resource Mix*, August 18, 2017, available at https://www.iso-ne.com/about/key-stats/resource-mix: "Several of the region's oldest generators-and some of its largest-have already ceased operations or plan to exit the markets. About 4,600 MW-an amount equal to about 16% of the region's current generating capacity-will have shut down between 2013 and 2021 and is likely being replaced primarily by natural-gas-fired plants and wind resources… Over 5,000 MW more of New England's oil and coal capacity is at risk of retirement due to age and infrequent operations in coming years, and uncertainty surrounds the future of 3,300 MW from the region's remaining nuclear plants." In addition to recently retired units, ISO-NE considers the following plants at risk of retirement: Yarmouth, Merrimack, Newington, Schiller, Mystic, West Springfield, Canal, Middletown, Montville, and New Haven.

**Q. Since the filing of NTE's original application, have there been developments that may increase the likelihood of additional generating asset retirements, or that highlight the importance of KEC's reliability attributes?**

A. Yes. A number of recent events have made it more likely for there to be continued retirements of existing generating units, heightened reliability concerns, and further increases in the need for low-carbon and flexible generation resources. These events make the firm natural gas transportation and dual-fuel capability of the KEC facility even more important from reliability and market perspectives. For example:

- There has been continued resistance in New England to natural gas infrastructure expansion, and major pipeline applications in New England have been suspended in recent years. Most recently, in June 2017 the application for the Access Northeast pipeline, a 125 mile pipeline project to replace existing pipelines with larger ones in Massachusetts and Connecticut and expand the capacity of the Algonquin Gas Transmission Line was withdrawn and the project was suspended.[19] This is on top of other cancellations or adverse regulatory decisions that occurred prior to 2017.[20] These examples do not mean

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19 See, for example, Jon Chesto, *Lacking financing, utilities put $3 billion natural gas pipeline on hold*, Boston Globe, June 29, 2017.

20 For example, the application for the Northeast Energy Direct pipeline, a 188 mile pipeline extension to bring gas from Pennsylvania to New England, was withdrawn in May 2016 after lack of assurance that ratepayers would pay for the project, and in August 2016 the Massachusetts Supreme Judicial Court blocked a funding mechanism that would have allowed utilities to pass on the cost of natural gas pipeline expansion to their customers. Jon Chesto, *Kinder Morgan shelves $3 billion pipeline project*, Boston Globe, April 20, 2016; and *New England in Need of More Natural Gas Pipeline Capacity*, Institute for Energy Research, August 30, 2016.

that additional pipeline capacity will not be added, but they do highlight the elevated significance of NTE's defense-in-depth approach to fuel security.

- The Northeast states in the Regional Greenhouse Gas Initiative ("RGGI") recently proposed lower carbon caps for future years which - by increasing generator operating costs and further restricting total allowable emissions - may further exacerbate generating unit retirements and reliability concerns in the region. Specifically, in late August 2017, RGGI released four proposed changes to the RGGI Program for the 2020 – 2030 period, including a reduction in the RGGI cap resulting in an additional 30% cap reduction by 2030, relative to 2020 levels.[21]
- The increased stringency of the RGGI cap, in combination with state-specific policies such as the Global Warming Solutions Act ("GWSA") in Massachusetts,[22] increase generator operating costs and thus increase the

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[21] RGGI Press Release, *RGGI States Announce Proposed Program Changes: Additional 30% Emissions Cap Decline by 2030*, August 23, 2017, available at https://www.rggi.org/docs/ProgramReview/2017/08-23-17/Announcement_Proposed_Program_Changes.pdf.; RGGI, *Table of Proposed Program Elements*, August 23, 2017, available at https://www.rggi.org/docs/ProgramReview/2017/08-23-17/Proposed_Program_Changes_Summary_Table.pdf.

[22] The Massachusetts GWSA was signed in August 2008, creating a framework for reducing GHG emissions from all sectors of the Commonwealth's economy (M.G.L. c. 21n, §§ 3(c), 3(d) and 7). In May 2016, the requirements of the GWSA were further clarified by the Massachusetts Supreme Judicial Court in Kain v. Department of Environmental Protection. In August 2017, the Massachusetts Department of Environmental Protection promulgated a package of regulations designed to meet the requirements of the GWSA, including a cap on emissions of $CO_2$ from power plants in that state that is far more stringent than the RGGI emission reduction requirements. See Commonwealth of Massachusetts Department of Environmental Protection, *Background Document on Proposed New and Amended Regulations, 310 CMR 7.00 & 310 CMR 6.00 Air Pollution Control for Stationary and Mobile Sources*, December 16, 2016 (hereafter "Background Document"). See also Commonwealth of Massachusetts Department of

likelihood of power plant retirements in the region,[23] and thus the need for adding efficient and flexible generating resources in Southern New England over time.

**Q. Please describe in more detail the growth in grid-connected and distributed variable resources and demand management, and the likelihood of this growth continuing due to economic and policy factors?**

A. The New England states have been at the forefront of the move towards lowering the carbon intensity of energy supply and consumption. State policies supporting the increased development of low-carbon resources include participation in RGGI, requirements for the purchase of renewable energy credits and long-term procurement of eligible renewable resources, mandated distribution utility investment in energy efficiency measures and programs, the establishment of net energy metering tariffs to support growth in distributed solar PV installations, initiatives to support demand-side management and other distributed resource incentives, as well as a host of state-specific measures to increase community and municipal efficiency and renewable investments. These policy preferences have been implemented coincident with a steep decline over the past decade in the cost to construct and/or install wind and solar PV resources, to the point that large variable renewable

Environmental Protection, *Fact Sheet: Electricity Sector Regulations, 310 CMR 7.75 and 310 CMR 7.74*, August 2017.

23 Tightening caps on emissions of $CO_2$ increase the likelihood of retirements by (1) creating a binding constraint on the total $CO_2$ emissions from - and thus operation of - competing fossil-fueled power plants, and (2) increasing the costs of operation in particular for less-efficient and more carbon-intensive generating facilities.

resources are becoming economic to develop and operate in competitive markets in many cases without additional subsidies.[24]

The end result of this combination of economic and policy factors is a future of increasing integration of variable renewable resources in bulk power and distribution systems, and new challenges associated with managing the uncertain impact this will have on variations in net electrical demand and reliable power system operations.[25]

The integration of variable resources - at the grid-connected and distributed levels - will not be completed overnight, but expectations are high for growth in variable resource operations in the coming years.[26] Successfully navigating a system that is changing rapidly towards variable distributed resources and demand management will require the addition and operation of efficient and flexible generating resources over the same time period. This means that the New England power system must have a foundation of flexible, efficient, and fast-responding resources to manage greater levels of net load variability on the

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24 Lazard, *Lazard's Levelized Cost of Energy Analysis - Version 11.0*, November 2017.

25 See NERC, *2016 Long-Term Reliability Assessment*, December 2016, p. 28 ("The North American electric grid is experiencing a shift in the resource mix, driven by a variety of factors that include retirements of conventional resources and the integration of new resources. This leads to potential impact on essential reliability services...such as frequency, voltage, and ramping capability. This transformation in the resource mix will change the planning and operation practices of the current electric grid. Although many resources are able to provide essential services needed to maintain BPS reliability, understanding system characteristics and related behaviors will aide in successful integration of new technologies.").

26 As of January 5, 2018 there were 7,601 MW of grid-connected wind projects and 1,037 MW of grid-connected solar projects in the ISO-NE Interconnection Queue; this does not account for the growth in behind-the-meter distributed generation. See ISO-NE public queue data, available at https://irtt.iso-ne.com/tacgw/Customization/disc.cshtml. Growth in solar PV resources alone anywhere on the New England system is expected to increase by almost 500 MW by the end of 2018. See ISO-NE, *Final 2017 PV Forecast*, May 1, 2017, p. 31.

system.[27]

Finally, in support of $CO_2$ reduction goals, states have actively evaluated the procurement of distant renewable resources - whether large wind farms in Northern New England, New York, and/or Canada, or hydro generating resources in the Eastern Canadian Provinces. The ultimate level of development of these resources remains uncertain, since it requires the siting of major new transmission infrastructure across multiple states, and generally will not occur without state-approved, long-term, out-of-market contracts that put the risk of transmission (and power plant) investment on distribution company ratepayers. However, given the likely addition of a significant quantity of distant resources added to meet policy goals, the existence of competitively-sourced, local and flexible/dispatchable resources such as KEC will continue to be critical to support the continued competitiveness of wholesale electricity markets, meet local reliability needs, and minimize the impact on distribution company ratepayers of long-term contractual obligations to pay for long-distance high-voltage transmission and generation development projects.[28]

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[27] As noted by ISO-NE, "New England's traditional power system is rapidly transforming into a more complex, less predictable hybrid grid where electricity needs are met with large generators and other power resources connected to the regional transmission system, in combination with thousands of small resources connected 'behind the meter' directly to retail customer sites or local distribution utilities. In addition to significant amounts of carbon-free renewable energy, the regional generation fleet will need to include fast, flexible power plants ready to jump in and balance the variable output from wind and solar resources." ISO-NE, *2017 Regional Electricity Outlook*, January 2017, p. 18.

[28] For example, the proposed 192-mile Northern Pass Transmission Line, capable of bringing hydro-power from Quebec to lower New England, is estimated to cost $1.6 billion and been has met with stiff opposition at the state and local levels. See *US DOE awards permit to Northern Pass transmission line*, November 17, 2017.

**Q. Please describe in more detail how KEC can help reduce emissions from operating generating plants in New England.**

A. KEC will help reduce the risks of climate change and contribute to regional air quality improvements in normal operations.[29] As generating assets are asked to support increasing levels of variable renewable resources over time to meet state policy objectives, it will be important that they do so with the greatest level of efficiency and lowest emission rates possible. KEC will support these objectives by displacing the generation of electricity at older, less efficient, and higher-emitting plants in the region. As shown in Exhibit 2, KEC will operate at a $CO_2$ emission rate lower than virtually all of the fossil generating capacity in the New England region, and far lower than those that often operate on the margin. For example, as can be seen in Exhibit 2, KEC will have one of the lowest - if not the lowest - emission rates (in pounds of $CO_2$ per MWh generated) of all natural gas, oil and coal-fired generating resources in New England. Thus, in every hour that KEC operates and the marginal resource is a natural gas, oil or coal resource, KEC will have the effect of reducing total emissions of $CO_2$ to meet the region's electricity demand. Thus, generation at KEC will more often than not generate emission reduction benefits while supporting reliable and competitive wholesale market operations.

## III. DETERMINATION OF NEED AND PUBLIC BENEFIT IN THE REGIONAL CONTEXT

[29] The Council has recognized the potential air quality benefits of KEC. See CSC Findings of Fact, No. 476

**Q. How does the Council evaluate an application for an electric generating facility such as KEC?**

A. In evaluating proposed projects, the Council evaluates the public need for and benefits of each facility. If public need and benefit for the facility are found, the environmental impacts are evaluated and weighed against the public benefits.[30] If the public benefits outweigh or balance the environmental impacts, the facility is granted a Certificate of Environmental Compatibility and Public Need ("Certificate") by the Siting Council.

**Q. How are public needs and benefits for electric generating facilities described in Connecticut statute?**

A. Connecticut General Statute, Chapter 227a, §16-50p(c) (3), states "a public benefit exists when a facility is necessary for the reliability of the electric power supply of the state or for the development of a competitive market for electricity and a public need exists when a facility is necessary for the reliability of the electric power supply of the state."

**Q. Does the statutory language in Connecticut set a specific threshold for the determination of need for new power plant construction in the State?**

A. No. The Connecticut language links a determination of need to power system reliability in the State of Connecticut, and "...the development of a competitive market for electricity."[31] This construct requires careful case-specific consideration and interpretation

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30 Specifically, "[t]he Council's statutory charge is to balance the public need or benefit of a proposed facility with the effects of the proposed facility on the natural environment of the state at the lowest reasonable cost to consumers." Connecticut Siting Council, *Frequently Asked Questions*, available at http://www.ct.gov/csc/cwp/view.asp?a=3&q=484186&cscNav=|, accessed November 14, 2017.

31 Connecticut General Statute, Chapter 227a, §16-50p(c) (3).

by the Council, because there are complex linkages among power plant development in a given state, the reliability of power supply within the State and across the New England power system, and the role of competitive markets in supporting reliable system outcomes. In particular, reliability within a state in New England cannot be separated from reliability in the region as a whole; similarly, power plants and other power system infrastructure (e.g., transmission, distribution, and distributed resources (such as solar, wind, hydro, and storage)) within a state affect and support not only the reliability of that state, but of the region as a whole.

Competitive markets, in turn, help meet state and regional reliability needs through competitive, least-cost market outcomes based on regional economics (including economic additions and economic retirement of generating and demand resources). The full range of regional system planning studies/analyses, real time system operations, and ISO-NE administration of wholesale markets at the regional level provides significant and specific benefits to Connecticut consumers through joint assurance of power system reliability, the removal from distribution company ratepayers of generating plant and transmission interconnection investment risk, and the operation of a wider geographic market to drive down the cost of reliable electric service. Thus, power system reliability and market economics, at both the state and regional level, are fully intertwined.

**Q. Have you reviewed the Council's May 2017 Decision?**

A. Yes.

**Q. Please summarize the Council's discussion relevant to the questions of need and public benefit.**

A. The Council recognized that Connecticut and the ISO-NE Region are "inextricably interconnected and rely on each other for a reliable electricity system" and that "[s]ystem reliability is comprised of two aspects: transmission security and resource adequacy."[32] The Council also recognized that "...the KEC project is the type of project that competitive markets were developed to create. KEC would not be relying on contracts with electric utilities in order to get built. KEC relies on market signals primarily for capacity and energy, as well as ancillary services, and it is responding to those market signals and identifying a need to build the plant."[33] In short, the Council recognizes that (1) Connecticut cannot be separated from ISO-NE for reliability purposes, (2) reliability comprises multiple essential reliability services, (3) KEC is a competitive generating facility that is not reliant on guaranteed ratepayer funding and supports the operation and administration of competitive electricity markets, and (4) the financial incentive for constructing new generating capacity like the KEC facility does not derive solely from the capacity market, but from multiple market revenue streams (energy, capacity, ancillary services). Plant economic viability and financing rests on expectations of revenues from all such markets over the life of the facility; not a single year's revenue from a single market such as the FCM.

**Q. What did the Council conclude and why?**

A. In the end, the Council found that the public benefit for KEC had not been demonstrated,

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32 CSC Findings of Fact No. 76

33 Id., p. 17.

and denied the issuance of a certificate without prejudice.[34] The Council came to this finding based at least in part on its conclusion that ISO-NE "...effectively determined that KEC is not required for resource adequacy... through ... 2021," because the region met installed capacity requirements through the FCM without KEC.[35] The Council determined that since KEC did not clear the FCM, "...the proposed facility is not necessary for the reliability of the electric power supply of the state or for a competitive market for electricity at this time."[36]

**Q. Do you agree with the Council's finding and, if not, please explain why?**

A. No. I think a strict focus on FCM outcomes in Certificate determinations of "need" in Connecticut (or in other competitive market states) would unnecessarily constrain the Council's decision-making authority, and diminish the reliability and competitiveness of the New England power system.

I recognize that in the current context – a regionally integrated system from reliability, operational, and market perspectives – it is *at best* challenging to interpret statutory language around whether a facility is necessary for the reliability of the electric power supply or a competitive market, and to evaluate the public benefits of a resource. This is because "reliability" cannot be reduced to a single metric or single point in time, and the reliability contributions of a resource are inextricably linked to the unique contributions the resource makes to addressing the state's and region's various reliability

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[34] CSC Decision and Order, p. 1.

[35] CSC Opinion, p. 5.

[36] CSC Opinion, p. 11.

challenges as the supply of and demand for electricity evolves over years, even decades. Further, the complicated links between power system reliability and competitive market outcomes increases the complexity of assessing "need" and "public benefit."

Obtaining a CSO through the FCM is an important indicator of a resource's contribution to meeting the market's resource adequacy objective in a single year, but resting a decision on whether a resource is necessary for reliability (of the state/region), contributes to market competition, and/or provides public benefits requires a far more expansive review of a resource's role in the regional reliability and market context than pinning the decision only on the outcome of a single market for a single supply year.

**Q. In your view, is clearing the FCM the only indicator that a resource is a necessary and economic contributor to the state and region's reliability needs?**

A. No it is not. The ultimate and explicit purpose of the design and administration of wholesale electricity markets is to procure resources that in total provide various reliability attributes - or "essential reliability services" - in sufficient quantities to maintain reliability at all times. Connecticut has recognized that it is often appropriate to view the question of "need" through this broader lens.[37] While clearing the FCM is an indicator that a resource

[37] See, for example, the Connecticut Siting Council's opinion on the approval of an earlier Lake Road combined cycle generating facility in Killingly: "[…] the proposed facility has been located based on market conditions, not simply intended to provide benefit only to the local community. It would be integrated with other electric suppliers providing capacity to the region, and must be assessed as a regional facility..." Connecticut Siting Council, Opinion, Docket No. 189 – An application by Lake Road Generating Company L.P. for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a proposed electric generating facility located off of Lake Road in Killingly, Connecticut, December 7, 1998, p. 1. See also a Connecticut Siting Council opinion approving a combined cycle generating facility in Middletown: "The project's benefits are that it would provide in-state generation of power to meet increasing demand; the likely replacement of more polluting

provides an economic contribution to meeting system resource adequacy needs in a single year, there are other essential reliability services or resource attributes needed to maintain local, state, and regional system reliability that are not necessarily obtained through the FCM, and that are assured through other market mechanisms administered by ISO-NE on a day-to-day, month-to-month, and year-to-year basis.

**Q. Please provide examples of the essential reliability services (other than resource adequacy) that are required to meet power system reliability needs.**

A. As noted above, resource adequacy refers to having sufficient resources available to meet electricity demand in the peak demand hour of the year (normally in New England, a weekday afternoon in July or August). However, the system requires resources that can provide specific reliability attributes needed to maintain reliable system operations every moment of the year, on a second-by-second, minute-by-minute, hour-by-hour basis. Resources that clear the FCM may contribute to providing such services, but the operational characteristics of different FCM resources on the system vary widely in whether and to what extent they provide such reliability attributes.[38] It is thus useful to

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and costly oil-fired units in the Independent Systems Operator New England (ISO-NE) system; and the diminished need to import power into Connecticut, given transmission import constraints." Connecticut Siting Council, Opinion, Docket No. 225 – Kleen Energy Systems, LLC application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance and operation of an Electric Generating Facility and Switchyard on River Road, Middletown, Connecticut, November 21, 2002, p.1.

[38] As a simple example, a variable wind resource with 100 MW of FCM capacity in Northern Maine cannot provide the same reserve, load-following, or ramping services as a gas-fired resource with 100 MW of FCM capacity located in Hartford, New Haven or Boston. See Hibbard, Paul, Tierney, Susan & Franklin, Katherine, *Electricity Markets, Reliability and the Evolving U.S. Power System*, Analysis Group, June 2017, p. 53-54. See also, NREL, *Integrating Variable Renewable Energy: Challenges and Solutions*, September 2013, pp. 8-9.

consider these various reliability attributes of proposed resources relative to system needs when evaluating the "need" for the facility, and its reliability and market benefits.

Examples of such reliability attributes - which are in part purchased through the various ISO-NE energy and ancillary services markets - include the following: voltage control; frequency response; automatic generation control; and various elements of unit responsiveness tailored to help respond to demand fluctuation and system contingencies on different time scales, such as "spinning" and "non-spinning" reserves (the capacity to come on line and/or increase output rapidly to help address sudden changes in system load/generation mix (due, e.g., to the loss of transmission or generating assets)); and "ramping" or "load-following" capability (the ability to help meet normal system fluctuations by quickly and efficiently increasing and decreasing generation output on time scales that range from seconds to hours). In addition, generating resource characteristics can in other ways increase the reliability value of the capacity relative to system needs, risks and dependencies, but may not be fully compensated for such value in wholesale markets. This would include, for example, the value of locating generation close to load to support local voltage requirements, and fuel security - or the ability to be available and perform in particular during times when the system is stressed or subject to common-mode failures (e.g., constraints on the capacity of the interstate natural gas pipeline system to move gas for power generation capacity into the region - discussed in more detail in Section II above).

**Q. In your opinion, how should the Council evaluate whether the KEC facility is "needed"?**

A. In my view, the Council should consider the full set of attributes KEC brings to addressing the state's and the region's reliability challenges over at least the coming decade, and the role it will play in achieving consumer and reliability outcomes through participation in the region's wholesale markets.

**Q. Why do you think it is important to understand and consider all of the reliability attributes of proposed resources when evaluating resource need?**

A. When evaluating whether a facility is necessary for reliability in the context of a regional wholesale market, it is the full scope of a resource's reliability attributes, and its potential contributions to meeting specific state *and* regional system reliability requirements, that are important.[39] This is particularly true in the current context, given how well the KEC project is suited to the unique reliability circumstances of Connecticut and New England at this time, as discussed in Section II, above.

**Q. Do you have any additional concerns with tying the determination of need for resources in any New England state siting proceeding too narrowly, or exclusively to the outcome of the region's Forward Capacity Market?**

A. Yes. First, it should be noted that resources that do not have a CSO may nevertheless contribute to power system reliability on a day to day basis, and different resources face different performance risks under the ISO-NE pay-for-performance structure. This is

39 The Council previously recognized this in evaluating KEC. See, e.g., the following comment by Commissioner Murphy made during the November 3, 2016 public hearing for KEC: "it seems to be that the applicant is resting upon the presumption that in the forward capacity auction coming up in February they're going to make the cut and that, per se, means they are needed. And that's an assumption that I just don't agree with at all." See Public Hearing for KEC, November 3, 2016, available at http://www.ct.gov/csc/lib/csc/pendingproceeds/docket_470)/transcripts/470-20161103-transcript.pdf.

because the performance risk value depends on the pay-for-performance penalty rate and a resource's operational/outage expectations during times of system scarcity. This risk value may exceed the potential financial benefits of participation in the FCM, or otherwise require inclusion of a risk premium high enough to cause the resource's capacity market offer to not clear the market. Importantly, this outcome is particularly likely for renewable resources that are not fully dispatchable, or whose output depends on factors outside their control.[40]

Second, it is important to consider the unique timing of the FCM auctions and associated capacity supply obligations relative to a proposed resource's development milestones. Specifically, limiting the review of "need" to whether or not a resource clears the FCM creates a fundamental structural discontinuity between the schedule for FCM auctions and the steps that must be taken by a developer to successfully develop and construct a power plant. While clearing the FCM is a clear indication of reliability benefits, *requiring* that a proposed resource clear the FCM *prior to* receiving siting approval could preclude the development of a resource that is otherwise beneficial to the state from reliability and economic/market perspectives.

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40 For example, a variable wind resource or solar PV plant may not obtain a CSO, yet still operate as an energy resource (and support system energy and ancillary services requirements), if the risks of the performance incentive program of the FCM outweigh potential FCM revenues in a given year. This would be the case if the resource anticipates shortage hours at times when physical/meteorological conditions may limit operations. In this example, a literal reading of the Council's findings in its prior decision would mean that such renewable resources that will not clear the FCM auction due to performance risks, by definition could not be granted a Certificate in the State of Connecticut - an outcome that is illogical and inconsistent with the State's competitive market structure, and energy and environmental policy goals and mandates.

The time between when a resource clears the FCM and when the unit must achieve commercial operation to meet its CSO obligation is 39 months, which is very little time to take all the steps necessary to obtain project financing, enter into contractual commitments for plant components and engineering/construction services, and carry out the construction and testing of plant operation - most of which cannot begin in earnest prior to receiving siting approval. In reality, many of these steps must be carried out prior to the decision to offer into the FCM, in order to be able to finalize the pricing of an offer, and to be prepared to rapidly meet construction deadlines upon successful clearing of the market. It is very difficult for a developer to absorb the financial risk of failing to obtain a siting approval and meet its CSO obligation (or alternatively, price that risk into its capacity market offer), when offering into the FCM auction. This is because clearing the market comes with a specific obligation to be in operation three years hence - one that introduces the risk of significant financial penalties, and can only be discharged through subsequent "reconfiguration" auctions at significant expense.

It is possible to approximate the financial magnitude of this risk by estimating what it would cost a resource to "buy out" of its CSO in an annual reconfiguration auction, if it turns out that an excessively compressed timeframe between acquiring a Certificate and the commencement of the capacity commitment period ("CCP") causes a resource to not be able to satisfy its capacity supply obligation. This represents the financial risk/cost that would have to be considered by a developer and potentially added in whole or part as an additional risk premium that a resource owner would need to price into its offer, *due solely to a requirement* that it obtain a CSO (i.e., clear the FCM) prior to obtaining a Certificate.

In order to provide an approximation of the potential magnitude of this impact, I assume a generic resource capacity of 500 MW, and consider the range of reconfiguration auction prices in ISO-NE's FCM for the past three CCPs. The average reconfiguration auction price from this time period was $5.25/kW-month, which leads to a potential CSO buyout cost of approximately $32,000,000.[41] While this result should not be interpreted as a specific forecast of the financial impact or risk premium, which would depend on the case-specific circumstances of a resource and the FCM period in question, it does provide a sense of the potential magnitude or impact of a Council requirement that a resource obtain a CSO prior to obtaining a Certificate.

Finally, it is worth noting that it is simply not necessary that a determination of need be based upon the outcome of a prior FCM auction, and many if not most new power plant construction in New England has not required this result.

## IV. CONCLUSIONS

**Q. Please summarize your conclusions.**

A. KEC would be a reliable, local, and efficient generating resource, capable of providing the essential reliability services needed to effectively and efficiently maintain power system reliability in Connecticut and New England. Further, KEC is exactly what the state and region need to address the most pressing reliability risks, and to help meet public policy

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41 Over the past three years reconfiguration auction prices have varied significantly with changing system conditions, reaching as high as $12.11/kW-month. At this price level, the potential CSO buyout cost for a 500 MW unit would be approximately $73 million.

objectives: it would be close to load in the most densely populated portion of the New England region, connected to the state's and region's 345kV system; it would implement a defense-in-depth approach to fuel security, guaranteeing reliable operations through any system contingencies and even under the harshest of winter conditions, and add a unique level of resilience to energy system operations; it would provide highly flexible and controllable operations to support the vast integration of low-carbon, variable renewable resources; and it would do so while providing emission reduction benefits to the state and region.

Interpreting the question of need, public benefits, and contributions to competitive markets in a fully intertwined regional power system and market is complicated by the fact that the planning, procurement and operation of resources to ensure power system reliability and efficient market outcomes are primarily regional in nature, and flow from federally-regulated reliability obligations and market designs. In this context, it is important for the Council to conduct a broader and more nuanced assessment of need, reflecting on reliability contributions to Connecticut and the New England region, and recognizing the complex nature of the interaction between wholesale electricity markets and power system reliability.

In short, in my view the Council should find that KEC is necessary for the reliability of electric supply, and will contribute to the competitiveness and efficiency of wholesale electricity markets.

**Q. Does this conclude your testimony?**

A. Yes.

Paul J. Hibbard

January 15, 2018

**Exhibit 1**
**Curriculum Vitae & Testimony**

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## PROFESSIONAL EXPERIENCE

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## TESTIMONY IN THE LAST FOUR YEARS

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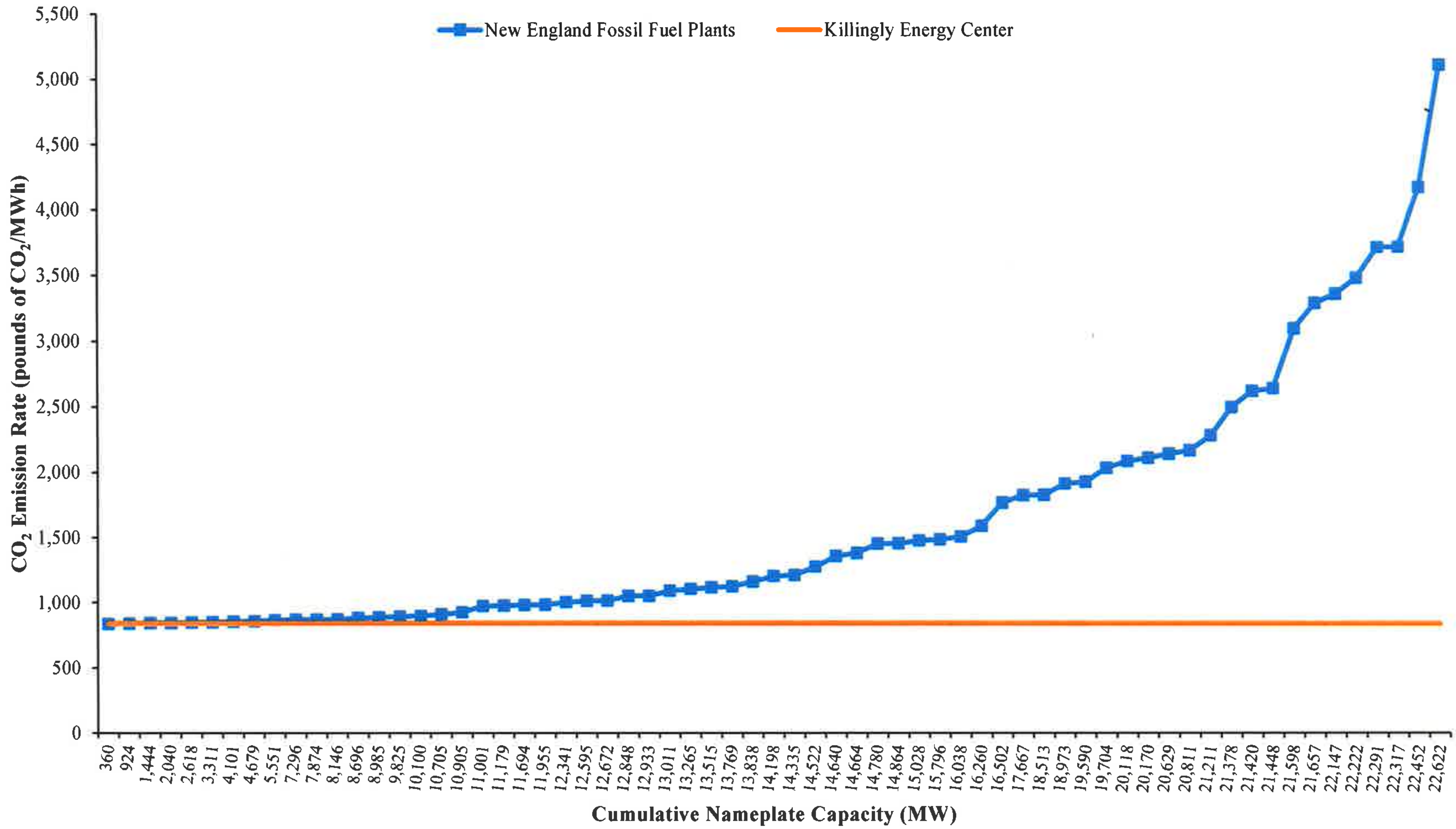
# Exhibit 2
## New England Fossil Fuel Generator Emission Rates, by Cumulative Capacity




**Notes:**
[1] The emission rate for Killingly Energy Center is the reported maximum tons of $CO_2$ equivalent emissions per year over the maximum annual generation of the plant.
[2] The emission rates for the rest of ISO-NE plants represent a three year (2014-2016) weighted average emission rate (annual $CO_2$ emissions over annual net generation), weighted by net generation for operating and operating & planned fossil plants where emissions data are available.

**Sources:**
[1] Killingly Energy Center, Minor Modification Application for Stationary Sources of Air Pollution Permit No. 089-0107, November 22, 2017.
[2] SNL Financial.