DOCKET NO. 470B – Application of NTE Connecticut, LLC application 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.

Direct Joint Testimony of Robert Fagan and Devi Glick, Synapse Energy Economics

Prepared on Behalf of Not Another Power Plant and Sierra Club
April 11, 2019

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1 Introduction

Q. Mr. Fagan, please state your name and occupation.

A. I am Robert M. Fagan, Vice President at Synapse Energy Economics in Cambridge, MA.

Q. Ms. Glick, please state your name and occupation.

A. I am Devi Glick, Senior Associate at Synapse Energy Economics in Cambridge, MA.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics is a research and consulting firm specializing in electricity industry regulation, planning and analysis. Synapse works for a variety of clients, including consumer advocates, regulatory commissions, and environmental advocates.

Q. Are you the same Robert Fagan that testified before the Council in Docket No. 470, in early 2017, after submitting Direct Testimony in November 2016?

A. Yes.

Q. Mr. Fagan, please summarize your qualifications.

A. I am a mechanical engineer and energy economics analyst, and I've analyzed energy industry issues for more than 30 years. My activities focus on many aspects of the electric power industry, in particular: production cost modeling of electric power systems, general economic and technical analysis of electric supply and delivery systems, wholesale and retail electricity provision, energy and capacity market structures, renewable resource alternatives, including wind and solar PV, and assessment and implementation of energy efficiency and demand response alternatives. I hold an MA from Boston University in energy and environmental studies and a BS from Clarkson University in mechanical engineering. My

resume is included as Attachment 1 hereto.

Q. Ms. Glick, please summarize your qualifications.

A. At Synapse and previously at Rocky Mountain Institute, I have focused on a wide range of energy and electricity issues, including: utility resource planning, distributed energy resource valuation, energy efficiency program impact analysis, and economics of plant operations. For this work, I develop in-house models and perform analysis using industry-standard models. I have submitted testimony as part of docketed proceedings on Public Utility Regulatory Policies Act (PURPA) avoided costs, power plant economics, and cost and environmental impact analysis of alternative resource portfolios.

I have a master's degree in public policy and a master's degree in environmental science from the University of Michigan; a bachelor's degree in environmental studies from Middlebury College; and more than six years of professional experience as a consultant, researcher, and analyst. My resume is included as Attachment 2 hereto.

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

A. We are testifying on behalf of Not Another Power Plant ("NAPP") and the Sierra Club.

Q. What is the purpose of your testimony?

A. The purpose of our testimony is to evaluate NTE's renewed proposal for the Killingly Energy Center (KEC) gas-fired plant to determine whether the facility is needed to ensure reliability in Connecticut and New England, whether it provides a net public benefit, and whether it is necessary for the continuing competitiveness of the electric power sector in the State or New England. We also evaluate the environmental impacts, in the form of greenhouse gas production, that would come with this proposed plant.

Q. Please summarize your conclusions.

A. We conclude that the proposed plant is not necessary to ensure reliability in New England and Connecticut, because it is not necessary to ensure either resource adequacy (capacity provision) or winter fuel security (energy provision during extreme cold periods). We also conclude that it will exacerbate New England's overreliance on natural gas fuel for electricity production, exposing Connecticut ratepayers to a higher risk of increased cost associated with natural gas price increases since those prices will continue to have a direct impact on the overall costs of electricity. The region needs to reduce, not increase, reliance on natural gas power plants. Also, the addition of the proposed plant is not an effective strategy for reducing greenhouse gas emissions in Connecticut even considering only direct stack emissions. Greenhouse gas emissions associated with this facility will be even higher than its direct emissions, due to upstream effects associated with natural gas extraction and transport. Alternative, cleaner, less expensive zero-emission resources are available to meet the region's electricity needs.

Our testimony demonstrates that fossil-fueled (coal, oil, gas) New England electric energy production will continue to be displaced by environmentally cleaner portfolios of resources composed of renewable solar and wind technologies, import energy, and supported by battery storage technologies. Also, critically, the underlying demand for electricity is declining due in large part to best-in-the-nation energy efficiency policies across the six states, which ease both capacity and energy security concerns. Flexible system operations will continue to be supported by a resource base that has more than sufficient existing resources (hydro, pumped storage, dispatchable imports, demand response, wind, existing gas plants)

and a burgeoning market for battery electric storage resources, a crucial fast-response, dispatchable resource.

We also conclude that the applicant has provided no quantitative support for its main assertions, that the plant will meet a public need, will provide a public benefit, will ease winter energy security concerns, and will help Connecticut and New England meet its greenhouse gas emission reduction targets. Notably, the applicant apparently ignores the "changed conditions" that are most critical to the Siting Council's deliberations: continuing projections of significantly lower net load than when NTE first analyzed regional supply/demand balance; lower cost, higher availability of increasing amounts of renewable and import energy for the New England region; and Connecticut policies that are calling for zero-carbon generation, not additional gas-fired plants.

Q. What documents do you rely upon in your analysis, and for your findings and observations?

A. We rely primarily upon various ISO New England (ISO NE) and New England state agency documents, especially: ISO NE's draft 2019 load, solar photovoltaic (PV) and energy efficiency (EE) forecasts that will underpin the forthcoming 2019 Capacity, Energy, Loads, Transmission (CELT) Report[1]; results of the 2019 FCA13[2]; the 2017 Draft ISO NE Air Emission Report[3];

[1] ISO NE, Final Draft 2019 CELT ISO-NE and States Annual Energy and Seasonal Peak Forecasts, March 29, 2019. Available at https://www.iso-ne.com/static-assets/documents/2019/03/lfc_29mar2019_final.pdf. We also rely on related CELT historical data. We note that the final 2019 CELT report is to be published on May 1, 2019. ISO NE, Draft 2019 Solar Photovoltaic (PV) Forecast, February 15, 2019. Available at https://www.iso-ne.com/static-assets/documents/2019/02/draft_2019_forecast_final.021519.pdf. ISO NE, Draft 2019 Energy Efficiency Forecast, February 8, 2019. Available at https://www.iso-ne.com/static-assets/documents/2019/02/eef2019_draftforecast_final.pdf.

[2] ISO NE, Forward Capacity Auction Obligations, FCA 13. Available at https://www.iso-ne.com/isoexpress/web/reports/auctions/-/tree/fca-results.

Massachusetts Department of Energy Resources (MA DOER), Connecticut Department of Energy and Environmental Protection (CT DEEP), and Rhode Island Office of Energy Resources documents describing the renewable procurement processes and storage targets in progress (for offshore wind, onshore wind, solar PV, Canadian hydro, and battery energy storage); Connecticut State documents concerning the State's climate goals and plan, and its recommendations on achieving greenhouse gas mitigation; and the applicant's filing and responses to information requests. We also incorporate by reference Mr. Fagan's prior testimony, except where superseded by more current information as discussed in this testimony.

Q. How is your testimony structured?

A. After this introductory section we list our summary findings. We then provide a brief summary of what has changed since Mr. Fagan's previous testimony in Docket 470 in November 2016, the essence of which still holds, even more forcefully now than in 2016. We provide a current load and resource summary for New England, and a description of an alternative resource portfolio that provides the same level of energy and capacity as the proposed plant, but with lower emissions, demonstrating that the current policies in the region are providing the energy and capacity that would come from KEC. Our testimony includes critiques of the applicant's case, with a focus on the applicant's lack of any credible, up-to-date quantitative support for its assertions. This includes an explanation of why the New England winter fuel security concerns described by the applicant i) do not require this plant for resolution, and ii) will not be resolved by this plant, which would add more gas-fired, oil-backup

[3] Draft 2017 ISO New England Electric Generator Air Emissions Report. January 2019. Available at https://www.iso-ne.com/static-assets/documents/2019/01/DRAFT_2017_emissions_report_20190122.docx.

capacity to a New England power sector which already has plentiful gas-fired, oil-backup capacity supply resources.

Lastly, we show that the proposed plant is not an effective greenhouse gas mitigation strategy. We conclude with a set of recommendations to the Siting Council.

2 Summary Findings

Q. Please summarize your findings.

A. Our findings are summarized below.

1. There is no public need[4] for this proposed power plant because it is unnecessary to ensure reliability. A significant surplus of electric capacity exists, and is projected to exist, in New England without this power plant even considering potential retirement of so-called "at-risk" power plants.[5] While this plant now holds a capacity supply obligation (CSO), an unbuilt plant holding a CSO in no way indicates reliability need for such a proposed plant.[6]
2. There is no incremental winter fuel security benefit to New England if this plant is built. Winter fuel security does not require new fossil generation capacity; it requires assurance of energy availability during winter cold snaps, which can be obtained absent this plant.
3. ISO NE's system can incorporate increasing levels of variable output renewable energy while depending on existing hydro, pumped storage, import, natural gas, demand response, and limited renewable energy resources to provide the system-wide flexibility needed for

[4] A public need exists only when a facility is "necessary for the reliability of the electric power supply of the state." Conn. Gen. Stat. § 16-50p(h), *see also* Conn. Gen. Stat. §16-50p(c)(3).
[5] See Section 4. The reliability-required planning reserve margin in New England is roughly 18%. New England's current margin is 28%, and its projected margin without this plant is 27% to 28% between 2022 and 2028.
[6] As evidenced by the Burrillville unit 1 in Rhode Island, which originally obtained a CSO in FCA10, and had that CSO terminated by ISO NE in FCA13. *See also* Fagan testimony in this original Docket 470.

reliability. The system can also readily depend on planned material increases in battery storage resources to offer additional fast-response capacity. In no way does the New England region need another new gas-fired combined cycle facility to ensure sufficient flexibility across its system to respond to well-understood patterns of varying load and supply.

4. KEC has presented no credible quantitative evidence for any of its claims that this plant is needed, or will provide material emissions benefits, during its operating lifetime. KEC presents a single graph (Exhibit 3 to Mr. Hibbard's testimony) showing a subset of the fossil generation in New England, which notably excludes 1,900 MW of new combined cycle generation that will be in operation before KEC would come online,[7] and excludes all remaining existing and planned non-fossil resources, all of which affects marginal emissions in New England.

5. The firm gas contract secured by NTE with a secondary supplier, Emera, and not with the Algonquin pipeline, does not necessarily increase the amount of gas that would otherwise be available to the region; nor does it lower the winter gas price; nor does it guarantee that KEC would always operate on gas during the most extreme winter peak periods. KEC as a dual-fuel facility facing gas and oil dispatch economic realities is similarly situated to other generators in New England. It may not be allowed to operate on oil if gas is available (per its air emissions permit). For those periods of time when oil-fired generation in New England is

[7] CPV Towantic (750.5 MW CSO; online in 2018), Salem Footprint (674 MW CSO; online in 2018), Bridgeport Harbor 5 (484.3 MW CSO; online in 2019).

less expensive to operate than gas-fired generation, this plant could elect to not operate, while other oil-fired resources do.[8]

6. Compared to the conditions in existence in 2016 (with the original application), New England has a lower projected electric peak and annual energy demand, and firmer commitments or increased estimates for incremental energy efficiency, offshore wind, solar PV, battery electric storage and Canadian electric import resources. Comparisons between the 2018 CELT forecast, on which KEC's CSO was based, and the draft 2019 CELT forecast show a 401 MW lower summer peak load forecast for 2022. In other words, in a single year's time, a revised ISO NE forecast has reduced peak load by more than 60% of the output of this proposed plant. Moreover, FCA13 already procured a capacity surplus of 1,089 MW above net installed capacity requirements.

7. Sufficient projected capacity exists or will exist to allow older coal and oil steam units to retire in New England, if desired economically, without the need for the KEC plant to provide capacity. 892 MW of older oil or coal steam units failed to receive CSOs in FCA13 for 2022/23,[9] yet there was still a surplus capacity procurement of 1,089 MW. In addition, once all of the older fossil units eventually do retire, natural gas fired units like KEC will not displace any oil or coal, thereby minimizing any incremental greenhouse gas emission

[8] *See, e.g.*, ISO New England Operational and Market Update, December 2017 - January 2018 Cold Weather Conditions, Compiled by ISO New England, External Affairs, January 12, 2018. Pages 3-4 describe the circumstance when it is less expensive to operate normally-higher-cost oil plants. Available at https://www.iso-ne.com/static-assets/documents/2018/01/december_2017_january_2018_cold_weather_operating_conditions_summary_january_12_2018_final.pdf.

[9] Yarmouth 1, 2, 3 and 4; Schiller 4; part of Schiller 6.

reduction when they operate and potentially resulting in incremental greenhouse gas emission increases.

8. The applicant has made no estimate of a public benefit for this plant, but instead relies on an analysis originally conducted in 2015, which was then flawed, and is now even more out of date.[10] That analysis is no longer relevant given the changes to system conditions in New England relative to what the applicant was projecting in 2015.

9. This proposed plant is not necessary "for the development of a competitive market for electricity."[11] Individual state procurement processes using RFPs and the ISO NE market structures (for energy, capacity, and ancillary services) will remain competitive absent KEC.

10. The proposed facility is not an effective greenhouse gas reduction strategy compared to adding zero-carbon renewable energy, which provides both near-term and long-term greenhouse gas reduction. Continuing improvements in currently-available wind, solar and battery technologies will also define the new resource landscape over the medium and long-term. Upstream emissions in the natural gas production sector also exacerbate greenhouse gas concerns.

3 Changes Since 2016

Q. What are the critical changed conditions since 2016?

A. The following summarizes the key changes since 2016. In total, northeastern States'

[10] See response to Council question No. 20. Applicant indicates no analysis was conducted for the current 650 MW plant. Applicant depends on a former analysis conducted for the period 2020-2024, assuming KEC entry in 2020. Applicant has conducted no analysis for an equivalent 5-year period (2022-2026). Conditions in the 2022-2026 period will include lower load and increased presence of renewable resources and import energy, relative to conditions used by the applicant in the 2016 analysis. *See also* Fagan original testimony, pages 43-45.
[11] Conn. Gen. Stat., § 16-50p(c)(3).

efforts towards more rapid development and deployment of renewable and clean energy technologies portends even earlier transformation of the resources used for electricity production than was envisioned in 2016:

1. Projected net load and projected net energy requirements forecasted for New England for 2022 and beyond are lower, reflecting both increased energy efficiency and increased small solar PV installations and projections, relative to ISO NE's prior 2016 CELT forecast. Specifically, the net peak load forecast for 2022 dropped 10.1% for the summer (2,720 MW lower) and 5.1% for the winter (1,057 MW lower) between the 2016 CELT and the 2019 draft CELT vintages. Net annual energy for 2022 dropped 3.9%, or 4,892 MWh.[12]
2. The costs of renewable energy – especially offshore wind, and solar PV – have dropped, significantly so.[13] This implies installation of these resources likely sooner, and in greater quantities.
3. The cost of battery storage continues to decline.[14]
4. States have taken numerous actions since 2016 that will result in increased amounts of both renewable energy and energy storage capacity:

[12] ISO NE, Final Draft 2019 CELT ISO-NE and States Annual Energy and Seasonal Peak Forecasts; and 2016 CELT.
[13] Offshore wind costs awarded in the Massachusetts 83C solicitation pursuant to the 2016 Massachusetts law mandating procurement were a strikingly low $65/MWh (levelized, real $2017). *See* MA DOER filing letter to the MA DPU, https://macleanenergy.files.wordpress.com/2018/08/doer-83c-filing-letter-dpu-18-76-18-77-18-78august-1-2018.pdf. Declining utility-scale solar PV costs are seen in the most recent utility-scale solar cost publication by Lawrence Berkeley National Laboratory, Utility Scale Solar: Empirical Trends in Project Technology, Cost, Performance, and PPA Pricing in the United States – 2018 Edition. September 2018. Available at https://emp.lbl.gov/sites/default/files/lbnl_utility_scale_solar_2018_edition_report.pdf.
[14] See, e.g., Lazard Levelized Cost of Storage Analysis, Version 4.0, December 2018, compared to Lazard's earlier analysis (version 2.0) from December 2016.

- Pursuant to Massachusetts' 2016 "Energy Diversity Act,"[15] the New England Clean Energy Connect (NECEC) project approved by MA DOER[16] and currently before the MA Department of Public Utilities (MA DPU)[17] is intended to provide 9,554,940 MWh of annual hydro energy to New England, with 1,090 MW of firm capacity.[18] If approved, it is estimated that NECEC will be in commercial operation by December 2022.
- Also pursuant to MA's 2016 Energy Diversity Act, the Vineyard Wind offshore wind project in Massachusetts was approved by the MA DOER (known as the solicitation under Section 83C), and is now before the MA DPU, at a levelized price of power of $65/MWh, for 800 MW of nameplate capacity to be installed by January 2023, with the first 400 MW by January 2022.[19] The capacity credit of this project will likely range from 30%-37%, or possibly higher.[20] This is the project that ultimately was

[15] An Act to Promote Energy Diversity, H.4568, https://malegislature.gov/Bills/189/H4568.pdf.
[16] NECEC is a project contracted by Massachusetts that will build a new transmission line in western Maine from the Canadian border to the Lewiston, ME region, and use the rest of the ISO NE grid to deliver an incremental 1,090 MW of capacity to New England. See MA DOER letter filing at: https://macleanenergy.files.wordpress.com/2018/07/doer-83d-filing-letter-dpu-18-64-18-65-18-66july-23-2018.pdf.
[17] MA DPU docket details available at docket 18-64, https://eeaonline.eea.state.ma.us/DPU/Fileroom/dockets/bynumber.
[18] Petition of NSTAR Electric Company d/b/a Eversource Energy for Approval of Proposed D.P.U. 18-64 Long Term Contracts for Clean Energy Projects Pursuant to Section 83D of An Act Relative to Green Communities, St. 2008, c. 169, as amended by St. 2016, c. 188, § 12, DPU 18-64, et al., Application Joint Testimony of Waltman/Brennan/ Furino D.P.U. 18-64/D.P.U. 18-65/ D.P.U. 18-66 July 23, 2018. Page 37 indicates that capacity of the NECEC at its delivery point in Maine is 1,090 MW. Available at https://eeaonline.eea.state.ma.us/EEA/FileService/FileService.Api/file/FileRoom/9636755.
[19] See filing letter at https://macleanenergy.files.wordpress.com/2018/08/doer-83c-filing-letter-dpu-18-76-18-77-18-78august-1-2018.pdf. MA DPU docket details available at docket 18-76, https://eeaonline.eea.state.ma.us/DPU/Fileroom/dockets/bynumber.
[20] ISO New England, *2015 Economic Study—Evaluation of Offshore Wind Deployment* (September 2, 2016), https://www.iso-ne.com/static-assets/documents/2016/09/2015_economic_study_offshore_wind_development_final.docx. Page 7. The 30-37% range is associated with peak hours between 2 and 6 PM. As additional solar PV is installed throughout New

able to clear only a portion (54 MW) of its 400 MW nameplate capacity in FCA13. It is expected that the remainder of this 400 MW resource, along with the second half of the project, will be available for full participation in FCA14; and the first portion will be available to participate in reconfiguration auctions for delivery in the FCA13 commitment period.

- Rhode Island announced procurement of 400 MW (nameplate) of offshore wind, Revolution Wind, installed by 2023.[21]
- Connecticut announced procurement of 200 MW of offshore wind, incremental to the Rhode Island procurement from Revolution Wind, installed by 2023.[22]
- Connecticut subsequently announced at the end of 2018 securing output under long-term contracts from both the Millstone and Seabrook nuclear power plants. This ensures no imminent loss of these zero-carbon-output resources from New England. Connecticut also built on its initial procurement from the Revolution Wind facility with an additional 100 MW procurement and secured 165 MW of new solar PV from in-state and other New England regions.[23]
- The new Massachusetts energy law (H.4857, listed in next bullet) includes the ability for the Massachusetts Department of Energy to investigate procurement of up to an additional 1,600 MW of offshore wind power by 2035, an increment above the 2016

England, the peak hour is expected to shift to later hours, and the capacity credit associated with offshore wind will be higher, since offshore wind levels increase throughout the afternoon in the summer.

[21] Rhode Island Office of the Governor, Press Release, May 23, 2018. https://www.ri.gov/press/view/33287.

[22] Connecticut Governor's office and CT DEEP press release, June 13, 2018, at https://www.ct.gov/deep/cwp/view.asp?A=4965&Q=603300. Revolution Wind, at http://dwwind.com/project/revolution-wind-ct/.

[23] See CT DEEP press release from December 28, 2018, at https://www.ct.gov/deep/cwp/view.asp?Q=607002&A=4965.

Energy Diversity Act's directive for Massachusetts to procure its first 1,600 MW of offshore wind power by 2027 (800 MW of which has now been procured).

- Massachusetts passed energy legislation (H.4857) on July 31, 2018.[24] The new energy law sets a storage target of 1,000 MWh by 2025, and the Massachusetts Department of Energy Resources has latitude to implement a number of policies including procurement methods to achieve the target. They have implemented an interim target of 200 MWh by January 1, 2020.[25]
- FERC issued Order 841 in February 2018, directing Independent System Operators (ISOs) to remove barriers to participation in wholesale markets by electric storage resources.[26] ISO NE submitted a compliance filing on December 3 2018[27] that finalized improvements in the wholesale market tariff structure to allow storage resources to participate in the New England wholesale markets.[28] Pursuant to FERC's Order, storage resources of 100 kW and above can now participate in the ISO's Forward Capacity Market and annual Forward Capacity Auctions, thereby allowing aggregators to include smaller installations for capacity counting purposes. These steps provide further support to projections that increasing amounts of storage resources will be installed in New England, providing yet additional capacity. The ISO NE Interconnection Queue has 3,275 MW of battery storage capacity

[24] Available at https://malegislature.gov/Bills/190/H4857.pdf.
[25] See MA DOER target, at https://www.mass.gov/service-details/energy-storage-target.
[26] https://www.ferc.gov/whats-new/comm-meet/2018/021518/E-1.pdf.
[27] Available at https://www.iso-ne.com/static-assets/documents/2018/12/rev_in_compliance_with_order_841.pdf.
[28] See ISO NE August 2018 presentation available here https://www.iso-ne.com/static-assets/documents/2018/08/a7_presentation_order_841_compliance.pptx.

(standalone, or with solar and wind) requesting interconnection as of April 10, 2019.[29]

- New York is currently targeting installation of 2,400 MW of offshore wind resources by 2030, and up to 9,000 MW of such resources by 2035.[30] It is also targeting 3,000 MW of energy storage by 2030, and 6,000 MW of solar PV by 2025 (up from earlier targets of 3,000 MW by 2023).[31] New York has committed to a 70 percent clean energy standard for 2030, and 100% zero carbon electricity by 2040.[32]

Q. Why are the New York changes important for this case?

A. The New York and New England electricity markets are closely linked. New England receives significant amounts of net imports from New York.[33] To the extent that New York increases its level of renewable resources, imports from New York to New England will have lower levels of source greenhouse gas emissions.

Q. How does the changed condition that KEC now has a CSO affect the reliability need for the proposed plant?

A. Obtaining a CSO does not alter the absence of a reliability need for the plant. ISO NE load forecasts, including the load forecast on which FCA13 was predicated, are consistently too high, resulting in excessive and inefficient forward-procurement of capacity obligations. As

[29] Tabulation by Synapse. See ISO NE queue at https://irtt.iso-ne.com/reports/external.
[30] See, e.g., https://www.utilitydive.com/news/new-york-gov-cuomo-moves-to-double-solar-triple-offshore-wind-capacity-tar/546179/.
[31] *See ibid.*
[32] Andrew M. Cuomo, 2019 State of the State Book: Justice Agenda, The Time Is Now, January 2019, at 314, available at https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/2019StateoftheStateBook.pdf.
[33] For example, in 2018, New England imported roughly 3,500 GWh (net) from New York, with most of the imports from northern New York. See ISO NE energy and demand reports for 2018, at https://www.iso-ne.com/static-assets/documents/2018/02/2018_energy_peak_by_source.xlsx.

noted, the current draft summer net peak load forecast (vintage 2019) shows a 401 MW lower peak demand in 2022 than the 2018 forecast, on which the CSO was awarded.

4 Reliability Need for Plant

Q. Has the overall construct for electric power reliability in Connecticut and New England changed since Mr. Fagan's testimony in November 2016?

A. No. In addition to ISO NE's winter energy security concerns, system reliability[34] still comprises two main aspects: resource adequacy and transmission security. Resource adequacy involves having sufficient resources to meet load at all times.[35] Transmission security means having a system that can withstand contingencies such as the loss of a transmission line, or successive losses of multiple transmission lines, or the loss of a major generation plant, during a time of high system load. This testimony, like Mr. Fagan's testimony in 2016, addresses resource adequacy for New England, in addition to winter energy security.

Q. What is the measure of resource adequacy?

A. A common measure of resource adequacy needs is the minimum capacity reserve margin (or planning reserve margin) required to meet reliability needs. The planning reserve margin is the amount of electric capacity above peak load levels required to ensure the lights do not go out. A reserve margin is required because planned and unexpected resource outages

[34] System reliability as used here refers to the bulk power transmission system and does not refer to distribution system outages or interruptions due to, for example, localized equipment failure or weather-related events.
[35] More specifically, reliability standards for resource adequacy in the US electric power industry generally require no more than a one in-ten years' frequency of "loss of load" events arising from a resource shortage. "Keeping the lights on" refers to this level of reliability. Based on this determination, regions can determine planning reserve margins to ensure adequate installed capacity resources, and ISO NE does that in its annual installed capacity reserve analyses.

do occur, and because load forecasts can vary from the expected peak loads.

Q. What is the required planning reserve margin for Connecticut and New England?

A. ISO NE computes and annually updates a "net installed capacity requirement" (NICR) for the New England region, which encompasses Connecticut, for a "planning year" that spans June 1 through May 31 of the following year. There is no separate NICR for Connecticut.[36] Based on the final assumptions used by ISO NE for forward capacity auction #13, the NICR for New England for the year 2022/2023 (June through May following) is 33,750 MW, and the forecast "normalized" or expected gross load (net of small solar PV) is 28,600 MW.[37] Thus the reserve margin *requirement* is roughly 18%.[38] Actual or projected reserve margins at any given time can be, and often are, in excess of this minimum planning reserve margin requirement. Notably, New England is a summer peaking region, meaning that more than adequate generation capacity is generally available in the winter[39]; resource adequacy needs are premised on tight summer conditions.

Q. What is the current and projected level of planning reserve capacity in New England at this time, accounting for planned retirements and additions, excluding and including the

[36] There are separate local capacity requirements, known as local sourcing requirements (LSR), for the southeast New England zone (eastern Massachusetts and Rhode Island). Connecticut is part of the greater "rest of pool" (ROP) ISO NE zone, and it is responsible for a peak load share of the capacity obligations of the ROP zone.
[37] ISO NE, "Summary of Historical Installed Capacity Requirements and Related Values," available from https://www.iso-ne.com/system-planning/resource-planning/installed-capacity-requirements. The capacity market auction allows for demand side resources (energy efficiency) to compete to provide capacity in support of the NICR, thus the "load" used for the NICR is a "gross" load and does not reflect the presence of new and existing energy efficiency resources.
[38] (33,750-28,600)/28,600=18.0%. As noted in the above footnote, "Gross" load in this context includes ISO NE's estimate of the effect of energy efficiency or "passive demand response." Actual "net" load is much lower than this value, reflecting the actual effects of energy efficiency programs instituted by the region's utilities over the years.
[39] Projected winter reserve margins equal or exceed 58%; *see, e.g.,* ISO NE 2018 CELT Tab 1.2 Winter Peak, Section 4.1 Installed Reserves.

proposed KEC plant?

A. Table 1 lists our projected level of planning reserve capacity for New England, based on the existing information from FCA13, the 2018 CELT report, and the draft 2019 load forecast and forecast of EE and PV for New England. In 2018, the margin was roughly 28%, far exceeding minimum needs.

Table 1. Estimated Reserve Margin, 2019-2028, New England, with and without KEC

2019 Draft CELT Data and Resource Summary from 2018 CELT and FCA13, Summer Peak MW	Projected - CELT 2018			Projected - FCA13 Results						
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Gross Load (50/50 Forecast)	28,943	29,130	29,341	29,561	29,774	29,987	30,196	30,406	30,616	30,831
Small PV (BTM) Peak Period Capacity Contribution	740	824	899	961	1,016	1,047	1,084	1,112	1,138	1,164
EE Capacity Contribution	3,200	3,550	3,925	4,450	4,525	4,700	4,950	5,100	5,229	5,350
Net Load	25,003	24,756	24,517	24,150	24,233	24,240	24,162	24,194	24,249	24,317
Projected Gen Supply and DR Resources and Imports w/o KEC	32,816	32,993	31,812	30,853	30,853	30,853	30,853	30,853	30,853	30,853
Projected Gen Supply and DR Resources and Imports w/ KEC	32,816	32,993	31,812	31,485	31,485	31,485	31,485	31,485	31,485	31,485
Baseline Reserve Margin, MW, w/o KEC	7,813	8,237	7,295	6,703	6,620	6,613	6,690	6,658	6,603	6,535
Baseline Reserve Margin, MW, with KEC	7,813	8,237	7,295	7,335	7,251	7,245	7,322	7,290	7,235	7,167
Baseline Reserve Margin % w/o KEC	31.2%	33.3%	29.8%	27.8%	27.3%	27.3%	27.7%	27.5%	27.2%	26.9%
Baseline Reserve Margin % with KEC	31.2%	33.3%	29.8%	30.4%	29.9%	29.9%	30.3%	30.1%	29.8%	29.5%

Source: Synapse Tabulation. ISO NE 2019 Draft Load Forecast, Energy Efficiency Forecast, and Solar PV Forecast. Results of FCA 13. 2018 CELT.

Q. Please provide further detail for Table 1.

A. Table 1 is the current projection of reserve margin assuming that the units that obtained a CSO in FCA 13 are in place in 2022 (but for KEC, for the "w/o KEC" entry), that the units that did not obtain a CSO are retired by 2022, and that load, energy efficiency, and small

solar PV projections will be as ISO NE currently forecasts them for the 2019 to 2028 period. In 2022, the reserve margin will be 27.8% without KEC, and 30.4% with KEC.

Q. What is the projected level of reserve margin when considering potential future additions to and retirements of capacity, not considered in your baseline table above?

A. Table 2 below lists projected reserve margins out to 2028. Table 2 illustrates that even with potential retirements of older units, there is more than sufficient capacity in the near-to-mid-term to maintain resource adequacy. The combined effect of continuing reductions in net peak load, additions of renewable resources (at summer capacity credit valuation), and the potential addition of firm import capacity from Canada results in planning margins that remain above 18 percent. The scenario listed in the table conservatively assumes relatively rapid retirement of many of the so-called "at-risk" resources, even though there is no specific evidence at this time that these units will retire in the sequence illustrated in the table. They are included as shown to demonstrate a possible "worst case" rapid retirement; and the units shown retiring in the later part of the decade are the newest of all those units. In particular, the largest and the least-aged of the listed plants could continue to have economic incentive to provide capacity and be available for winter energy production during extreme peak periods.

Table 2. Estimated Reserve Margin, 2019-2028, New England, Illustration of Sensitivity to Additions and Retirements Not Reflected in Results of FCA13

Scenario of Retirements and Additions	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Projected Supply and DR Resources and Imports w/o KEC										
Total Capacity, MW										
w/o KEC, with new additions and retirements	32,816	32,993	31,812	30,885	29,612	30,716	30,729	28,772	29,024	29,037
Net Peak Load, MW	25,003	24,756	24,517	24,150	24,233	24,240	24,162	24,194	24,249	24,317
Reserve Margin %										
w/o KEC, with new additions and retirements	31.2%	33.3%	29.8%	27.9%	22.2%	26.7%	27.2%	18.9%	19.7%	19.4%
Scenario Components - Additions and Retirements										
Additions - Capacity Credit Value (Cumulative)		2020	2021	2022	2023	2024	2025	2026	2027	2028
Offshore Wind I (MA, CT, RI, not in above)				-	390	390	390	390	630	630
Utility Solar PV				32	47	60	73	85	97	111
Canadian Hydro (NECEC)				-	-	1,090	1,090	1,090	1,090	1,090
Total Additions		0	0	32	437	1,540	1,553	1,565	1,817	1,831
Further Oil/Coal Retirements		2020	2021	2022	2023	2024	2025	2026	2027	2028
Merrimack coal					438	438	438	438	438	438
Remaining Schiller coal (part of 6)					14	14	14	14	14	14
Montville 5&6					480	480	480	480	480	480
Middletown 2+4					744	744	744	744	744	744
Newington 1								400	400	400
New Haven Harbor								448	448	448
Canal 1&2								1,121	1,121	1,121
Total		0	0	0	1,677	1,677	1,677	3,646	3,646	3,646
Net Additions and Retirements	-	-	-	32	(1,240)	(137)	(124)	(2,081)	(1,829)	(1,815)

Notes:

1. MA offshore wind assumes second block of 800 MW nameplate is installed by 2027.

2. CT and RI offshore wind assumed installed by 2023.

3. All offshore wind capacity credits based on a 30% factor. ISO NE notes a range of 30-37% in its 2016 Economic Study.

4. Incremental Utility Scale Solar PV based on 2019 draft solar PV forecast, net increases for non-FCM utility scale solar.

5. All retirements assumed as listed, for illustrative purposes only.

6. Expected new battery storage capacity ignored (conservatism).

Q. Please summarize what you've described above, and what you've shown in Tables 1 and 2 above.

A. The tables above show the fundamental peak load and supply resource balance in New England through 2028 and demonstrate that more than sufficient capacity will be available to meet reliability needs without KEC, even assuming rapid retirement of older steam units and conservatively ignoring anticipated battery storage resource installations in the region. Peak load decline, which results from the combination of best-in-the-nation energy efficiency policies and aggressive solar PV development, provides significant "headroom" to allow for older unit retirement; and ongoing state actions investing in renewable resources continue to add capacity (and energy) to the grid. KEC is seen to be completely unnecessary to ensure resource adequacy in the region.

Flexibility

Q. What data exist on the ability of the existing resource base to provide "flexible" operation to support integration of increased renewables on the ISO NE grid?

A. The 2018 CELT report contains a summary of capacity by unit-type, for all years of the planning period. Tab 1.3 of the report, "Summary Summer Capability by Fuel/Unit Type (MW)" is reproduced below in Figure 1.

Figure 1. Reproduction of Table in ISO NE 2018 CELT Report, Tab 1.3

1.3 - Summary Summer Capability by Fuel/Unit Type (MW) [1]								
	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23		2027-28
NUCLEAR STEAM	4008	4010	3349	3344	3343	3343		3343
HYDRO (DAILY CYCLE - PONDAGE)	340	332	333	333	333	333		333
HYDRO (DAILY CYCLE - RUN OF RIVER)	252	222	253	260	220	220		220
HYDRO (WEEKLY CYCLE)	876	873	872	862	871	871		871
HYDRO (PUMPED STORAGE)	1,682	1,682	1,682	1,667	1,859	1,859		1,859
GAS COMBINED CYCLE	8,806	9,563	10,108	10,202	9,000	9,000		9,000
GAS/OIL COMBINED CYCLE	4,333	4,388	4,313	4,430	4,401	4,401		4,401
GAS COMBUSTION (GAS) TURBINE	227	309	836	1,321	1,379	1,379		1,379
GAS/OIL COMBUSTION (GAS) TURBINE	556	553	548	546	519	519		519
OIL COMBUSTION (GAS) TURBINE	1,692	1,700	1,714	1,696	1,663	1,663		1,663
COAL STEAM	927	922	917	917	468	468		468
GAS/OIL STEAM	2,485	2,511	2,490	2,490	2,507	2,507		2,507
OIL STEAM	2,216	2,217	2,192	2,041	2,104	2,104		2,104
GAS INTERNAL COMBUSTION	5	5	5	5	-	-		-
GAS/OIL INTERNAL COMBUSTION	9	9	9	9	9	9		9
OIL INTERNAL COMBUSTION	116	109	110	105	103	103		103
BIO/REFUSE	948	922	963	904	961	961		961
WIND TURBINE	122	105	123	118	122	122		122
GAS FUEL CELL	20	16	21	23	23	23		23
PHOTOVOLTAIC	5	24	62	66	86	86		86
SUBTOTAL ISO-NE RELIABILITY COORDINATOR AREA CAPACITY [2, 4]	**29,627**	**30,471**	**30,901**	**31,338**	**29,971**	**29,971**		**29,971**
DEMAND RESOURCES [2]	2,691	2,956	2,828	3,211	3,600	3,600		3,600
IMPORTS [3]	1,376	1,598	1,481	1,265	1,247	81		81
TOTAL ISO-NE RELIABILITY COORDINATOR AREA CAPACITY [4]	**33,693**	**35,025**	**35,210**	**35,814**	**34,818**	**33,652**		**33,652**

Source: ISO NE, 2018 CELT, Tab 1.3 Notes omitted, but directly available in CELT report.

Q. What does this table indicate about the relative flexibility of the ISO NE system, given the resources available?

A. This table shows that in 2021, the year before KEC would come online, there will be more than 13,000 MW of gas or oil-fired combined cycle units, more than 1,800 MW of pumped storage, and more than 3,000 MW of gas turbines (gas or oil fired). There are more than 300 MW of pondage hydro. And we know that there are more than 1,200 MW of dispatchable imports. All of these resources have some degree of maneuverability, and in total they are more than sufficient to serve as resources to integrate increasing amounts of

renewable energy.

Q. Does this table include any battery storage resources?

A. No. There are over 3,000 MW of battery storage resources currently queued up with ISO NE for interconnection. Even if only 25% of those resources eventually connect, they would still present a substantial level of incremental (to the existing resource base) fast-responding resources available to ISO NE.

Q. How much "flexibility" would KEC add?

A. Based on the response to Council Interrogatory No. 18, KEC would have a minimum operating level of 47% of its capacity, so it can only provide "flexibility" services associated with roughly 53% of its rated capacity.

Q. In your opinion, is KEC necessary in order for ISO NE to incorporate increasingly higher amounts of renewable energy onto its grid?

A. No. A sufficient level of existing resources and planned new battery resources will exist in 2022 and beyond to support increasingly higher levels of renewables.

5 Clean Energy Portfolio Alternative

Q. Is there a portfolio of clean energy resources that provides similar amounts of energy and capacity to KEC, but with much lower emissions?

A. Yes. Table 3 below contains one such illustrative alternative portfolio, which is explained further below.

Table 3. Illustrative Clean Energy Portfolio – Displacing KEC

Energy

Resource	Nameplate MW	Estimated Annual Capacity Factor	MWh/year	Annual CO2 Emissions, millions Tons/Year	Average CO2 Emissions, Tons/MWh	Lifetime CO2 Emissions (Million Tons/30 yrs)
Solar PV	300	0.16	420,480	0.00	0.00	0.00
Offshore Wind	300	0.45	1,182,600	0.00	0.00	0.00
Energy Efficiency	150	0.50	657,000	0.00	0.00	0.00
Battery Storage	100	-0.10	(87,600)	0.03	0.34	0.90
Imports	250	0.70	1,533,000	0.14	0.09	4.18
Total	**1100**		**3,705,480**	**0.17**	**0.05**	**5.07**
Compare: KEC, gas combined cycle	650	0.65	3,701,100	1.52	0.41	45.52
More emissions intensive than clean portfolio by a factor of:				9.0		

Capacity

	MW, nameplate	Summer Capacity Contribution %	Firm Capacity, MW
Solar PV	300	0.3	90
Offshore Wind	300	0.3	90
Energy Efficiency	150	1	150
Battery Storage	100	1	100
Imports	250	1	250
Total	1100		680
Killingly	650	1	650

Source: Synapse.

Q. Please explain what this table contains, and what it means in the context of this case.

A. The table is illustrative of the way alternatives that currently exist and are being installed by various entities in New England can match the characteristics of KEC, while providing additional environmental and climate benefits. While there are an unlimited number of possible alternative portfolios that could provide equivalent energy and capacity to the

proposed KEC facility, for illustration, we show a reasonably-diversified portfolio that is appropriate for New England. The emitting components of this portfolio are imports (using a weighted average emissions rate) and battery storage (zero emissions during discharge, but non-zero emissions during charging from the grid). Our weighted average emission rate for imports reflects a split assuming roughly 60% are from Quebec, and 40% are from New Brunswick and New York (based on actual 2018 ISO NE import totals). For battery storage we assume an "all units" marginal emissions rate of 600 pounds/hour since battery storage charging would occur during times when either emitting or non-emitting resources are marginal.

Q. What does this table show?

A. It shows that a reasonable portfolio of alternative, clean energy and capacity resources readily available in New England will have roughly nine times lower emission rates than the proposed plant. The cost of such a portfolio is likely to be roughly similar, and possibly less expensive, than the KEC plant depending on the assumptions one makes concerning gas price volatility and gas price trajectories in New England, the specific output profiles and capacity contributions that could be expected from offshore wind, and the value one places on avoiding the costs associated with greenhouse gas emissions.

6 Winter Energy Security

Q. What do you address in this section?

A. We address winter energy security, or sufficiency of energy supply during longer-duration extreme cold periods. This is a dominant reliability issue associated with ISO NE's

system.

Q. What is the core winter energy security issue?

A. The core winter energy security issue is sufficiency of electric supply to meet projected loads during extended periods of extreme cold weather, such as during a multi-day or multi-week cold snap. The region has become overly reliant on natural gas generation to provide electric energy. During the winter, there have been times when insufficient gas has been available for generator use during extended periods of extreme cold weather because the region relies on natural gas for heating homes and businesses. ISO NE has had to rely on other sources of energy to meet load that, during other less extreme weather periods, would be met with natural gas-fired generation. Those other sources have historically included coal and oil, in addition to import energy and renewable energy.

Q. Is the issue an electric generation capacity concern, or an energy concern?

A. The winter energy security concern is not at all a capacity concern – it is an energy concern. As succinctly stated by ISO NE,

> "In today's environment, however, we do not face a capacity shortfall problem (**indeed, the system is awash in capacity**). We, instead, face an *energy security* problem due to the constraints – and uncertainties – on energy for power production." ISO NE, 4/1/19[40] [**emphasis added**]

No additional generation capacity, such as the proposed KEC facility, is required to address the core issue.

Q. What is needed to resolve the concern?

A. Assurance of fuel supply and/or reduced load – i.e., energy efficiency, stored energy

[40] ISO NE, Energy Security Improvements, ISO Discussion Paper – Version 1. April 1, 2019. Page 4. Available at https://www.iso-ne.com/static-assets/documents/2019/04/a00_iso_discussion_paper_energy_security_improvements.pdf.

(batteries or pumped storage hydro), wind, water (hydro), solar irradiation, nuclear fuel, import energy, natural gas, oil, LNG, and coal – is required to resolve the concern. Increasing the amount of energy efficiency, renewable energy, and import energy all reduce the net amount of in-region fossil-based energy otherwise required during extreme or longer-duration cold periods.

Q. What are the solutions to winter energy security suggested by ISO NE?

A. ISO NE is addressing energy market changes to better-enable the ability of the market to provide the energy needed.[41] ISO NE suggests increasing storage of LNG and oil, increasing the amount of imports, and greater use of renewable energy. ISO NE suggests energy and ancillary service market mechanisms to support these solutions.[42] ISO NE explicitly *does not* suggest that increased development of new, gas-fired combined cycle generation is the solution to the energy security concerns. ISO NE states

> "A resource mix with higher levels of LNG, imports, and renewables shows less system stress than the reference case. These scenarios, while based on resources dependent on uncontrollable factors—the global LNG market, the coincident winter demands of regions exporting power to New England, and weather— result in fewer hours of emergency actions, depletion of reserves, and load shedding. To achieve these levels of LNG, imports, and renewables, firm contracts for LNG delivery, assurances that electricity imports will be delivered in winter, and aggressive development of renewables, including expansion of the transmission system to import more clean energy from neighboring systems, would be required." [page 54, ISO NE Operational Fuel Security Analysis, "More Positive Outcomes"][43]

Q. What does the applicant claim concerning its proposed plant and energy security issues?

[41] Ibid.
[42] Ibid., page 5.
[43] Available at https://www.iso-ne.com/static-assets/documents/2018/01/20180117_operational_fuel-security_analysis.pdf.

A. The applicant claims that addressing winter fuel security is an important component of the public need for its KEC plant. We disagree. None of the solutions considered by ISO NE or by the applicant's witness, Mr. Hibbard in his analysis for the Massachusetts Attorney General,[44] involve adding new natural gas generation (even with a firm gas contract and dual fuel capability). Rather, as Mr. Hibbard himself previously found, the most environmentally beneficial and cost-effective solution sets involve a combination of energy efficiency and demand response (lowest cost) or energy efficiency and firm imports of low-carbon resources via new or existing transmission lines (lowest greenhouse gas emissions).[45] And to the extent that reduced load, increased renewable energy, and increased import energy are not sufficient to fully address energy security, incremental storage of additional fossil fuel – liquefied natural gas (LNG) or oil – is what's needed and can be obtained from existing resources without the proposed KEC plant.[46]

Q. The applicant references the proposed plant's dual-fuel capability, and that it will "provide exactly the type of fuel security needed to address Connecticut's and New England's most pressing system resilience/reliability challenge…".[47] Does the proposed plant provide any meaningful, incremental assets to the region to address winter fuel security concerns?

[44] Paul J. Hibbard & Craig P. Aubuchon, Power System Reliability in New England :Meeting Electric Resource Needs in an Era of Growing Dependence on Natural Gas, November 2015, available at https://www.mass.gov/files/documents/2016/11/pe/reros-study-final.pdf.
[45] Ibid.
[46] For example, retention of the Mystic 8 and Mystic 9 LNG-fuel power plants in Boston through 2024/25 via a cost of service agreement demonstrates a type of energy security solution. See, e.g., ISO New England Inc. Compliance Filing to Establish a Fuel Security Reliability Standard, Short-Term Cost-of-Service Mechanism, and Related Cost Allocation for Out-of-Market Compensation in Docket No. EL18-182-000, and Docket No. ER18-___-000. August 31, 2018. https://www.iso-ne.com/static-assets/documents/2018/08/fuel_security_compliance_filing.pdf.
[47] Application, Tetra Tech report, Section 9: Alternatives, page 180; Environmental Overview in Support of Petition for Changed Conditions, page 3; Paul Hibbard Testimony, page 4.

A. No. The proposed plant can burn natural gas or oil,[48] as can many other fossil-fueled units in New England. The region has an excess of power plants that can burn natural gas, and plentiful resources that can burn oil, and more than 9,900 MW that can burn both fuels.[49] Just because the proposed plant would have dual-fuel characteristics does not mean that it is needed to address New England's winter fuel security concerns.

Q. Did the applicant directly account for, or analyze the effect of, planned ISO NE market improvements, future peak winter load reductions, and future supplies of additional PV, offshore wind, and import energy, in its assessment of winter fuel security concerns that would exist starting in 2022/23, when its plant might first be available?

A. No. The applicant focused only on the fact that its proposed plant can burn gas or oil. The applicant provided no direct analysis of conditions in 2022 or any later year accounting for these developments. The applicant did not present information on the overall system capabilities to address the region's winter energy concerns.

Q. What is the winter net peak load forecast for 2019/20, and by how much does it drop in 2022/23, and 2025/26?

A. The net peak forecast for next winter is 20,476 MW. By the 2022/23 winter, the net forecast drops by 668 MW (to 19,808 MW). By 2025/26, the forecast drops by 1,040 MW from

[48] Under the facility's air permit, the facility's ability to burn oil is generally limited by its air permit to situations in which ISO NE declares an Energy Emergency as defined in ISO New England's Operating Procedure No. 21 and requests the firing of ULSD or the natural gas supply is curtailed by an entity through which gas supply and/or transportation is contracted.

[49] ISO NE's Responses to Questions Relative to Energy Security Proposal, Revised March 21, 2019. Available at https://www.iso-ne.com/static-assets/documents/2019/01/a7_iso_memo_containing_responses_to_joint_requestors_questions_on_energy_security_proposal.pdf.

next winter's projection (to 19,436 MW).[50]

Q. What is the dual-fuel capability of the fossil-fired units on the ISO NE system?

A. In the winter, current dual-fuel (oil and gas) capability is 9,644 MW, or roughly 15 times the capacity of the proposed plant. In 2022 and later years, that number will be different, as the Bridgeport Harbor 5 unit (online this year) will add to it, market responses to ISO NE's pending reforms for energy security could add to it,[51] and a potentially retiring older dual-fuel unit (i.e., Mystic 7) could reduce it. Notably, roughly 4,500 MW of the dual-fuel capable units are less than 20 years old, and do not include any of the "at risk" fossil units, all of which are more than 30 years old.[52] It is these newer units, along with existing and new renewable energy resources, existing nuclear units, single-fuel (e.g., gas or oil) units, and import energy that will be available to provide winter energy in 2022 and the years following.

Q. Why is this identification and documentation of existing dual-fueled fossil units important for this case?

A. New England has many gas and oil fired resources that are not facing retirement, and that have the capability to provide winter energy security through on-site fuel storage. Other single-fuel units could potentially add dual-fuel capability. Energy security solutions would provide a financial incentive to store enough fuel, though only to the extent that renewable

[50] ISO NE, Final Draft 2019 CELT ISO-NE and States Annual Energy and Seasonal Peak, slide 17. March 29, 2019. Available at https://www.iso-ne.com/static-assets/documents/2019/03/lfc_29mar2019_final.pdf.
[51] ISO NE is filing to FERC in 2019 a market-based plan to better address fuel security issues.
[52] See page 13 of ISO NE's Responses to Questions Relative to Energy Security Proposal, Revised March 21, 2019. We note that Mystic 8 and 9 are less than 20 years old, and now are likely to be online at least through the 2024/25 period, according to the FERC-approved fuel cost guarantee arrangement between the owners and ISO NE. Whether they remain online after that agreement expires depends on the market and tariff arrangements in place at that time. Source: ISO NE, Responses to Questions Relative to Energy Security Proposal, Revised March 25, 2019.

resources, import energy, and lower loads continue to require in-region fuel storage to address conditions during extreme winter peak periods. The ISO NE's winter reliability program performed this function in the recent past, and the planned fuel security filing by ISO NE later this year is expected to address the concerns through market mechanisms.

Q. In sum, is the proposed KEC plant needed for winter energy security?

A. No. As Mr. Fagan stated in 2016, and as continues to be true today, the New England region has sufficient dual-fuel capabilities, plentiful reserve capacity,[53] and policies in place and pending or planned[54] to ensure winter reliability without the additional generating capacity of the proposed KEC plant.

Overreliance on Gas Generation

Q. Is the region overly reliant on natural gas for electricity generation?

A. Yes. ISO NE's efforts to address winter energy security have arisen in large part because of the increasing level of electricity production from natural-gas fueled plants. During the winter, natural gas prices regularly increase when heating demand swells, and during extended cold snap periods, they can spike to levels that can be 3-5 times the normal price range, or even higher.

Q. How do natural gas prices effect electricity costs?

A. Since natural gas fueled power plants have historically been marginal for much of the time, higher gas prices translate directly into higher electricity prices. To the extent that the

[53] Winter reserve margins exceed 50%. ISO NE 2018 CELT, Tab 1.2, Section 4.1, "Installed Reserves".
[54] Recent ISO NE programs include the Winter Reliability Program, and the Pay for Performance aspect of the capacity market. In 2019, ISO NE plans a FERC filing aimed at better developing market-based mechanisms to, e.g., ensure sufficient stored fuel for winter cold snap periods. ISO NE's recent "Energy Security Improvements" discussion paper also addresses the winter issues.

region can reduce reliance on natural gas fuel for electricity production, customers will be less exposed to the price effects of commodity natural gas.

Q. Does the proposed plant provide incremental regional natural gas pipeline system capacity?

A. No. KEC is obtaining a firm delivery contract, through a secondary supplier of commodity gas (not the pipeline company itself),[55] which provides KEC with the option to receive gas on days when the pipeline system is constrained; but it doesn't add gas capacity to the broader region. KEC's contract essentially gives it the right to use natural gas before other "interruptible" users on the pipeline system, but it doesn't result in any expansion of the pipeline system itself. ISO NE calls for pipeline system expansion itself if an existing or new gas plant were to contribute to addressing its overall winter security concerns.[56]

Q. If there was additional pipeline capacity made available to the region, would this proposed plant be necessary to take advantage of it?

A. No. Any natural gas fueled plant could obtain rights to additional pipeline capacity. There is no need to build a new generator in order to obtain firmer rights to natural gas pipeline capacity.

Q. Considering the possible increases in total natural gas consumption that might arise if this plant were built, will consumers be worse off because of their exposure to gas prices?

A. Yes. Consumers will be far better served by meeting incremental electricity needs with

[55] NTE response to Council interrogatory No. 43.

[56] "Contracting with pipelines for some level of firm natural gas delivery could solve this problem if the pipeline system expanded to accommodate the increased contracted demand. However, contracting for firm pipeline capacity is costly and requires a long-term commitment. This has been a deterrent for natural gas power plant owners, who have short- to medium-term financial horizons and are a diverse group with diverse market interests." ISO NE Operational Fuel Security Analysis, January 2018. Page 17.

energy efficiency, renewable resources, and imports, rather than having further potential increases in natural gas fueled electricity production.

7 Summary Critique of Applicant's Case

Q. What are your primary critiques of the applicant's case?

A. KEC has not updated any of its analyses from 2016. KEC has not directly considered any of the newly-relevant material concerning significant increases in procurement of renewable energy, including offshore wind and potential Canadian imports. KEC has not directly considered the continuing increases in projected solar PV installations in New England. KEC has not considered the ongoing increases in energy efficiency and their effects on declining peak and energy loads in New England. KEC does not address new Connecticut policies that i) increase the RPS trajectory in the State to 40% by 2030, ii) increase the greenhouse gas reduction target for the interim period 2030, to 45% below 2001 carbon dioxide (CO_2) emissions by 2030, and iii) call for zero-carbon generation. KEC does not incorporate any of these developments into its assessment of how KEC could displace energy from oil and coal plants in New England or provide incremental winter energy security.

Q. Has KEC presented any quantitative evidence of a need for capacity from this plant?

A. No. KEC notes that it now has a capacity supply obligation, but Mr. Hibbard directly notes that a CSO is not determinative of reliability need.[57] The applicant provides no showing that the plant is needed; in contrast, we demonstrate that reserve margins remain well above threshold requirements without this proposed plant.

[57] Hibbard testimony, page 32.

Q. Has KEC incorporated the effects of 2016-2018 legislative and regulatory determinations in MA, CT and RI that have led to planned installations of 1,500 MW of offshore wind by roughly the period when their proposed plant would come online, and roughly 2,300 MW by just a few years later?

A. No. The offshore wind resource is poised to provide direct injections of zero-emissions winter energy, and significantly impact the need for in-region oil or coal-based energy. It also directly affects the marginal energy resource in New England, and any claimed emission benefit would need to directly account for the offshore resource presence. Lastly, the statutory policies in place in Massachusetts will result in another 800 MW of offshore wind by 2027 (1,600 total by 2027 for MA alone), and the potential for a further 1,600 MW of offshore wind by 2035 (3,200 MW total by 2035, MA alone).

These increments of renewable energy will provide much more energy than the proposed KEC plant would provide and will continue to drive down the marginal emission rate in New England while KEC is still in the early portion of its projected lifetime. For example, by 2027, just a couple of years after KEC operation might commence, the roughly 2,300 MW of offshore wind would produce approximately 685 GWh in a winter month,[58] notionally displacing much of the oil used to generate energy during the December 2017 (464 GWh)[59] or January 2018 (1,008 GWh) cold snap.

The applicant does not address how ongoing installations of zero-emitting renewable resources will continue to drive down emissions in the region and will contribute to helping

[58] 2300 MW x 744 hours (January), x ~40% capacity factor.
[59] ISO NE reports monthly electric generation by fuel type. E.g., data available here for 2018 https://www.iso-ne.com/static-assets/documents/2018/02/2018_energy_peak_by_source.xlsx.

ensure the eventual retirement of the dirtiest plants in the region – plants which KEC asserts will be displaced by energy from its facility.

Q. What is the trend and value of the marginal CO_2 emission rates in New England?

A. The 2017 marginal emission rate for CO_2 in New England was 654 lbs./MWh, across all units on the margin. The 2017 marginal CO_2 emission rate for "emitting" units was 971 lbs/MWh. Marginal units in New England are composed of both non-emitting resources (e.g., hydro, imports) and emitting units (e.g., gas). CO_2 emission rates have been dropping steadily in New England: across all units, it has dropped 29% since 2009, and 16% for "emitting" units since 2009.[60] This trend will continue as increased amounts of renewable energy are added to the grid.

Q. What do these values indicate with respect to the proposed KEC plant?

A. They indicate that the marginal emitter across all resources already has, in 2017, a lower emission profile than KEC (which is reported as roughly 820 lbs./MWh)[61] The historical patterns seen in marginal CO_2 emission rates do not tell us what the system-wide emission rates will be in 2022 and beyond, but we know that with more renewable resources injecting onto the grid, a declining marginal CO_2 emission trend is expected.

Q. Did the applicant conduct comprehensive production cost modeling to demonstrate the emission effect of its proposed plant?

A. No. The applicant did not conduct any such emissions modeling. An industry-standard production cost model would essentially create the supply curve of resources available in New

[60] ISO NE, Draft 2017 Air Emissions Report, Tables 5-3 and 5-4; Appendix Tables 16 and 17.
[61] KEC, response to intervenor interrogatory No. 15.

England, for any and all given hours of the year, and compare that to the load that exists in that hour, in order to determine a clearing point and an estimate of the marginal resource, for that hour. If done appropriately, the modeling exercise would use different scenarios to determine a robust outcome and incorporate all planned future resources, especially the large volumes of anticipated offshore wind energy. The applicant did none of this testing.

Q. What analysis on emissions did the Applicant conduct to support the claim that KEC will reduce greenhouse gas emissions in Connecticut?

A. The applicant provided Exhibit 3 which shows the estimated emissions rate of KEC relative to the estimated emissions rates of the rest of New England's fossil fuel generators (those present in 2015-2017). The analysis compares KEC's estimated full-load emission rate to the 2015-2017 weighted average emission rates for all other then-present New England fossil units. The applicant did not account for existing and new zero or low-emission capacity resources in New England that also do (or will by 2022) represent marginal resources, such as hydro, pumped storage, import, and some wind emitters, on the graph. The applicant also did not include on the Exhibit the presence of 1,900 MW of new combined cycle generation resources that have a similar emissions rate and will have a significant effect on the marginal emission rates in the region. Finally, the applicant did not frame the analysis in the context of load, and in particular in the context of projected lower loads in the next decade (winter and summer) to show which resources actually represent marginal emissions rates.

Q. Is the applicant's analysis useful in demonstrating the marginal resources and emissions rates in ISO New England in 2022 and beyond?

A. No. The marginal emission rate in New England will be affected by a number of critical

factors which were not acknowledged by KEC when describing the effect the proposed plant would have on New England marginal CO_2 emissions.

Q. Have you provided an updated emissions graph that illustrates how inclusion of zero-emission resources, new gas capacity, and updated load forecasts could affect future marginal emissions rates in New England?

A. Yes. Figure 2 below illustrates how the set of factors described above could be represented on a system-wide supply curve, to discern the broad patterns that will be in place next decade when this plant would begin operations. The Figure illustrates that KEC might at best result only in minimal, and perhaps de minimis, reductions in emissions during some periods, and would exhibit emissions rates that fall above the resources or set of resources that might set marginal emission rates in the coming decades.

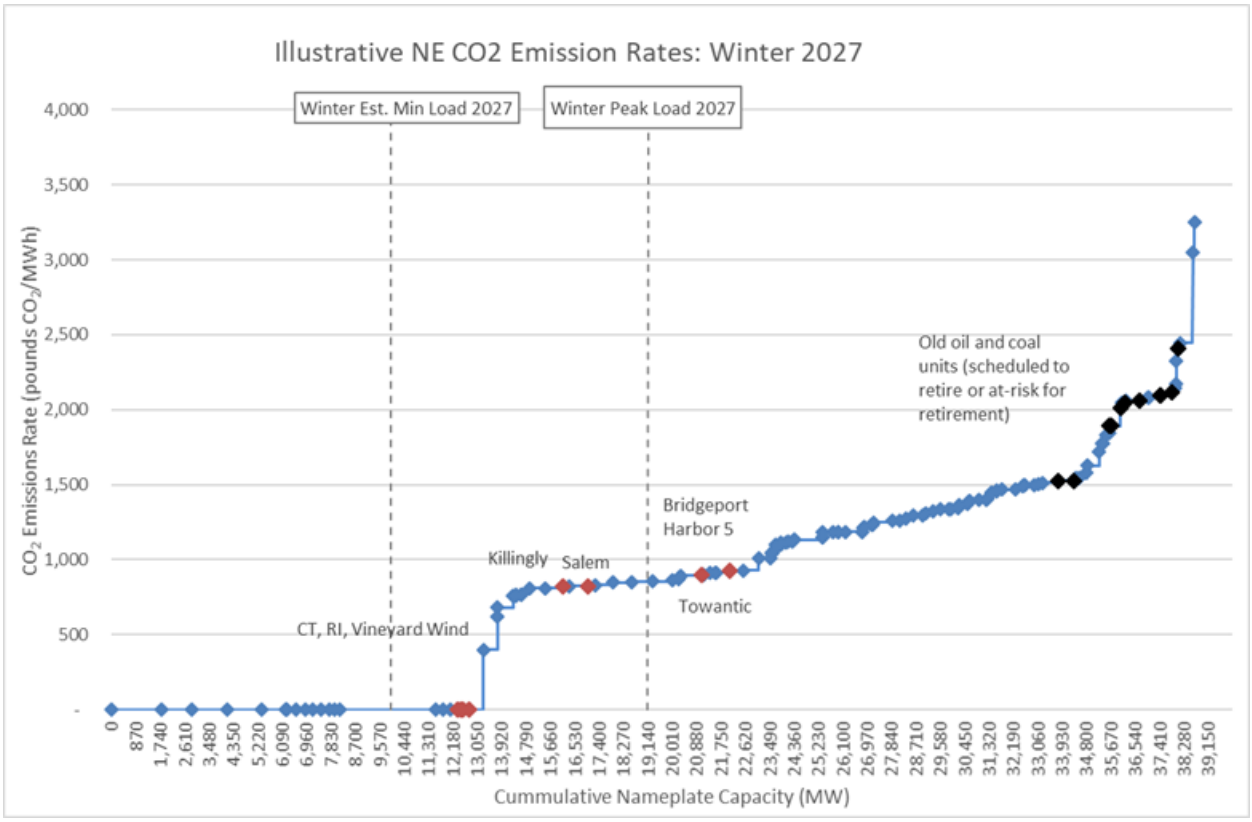
Specifically, the graph shows that KEC would fall outside the marginal resource at times, and at other times would be on a relatively "flat" section of the emissions curve, with other combined-cycle natural gas plants, occasionally serving as the marginal resource. The emissions rate of KEC is only marginally lower than the emissions rates of other gas plants, including the three new gas plants Towantic, Bridgeport Harbor 5, and Salem Footprint. In essence, the more efficient combined cycle gas plants in New England would effectively be among a group of gas plants that would dominate price-setting intervals in New England for periods when net load is above the roughly 13,000 MW mark.

Q. Why is "net" load important, in this instance?

A. Small, behind-the-meter solar PV resources reduce the net load seen on the grid, which is served by resources such as the proposed KEC plant. The greater the level of solar PV, the

lower the net load, and the lower the likelihood that resources "upstream" on the supply curve will be marginal.

Figure 2. CO_2 Emission Rates for Marginal Units, Range of Load, and Indication of KEC and Other Fossil Plants on System-Wide Supply Curve – for Illustrative Future Year (Winter 2027)



Note: Includes 2,300 MW of offshore wind (30% capacity factor). Includes Import energy from QC, NB, and New York. Excludes all solar resources, which would be present during daytime winter conditions.

8 Conclusions / Recommendations

Q. Please summarize your conclusions.

A. Based on the analysis and observations in the body of our testimony, and considering the information provided in Mr. Fagan's original, November 2016 Direct Testimony, we conclude the following major points in regards to the proposed KEC plant:

1. **No Public Benefit or Public Need – Reliability.** The proposed KEC plant is not necessary for

reliability. Resource adequacy and energy security can easily be met absent the plant.

2. **No Public Benefit – Competitive Market.** The proposed KEC plant is not necessary for the development of competitive markets, as they already exist in multiple forms – ISO NE's forward capacity market, state resource procurements, and ISO NE's energy, and ancillary services markets.

3. **Emissions claims unsupported**. The applicant's claim that KEC will support greenhouse gas emission reduction is unsupported with any credible quantitative analysis.

4. **No Capacity Need**. Overall resource adequacy need for the proposed KEC is non-existent. Capacity surplus exists through 2028 even in a scenario of an accelerated retirement of the oldest so-called "at risk" oil-fired steam units. Sufficient new additions, along with declining net load trends and the structure of the ISO NE capacity market will ensure reliability even under conditions where the remaining at-risk plants begin to retire during the decade of the 2020s.

5. **Not required for winter energy security**. There are no winter reliability concerns sufficient to suggest a need for the proposed KEC plant. Excess generation capacity reserve exists, and mechanisms are in place to ensure fuel supplies during winter periods. A report co-authored by the applicant's witness (Mr. Hibbard) indicated that the least costly "solution sets" to winter fuel security concerns are incremental energy efficiency and demand response.

6. **Decreasing net loads**. Historical and continuing investment in energy efficiency and small solar PV has lowered the net load on the New England system, and net load is projected to decline over the next decade. This allows the region sufficient time to ensure new, larger-

scale renewables and Canadian imports are online to help meet greenhouse gas emission targets and simultaneously contribute to ensuring reliability through capacity provision.

7. **Sufficient "flexible" resources without KEC**. The existing fleet of supply and demand-side capacity resources in New England, along with existing and new imports and new storage resources is more than sufficient to ensure reliable integration of increasing levels of renewable energy in New England. The applicants have presented no evidence that the KEC plant is required to provided additional operating reserve to help with integration needs.

8. **Changed Conditions**. The most important "changed conditions" since the Council's May 2017 Decision are not those recited by the applicant, from the perspective of whether or not there is a "public need" for the proposed plant. The most important changed conditions include the increasing surplus capacity, planned renewable and energy imports that address winter fuel security, and continuing lower net load. Applicants have failed to reflect these changed conditions in any meaningful way in their analyses.

Q. What do you recommend?

A. We recommend the Siting Council deny a Certificate of Environmental Compatibility and Public Need for this proposed plant.

Q. Does this conclude your testimony?

A. Yes.

Robert M. Fagan, Vice President

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SUMMARY

Mechanical engineer and energy economics analyst with over 30 years of experience in the energy industry. Activities focused primarily on electric power industry issues, especially economic and technical analysis of transmission, wholesale electricity markets, renewable resource alternatives and assessment and implementation of demand-side alternatives.

In-depth understanding of the complexities of, and the interrelationships between, the technical and economic dimensions of the electric power industry in the US and Canada, including the following areas of expertise:

- Wholesale energy and capacity provision under market-based and regulated structures; the extent of competitiveness of such structures.
- Potential for and operational effects of wind and solar power integration into utility systems; modeling of such effects.
- Transmission use pricing, encompassing congestion management, losses, LMP and alternatives; transmission rights; and transmission asset pricing (embedded cost recovery tariffs).
- Physical transmission network characteristics; related generation dispatch/system operation functions; and technical and economic attributes of generation resources.
- RTO and ISO tariff and market rules structures and operation, and related FERC regulatory policies and initiatives, including those pertaining to RTO and ISO development and evolution.
- Demand-side management, including program implementation and evaluation; and load response presence in wholesale markets.
- Building energy end-use characteristics, and energy-efficient technology options.
- Fundamentals of electric distribution systems and substation layout and operation.
- Energy modeling (spreadsheet-based tools, industry standard tools for production cost and resource expansion, building energy analysis, understanding of power flow simulation fundamentals).
- State and provincial level regulatory policies and practices, including retail service and standard offer pricing structures.
- Gas industry fundamentals including regulatory and market structures, and physical infrastructure.

PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Inc., Cambridge, MA. *Vice President*, 2018 – Present, *Principal Associate*, 2004 – 2018.

Responsibilities include consulting on issues of energy economics, analysis of electricity utility planning, operation, and regulation, including issues of transmission, generation, and demand-side management. Provide expert witness testimony on various wholesale and retail electricity industry issues. Specific project experience includes the following:

- Analysis of New England region electric capacity need issues, including assessment of the effects of energy efficiency and small scale solar resources on net load projections, and implications for carbon emissions based on regional supply alternatives.
- Analysis of California renewable energy integration issues, local and system capacity requirements and purchases, and related long-term procurement policies.
- Analysis of air emissions and reliability impacts of Indian Point Energy Center retirement.
- Analysis of PJM and MISO wind integration and related transmission planning and resource adequacy issues.
- Analysis of Nova Scotia integrated resource planning policies including effects of potential new hydroelectric supplies from Newfoundland and demand side management impact; analysis of new transmission supplies of Maritimes area energy into the New England region.
- Analysis of Eastern Interconnection Planning Collaborative processes, including modeling structure and inputs assumptions for demand, supply and transmission resources. Expanded analyses of the results of the EIPC Phase II Report on transmission and resource expansion.
- Analysis of need for transmission facilities in Maine, Ontario, Pennsylvania, Virginia, Minnesota.
- Ongoing analysis of wholesale and retail energy and capacity market issues in New Jersey, including assessment of BGS supply alternatives and demand response options.
- Analysis of PJM transmission-related issues, including cost allocation, need for new facilities and PJM's economic modeling of new transmission effects on PJM energy market.
- Ongoing analysis of utility-sponsored energy efficiency programs in Rhode Island as part of the Rhode Island DSM Collaborative; and ongoing analysis of the energy efficiency programs of New Jersey Clean Energy Program (CEP) and various utility-sponsored efficiency programs (RGGI programs).
- Analysis of California renewable integration issues for achieving 33% renewable energy penetration by 2020, especially modeling constructs and input assumptions.
- Analysis of proposals in Maine for utility companies to withdraw from the ISO-NE RTO.

- Analysis of utility planning and demand-side management issues in Delaware.
- Analysis of effect of increasing the system benefits charge (SBC) in Maine to increase procurement of energy efficiency and DSM resources; analysis of impact of DSM on transmission and distribution reinforcement need.
- Evaluation of wind energy potential and economics, related transmission issues, and resource planning in Minnesota, Iowa, Indiana, and Missouri; in particular in relation to alternatives to newly proposed coal-fired power plants in MN, IA and IN.
- Analysis of need for newly proposed transmission in Pennsylvania and Ontario.
- Evaluation of wind energy "firming" premium in BC Hydro Energy Call in British Columbia.
- Evaluation of pollutant emission reduction plans and the introduction of an open access transmission tariff in Nova Scotia.
- Evaluation of the merger of Duke and Cinergy with respect to Indiana ratepayer impacts.
- Review of the termination of a Joint Generation Dispatch Agreement between sister companies of Cinergy.
- Assessment of the potential for an interstate transfer of a DSM resource between the desert southwest and California, and the transmission system impacts associated with the resource.
- Analysis of various transmission system and market power issues associated with the proposed Exelon-PSEG merger.
- Assessment of market power and transmission issues associated with the proposed use of an auction mechanism to supply standard offer power to ComEd native load customers.
- Review and analysis of the impacts of a proposed second 345 kV tie to New Brunswick from Maine on northern Maine customers.

Tabors Caramanis & Associates, Cambridge, MA. *Senior Associate*, 1996 – 2004.

- Provided expert witness testimony on transmission issues in Ontario and Alberta.
- Supported FERC-filed testimony of Dr. Tabors in numerous dockets, addressing various electric transmission and wholesale market issues.
- Analyzed transmission pricing and access policies, and electric industry restructuring proposals in US and Canadian jurisdictions including Ontario, Alberta, PJM, New York, New England, California, ERCOT, and the Midwest. Evaluated and offered alternatives for congestion management methods and wholesale electric market design.
- Attended RTO/ISO meetings, and monitored and reported on continuing developments in the New England and PJM electricity markets. Consulted on New England FTR auction and ARR allocation schemes.

- Evaluated all facets of Ontario and Alberta wholesale market development and evolution since 1997. Offered congestion management, transmission, cross-border interchange, and energy and capacity market design options. Directly participated in the Ontario Market Design Committee process. Served on the Ontario Wholesale Market Design technical panel.
- Member of TCA GE MAPS modeling team in LMP price forecasting projects.
- Assessed different aspects of the broad competitive market development themes presented in the US FERC's SMD NOPR and the application of FERC's Order 2000 on RTO development.
- Reviewed utility merger savings benchmarks, evaluated status of utility generation market power, and provided technical support underlying the analysis of competitive wholesale electricity markets in major US regions.
- Conducted life-cycle utility cost analyses for proposed new and renovated residential housing at US military bases. Compared life-cycle utility cost options for large educational and medical campuses.
- Evaluated innovative DSM competitive procurement program utilizing performance-based contracting.

Charles River Associates, Boston, MA. *Associate*, 1992 – 1996.

Developed DSM competitive procurement RFPs and evaluation plans, and performed DSM process and impact evaluations. Conducted quantitative studies examining electric utility mergers; and examined generation capacity concentration and transmission interconnections throughout the US. Analyzed natural gas and petroleum industry economic issues; and provided regulatory testimony support to CRA staff in proceedings before the US FERC and various state utility regulatory commissions.

Rhode Islanders Saving Energy, Providence, RI. *Senior Commercial/Industrial Energy Specialist*, 1987 – 1992.

Performed site visits, analyzed end-use energy consumption and calculated energy-efficiency improvement potential in approximately 1,000 commercial, industrial, and institutional buildings throughout Rhode Island, including assessment of lighting, HVAC, hot water, building shell, refrigeration and industrial process systems. Recommended and assisted in implementation of energy efficiency measures, and coordinated customer participation in utility DSM program efforts.

Fairchild Weston Systems, Inc., Syosset, NY. *Facilities Engineer*, 1985 – 1986.

Designed space renovations; managed capital improvement projects; and supervised contractors in implementation of facility upgrades.

Narragansett Electric Company, Providence RI. *Supervisor of Operations and Maintenance*, 1981 – 1984.

Directed electricians in operation, maintenance, and repair of high-voltage transmission and distribution substation equipment.

EDUCATION

Boston University, Boston, MA
Master of Arts in Energy and Environmental Studies – Resource Economics, Ecological Economics, Econometric Modeling, 1992

Clarkson University, Potsdam, NY
Bachelor of Science in Mechanical Engineering – Thermal Sciences, 1981

ADDITIONAL EDUCATION

- **Utility Wind Integration Group**: Short Course on Integration and Interconnection of Wind Power Plants into Electric Power Systems, 2006
- **University of Texas at Austin**: Short course in Regulatory and Legal Aspects of Electric Power Systems, 1998
- **Illuminating Engineering Society**: courses in lighting design, 1989
- **Worcester Polytechnic Institute and Northeastern University**: Coursework in Solar Engineering; Building System Controls; and Cogeneration, 1984, 1988 – 1989
- **Polytechnic Institute of New York**: Graduate coursework in Mechanical and Aerospace Engineering, 1985 – 1986

REPORTS AND PAPERS

Fagan, B., M. Chang, S. Fields. 2017. *Fair and Non-Discriminatory Transmission Access on Prince Edward Island: Compliance of Maritime Electric Company Ltd. (MECL) Open Access Transmission Tariff with US Federal Energy Regulatory Commission Standards*. Prepared for Carr, Stevenson and Mackay (CSM), Counsel to the Prince Edward Island Regulatory and Appeals Commission.

Horowitz, A., A. Allison, N. Peluso, B. Fagan, M. Chang, D. Hurley, P. Peterson. 2017. *Comments on the United States Department of Energy's Proposed Grid Resiliency Pricing Rules (FERC Docket RM18-1-000)*. Prepared for Earthjustice.

Fagan, B., A. Napoleon, S. Fields, P. Luckow. 2017. *Clean Energy for New York: Replacement Energy and Capacity Resources for the Indian Point Energy Center Under New York Clean Energy Standard (CES).* Synapse Energy Economics for Riverkeeper and Natural Resources Defense Council.

Jackson, S., J. Fisher, B. Fagan, W. Ong. 2016. *Beyond the Clean Power Plan: How the Eastern Interconnection Can Significantly Reduce CO_2 Emissions and Maintain Reliability.* Prepared by Synapse Energy Economics for the Union of Concerned Scientists.

Luckow, P., B. Fagan, S. Fields, M. Whited. 2015. *Technical and Institutional Barriers to the Expansion of Wind and Solar Energy.* Synapse Energy Economics for Citizens' Climate Lobby.

Stanton, E. A., P. Knight, J. Daniel, R. Fagan, D. Hurley, J. Kallay, E. Karaca, G. Keith, E. Malone, W. Ong, P. Peterson, L. Silvestrini, K. Takahashi, R. Wilson. 2015. *Massachusetts Low Gas Demand Analysis: Final Report.* Synapse Energy Economics for the Massachusetts Department of Energy Resources.

Fagan, R., R. Wilson, D. White, T. Woolf. 2014. *Filing to the Nova Scotia Utility and Review Board on Nova Scotia Power's October 15, 2014 Integrated Resource Plan: Key Planning Observations and Action Plan Elements.* Synapse Energy Economics for the Nova Scotia Utility and Review Board.

Fagan, R., T. Vitolo, P. Luckow. 2014. *Indian Point Energy Center: Effects of the Implementation of Closed-Cycle Cooling on New York Emissions and Reliability.* Synapse Energy Economics for Riverkeeper.

Fagan, R., J. Fisher, B. Biewald. 2013. *An Expanded Analysis of the Costs and Benefits of Base Case and Carbon Reduction Scenarios in the EIPC Process.* Synapse Energy Economics for the Sustainable FERC Project.

Fagan, R., P. Luckow, D. White, R. Wilson. 2013. *The Net Benefits of Increased Wind Power in PJM.* Synapse Energy Economics for the Energy Future Coalition.

Hornby, R., R. Fagan, D. White, J. Rosenkranz, P. Knight, R. Wilson. 2012. *Potential Impacts of Replacing Retiring Coal Capacity in the Midwest Independent System Operator (MISO) Region with Natural Gas or Wind Capacity.* Synapse Energy Economics for the National Association of Regulatory Utility Commissioners.

Fagan, R., M. Chang, P. Knight, M. Schultz, T. Comings, E. Hausman, R. Wilson. 2012. *The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region*. Synapse Energy Economics for the Energy Future Coalition.

Woolf, T., M. Wittenstein, R. Fagan. 2011. *Indian Point Energy Center Nuclear Plant Retirement Analysis.* Synapse Energy Economics for the Natural Resources Defense Council (NRDC) and Riverkeeper.

Napoleon, A., W. Steinhurst, M. Chang, K. Takahashi, R. Fagan. 2010. *Assessing the Multiple Benefits of Clean Energy: A Resource for States*. US Environmental Protection Agency with research and editorial support from Stratus Consulting, Synapse Energy Economics, Summit Blue, Energy and Environmental Economics, Inc., Demand Research LLC, Abt Associates, Inc., and ICF International.

Peterson, P., E. Hausman, R. Fagan, V. Sabodash. 2009. *Synapse Report and Ohio Comments in Case No. 09-09-EL-COI, "The Value of Continued Participation in RTOs."* Synapse Energy Economics for Ohio Consumers' Counsel.

Hornby, R., J. Loiter, P. Mosenthal, T. Franks, R. Fagan and D. White. 2008. *Review of AmerenUE February 2008 Integrated Resource Plan.* Synapse Energy Economics for the Missouri Department of Natural Resources.

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Fagan, R., R. Tabors, A. Zobian, N. Rao, R. Hornby. 1999. *Tariff Structure for an Independent Transmission Company*. Tabors Caramanis & Associates Working Paper 101-1099-0241.

Fagan, R. 1996. *The Market for Power in New England: The Competitive Implications of Restructuring*. Tabors Caramanis & Associates and Charles River Associates for the Office of the Attorney General, Commonwealth of Massachusetts.

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Fagan, R., P. Spinney. 1995. *Demand-side Management Information Systems (DSMIS) Overview*. Charles River Associates for Electric Power Research Institute. Technical Report TR-104707.

Fagan, R., P. Spinney. 1994. *Northeast Utilities Energy Conscious Construction Program (Comprehensive Area): Level I and Level II Impact Evaluation Reports*. Charles River Associates, Energy Investments (Abbe Bjorklund) for Northeast Utilities.

PRESENTATIONS

Fagan, R., R. Tabors. 2003. “SMD and RTO West: Where are the Benefits for Alberta?” Keynote paper prepared for the 9th Annual Conference of the Independent Power Producers Society of Alberta, March 2003.

Fagan, R. 1999. “A Progressive Transmission Tariff Regime: The Impact of Net Billing”. Presentation at the Independent Power Producer Society of Ontario Annual Conference, November 1999.

Fagan, R. 1999. “Transmission Congestion Pricing Within and Around Ontario.” Presentation at the Canadian Transmission Restructuring Infocast Conference in Toronto, June 1999.

Fagan, R. 1998. “The Restructured Ontario Electricity Generation Market and Stranded Costs.” Presentation to the Ontario Ministry of Energy and Environment on behalf of Enron Capital and Trade Resources Canada Corp., February 1998.

Fagan, R. 1998. “Alberta Legislated Hedges Briefing Note.” Presentation to the Alberta Department of Energy on behalf of Enron Capital and Trade Resources Canada, January 1998.

Fagan, R. 1997. “Generation Market Power in New England: Overall and on the Margin.” Presentation at Infocast Conference: New Developments in Northeast and Mid-Atlantic Wholesale Power Markets in Boston, MA, June 1997.

Spinney, P., J. Peloza, R. Fagan presented. 1993. “The Role of Trade Allies in C&I DSM Programs: A New Focus for Program Evaluation.” Charles River Associates and Wisconsin Electric Power Corp presentation at the Sixth International Energy Evaluation Conference in Chicago, IL, August 1993.

TESTIMONY

Council of the City of New Orleans (Case UD-16-02): Pre-Filed Direct Testimony examining and critiquing Entergy New Orleans proposal to install gas-fired generation in New Orleans at the existing site of the retired Michoud generating station. Testimony filed on behalf of Sierra Club, Deep South Center for Environmental Justice, the Alliance for Affordable Energy, and 350 Louisiana – New Orleans. October 16, 2017.

Michigan Public Service Commission (Case U-18255): Pre-Filed Direct Testimony examining Midwest ISO resource adequacy issues and DTE Energy Tier 2 coal plant retirement issues in Michigan and the broader MISO region. Testimony filed on behalf of Michigan Environmental Council, NRDC and Sierra Club. August 29, 2017.

Rhode Island Energy Facilities Siting Board (Docket No. SB 2015-06): Pre-Filed Direct Testimony examining reliability need for the proposed Clear River Energy Center in Burrillville, RI. Testimony filed on behalf of Conservation Law Foundation, August 7, 2017.

Nova Scotia Utility and Review Board (Matter No. 07718): Joint direct testimony of Robert Fagan and Tyler Comings regarding economic analysis of the Maritime Link Project. On behalf of Nova Scotia Utility and Review Board Counsel. April 19, 2017.

Illinois Commerce Commission (Docket No. 16-0259): Direct and rebuttal testimony on Commonwealth Edison Company’s annual formula rate update and revenue requirement reconciliation on distribution and business intelligence investments. On behalf of the Office of Illinois Attorney General. June 29, 2016 and August 11, 2016.

Connecticut Siting Council (Docket No. 470): Direct and Surrebuttal Testimony regarding the need for and emissions impact of NTE's proposed 550 MW combined cycle power plant ("Killingly Energy Center"). On behalf of Sierra Club and Not Another Power Plant. November 15, 2016 and December 22, 2016.

Federal Energy Regulatory Commission (Docket No. ER17-284): Affidavit examining and critiquing the Midwest Independent System Operator's (MISO) proposal for a "Competitive Retail Solution (CRS)", a proposed change to the capacity procurement construct for a portion of MISO load. December 15, 2016.

Massachusetts Electric Facilities Siting Board (Docket 15-06): Direct and Supplemental Direct Testimony regarding the impact of Exelon’s proposed Canal 3 power plant on compliance with the Global Warming Solutions Act and estimation of emissions avoided with its operation. On behalf of Conservation Law Foundation. July 15, 2016 and September, 2016.

Rhode Island Public Utilities Commission (Docket No. 4609): Pre-Filed Direct Testimony examining reliability need for the proposed Clear River Energy Center in Burrillville, RI. Testimony filed on behalf of Conservation Law Foundation, June 14, 2016.

California Public Utilities Commission (Docket No. A.15-04-012): Testimony examining San Diego Gas & Electric's Marginal Energy Costs and LOLE Allocation among TOU Periods. Jointly, with Patrick Luckow. On behalf of the California Office of Ratepayer Advocate. June, 2016.

Federal Energy Regulatory Commission (Docket No. ER16-833-000): Affidavit addressing certain technical issues (accounting for "counterflow" effects on capacity import limits (CIL) for Local Reliability Zones) surrounding MISO's then-forthcoming Planning Resource Auction (PRA), which took place in April 2016. February 2016.

Massachusetts Electric Facilities Siting Board (Docket 15-1): Testimony regarding the impact of Exelon's proposed Medway power plant on compliance with the Global Warming Solutions Act. On behalf of Conservation Law Foundation. November 13, 2015.

California Public Utilities Commission (Docket No. A.14-06-014): Testimony examining Southern California Edison (SCE) proposals for Marginal Energy and Capacity Costs in Phase 2 of its 2015 General Rate Case (GRC). On behalf of the California Office of Ratepayer Advocate. Jointly, with Patrick Luckow. February 13, 2015.

California Public Utilities Commission (Docket No. A.14-11-014): Testimony examining Pacific Gas and Electric's Marginal Energy Costs and LOLE Allocation among TOU Periods. Jointly, with Patrick Luckow. On behalf of the California Office of Ratepayer Advocate. May 1, 2015.

California Public Utilities Commission (Docket No. A.14-11-012): Testimony reviewing Southern California Edison 2013 local capacity requirements request for offers for the western Los Angeles Basin, specifically related to storage. On behalf of Sierra Club. March 25, 2015.

California Public Utilities Commission (Docket No. A.14-01-027): Testimony examining San Diego Gas & Electric's proposal to change time-of-use periods in its application for authority to update its electric rate design. Jointly, with Patrick Luckow. On behalf of the California Office of Ratepayer Advocate. November 14, 2014.

California Public Utilities Commission (Docket No. R.12-06-013): Rebuttal testimony regarding the relationship between California investor-owned utilities hourly load profiles under a time-of-use pricing and GHG emissions in the WECC regions in the Order Instituting Rulemaking on the Commission's Own Motion to Conduct a Comprehensive Examination of Investor Owned Electric Utilities' Residential Rate Structures, the Transition to Time Varying and Dynamic Rates, and Other Statutory Obligations. On behalf of the California Office of Ratepayer Advocate. October 17, 2014.

California Public Utilities Commission (Docket No. R.13-12-010): Direct and reply testimony on Phase 1a modeling scenarios in the Order Instituting Rulemaking to Integrate and Refine Procurement Policies

and Consider Long-Term Procurement Plans. On behalf of the California Office of Ratepayer Advocate. August 13, 2014, October 22, 2014, and December 18, 2014.

New York State Department of Environmental Conservation (DEC #3-5522-00011/000004; SPDES #NY-0004472; DEC #3-5522-00011/00030; DEC #3-5522-00011/00031): Direct, rebuttal, and surrebuttal testimonies regarding air emissions, electric system reliability, and cost impacts of closed-cycle cooling as the "best technology available" (BTA), and alternative "Fish Protective Outages" (FPO), for the Indian Point nuclear power plant. On behalf of Riverkeeper. February 28, 2014, March 28, 2014, July 11, 2014, June 26, 2015, and August 10, 2015.

California Public Utilities Commission (Docket No. RM.12-03-014): Reply and rebuttal testimony on the topic of local reliability impacts of a potential long-term outage at the San Onofre Nuclear Power Station (SONGS) in Track 4 of the Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans. On behalf of the California Office of Ratepayer Advocate. September 30, 2013 and October 14, 2013.

Nova Scotia Utility and Review Board (Matter No. 05522): *Filing to the Nova Scotia Utility and Review Board on Nova Scotia Power's October 15, 2014 Integrated Resource Plan, Key Planning Observations and Action Plan Elements*. On behalf of Board Counsel to the Nova Scotia Utility and Review Board, October 20, 2014. With Rachel Wilson, David White and Tim Woolf.

Nova Scotia Utility and Review Board (Matter No. 05419): Direct examination regarding the report *Economic Analysis of Maritime Link and Alternatives: Complying with Nova Scotia's Greenhouse Gas Regulations, Renewable Energy Standard, and Other Regulations in a Least-Cost Manner for Nova Scotia Power Ratepayers* jointly authored with Rachel Wilson, Nehal Divekar, David White, Kenji Takahashi, and Tommy Vitolo. In the Matter of The Maritime Link Act and In the Matter of An Application by NSP MARITIME LINK INCORPORATED for the approval of the Maritime Link Project. On behalf of Board Counsel to the Nova Scotia Utility and Review Board. June 5, 2013.

Prince Edward Island Regulatory and Appeals Commission (Docket UE30402): Jointly filed expert report with Nehal Divekar analyzing the Proposed Ottawa Street – Bedeque 138 kV Transmission Line Project in the matter of Summerside Electric's Application for the Approval of Transmission Services connecting Summerside Electric's Ottawa Street substation to Maritime Electric Company Limited's Bedeque substation. Oh behalf of the City of Summerside. November 5, 2012.

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

California Public Utilities Commission (Docket No. RM.12-03-014): Direct and reply testimony regarding the long-term local capacity procurement requirements for the three California investor-owned utilities in Track 1 of the Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans. On behalf of the California Office of Ratepayer Advocate. June 25, 2012 and July 23, 2012.

California Public Utilities Commission (Docket No. A.11-05-023): Supplemental testimony regarding the long-term resource adequacy and resource procurement requirements for the San Diego region in the Application of San Diego Gas & Electric Company (U 902 3) for Authority to Enter into Purchase Power Tolling Agreements with Escondido Energy Center, Pio Pico Energy Center, and Quail Brush Power. On behalf of the California Office of Ratepayer Advocate. May 18, 2012.

New Jersey Board of Public Utilities (Docket No. GO11070399): Direct testimony in the matter of the petition of Pivotal Utility Holdings, Inc. D/B/A Elizabethtown Gas for authority to extend the term of energy efficiency programs with certain modifications and approval of associated cost recovery. On behalf of New Jersey Division of Rate Counsel. December 16, 2011.

New Jersey Board of Public Utilities (Docket No. EO11050309): Direct testimony regarding aspects of the Board's inquiry into capacity and transmission interconnection issues. October 14, 2011.

Federal Energy Regulatory Commission (Docket Nos. EL11-20-000 and ER11-2875-000): Affidavit regarding reliability, status of electric power generation capacity, and current electric power procurement policies in New Jersey. On behalf of New Jersey Division of Rate Counsel. March 4, 2011.

New Jersey Board of Public Utilities (Docket Nos. GR10100761 and ER10100762): Certification before the Board regarding system benefits charge (SBC) rates associated with gas generation in the matter of a generic stakeholder proceeding to consider prospective standards for gas distribution utility rate discounts and associated contract terms. On behalf of New Jersey Division of Rate Counsel. January 28, 2011.

New Jersey Board of Public Utilities (Docket No. ER10040287): Direct testimony regarding Basic Generation Service (BGS) procurement plan for service beginning June 1, 2011. On behalf of New Jersey Division of Rate Advocate. September 2010.

State of Maine Public Utilities Commission (Docket 2008-255): Direct and surrebuttal testimony regarding the non-transmission alternatives analysis conducted on behalf of Central Maine Power in the Application of Central Maine Power Company and Public Service of New Hampshire for a Certificate of Public Convenience and Necessity for the Maine Power Reliability Program Consisting of the Construction of Approximately 350 Miles of 345 and 115 kV Transmission Lines, a $1.55 billion transmission enhancement project. On behalf of the Maine Office of the Public Advocate. January 12, 2009 and February 2, 2010.

Virginia State Corporation Commission (CASE NO. PUE-2009-00043): Direct testimony regarding the need for modeling DSM resources as part of the PJM RTEP planning processes in the Application of Potomac-Appalachian Transmission Highline (PATH) Allegheny Transmission Corporation for CPCN to construct facilities: 765 kV proposed transmission line through Loudoun, Frederick, and Clarke Counties. On behalf of Sierra Club. October 23, 2009.

Pennsylvania Public Utility Commission (Docket number A-2009-2082652): Direct and surrebuttal testimony regarding the need for additional modeling for the proposed Susquehanna-Roseland 500 kv

transmission line in portions of Luckawanna, Luzerne, Monroe, Pike, and Wayne counties to include load forecasts, energy efficiency resources, and demand response resources. On behalf of the Pennsylvania Office of Consumer Advocate. June 30, 2009 and August 24, 2009.

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

New Jersey Board of Public Utilities (Docket No. ER08050310): Direct testimony filed jointly with Bruce Biewald on aspects of the Basic Generation Service (BGS) procurement plan for service beginning June 1, 2009. On behalf of the New Jersey Division of the Ratepayer Advocate. September 29, 2008.

Wisconsin Public Service Commission (Docket 6680-CE-170): Direct and surrebuttal testimony in the matter of the alternative energy options available with wind power, and the effect of the MISO RTO in helping provide capacity and energy to the Wisconsin area reliably without needed the proposed coal plant in the CPCN application by Wisconsin Power and Light for construction of a 300 MW coal plant. On behalf of Clean Wisconsin. August 11, 2008 and September 15, 2008.

Ontario Energy Board (Docket EB-2007-0707): Direct testimony regarding issues associated with the planned levels of procurement of demand response, combined heat and power, and NUG resources as part of Ontario Power Authority's long-term integrated planning process in the Examination and Critique of Demand Response and Combined Heat and Power Aspects of the Ontario Power Authority's Integrated Power System Plan and Procurement Process. On behalf of Pollution Probe. August 1, 2008.

Ontario Energy Board (Docket EB-2007-0050): Direct and supplemental testimony filed jointly with Peter Lanzalotta regarding issues of congestion (locked-in energy) modeling, need, and series compensation and generation rejection alternatives to the proposed line of in the matter of Hydro One Networks Inc.'s application to construct a new 500 kV transmission line between the Bruce Power complex and the town of Milton, Ontario. On behalf of Pollution Probe. April 18, 2008 and May 15, 2008.

Federal Energy Regulatory Commission (Dockets ER06-456, ER06-954, ER06-1271, ER07-424, EL07-57, ER06-880, et al.): Direct and rebuttal testimony addressing merchant transmission cost allocation issues on PJM Regional Transmission Expansion Plan (RTEP) Cost Allocation issues. On behalf of the New Jersey Division of the Ratepayer Advocate. January 23, 2008 and April 16, 2008.

State of Maine Public Utilities Commission (Docket No. 2006-487): Pre-file and surrebuttal testimony on the ability of DSM and distributed generation potential to reduce local supply area reinforcement needs in the matter of the Analysis of Central Maine Power Company Petition for a Certificate of Public Convenience and Necessity to Build a 115 kV Transmission Line between Saco and Old Orchard Beach. On behalf of Maine Office of the Public Advocate. February 27, 2007 and January 10, 2008.

Minnesota Public Utilities Commission (OAH No. 12-2500-17037-2 and OAH No. 12-2500-17038-2; and MPUC Dkt. Nos. CN-05-619 and TR-05-1275): Supplemental testimony and supplemental rebuttal testimony on applicants' estimates of DSM savings in the Certificate of Need proceeding for the Big Stone II coal-fired power plant proposal In the Matter of the Application by Otter Tail Power Company and Others for Certification of Transmission Facilities in Western Minnesota and In the Matter of the Application to the Minnesota Public Utilities Commission for a Route Permit for the Big Stone Transmission Project in Western Minnesota. On behalf of Fresh Energy, Izaak Walton League of America – Midwest Office, Wind on the Wires, Union of Concerned Scientists, Minnesota Center for Environmental Advocacy. December 8, 2006 and December 21, 2007.

Pennsylvania Public Utility Commission (Docket Nos. A-110172 *et al*.): Direct testimony on the effect of demand-side management on the need for a transmission line and the level of consideration of potential carbon regulation on PJM's analysis of need for the TrAIL transmission line. On behalf of the Pennsylvania Office of Consumer Advocate. October 31, 2007.

Iowa Public Utilities Board (Docket No. GCU-07-01): Direct testimony regarding wind energy assessment in Interstate Power and Light's resource plans and its relationship to a proposed coal plant in Iowa. On behalf of Iowa Office of the Consumer Advocate. October 21, 2007.

New Jersey Board of Public Utilities (Docket No. EO07040278): Direct testimony on certain aspects of PSE&G's proposal to use ratepayer funding to finance a solar photovoltaic panel initiative in support of the State's solar RPS. September 21, 2007.

Indiana Utility Regulatory Commission (Cause No. 43114): Direct testimony on the topic of a proposed Duke – Vectren IGCC coal plant and wind power potential in Indiana. On behalf of Citizens Action Coalition of Indiana. May 14, 2007.

British Columbia Utilities Commission: Pre-filed evidence regarding the "firming premium" associated with 2006 Call energy, liquidated damages provisions, and wind integration studies In the Matter of BC Hydro 2006 Integrated Electricity Plan and Long Term Acquisition Plan. On behalf of the Sierra Club (BC Chapter), Sustainable Energy Association of BC, and Peace Valley Environment Association. October 10, 2006.

Maine Joint Legislative Committee on Utilities, Energy and Transportation (LD 1931): Testimony regarding the costs and benefits of increasing the system benefits charge to increase the level of energy efficiency installations by Efficiency Maine before in support of an Act to Encourage Energy Efficiency. On behalf of the Maine Natural Resources Council and Environmental Defense. February 9, 2006.

Nova Scotia Utility and Review Board: Direct testimony and supplemental evidence regarding the approval of the installation of a flue gas desulphurization system at Nova Scotia Power Inc.'s Lingan station and a review of alternatives to comply with provincial emission regulations In The Matter of an Application by Nova Scotia Power Inc. for Approval of Air Emissions Strategy Capital Projects and The Public Utilities Act, R.S.N.S., 1989, c. 380, as amended. On behalf of Nova Scotia Utility and Review Board Staff. January 30, 2006.

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

Indiana Utility Regulatory Commission (Cause No. 42873): Direct testimony addressing the proposed Duke – Cinergy merger. On behalf of Citizens Action Coalition of Indiana. November 8, 2005.

Indiana Utility Regulatory Commission (Causes No. 38707 FAC 61S1, 41954, and 42359-S1): Responsive testimony addressing a proposed Settlement Agreement between PSI and other parties in respect of issues surrounding the Joint Generation Dispatch Agreement in place between PSI and CG&E. On behalf of Citizens Action Coalition of Indiana. August 31, 2005.

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

Illinois Commerce Commission (Docket 05-0159): Direct and rebuttal testimony addressing wholesale market aspects of Commonwealth Edison's proposed BUS (Basic Utility Service) competitive auction procurement. On behalf of Illinois Citizens Utility Board and Cook County State's Attorney's Office. June 8, 2005 and August 3, 2005.

State of Maine Public Utilities Commission (Docket No. 2005-17): Joint testimony with David Schlissel and Peter Lanzalotta regarding an Analysis of Eastern Maine Electric Cooperative, Inc.'s Petition for a Finding of Public Convenience and Necessity to Purchase 15 MW of Transmission Capacity from New Brunswick Power and for Related Approvals. On behalf of Maine Office of the Public Advocate. July 19, 2005.

Indiana Utility Regulatory Commission (Cause No. 38707 FAC 61S1): Direct testimony in a Fuel Adjustment Clause (FAC) proceeding concerning the pricing aspects and merits of continuation of the Joint Generation Dispatch Agreement in place between PSI and CG&E, and related issues of PSI lost revenues from inter-company energy pricing policies. On behalf of Citizens Action Coalition of Indiana. May 23, 2005.

Indiana Utility Regulatory Commission (Cause No. 41954): Direct testimony concerning the pricing aspects and merits of continuation of the Joint Generation Dispatch Agreement in place between PSI and CG&E. On behalf of Citizens Action Coalition of Indiana. April 21, 2005.

State of Maine Public Utilities Commission (Docket No. 2004-538): Joint testimony with David Schlissel and Peter Lanzalotta regarding an Analysis of Maine Public Service Company Request for a Certificate of Public Convenience and Necessity to Purchase 35 MW of Transmission Capacity from New Brunswick Power. On behalf of Maine Office of the Public Advocate. April 14, 2005.

Nova Scotia Utility and Review Board (Order 888 OATT): Testimony regarding various aspects of OATTs and FERC's *pro forma* In The Matter of an Application by Nova Scotia Power Inc. for Approval of an Open Access Transmission Tariff (OATT). On behalf of the Nova Scotia Utility Review Board Staff. April 5, 2005.

Texas Public Utilities Commission (Docket No. 30485): Testimony regarding excess mitigation credits associated with CenterPoint's stranded cost recovery in the Application of CenterPoint Energy Houston Electric, LLC. for a Financing Order. On behalf of the Gulf Coast Coalition of Cities. January 7, 2005.

Ontario Energy Board (RP-2002-0120): Filed testimony and reply comments reviewing the Transmission System Code (TSC) and Related Matters, Detailed Submission to the Ontario Energy Board in Response To Phase I Questions Concerning the Transmission System Code and Related Matters. On behalf of TransAlta Corporation. October 31, 2002 and November 21, 2002.

Alberta Energy and Utilities Board (Application No. 2000135): Filed joint testimony with Dr. Richard D. Tabors in the matter of the Transmission Administrator's 2001 Phase I and Phase II General Rate Application pertaining to Supply Transmission Service charge proposals. On behalf of Alberta Buyers Coalition. March 28, 2001.

Ontario Energy Board (RP-1999-0044): Testimony critiquing Ontario Hydro Networks Company's Transmission Tariff Proposal and Proposal for Alternative Rate Design. On behalf of the Independent Power Producer's Society of Ontario. January 17, 2000.

Massachusetts Department of Public Utilities (Docket # DPU 95-2/3-CC-I): Filed a report (Fagan R., G. Watkins. 1995. *Sampling Issues in Estimating DSM Savings: An Issue Paper for Commonwealth Electric*. Charles River Associates). On behalf of COM/Electric System. April 1995.

Massachusetts Department of Public Utilities (Docket # DPU 95-2/3-CC-I): Filed initial and updated reports (Fagan R., P. Spinney, G. Watkins. 1994. *Impact Evaluation of Commonwealth Electric's Customized Rebate Program*. Charles River Associates. Updated April 1996). April 1994 and April 1995.

Resume dated May 2018

Devi Glick, Senior Associate

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Senior Associate*, April 2019 – Present, *Associate*, January 2018 – March 2019

Conducts research and provides consulting on energy sector issues. Examples include:

- Modeling for resource planning using PLEXOS and Encompass utility planning software to evaluate the reasonableness of utility IRP modeling.
- Modeling for resource planning to explore alternative, lower cost and lower emission resource portfolio options.
- Assessing the reasonableness of methodologies and assumptions relied on in utility IRPs and other long-term planning documents in Kentucky, South Africa, New Mexico, Florida, South Carolina, and North Carolina.
- Contributing to the evaluation of the economics of utility plant operation and capacity planning decisions relative to market prices and alternative resource costs.
- Serving as an expert witness on avoided cost of distributed solar PV and submitting direct and surrebuttal testimony regarding the appropriate calculation of benefit categories associated with the value of solar calculations.
- Reviewing, assessing, and co-authoring public comments on the adequacy of utility coal ash disposal plans, and federal coal ash disposal rules and amendments.
- Analyzing system-level cost impacts of energy efficiency at the state and national level.
- Developing a manual and providing quality control for a tool to analyze the impacts of climate measures and energy policies in Morocco.

Rocky Mountain Institute, Basalt, CO. August 2012 – September 2017
Senior Associate

- Led technical analysis, modeling, training and capacity building work for utilities and governments in Sub-Saharan Africa around integrated resource planning for the central electricity grid energy and identified over a billion dollars in savings based on improved resource-planning processes.
- Represented RMI as a content expert and presented materials on electricity pricing and rate design at conferences and events.
- Led a project to research and evaluate utility resource planning and spending processes, focusing specifically on integrated resource planning, to highlight systematic overspending on conventional resources and underinvestment and underutilization of distributed energy resources as a least-cost alternative.

Associate

- Led modeling analysis in collaboration with NextGen Climate America which identified a CO_2 loophole in the Clean Power Plan of 250 million tons, or 41 percent of EPA projected abatement, and was submitted as an official federal comment, and led to a modification to address the loophole in the final rule.
- Led financial and economic modeling in collaboration with a major U.S. utility to quantify the impact that solar PV would have on their sales, and helped them identify alternative business models that would allow them to recapture a significant portion of this at-risk value.
- Supported the planning, content development, facilitation, and execution of numerous events and workshops with participants from across the electricity sector for RMI's Electricity Innovation Lab (eLab) initiative.
- Co-authored two studies reviewing valuation methodologies for solar PV and laying out new principles and recommendations around pricing and rate design for a distributed energy future in the United States. These studies have been highly cited by the industry and submitted as evidence in numerous Public Utility Commission rate cases.

The University of Michigan, Ann Arbor, MI. *Graduate Student Instructor*, September 2011 – July 2012

Prepared lesson plans, taught classes, graded papers and other coursework, met regularly with students.

The Virginia Sea Grant at the Virginia Institute of Marine Science, Gloucester Point, VA. *Policy Intern*, Summer 2011

Managed a communication network analysis study of coastal resource management stakeholders on the Eastern Shore of the Delmarva Peninsula.

The Commission for Environmental Cooperation (NAFTA), Montreal, QC. *Short Term Educational Program/Intern*, Summer 2010

Researched energy and climate issues relevant to the NAFTA parties to assist the executive director in conducting a GAP analysis of emission monitoring, reporting, and verification systems in North America.

Congressman Tom Allen, Portland, ME. *Technology Systems and Outreach Coordinator*, August 2007 – December 2008

Directed Congressman Allen's technology operation, responded to constituent requests, and represented the Congressman at events throughout southern Maine.

EDUCATION

The University of Michigan, Ann Arbor, MI
Master of Public Policy, Gerald R. Ford School of Public Policy, 2012
Master of Science, School of Natural Resources and the Environment, 2012

Masters Project: *Climate Change Adaptation Planning in U.S. Cities*

Middlebury College, Middlebury, VT
Bachelor of Arts, 2007
Environmental Studies, Policy Focus; Minor in Spanish
Thesis: *Environmental Security in a Changing National Security Environment: Reconciling Divergent Policy Interests, Cold War to Present*

PUBLICATIONS

Glick, D., F. Ackerman, J. Frost. 2019. *Assessment of Duke Energy's Coal Ash Basin Closure Options Analysis in North Carolina.* Synapse Energy Economics for the Southern Environmental Law Center.

Glick, D., N. Peluso, R. Fagan. 2019. *San Juan Replacement Study: An alternative clean energy resource portfolio to meet Public Service Company of New Mexico's energy, capacity, and flexibility needs after the retirement of the San Juan Generating Station*. Synapse Energy Economics for Sierra Club.

Suphachalasai, S., M. Touati, F. Ackerman, P. Knight, D. Glick, A. Horowitz, J.A. Rogers, T. Amegroud. 2018. *Morocco – Energy Policy MRV: Emission Reductions from Energy Subsidies Reform and Renewable Energy Policy.* Prepared for the World Bank Group.

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

Allison, A., R. Wilson, D. Glick, J. Frost. 2018. *Comments on South Africa 2018 Integrated Resource Plan.* Synapse Energy Economics for Centre for Environmental Rights.

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

Knight, P., E. Camp, D. Glick, M. Chang. 2018. *Analysis of the Avoided Costs of Compliance of the Massachusetts Global Warming Solutions Act*. Supplement to 2018 AESC Study. Synapse Energy Economics for Massachusetts Department of Energy Resources and Massachusetts Department of Environmental Protection.

Fagan, B., R. Wilson, S. Fields, D. Glick, D. White. 2018. *Nova Scotia Power Inc. Thermal Generation Utilization and Optimization: Economic Analysis of Retention of Fossil-Fueled Thermal Fleet To and Beyond 2030 – M08059*. Prepared for Board Counsel to the Nova Scotia Utility Review Board.

Ackerman, F., D. Glick, T. Vitolo. 2018. *Report on CCR proposed rule*. Prepared for Earthjustice.

Lashof, D. A., D. Weiskopf, D. Glick. 2014. *Potential Emission Leakage Under the Clean Power Plan and a Proposed Solution: A Comment to the US EP*A. NextGen Climate America.

Smith, O., M. Lehrman, D. Glick. 2014. *Rate Design for the Distribution Edge*. Rocky Mountain Institute.

Hansen, L., V. Lacy, D. Glick. 2013. *A Review of Solar PV Benefit & Cost Studies*. Rocky Mountain Institute.

TESTIMONY

Public Service Commission of South Carolina (Docket No. 2018-3-E): Surrebuttal testimony of Devi Glick regarding annual review of base rates of fuel costs for Duke Energy Carolinas. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. August 31, 2018.

Public Service Commission of South Carolina (Docket No. 2018-3-E): Direct testimony of Devi Glick regarding the annual review of base rates of fuel costs for Duke Energy Carolinas. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. August 17, 2018.

Public Service Commission of South Carolina (Docket No. 2018-1-E): Surrebuttal testimony of Devi Glick regarding Duke Energy Progress' net energy metering methodology for valuing distributed energy resources system within South Carolina. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. June 4, 2018.

Public Service Commission of South Carolina (Docket No. 2018-1-E): Direct testimony of Devi Glick regarding Duke Energy Progress' net energy metering methodology for valuing distributed energy resources system within South Carolina. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. May 22, 2018.

Public Service Commission of South Carolina (Docket No. 2018-2-E): Direct testimony of Devi Glick on avoided cost calculations and the costs and benefits of solar net energy metering for South Carolina Electric and Gas Company. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. April 12, 2018.

Public Service Commission of South Carolina (Docket No. 2018-2-E): Surrebuttal testimony of Devi Glick on avoided cost calculations and the costs and benefits of solar net energy metering for South Carolina Electric and Gas Company. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. April 4, 2018.

Resume updated April 2019