PROPOSED REDACTED VERSION

THE STATE OF NEW HAMPSHIRE

BEFORE THE

NEW HAMPSHIRE SITE EVALUATION COMMITTEE

DOCKET NO. 2015 – 06

PRE-FILED DIRECT TESTIMONY OF JULIA FRAYER

IN SUPPORT OF THE
APPLICATION OF NORTHERN PASS TRANSMISSION LLC
AND PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
D/B/A EVERSOURCE ENERGY
FOR A CERTIFICATE OF SITE AND FACILITY TO CONSTRUCT A NEW HIGH VOLTAGE TRANSMISSION LINE AND RELATED FACILITIES IN NEW HAMPSHIRE

October 16, 2015

Qualifications and Purpose of Testimony

Q. Please state your name, business affiliation, and business address.

A. My name is Julia Frayer, and I am one of the partners and a Managing Director of London Economics International LLC ("LEI"). My business address is 717 Atlantic Avenue, Suite 1A, Boston, MA 02111.

Q. Please summarize your relevant professional background.

A. As Managing Director of LEI, I currently direct many of the company's engagements involving simulation modeling and market analysis, and within this area, I work on a variety of transmission-related evaluations. I have also testified in front of the Federal Energy Regulatory Commission ("FERC") and various state regulatory commissions on a variety of issues, including: questions of market design, issues related to siting and economic benefits of transmission projects, market power, transmission planning and tariff design policy, renewable policy, competitive procurements, and resource adequacy.

I have been actively engaged in New England power market-related work for almost two decades, having assisted potential buyers in the due diligence of various generation asset sales during the first years of restructuring and provided market analysis to investors in advance of the start of ISO-NE operations. I have worked in New England with private investors, independent power producers ("IPPs"), utilities, state regulators, large retail consumers, and policymakers. I have performed numerous analyses involving the forecasting of future electricity prices and the impact of market design and new investment on the market.

I have worked on a number of merchant and regulated transmission projects in the last ten years in New England. In 2004, my team completed a study of market benefits of the Northeast Reliability Interconnect ("NRI"), an 85-mile long, 345 kilovolt transmission line that was built to interconnect the electrical systems of Maine (within the control area of ISO New England) and the Canadian Maritimes Provinces. Although the NRI was built as a reliability transmission project, this study demonstrated that reliability projects and economically beneficial projects are not mutually exclusive. During similar timeframe, my team also performed a market study for a proposed Maine to Boston transmission project using high voltage direct current ("HVDC") technology. In 2009, I testified on the economic benefits of the Greater Springfield Reliability Project ("GSRP") in front of the Connecticut Siting Council ("CSC")[1] and the Energy Facilities Siting Board ("EFSB")[2] in Massachusetts. In 2010, I submitted a report to the New York Public Service Commission ("NYPSC") on behalf of Transmission Developers Inc. ("TDI"), which presented projected economic benefits and environmental benefits of the proposed Champlain–Hudson Power Express ("CHPE") project. This analysis on economic benefits of the project contributed to the NYPSC's decision to grant siting permission to CHPE.[3] In 2011 through 2013, my team assessed the cost and benefits of interconnecting Northern Maine ISO-NE with ISO-NE's transmission system. In 2013, I assisted a utility in eastern Canada in the analysis of long term energy contracts associated with new transmission links and in 2014, I advised a developer on the energy and capacity markets assessment and local economic benefits of new transmission in New England. I am currently also advising National Grid and Eversource

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[1] Connecticut Siting Council. CT Valley Electric Transmission Project. 2009-2010. Docket 370. Online. <http://www.ct.gov/csc/cwp/view.asp?a=962&Q=425498&PM=1>

[2] MA Energy Facilities Siting Board. Docket No. EFSB 08-2/D.P.U. 08-105/D.P.U. 08-106. Final Decision. September 28, 2010. Online. <http://www.env.state.ma.us/dpu/docs/siting/efsb08-2/dpu08-105/08-106/92810efsbord.pdf>

[3] U.S. Department of Energy. *Appendix C: NYSPSC Order Granting Certificate of Environmental Compatibility and Public Need for the Proposed CHPE Project*. September 2013. Online. <http://chpexpresseis.org/docs/library/environmental-impact-statement/easy/CHPE%20DEIS_Vol%20II_Appendices_Appendix%20C-E.pdf>

on the feasibility and cost effectiveness of non-transmission alternatives to several proposed reliability-based transmission projects across New England.

In the last two years, I have provided market advisory services for and evaluated a number of merchant transmission developments across North America, including projects in MISO, PJM, NYISO, New England, Ontario, SPP, Texas, Southwest (Desert sub-region) and California. A typical engagement would involve establishing a forecast of potential revenues for the proposed transmission project, support in negotiations with potential consumers, and also evaluation of social benefits to consumers (i.e., electricity market benefits, as well as local economic benefits).

Other transmission-related engagements have also covered issues such as transmission planning, cost allocation and tariff design, competitive procurement and auction design, congestion management rules and policies for assignment of transmission rights. For further details on my professional experience and qualifications, please see my resume in Curriculum Vitae for Julia Frayer.

Q. What is the purpose of your testimony?

A. I was asked to assess the Northern Pass Transmission Project ("Northern Pass" or the "Project") as proposed by Northern Pass Transmission LLC ("NPT") and to provide an expert analysis of the economic and environmental impacts of the Project. More specifically, through the use of simulation-based modeling, I projected the wholesale and retail electricity market impacts, environmental impacts, and local economic impacts of the construction and operations of the Project. The details of my assessment are contained in a report, which is included as Appendix 43. (referred to herein as the "Report").

Q. What are your key findings?

A. I identified and estimated a variety of economic and environmental benefits associated with the construction and operation of the Project. There are five categories of benefits that I focused on and which I discuss in my Report: (i) wholesale electricity market benefits, (ii) retail electricity cost savings, (iii) local economic benefits, (iv) production cost savings, and (v) emissions reductions, as shown in the figure below. It is important to understand that there is a relationship between these benefit categories. For example, wholesale electricity market impacts create the retail electricity market benefits for retail consumers, which then motivate local economic benefits. Production cost savings and emissions reductions are also related to the wholesale electricity market impacts.

In summary, wholesale electricity market benefits are estimated to average $851 million to $866 million per annum for New England and $81.0 million to $82.5 million per annum for New Hampshire over the study timeframe of 2019 through 2029. These wholesale electricity market benefits are composed of both wholesale energy and capacity market price impacts, as I describe further below.

Retail electricity cost savings are smaller than the wholesale electricity market benefits because some portion of load in some states may be under long term obligations at pre-set pricing terms. For example, under the Levelized Cost of Pipeline/Henry Hub ("LCOP/ HH") gas scenario (more detailed description of this scenario can be found on page 8 of this testimony), while wholesale electricity market benefits average $81.0 million per annum for New Hampshire, retail electricity market benefits average $79.9 million per annum.

Local economic benefits during operations period—of over $1.1 billion per year on average for New England as a whole and over $160 million per year for New Hampshire—are bigger than the retail electricity savings because of the multiplier effects of such new investment and its benefit to electricity consumers. Electricity is a ubiquitous service that affects virtually all segments of the economy. In terms of jobs, during the operations period, the Project will create over 6,800 jobs per year on average for New England as a whole and over 1,100 jobs per year for New Hampshire.

In addition to the tangible market price reductions that will affect the ISO-NE wholesale electricity markets and ultimately flow through to retail customers as retail electricity cost savings, there are other electricity market-related benefits associated with the operations of the Project. The hydroelectric based energy flows that will be imported from Quebec and transmitted on NPT will lead to a reduction in carbon emissions within New England. Based on LEI's simulation modeling of the Base Case and Project Case, the 7,957 GWh of energy flowing on NPT will result in approximately 3.3 to 3.4 million metric tons of avoided CO_2 emissions per year in New England.[4] This level of reduction is equivalent to removing roughly 690,000 passenger vehicles off the road annually. More importantly, the Project will effectively help New Hampshire and other New England states to meet Environmental Protection Agency's ("EPA") recently announced final Clean Power Plan ("CPP") rules. For more detailed information on each benefit category for New England and New Hampshire, please refer to the Figure 1 below.

[4] This is a net figure that already accounts for the greenhouse gases emitted in Québec in the production of these 7,957 GWh of energy (based on the estimated average life-cycle CO_2 emissions from large hydroelectric systems).

Figure 1. Summary of the annual average benefits created by NPT

Benefit Categories	New England	New Hampshire
Wholesale Market	($millions, nominal)	($millions, nominal)
Wholesale Market Benefits (11-yr avg)	$851 - $866	$81.0 - $82.5
Energy Market (11-yr avg)	$80 - $100	$8.2 - $10.2
Capacity Market (10-yr avg)	$843 - $848	$79.6 - $80.1
Production Costs	($millions, nominal)	
Production Cost Savings (11-yr avg)	$330 - $425	
Environmental Benefits	Metric Tons	
CO_2 Reduction (11-yr avg)	3.3 - 3.4 millon	
NO_x Reduction (11-yr avg)	537 - 624	
SO_2 Reduction (11-yr avg)	261 - 460	
Gross Domestic Product	($millions, nominal)	($millions, nominal)
During Construction Peak (2017)	$489	$214
During Operation (11-yr avg)	$1,156	$162
Jobs	Jobs	Jobs
During Construction Peak (2017)	5,574	2,677
During Operation (11-yr avg)	6,820	1,148

Q. Please describe how you measured the impact of the Project on the wholesale electricity markets.

A. There were two primary components of the wholesale electricity market impacts, namely the reduction in the wholesale price of energy and the reduction in the capacity clearing price. Starting in May 2019, Northern Pass is expected to provide for the transmission of up to 1,090 MW of additional energy from Québec into the New England system. I conservatively assumed that the energy that flows over Northern Pass would amount to 7,957 GWh of energy per annum, imported into New Hampshire (and therefore, into New England).[5] By virtue of this new energy, other more expensive generation will be displaced and consequently the locational marginal prices ("LMPs") in ISO-NE's energy markets will decline. I estimated a decline of $0.6/MWh to

[5] This is equivalent to an 83% annual load factor, with 1,090 MW of energy flowing on-peak and 545 MW of energy flowing off-peak.

$0.8/MWh[6] on a system-wide, load-weighted basis over the May 2019 through December 2029 timeframe, which yields wholesale energy market benefits in the range of $80 million to $100 million per year for wholesale load in New England.[7]

By displacing more expensive generation, Northern Pass also creates production cost savings for the system as a whole. Assuming that the energy flows over the Project have a marginal production cost of zero, Northern Pass will yield production cost saving of $330 million to $425 million per year, on average, in the New England energy market.

A similar dynamic will occur in the wholesale capacity market. Northern Pass would create new import capacity into the Forward Capacity Market ("FCM"). ISO-NE's FCM rules allow external generators to sell their capacity. Capacity prices in New England are supported by a demand curve that is based on the levelized all-in cost of new CCGT technology. Based on Forward Capacity Auction ("FCA") #9, ISO-NE was one of the highest priced capacity markets across all of the US. In view of such a revenue opportunity, I expect that shippers on Northern Pass would seek to sell a qualified capacity of 1,000 MW.

Given the timeframe for qualifications of new capacity resources, I conservatively assumed that the capacity associated with the Project would first clear FCA#11. I forecast that the 1,000 MW of additional capacity from Northern Pass will yield a [redacted] reduction in capacity prices over the study timeframe[8] and a benefit to wholesale load in ISO-NE of $843

[6] There is a range of LMP impacts based on two gas price assumptions. More detailed discussion can be found on page 8.

[7] All figures are in nominal dollar terms.

[8] I studied the ten FCAs between 2020 and 2029 (FAC#11 to FCA#20)

million to $848 million per year on average.[9] The capacity market price reductions are larger in the earlier years of the Project's operations because, with time, the reduction in capacity clearing price is mitigated through demand growth (which absorbs the excess capacity and market prices re-balance to the price levels that would have otherwise occurred, but for the Project).

Q. Why you are presenting a range of market price benefits in your impact analysis?

A. The range of market price benefits is based on modeling using two different natural gas price outlooks for New England. There is significant gas price uncertainty in New England, around the timing and quantity of potential pipeline expansion and proliferation of Marcellus Shale gas supply.

Even though the energy market benefits are estimated as the difference in price levels between the Base Case and the Project Case, there is a correlation between gas price levels and energy price differences (i.e., energy market benefits). A higher gas price will result in higher wholesale energy market benefits and production cost savings, holding all else constant. Therefore, I believe it is important to provide a range of outcomes, keyed off different gas price forecasts for New England.

As I discuss in my Report, Section 5.5, I prepare the analysis under two gas scenarios. The first gas scenario assumes that New England will continue to source its gas supplies from Henry Hub. This scenario utilizes LEI's Levelized Cost of Pipeline ("LCOP") forecasting approach (and is referred to throughout this testimony as "LCOP/HH"). For this, I relied on the EIA's 2015 Annual Energy Outlook ("AEO 2015") for Henry Hub gas prices and the basis of

[9] Throughout my testimony, the wholesale market benefits are an 11-year average of energy and capacity market benefits combined. Note that there is no capacity market benefit in 2019 and the capacity market benefit in 2020 only covers the months of June through December, reflecting the FCA#11 capability period.

forwards at the Algonquin Citygate to develop this gas price outlook for New England. The full methodology is documented in my Report, starting on page 41.

The second gas scenario explores the possibility that the Marcellus Shale ("MS") region will overtake Henry Hub as New England's marginal gas supply point, which is enabled through the development of the gas pipeline infrastructure. This gas scenario utilizes a detailed gas infrastructure model, Gas Pipeline Competition Model ("GPCM"), produced by RBAC. This scenario and the associated results are referred to throughout this testimony with the "GPCM/MS" label.

It should be noted that each gas scenario has its own growth trend – it is not simply a high and low gas price scenario. This is because the dynamics of the gas supply point (Henry Hub and Marcellus Shale) will impact the delivered gas price in New England differently.

Q. What is the impact of the two gas scenarios in the resulting wholesale electricity market benefits?

A. The two gas scenarios will impact the various benefit categories differently. For wholesale (and retail) energy market benefits, the LCOP/HH gas scenario will result in slightly higher energy market benefits. However, for capacity market benefits, the GPCM/MS gas scenario results in slightly higher benefits. Although the supply in both gas scenario is exactly the same, the Net CONE is affected by the trend in energy and ancillary services credits, which is ultimately affected by the growth trends in the gas prices. Once aggregating the wholesale energy market benefits and capacity market benefits, the total wholesale electricity market benefits are very similar.

Q. Have you performed retail electricity market benefits and local economic benefits using both gas scenarios?

A. When calculating the retail electricity market benefits and the local economic benefits (which use the retail electricity market benefits), I used one set of results - namely the results from the LCOP/HH gas scenario - in order to simplify the analysis.

Q. How were retail electricity benefits measured?

A. Retail consumers must pay for the energy and capacity that they consume that is reflected in the commodity or supply portion of the bill. Not all retail consumers, however, are exposed to wholesale price dynamics. For example, in some cases, a load serving entity may have signed a long term contract with resources that insulates its consumers from changes in wholesale market prices. In other instances, the load serving entity may have its own regulated cost of service generation, which it uses to meet its retail load obligations. As such, wholesale market price changes do not necessarily flow through dollar for dollar to retail consumers' bills. Based on state-by-state analysis of long term contracts and utilities with self-supply (regulated generation), I was able to estimate the percentage of load exposed to the wholesale electricity market impacts in each state. This load exposure ratio was then used to convert the wholesale energy price impacts into retail rate impacts for each state in New England. Over the 11 year period, retail consumers across the region are exposed to 92% of wholesale energy market price changes and 94% of wholesale capacity market price changes. In summary, New England retail consumers are projected to enjoy $577.7 million per annum of retail electricity cost savings while New Hampshire retail consumers are expected to receive $79.9 million per annum in retail electricity cost savings. The full discussion is documented in Section 5.9 and Section 11 of my Report.

Q. What other economic benefits did you estimate?

A. I also measured the ramifications of the Project to the New Hampshire economy and the economies of other states in New England. Local economic benefits of an infrastructure project such as Northern Pass arise in both the construction phase and operating phase of the Project.

During the construction phase,[10] local economic benefits accrued as a result of increased employment (construction labor). The construction of the Project would create an estimated 1,369 total jobs on average per year in New Hampshire and 1,548 total jobs on average per year across other states in the New England region. In addition to—and as a result of—the increased employment, Northern Pass will spur economic growth and raise New England states' regional Gross Domestic Products ("GDPs") by approximately $263 million on average per year and about 42% of that economic growth (or $111 million per annum) is located in New Hampshire. These new construction workers, as well as associated spending on materials, will create an increase in the demand for other goods and services and therefore the direct spending by the Project will ripple through the whole economy, stimulating more activity.

During the operating phase, as a result of reduced retail costs of electricity, households will be able to save more or spend their higher disposable income on other goods or services, stimulating the economy. Similarly, firms that benefit from lower costs of electricity will be able to expand production, further benefiting the local economy. Furthermore, NPT's management would also need to hire more local labor for operations and maintenance ("O&M") of the infrastructure. Northern Pass will also contribute to a total of $205.3 million economic

[10] While the bulk of construction would occur in 2017 and 2018, we have referred to the construction period as covering 2016 to early 2019 in our calculation of impacts and benefits. As such, we have included includes pre-construction spending from 2016 in our analysis.

development fund to New Hampshire economy, which is assumed to be paid out in the first 20 years, in increments of $10.5 million/year in the first 10 years, $10.3 million in year 11, and $10 million/year from year 12 to year 20.

In total, New Hampshire would see an estimated increase in State GDP by $162 million per year during the first 11 years of operations of the Project. The State will also see an increase of over 1,100 total jobs on average per annum over this period. Other states in New England would benefit as well. The full discussion of local economic benefits is documented in Section 7 of my Report.

NPT will also pay property taxes in New Hampshire and corporate income taxes, which may be used by the state (and local governments) to increase government spending on programs that benefit the economy.[11] Finally, there will also be other local benefits associated with the Project (for example, NPT is also setting aside funds for local jobs initiatives and training (apprenticeship) programs, which I have not included in the quantitative assessment of local economic benefits).

Q. Through your modeling, do you assess any other benefits of the Project to New Hampshire in New England?

A. Yes, I also quantified the reduction in SO_2, NO_X, and CO_2 emissions across New England, as a result of the operations of the Project. CO_2, SO_2, and NO_X are emitted from fossil fuel-fired generators when fossil fuel is converted to electricity in the combustion process. The energy flows over Northern Pass will be sourced primarily from hydroelectric resources so the

[11] For conservativeness, LEI did not include property taxes and corporate income taxes as inputs to the local economic benefit modeling.

associated emissions footprint of the energy flows over the Project are limited[12] in comparison to conventional fossil fuel-fired generation. As I described earlier in this Testimony, the energy flows over Northern Pass will displace the production of older, less efficient generation, including fossil fuel-fired plants; therefore, the emissions of such pollutants will decrease in New England.

In summary, the operations of the Project and associated energy flows will lead to over 3.3 million metric tons of avoided CO_2 emissions per year in New England (under the assumed 7,957 GW of energy flows). This is equivalent to removing approximately 690,000 passenger vehicles based on the EPA's conversion metric. Nitrous oxide ("NOx") emissions will also decline by approximately 537 to 624 short tons per year over the study timeframe. Sulfur dioxide ("SO_2") emissions decrease by approximately 261 to 460 short tons per year over the same timeframe. The full discussion of environmental benefits is documented in Section 6 of my Report.

2 Wholesale Electricity Market Impacts & Retail Impacts

Q. Please describe your wholesale electricity market analysis.

A. In order to quantify the impact of the Project on wholesale energy and capacity markets, I need to be able to measure how the Project and associated energy flows and capacity sales would impact the wholesale electricity market in New England.[13] The best methodological approach for examining and estimating these impacts involves simulation modeling.

[12] I have conservatively accounted for the carbon footprint of Hydro Québec's portfolio, given the propensity of large hydroelectric resources in their fleet. Please see Section 6 of my Report for further details.

[13] New Hampshire is an integral part of the New England wholesale electricity market. It is not feasible to examine New Hampshire dynamics on a stand-alone basis. Therefore, the modeling covered the entire ISO-NE control area.

Q. How did you isolate the impact of the Project on the ISO-NE market?

A. To quantify the impact of the Project, I developed two cases: Base Case and Project Case. I started by developing a "Base Case," spanning an 11-year period of 2019 through 2029 (which represents the first eleven years of the project's operations), which combines the most likely set of market assumptions for key market drivers along with normal system operations and average load conditions, based on ISO-NE's "50/50" load forecasts, but intentionally excluded the Project.

Once the Base Case was set, I then simulated a scenario where I added the Project. This is referred to as the "Project Case." The market benefits of the Project were measured as a function of the difference in market prices between the Base Case and the Project Case. In this way, the Project Case is a realistic representation of the dynamics in the wholesale electricity markets and the projected benefits are conservative.

The Project Case is not simply the Base Case with the addition of NPT. In fact, we recalibrated the new entry and tested for retirements under the Project Case, in order to more realistically account for investment feedback effects caused by the Project's entry into the market. If we had not modeled investment response, we would have essentially overstated the market benefits of the Project. In addition, we would have presented unrealistic results, where the market is not properly functioning to price signals.

Q. Why did you study only the first 11 years of operations?

A. A ten year simulation analysis provides a long enough timeframe to establish year-over-year market trends. A simulation-based forecast beyond ten years likely needs more assumptions and therefore involves an increasing forecast error. It is also likely that market design and government policy could change in unexpected ways once we look out beyond the next fifteen years. I have considered 11 years of operations, because although the Project begins commercial operations in May 2019, there are still energy market benefits to be realized for New England. Furthermore, given my experience with such modeling exercises and based on the observations in the first ten years of the modeling in the case of Northern Pass, the market price impacts will dissipate with time as the market re-calibrates to a balanced supply-demand condition. Therefore, I only focused on the first ten years since the project starts. However, given that there is some uncertainty about whether the Project could qualify for FCA#10, I moved the capacity market participation out to start one year later. To capture 10 years of capacity benefits, I chose to study the first 11 years of the project operation.

Q. What modeling tools did you use to perform the analysis?

A. For the wholesale energy price outlook, I employed my firm's proprietary simulation model, POOLMod, to forecast wholesale energy prices in ISO-NE. POOLMod simulates the dispatch of generating resources in the market subject to least cost dispatch principles to meet projected hourly load, while taking into account technical assumptions on generation operating capacity and availability of transmission.

In addition to the wholesale energy market, we also simulated the FCM. The capacity market simulations provide a projection of the annual FCA clearing prices, and, importantly, a determination of new entry and retirements that then affects the energy market simulations in POOLMod. My firm has developed a proprietary FCA model that represents the key features of the FCM (such as the downward sloping demand curve). Furthermore, my modeling of the New England wholesale electricity market properly represents the linkages between energy and capacity market designs. Capacity market outcomes from the proprietary model of the FCM determine the new entry profile and schedule of economic retirements, which are then reflected in the energy modeling using POOLMod. There is also a feedback effect from the energy modeling, whereby the energy profits for new CCGTs is used to adjust the Net CONE calculation which is the critical input in the capacity model. The full discussion of POOLMod and FCA simulator is documented in Section 9 of my Report.

Q. How was Northern Pass represented in these simulations?

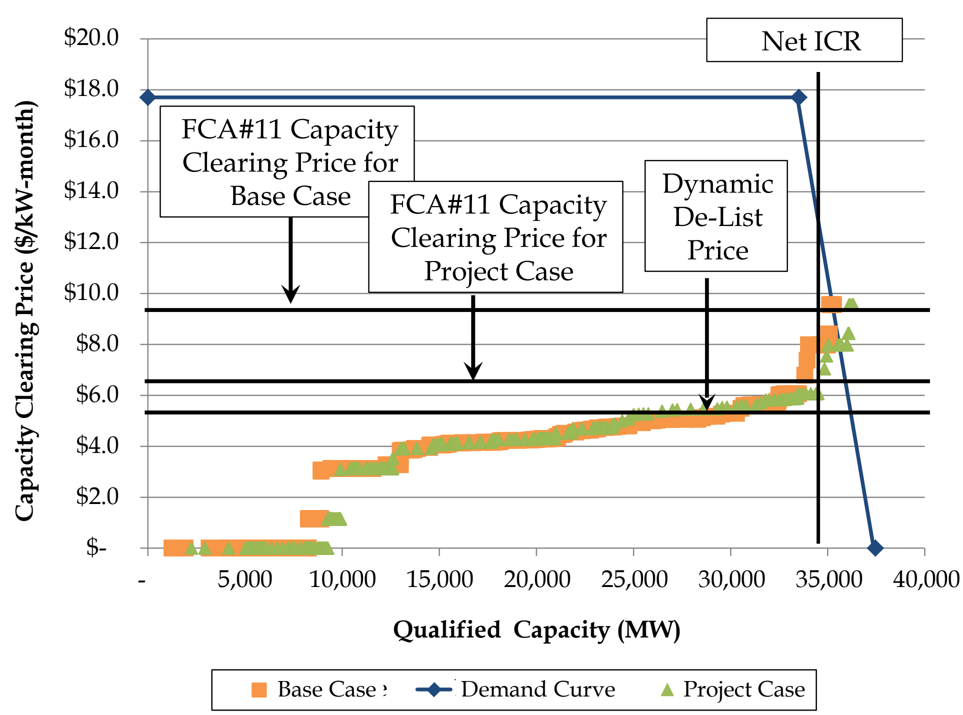
A. The Project is expected to start commercial operations and provide for the transmission of imported energy into New England market in May 2019. For the capacity market, I assumed that the Project's infrastructure would be used to deliver and sell capacity starting in June 2020, based on the expected timing of qualifications for new resources for FCA#11. I further assumed that the Project's capacity would qualify to sell 1,000 MW.

Q. Please summarize the results of your wholesale capacity electricity market analysis.

A. With Northern Pass, wholesale capacity prices drop [redacted] on average over the 2020 to 2029 timeframe (specifically, FCA #11 through FCA #20). The impact is bigger in the initial years and then declines with time, as demand grows and absorbs some of the excess supply. Although capacity prices fall, they are still above the threshold level where we believe an existing capacity resources would decide to permanently shut down (or permanently delist), especially given that the low capacity prices are a temporary phenomenon. The ISO-NE has set a dynamic de-list price of $5.5/kW-month, which is an indication of the generic threshold price at which it believes existing capacity suppliers may want to exist the market. We have also calculated an indicative minimum going forward fixed cost for each generator. The chart below illustrates the shift of indicative supply curves given additional capacity additions from the

Project. As shown in the supply curve below, some generating units have the capacity offer prices (based on an estimate of their minimum going forward fixed costs) which are above the dynamic delist. These are the units that may be susceptible to retirement if capacity market prices were to fall below these levels consistently for a few consecutive years, we would expect retirement. However, in the modeling, even with the impact of the Project's 1,000 MW of capacity, capacity market prices do not stay at low levels for more than three years, and therefore, there is no motivation for permanent retirement of existing resources.

Figure 2. Illustrative capacity market supply curve for FCA#11



Note: The capacity market supply curve for Base Case was based on LEI's estimation of the indicative minimum going forward fixed costs for existing units and all-in fixed cost for new units.

The profitability of the existing units was reviewed in the context of modeled outcomes and also performance requirements under the FCM. [redacted]

[redacted]

The wholesale capacity prices reduction equates to a 10-year average wholesale capacity market benefit of approximately $843 million to $848 million per annum (2020 through 2029) for the ISO-NE region as a whole, as summarized in the figure above. New Hampshire accounts for 9.5% of New England peak demand. On average, I expect New Hampshire wholesale load to benefit by approximately $79.6 million to $80.1 million per year over the ten year forecast horizon from these wholesale capacity market impacts. Please refer to the Figure 3 above for more detailed information on the year on year wholesale capacity market benefits for ISO-NE and New Hampshire. Note that the wholesale capacity market benefits declines overtime as the demand catch up with additional capacity brought by the Project. A more detailed discussion of wholesale capacity market results can be found in Section 5.6 of my Report.

Q. Please summarize the results of your wholesale energy electricity market analysis.

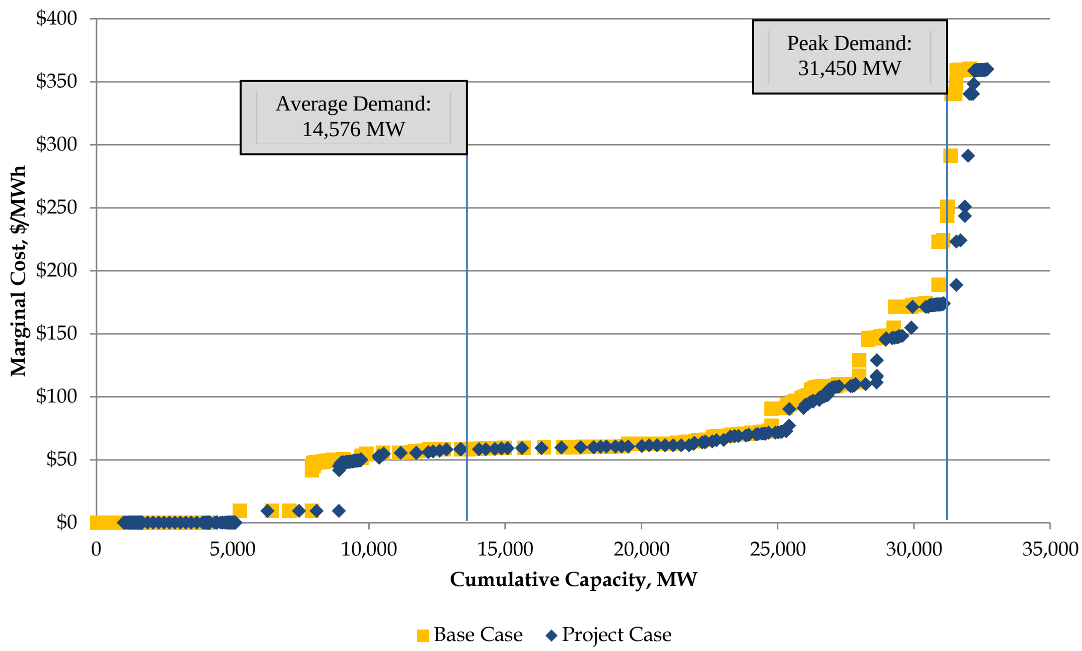
A. Beginning in May 2019, the Project is expected to inject 7,957 GWh/ year of lower cost energy into the New England system.[14] In order to ensure that the value of the energy and capacity is optimized, it is reasonable to assume that the shipper will choose to be a price taker in the ISO-NE wholesale electricity market. The energy imports accommodated by the Project will replace the existing, more expensive generation fleet in the system and consequently the market clearing price of energy (i.e., LMPs) will decline.

I project that Northern Pass is expected to decrease wholesale energy prices by an annual load-weighted average price of $0.6/MWh to $0.8/MWh over the first eleven years of operation in the ISO-NE energy market (2019 through 2029). As shown in figure below, the indicative

[14] Given Northern Pass will be in service as of May 2019, the energy flow in 2019 is proportionally reduced to 5,341 GWh to account for partial year operation.

supply curve shifts outward and intersects with the vertical demand curve at a lower price. Northern Pass will be bid into the market as a price taker and will not be marginal or price siting. Nevertheless, it will cause a shift outward of the supply curve.

Figure 4. Indicative internal supply curve for New England under Project Case, 2024



The wholesale energy market savings are estimated to be approximately $80 million to $100 million on average per year for all wholesale load in New England (see

Figure 5).[15] New Hampshire's share of these direct wholesale energy market benefits is $8.2 million to $10.2 million on average per year. Similar to wholesale capacity market benefits, the wholesale energy market benefits declines overtime as the demand catch up with additional energy brought by the Project. Please refer to the Figure 5 below for more detailed discussion on

[15] I tested the statistical significance of LMP reductions caused by the Project to determine whether the price impact was robust relative to other factors that cause price increases, such as the outage schedule of generators. I conclude that all the annual average price impacts are statistically significant.

the year-on-year wholesale energy market benefits for ISO-NE and New Hampshire. A more detailed discussion of wholesale energy market results can be found in Section 5.7 of my Report.

[redacted]

Q. Are the above results based on an assumed energy import profile?

A. Yes, for the Project Case, an 83% annual load factor was used. This is a reasonable assumption, and in fact may be conservative relative to recent dynamics on existing interties between Québec and New England. In the future, energy flows over the Project may vary from the assumed 83% capacity factor, depending on the supply and demand conditions in Québec and market outcomes in ISO-NE.

Q. You mentioned in your Report that the Base Case results and above sensitivities are premised on "normal operating conditions". Did you study the Project under other types of market conditions?

A. Yes, I examined the wholesale energy market benefits of the Project under more stressed system conditions. Recent history has shown that actual conditions can depart dramatically from "weather normal" conditions. For example in the winter of 2013-14, ISO-NE experienced severely cold weather, which led to very significant energy price increases due to the system stress events. The most severe of these cold snaps occurred in January 2014 - nine days that month were in the coldest 5% of days over the past 20 years.[16]

System stress conditions can also occur during the summer – the traditional peak season for New England. In fact, actual peak load has been near or exceeded the 90/10 forecast six times over the last 23 years because of hot and humid weather conditions, and it has been near or above the 50/50 forecast eleven times during the same period.[17]

A project such as the Northern Pass can provide valuable "insurance" to consumers by mitigating some of the market price impacts of such events, as its resource mix is not dependent on natural gas prices (or availability of gas pipeline capacity) and the summer peak for Québec is not correlated with that of New England. To gauge the insurance value of the Project, I

[16] Babula, Mark. Post Winter 2013/14 Review. ISO-NE. March 6, 2014. Speaker.

[17] Weather conditions were slightly above the expected 90/10 weather during the 2006, 2011, and 2014 peaks. <http://www.isone.com/markets/hstdata/rpts/ann_seasonal_pks/seasonal_peak_data_summary.xls>

conducted simulations that replicated actual conditions in recent years (such as high demand, plant outages and high fuel prices). We refer to these simulations as "system stress" cases.

Q. What were the system stress cases you simulated?

A. The first system stress case recreates high summer load. In mid-July 2013, New England experienced higher than normal temperatures (≥89° F) for six consecutive days beginning on Monday, July 15th and ending on Saturday, July 20th. During this period, more expensive units were required to come online to serve the higher electricity loads in the region. Many of these more expensive units were marginal (price setting), causing Day-Ahead and Real-Time wholesale electricity prices to rise.

The second system stress case recreates the conditions of an extremely cold week during the winter of 2013-14, when a confluence of fundamentals led to the extremely high natural gas prices and resulting high LMPs. The consequence of the winter 2013-14 market outcomes was extremely high costs to consumers - the total value of the wholesale energy market in New England for the months of December, January, and February was about $5.05 billion, or roughly the same value of the entire 12 months of 2012.[18]

Q. How could Northern Pass have benefited consumers under such system stress events?

A. Between July 15, 2013 and July 19, 2013, New England experienced a prolonged heat wave that resulted in prices as high as $218/MWh in the day-ahead energy market because of unusually high load and a supply shortfall (that actually caused an Operating Procedure No. 4, Action During a Capacity Deficiency, event on July 19). Although the weather was a big

[18] Babula, Mark. Post Winter 2013/14 Review. ISO-New England. March 6, 2014. Speaker.

contributor to these events and the fact that peak load breached the ISO-NE's 90/10 demand forecast from the prior year, similar peak demand occurrences have occurred in other years – indeed, ISO-NE has recorded actual demand exceeding 90/10 expectations six times in the last 23 years. [redacted]

The winter of 2013-14 was a record breaking winter in terms of natural gas prices in New England. Constrained natural gas pipelines led to exceptionally high delivered natural gas prices and therefore also very high wholesale energy prices. Some gas-fired plants were not able to get fuel and the cold weather compounded the problem of unavailability of resources with other generation outages. [redacted] In addition, pricing in some hours were driven by oil-fired units, rather than natural gas-fired generation, therefore, increasing New England's emissions footprint. [redacted] A more detailed discussion of the stress cases can be found in Section 5.10 of my Report.

Q. Are there other wholesale energy market-related benefits associated with Northern Pass?

A. Yes. In addition to evaluating wholesale energy market price impacts of the Project, I also measured the change in the total marginal costs of production for the entire ISO-NE system. Production costs decline as a result of the Project because the energy flows over Northern Pass displace other, more expensive generation resources in the wholesale energy market. As such, production costs savings measure not just the change in the marginal unit's operation, but the cost savings across the entire supply curve.

[redacted] the level of production cost savings will depend on the actual physical marginal costs of production for the hydroelectric-based imports over Northern Pass (essentially zero physical costs of marginal production given negligible variable operating and maintenance costs).

Even under alternative assumptions, where I assume $25/MWh of additional opportunity cost assigned to the imported energy that is transmitted on NPT, the production cost savings for ISO-NE's power system are still substantial, at over $137 million to $232 million per year. Please refer to the Figure 6 above for more detailed information on the year on year production cost savings. A more detailed discussion of the production cost savings can be found in Section 5.8 of my Report.

Q. Why is your Base Case simulation-based analysis conservative?

A. There are seven reasons why my analysis is conservative. [redacted] Actual results have a probability to exceed that, as recent history has shown. When load conditions are higher, market prices rise a lot more, and a project like the Project will create bigger energy market price reductions. On the other hand, when load conditions are lower, the decline in wholesale energy market prices is not likely to be as large due to the shape of the supply curve and abundance of similar generating technology (i.e., CCGTs) in New England. Therefore, even under lower load conditions, energy market price reductions will not be much smaller than what I have already estimated because the price setting resources will be the same. And, it is improbable that load levels would ever fall to the point where nuclear and renewables would be price setting frequently.

[redacted]

[redacted]

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[19] The load factor was calculated using total transfer capability ("TTC") as reported by ISO. TTC limit is a dynamic limit and is calculated in advance of each hour and is used for scheduling purposes. < http://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/ttc-tables>

[redacted]

Q. How do the projected wholesale market impacts under the Base Case affect retail consumers of electricity across New England?

A. To properly evaluate the impact of the Project on New England's retail consumers, I converted the wholesale energy price impacts into a retail rate impact figure. To estimate the effect of the wholesale market changes on retail rates, I took into account limitations on retail load's exposure to wholesale market conditions, including self-supply and long term contract for both energy and capacity terms. Please refer to the Figure 7 below for more detailed information on the year on year retail electricity cost savings by state and consumer class.

[redacted]

On a regional basis, New England retail consumers are projected to enjoy on average $577.7 million per annum of total retail electricity cost savings over the study timeframe. Although New Hampshire's retail load is somewhat insulated from wholesale market impacts with cost-of-service generation and long term contracts, New Hampshire retail consumers are nevertheless able to enjoy $79.9 million per annum in retail electricity cost savings. About half of these retail savings goes to residential consumers, based on the current composition of retail load in the state. More detailed results of retail electricity costs savings can be found in Section 5.9 and Section 11 of my Report.

Q. Who will pay the costs to construct Northern Pass?

A. NPT will finance and fund the full cost of the development and construction of Northern Pass, and will recover those costs from Hydro Renewable Energy, LLC, a wholly owned subsidiary of Hydro-Québec, over the 40-year term of a FERC accepted Transmission Service Agreement. NPT will own and operate the transmission line and related facilities. Northern Pass will be offered into the Clean Energy RFP, which is more fully described in Section 4 of my Report. If the Project is selected in the Clean Energy RFP, some Project costs (including both capital costs and O&M costs) may be passed through and paid for by consumers of the electric distribution utilities in the states sponsoring the Clean Energy RFP for some period of time. In the local economic impact analysis presented below, I have conservatively factored in the allocation of the Project costs to the three states of Connecticut, Massachusetts, and Rhode Island for the duration of the 11-year modeling period.

Q. In 2010, there was another study prepared on behalf of NPT, which covered the energy market impacts of the Project. How does your analysis compare to the prior study?

A. Yes. Charles River Associates ("CRA") prepared a study on behalf of NPT in 2010 (it was issued on December 7, 2010). The study was done four years ago, and the outlook for future market conditions have changed materially and market rules have been re-designed over this period. As mentioned before, I quantified five categories of benefits, including wholesale electricity market benefits, retail electricity cost savings, local economic benefits, production cost savings and emissions reductions. CRA's report focused on wholesale energy market portion of the wholesale electricity market benefits.[20] CRA concluded that the Project would result in $306 million (2009 dollars) and $326 million (2009 dollars) wholesale energy market benefits in 2021 and 2024 for New England. As discussed through this section of my Testimony, I estimated that NPT will result in smaller energy market benefits. However, I also estimated wholesale capacity market benefits, and therefore the total wholesale electricity market benefits are much larger at $851 million to $866 million on average per annum over the study timeframe for New England as a whole, as summarized in Figure 1 on page 6.[21]

Q. Have you reviewed the draft environmental impact statement ("DEIS") issued by the U. S. Department of Energy on July 21, 2015?

A. Yes, I have reviewed several topics that correspond to the elements of my testimony. Under the heading of Socioeconomics, the DEIS contains analysis that was performed by another consulting firm that estimates impacts on economic activity, during construction and operation, measured in terms of GDP, jobs, and also the Project's impact on wholesale energy prices. Under the heading of Air Quality, the DEIS also has estimates prepared by the other consulting firm as it relates to carbon emissions reductions.

Q. How does the DEIS compare to your conclusions?

A. The analyses are fundamentally consistent in that both my testimony and the DEIS identify substantial economic benefits from the Project. There are a myriad of assumptions and input parameters that go into an economic analysis of a project like Northern Pass. In reviewing

[20] Local economic benefits was performed by Lisa Shapiro of Gallagher, Callahan & Gartrell, P.C. as discussed further below.

[21] Note that my study and CRA's study covered different timeframes and the CRA study reports its results in 2009 real dollar terms, while my results are presented in nominal dollar terms.

the DEIS, it is possible in some cases to determine that different assumptions were made by the other consultant, based on different vintages of underlying reports such as the ISO-NE CELT (Capacity, Energy, Loads and Transmission) Report. In other cases, however, it is not entirely clear what assumptions were made. Therefore, a comprehensive comparison is beyond my current capabilities.

Focusing on the general magnitude of the respective results, as opposed to the specifics, however, it is possible to offer a few observations. With respect to wholesale market price effects, the report in the DEIS identifies a higher level of energy benefits, $16 million in New Hampshire annually[22] versus $8 million, but it does not consider capacity market benefits, which are a significant element of the wholesale electricity market benefits that I measure. With respect to GDP, the DEIS forecasts greater benefits during the peak of construction (2018), $338 million versus $214 million (in peak construction year of 2017) that I have estimated in my analysis, for New Hampshire. In contrast, I forecast greater GDP benefits during operations (probably because I took into account and measured wholesale capacity market benefits). Similarly, with respect to employment, the DEIS estimates a greater number of jobs during the peak of the construction phase as compared to my forecast, 3,149 versus 2,676 in New Hampshire (in peak construction year of 2017). That said, I estimate a greater number of jobs during the operation phase. Finally, the respective conclusions on reduced air emissions are similar. Overall the DEIS reinforces my conclusions, though there are specific assumptions or approaches that I might not make or take myself.

[22] U.S. Department of Energy. Office of Electricity Deliver and Energy Reliability, *Socioeconomics Technical Report for the Draft Environmental Impact Statement*. July 13, 2015, Appendix 4, page 4-11 to page 4-15.

Q. How do the results of your energy and capacity market analysis compare to those prepared for the New England Clean Power Line ("NECPL") project in Vermont?

A. Seth G. Parker of Levitan & Associates, Inc. ("LAI") evaluated the economic benefits on behalf of Champlain VT, LLC d/b/a TDI New England ("TDI-NE"), the developer of the proposed NECPL. Mr. Parker's testimony was issued on December 8, 2014. Mr. Parker estimates that NECPL will result in \$1.04/MWh (2014 dollars, ten-year average) wholesale system energy price reductions or \$1,590 million (2014 dollars, ten-year sum) in New England-wide wholesale energy market savings. My analysis was more conservative and I project lower energy market benefits [redacted] Mr. Parker disclosed a number of assumptions that differ from my analysis (such as the new entry for example), but not all of his assumptions were documented. Therefore, it is difficult to make an apples-to-apples comparison.

Mr. Parker also projected a wholesale capacity market benefit. However, he has modeled the capacity of the NECPL at 500 MW, so it is not surprising that his forecasted capacity price reduction of \$0.64/kW-month (2014 dollars, ten-year average) is lower than what I project for the 1,000 MW NPT project [redacted] on a ten-year average in nominal dollar terms).

Notably, Mr. Parker has assumed no market response in his estimates of wholesale market benefits. This would suggest that my analysis should otherwise be more conservative.

3 Environmental Impacts

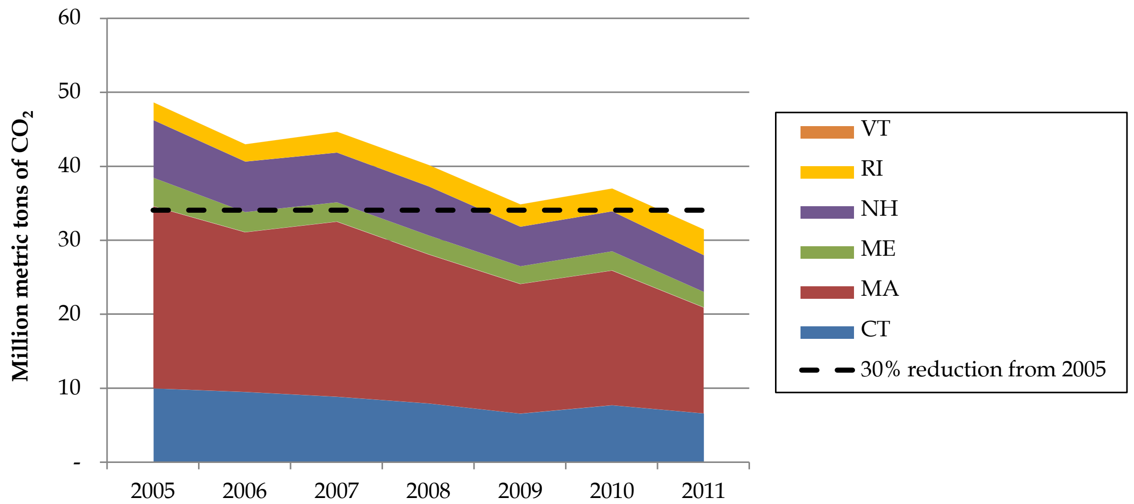
Q. Did you consider environmental regulations in your analysis?

A. Yes, as I discuss further in Section 6 of my report, I have included representation of major environmental regulations directly in the simulation modeling. For example, I modeled the RGGI and Clean Power Plan ("CPP"). While New England states are not part of Cross-State Air Pollution Rule ("CSAPR"),[23] LEI assumed that an equivalent emissions compliance rule will prevail in the long term for all New England states over the modeling timeframe. And therefore, we accounted for the allowance costs for SO_2 and NOx under CSAPR as part of the short run marginal costs of generators in New England.

Currently, all states in ISO-NE participate in the RGGI. The RGGI is a regional cap-and-trade program for CO_2 emissions from power plants among northeast US states that requires power generation facilities with an installed capacity of over 25 MW to reduce their CO_2 emissions by 30% by 2020 relative to the 2005 emissions level. A high level review of New England states' CPP carbon reduction goals relative to historical emissions highlights that the region has already essentially achieved the requisite reductions from 2005 levels (see figure below).

[23] In 2014, the US Court of Appeals for the DC Circuit struck down CSAPR and ordered EPA to continue enforcing the Clean Air Interstate Rule ("CAIR") until a CSAPR replacement is finalized. As of July 2015, states subject to CSAPR asked the US Court of Appeals for the DC Circuit to review the emissions limits set by the EPA on the grounds that the strict limits were actually causing some states and areas to exceed reduction goals. The DC Circuit has agreed, remanding the rule back to the EPA to review the 2014 limits without vacating it. In the meantime, CSAPR will remain in effect.

Figure 8. Historical carbon emissions by state, 2005-2011



Source: Energy Information Administration ("EIA").
<http://www.eia.gov/environment/emissions/state/state_emissions.cfm>

[redacted]

Q. How did you track emissions reductions achieved as a result of the Project?

A. Each plant's emissions were tracked based on simulated generation (and fuel consumption) and unit-specific emissions rates (as reported to the EPA via their Continuous Emissions Monitoring System ("CEMS")). I calculated the emissions reductions realized by operation of NPT by estimating the total tons of SO_2, NO_X and CO_2 emitted within the ISO-NE footprint each year of the forecast time horizon under the Base Case and Project Case and then the difference.

Q. How much emissions reduction are you projecting as a result of the Project?

A. I find that over the eleven-year modeling timeframe, and as a result of the energy imported over the Project, New England would see a reduction of SO_2 emissions by around 261 to 460 tons, NO_X emissions by around 537 to 624 tons, and CO_2 emissions between 3.3 million and 3.4 million metric tons.

Figure 9. SO_2 and NO_X reductions due to NPT (short tons)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	11-Yr Average
NOx reduction, short tons												
LCOP/HH	417	602	612	604	613	643	682	684	658	675	670	624
GPCM/MS	365	530	541	542	549	553	598	575	547	546	555	537
SO2 reduction, short tons												
LCOP/HH	337	473	509	479	508	490	502	480	427	442	409	460
GPCM/MS	176	244	283	287	312	293	327	283	206	219	243	261

The forecast of avoided CO_2 emissions in ISO-NE's control area is also summarized in the figure above. In this figure, I included a deduction for the assumed CO_2 emitted by the large hydroelectric plants in Quebec, which are the source of the energy flows over the Project. There is substantial scientific and policy debate on how to estimate possible CO_2 emissions from hydroelectric resources. I applied a pragmatic method, where I acknowledge that large hydroelectric resources may emit carbon due to the decomposition of fauna in the newly formed reservoir. Based on studies conducted by Hydro Québec scientists, it has been forecast that a large hydroelectric complex such as Eastmain 1/1A had a lifecycle emissions profile of greenhouse gases of 136 lbs/MWh.[24] Notably, this figure is considerably higher than the actual historical system-wide profile of CO_2 emissions reported by Hydro Québec of 239 metric tonnes/TWh (approximately 0.5 lbs/MWh).[25] Although the emissions profiles of new large hydroelectric plants are likely to be higher in the initial years than this lifecycle figure, it is difficult and intractable to pinpoint the exact, time-specific emissions profile of the energy flows over the Project, as they will not be associated with any single generation development. Therefore I chose to apply the lifecycle rate of 136 lbs/MWh. It results in approximately 491,000 metric tons of carbon for the 7,957 GWh of energy imported over the Project under the Base Case assumptions.

I further estimated the incremental value to society of the avoided CO_2 emissions. Northern Pass will create approximately \$207 million to \$208 million in annual, incremental social benefits from CO_2 reductions. The logic behind this number is presented in Figure 10. A more detailed discussion of the environmental benefits created by the Project can be found in Section 6 of my Report.

[redacted]

[24] Teodoru, C. R., et al. (2012), The net carbon footprint of a newly created boreal hydroelectric reservoir, Global Biogeochem. Cycles, 26

[25] Hydro Quebec Production's Electricity Facts. 2013.

4 Local Economic Impacts

Q. What local economic impacts did you evaluate?

A. I analyzed the potential local economic benefits of the Project in terms of the employment and GDP impacts to New Hampshire and the rest of New England for both the construction phase and the commercial operations phase. During the construction phase, the local economy benefits from increased employment (such as construction jobs and the employment generated from the regional supply chain effects of various other goods and services being supplied for the construction of the Project) and the induced effects (for example, the local spending of these construction workers—at restaurants, hotels, and for other services).

The economic benefits created during the construction phase are the result of the Project spending in this period in New Hampshire and other New England states. Including labor and materials, NPT anticipates spending approximately $1.2 billion in direct costs to develop and construct the transmission facilities, from the current development stage (2015) through the construction phase (January 2016 to April 2019). It should be noted that while the bulk of construction would occur during 2017 and 2018, we have referred to 2016 through 2019 as encompassing the construction period in our calculation of benefits. Therefore, we include pre-construction spending from 2016. Of this $1.2 billion, approximately $524 million will be spent on labor in New England, creating new jobs. The GDP growth during the construction phase is largely based on the increases in employment during this period.

During the commercial operations phase, as a result of reduced retail costs of electricity, households will be able to save more or spend their higher disposable income on other goods or services, stimulating the economy. Similarly, firms that benefit from lower costs of electricity will be able to expand production, further benefiting the local economy. NPT will pay property taxes which may be used by the state and local governments to increase government spending on programs that benefits the economy. NPT would also need to hire more local labor for operations and maintenance ("O&M") of the infrastructure.

NPT expects the pre-construction and construction periods for the transmission line will be completed over a 40 month period, starting in January 2016 and concluding in April 2019. There is also certain pre-construction spending, which is associated with development of the Project in 2015, which we have included in our modeling of the local economic benefits (this is identified as the "planning" period in the charts and tables herein). The operating life of the Project is expected to commence in 2019 for the purposes of this analysis, and is expected to go out 40 years (or even longer). However, I modeled only the first 11 years of operations, consistent with the timeframe of analysis for the wholesale electricity market impacts.

Q. How did you quantify these local economic benefits?

A. I employed the dynamic forecasting and policy analysis PI^+ model developed by REMI to measure the local economic benefits of the Project to New Hampshire and other states in New England. The PI^+ model incorporates several modeling approaches, including input-output ("I/O"), computable general equilibrium theory, econometric equations, and new economic geography theory to create a comprehensive model that understands detailed interrelated changes in a regional (or state) economy. PI^+ generates year-by-year estimates of the total regional effects of any specific policy initiative or large investment. The REMI model used for this analysis was a 70 sector, state-level model that covers the entire New England region. The full REMI PI^+ methodology is documented in Section 12 of my Report.

Q. What are the results of your local economic analysis for the Project**?**

A. At the peak of construction (in 2017), NPT is projected to directly employ over 2,089 persons and spend, in terms of materials and other non-labor services, as much as $68 million per year within New Hampshire and other New England states. As a consequence of this local investment, and at the height of construction (2017), Northern Pass would create a total of nearly 2,676 jobs in New Hampshire (this number includes direct, indirect, and induced jobs) and 2,898 total jobs across the other states in the New England region. In terms of GDP, Northern Pass will increase New England states' regional GDPs by approximately $489 million a year (at the peak of construction in 2017) and about 44% of that economic growth (or $214 million per annum) is located in New Hampshire. Please refer to Figure 11 and Figure 12 for more detailed information on the year on year estimated jobs and GDP increase in New Hampshire and rest of New England during construction phase.

Figure 11. Estimated number of new jobs in New England from the proposed Project during the planning and construction phase

Region	Planning	Construction Phase				Construction
	2015	2016	2017	2018	2019	Average
New Hampshire	225	136	2,676	2,238	427	1,369
Rest of New England	216	147	2,898	2,527	622	1,548
Total	440	283	5,574	4,765	1,049	2,918

Figure 12. Estimated increase in state GDPs in New Hampshire and rest of New England during the construction phase (in nominal $ millions)

Region	Planning	Construction Phase				Construction	Total
	2015	2016	2017	2018	2019	Average	
New Hampshire	$19	$11	$214	$185	$35	$111	$445
Rest of New England	$21	$15	$276	$251	$66	$152	$607
Total	$40	$25	$489	$436	$101	$263	$1,052

Note: While the bulk of construction would occur in 2017 and 2018, we have referred to 2016 through 2019 as encompassing the construction period in our calculation of benefits. Therefore, we include pre-construction spending from 2016.

During the commercial operations phase (2019-2029), Northern Pass will create, on average, over 6,800 jobs per annum across New England. In this same period, New Hampshire will see an average of over 1,100 new jobs per year. These local economic impacts are primarily being driven by the retail electricity savings; however, NPT is also providing additional support to New Hampshire through $13.5 million of annual direct spending (through annual O&M payments for NPT's infrastructure in the state and also approximately $10 million to $10.5 million per year of economic development funding initiatives for the first 20 years). In addition to the increased employment, NPT will generate over $1,156 million dollars annually in new economic activity for the New England region (distributed across all six states in New England). New Hampshire's annual GDP would increase by over $162 million on average over the forecast timeframe.

Figure 13. Estimated number of total new jobs created in New England during its first 11 years of the commercial operations by state

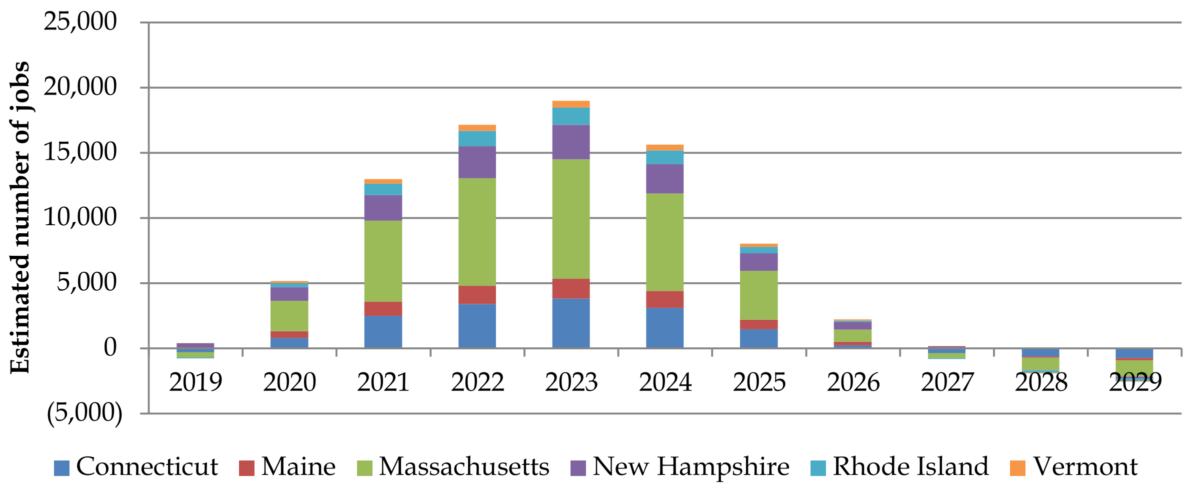
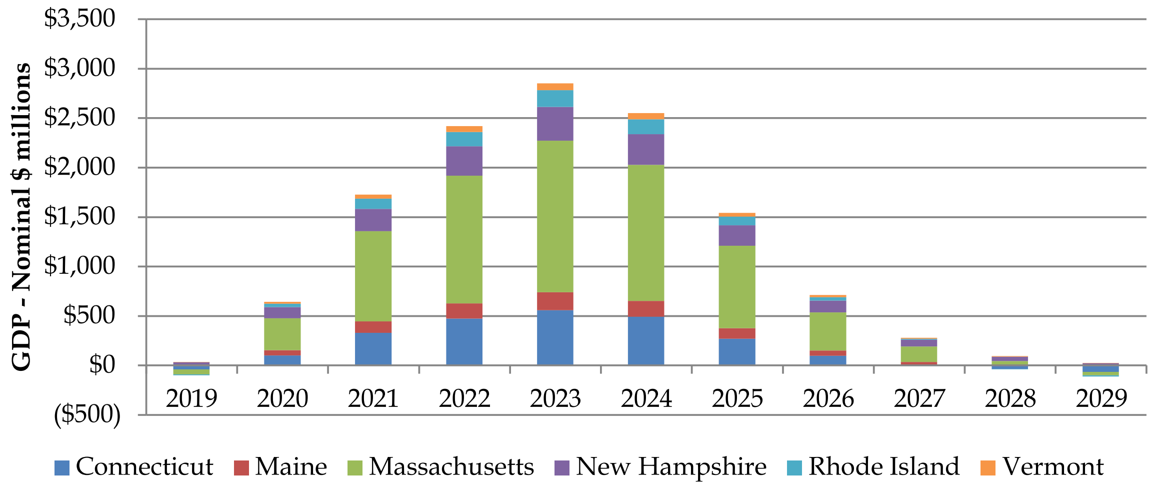


Figure 14. Estimated increase in states' annual GDP during the first 11 years of commercial operations



Please refer to Figure 13 and

Figure 14 for more detailed information on the year on year estimated jobs and GDP increase in New Hampshire and rest of New England during operations phase. More detailed results of local economic benefits can be found in Section 7 of my report.

Q. How do these local economic impacts compare to the analysis previously filed on behalf of NPT?

A. As I mentioned earlier in my testimony, Lisa Shapiro of Gallagher, Callahan & Gartrell, P.C. had performed a local economic benefits study in April 2011. There are a number of differences in assumptions and also PI^+ model variations. For example, the configuration of the Project has changed since 2011 when Ms. Shapiro conducted her study—it is now a 1,090 MW project and there is a segment that will be buried underground. The total direct project cost estimate has increased from $1.1 billion to $1.3 billion.[26] In addition, NPT has also developed more detailed information on local spending and direct hires over the past couple of years.

In terms of modeling tools, Ms. Shapiro and I both used the REMI PI^+ model. However, while Ms. Shapiro used a PI^+ focused on New Hampshire alone; I employed a six state model version so that I could capture the regional dynamics related to trade and the state economies. Furthermore, simply because of the timing of the two analyses, the REMI model version I used relies on more recent economic data.

Q. Can you please discuss how these differences impact the conclusions regarding local economic benefits?

A. Ms. Shapiro performed the first study in October 2010 and then updated in April 2011. In

[26] The direct project cost is an “unloaded” total cost estimate. The “fully loaded” total cost estimate is $1.6 billion, which includes contingency, property taxes and allowance for funds used during construction (“AFUDC”), in addition to the “unloaded” total costs.

the updated study, Ms. Shapiro estimated, during construction phase,[27] a slightly lower total job count for New Hampshire—1,345 total jobs per year on average, while I projected 1,369 total jobs per year (on average over the construction period). The higher total job creation under Ms. Shapiro's study is likely due to changes in assumptions, based on the refinements that NPT has made in subsequent years to its construction plan.

In terms of annual average state GDP benefits during the construction period in New Hampshire, I project a modestly higher GDP increase of $111 million (in nominal dollars) per year in contrast to $82.4 million (in real 2010 dollars) per year in Ms. Shapiro's 2011 study.

Ms. Shapiro had also concluded 200 additional jobs would be created in New Hampshire during the operations phase as a result of the electricity cost savings forecast by CRA in their 2011 study. By including wholesale capacity market benefits, the retail consumer benefits I forecast are larger and therefore my projected impact on employment and the economy during the operations phase is more significant.[28]

Q. Are there any comparable local economic benefits studies conducted recently by other transmission developers?

A. Yes, Mr. Thomas E. Kavet of Kavet, Rockler & Associates, LLC ("KRA") recently filed testimony with Vermont Public Service Board that details the economic impacts of the proposed NECPL. It is important to understand that Mr. Kavet's study and my study is not an apples-to-apples comparison because the Vermont economy is smaller and less diversified compared to

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[27] In Ms. Shapiro's study, the construction period referred to 2013 to 2015. In my study, the construction period covered 2017 to 2019.

[28] In addition, it should be noted that Ms. Shapiro did not account for any O&M spending or the economic development funding of $10 million to $10.5 million a year (for 20 years), which would also explain a lower impact figure.

New Hampshire and it will naturally result in smaller local economic benefits. In addition, due to the makeup of the labor pool in Vermont, the NECPL may not be able to employ as many local workers and therefore would have a more muted effect on the state's employment situation during construction. In addition, the project configuration of NECPL is different. TDI will be using underwater HVDC technology, which requires specialized labor for installation. This could also result in fewer (and less substantial) benefits to the state of Vermont.

Q. How do the results of your local economic benefits compare to those prepared for the NECPL project?

A. NECPL projected a total project cost of $1.19 billion while NPT estimated a total Project cost of $1.3 billion. There were differences as well in O&M spending and other direct local expenditures.

NECPL has a capacity rating of 1,000 MW and the Project has a revised capacity rating of 1,090 MW (with 1,000 MW of capacity supply obligation). NECPL assumed that its transmission line would carry energy at a capacity factor of 95% (or 8.3 TWh of annual energy flows), while I conservatively assumed in my modeling that the Project would have a capacity factor of 83% (or nearly 8.0 TWh of annual energy flows). In addition, Mr. Parker modeled a smaller wholesale capacity market benefit as he assumed only 500 MW of qualified capacity would be sold off the NECPL.

During the three-year construction period, NECPL estimated to local Vermont spending of $234 million, while NPT estimated local New Hampshire spending of $384 million over a four-year timeframe.[29] As noted above, given the make-up of the Vermont economy, it is not surprising that there would be less direct spending in-state. As shown in figures below, higher local spending results in higher job creation and state GDP benefits for the Project.

Figure 15. Construction period benefits

Project	Local State Jobs Per Year		Local State GDP per year ($ millions)
	Direct	Total	Annual Average GDP
NECPL (Kavet)	140	493	$38.8
NPT (LEI)	582	1,369	$111.2

Similarly, the inputs to the operations phase produce variations in the results. For example, I have forecast a larger retail electricity market benefit for consumers (as highlighted in the last column of the figure below), and therefore, it is not surprising that the local state impacts are larger than that projected by Mr. Kavets for NECPL. Furthermore, the New Hampshire economy is larger than Vermont and can therefore convert these electricity cost savings into economic growth at an expanded scale.

Figure 16. Operations period benefits

Project	Total Jobs in Local State	Local State GDP ($ millions)	Local State	Did they include capacity market benefits?	Retail Energy + Capacity Market Benefits for Local State ($ millions, annual avg)
	Annual Average	Annual Average			
NECPL (Kavet)	205	$31.6	Vermont	No, but it was studied	$19.2
NPT LEI	1,148	$162.0	New Hampshire	Yes	$79.9

5. **Other Potential Benefits**

Q. Is there a need for such infrastructure investment in New England?

A. Yes, I believe that there is a need in the economic sense, as my analysis of benefits would suggest. Furthermore, ISO-NE has explicitly mentioned that there are looming concerns with

[29] NECPL's local spending included labor costs of $83 million, materials and overhead costs of $110 million, and taxes and fees of $41 million. NPT's local spending included only employment and material expenditures. Taxes were not included in my study.

inadequate supply in the latest Regional System Plan ("RSP"). The diminishing surplus supply situation is also reflected in recent capacity market results. Based on the announced and approved retirements as well as forecasts for load growth, it is abundantly clear that New England needs more energy resources and possibly other infrastructure investments in the coming years.

In the ISO-NE 2015 RSP, the operable capacity analysis suggested that *"if the loads associated with the 50/50 forecast occurred, the ISO would expect New England to experience a negative operable capacity margin ranging from 6 MW to 1600 MW four out of the 10 years of the study period…...New England could have experienced larger negative operable capacity margins of approximately 1,680 MW as early as summer 2015 if the 90/10 peak loads occurred."*[30]

In fact, in FCA#8, the market cleared at an administratively set price because there was not sufficient competition to meet the projected ICR for the 2017-18 timeframe. In the most recent FCA#9, which concluded on February 5, 2015, the "Rest of Pool" capacity price cleared at $9.55/kW-month while the SEMARI zone cleared at administered pricing levels ($17.73/kW-month for new resources and $11.08/kw-month for existing resources), because of insufficiency of supply.

The looming prospect of supply shortfalls is further magnified by the aging fleet and the high probability of additional retirements – especially in light of capacity market design changes, which would penalize resources that cannot provide energy in the real time market

[30] ISO-NE. Draft 2015 Regional System Plan. Pages 66 and 68.

commensurate with their capacity supply obligation. In total, nearly 13,300 MW – or almost 44% of the total fossil supply – is over 30 years old. In addition, these older, less efficient oil units (over 6,000 MW) on average ran only 3.1% of the time.[31] Such units are candidates for retirement with relatively low energy price markets and the upcoming "pay for performance" requirements in the capacity market.

Q. Are there any initiatives being taken by ISO-NE or others to forestall a supply shortfall and how does Northern Pass fit into that strategy?

A. Yes, there is a multi-state initiative led by the New England States Committee on Electricity ("NESCOE") that has also called for new investment in various infrastructure assets. In December 2013, the six New England state governors agreed to work together, in coordination with ISO-New England and through NESCOE, to advance a regional energy infrastructure initiative that involves new transmission and new natural gas pipelines, in an effort to diversify the region's energy supply portfolio.[32] In January 2014, in its Request for ISO-NE technical support and assistance with tariff filings related to electric and natural gas infrastructure in New England, the governors of the New England states agreed that in the future, they would issue one or more requests for proposals ("RFPs") for the development of transmission infrastructure that would enable delivery of at least 1,200 MW and as much as 3,600 MW of clean energy into the New England electric system from no and/or low carbon emissions resources.

However, NESCOE's efforts were superseded by a joint solicitation for clean energy and transmission to accommodate such clean energy from three states. The Connecticut Department

[31] Based on latest available data (2013).

[32] http://www.nescoe.com/uploads/New_England_Governors_Statement-Energy_12-5-13_final.pdf

of Energy and Environmental Protection, the Massachusetts Department of Energy Resources, Eversource, National Grid and Unitil have developed a Request for Proposals ("RFP") to advance the statutory and policy goals of Connecticut, Massachusetts and Rhode Island.[33] The draft Clean Energy RFP was issued on February 25th, 2015 and the Clean Energy RFP was filed with Massachusetts DPU and Rhode Island PUC on June 25th and 26th, respectively. It is expected that the RFP will be released to the bidders in the early third quarter of 2015. As mentioned earlier, Northern Pass will be offered into this RFP.

NESCOE is also seeking to increase the amount of firm pipeline capacity serving New England – by as much as 1,000 mmcf/day above 2013 levels or, 600 mmcf/day beyond what has already been announced for the Algonquin Incremental Market ("AIM") and CT expansion projects.[34] My analysis of wholesale electricity market benefits conservatively takes into account some level of new pipeline expansion in the region, be that a NESCOE process or an outcome of market-driven investments. If new natural gas pipelines are not built, natural gas prices would be much higher and therefore the energy prices would also be higher, leading to bigger wholesale energy market benefits of the Project.

Q. With that in mind, are there other, potential electricity market-related benefits for New England ratepayers?

A. Yes, I believe that there are other electricity market benefits to ratepayers, which extend beyond the readily measureable reductions in market prices, associated retail electricity cost

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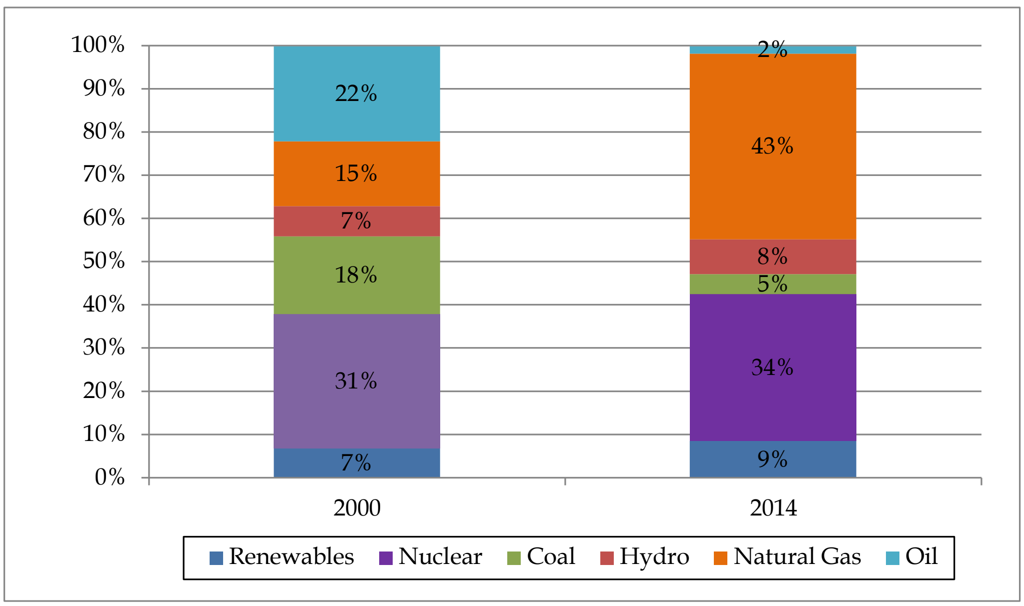
[33] http://cleanenergyrfp.com/

[34] Berwick, Ann G. (President, New England States Committee on Electricity). Letter to Gordon van Welie, President and CEO, ISO New England, Inc. January 21st, 2014. <http://www.nescoe.com/uploads/ISO_assistance_Trans___Gas_1_21_14_final.pdf>

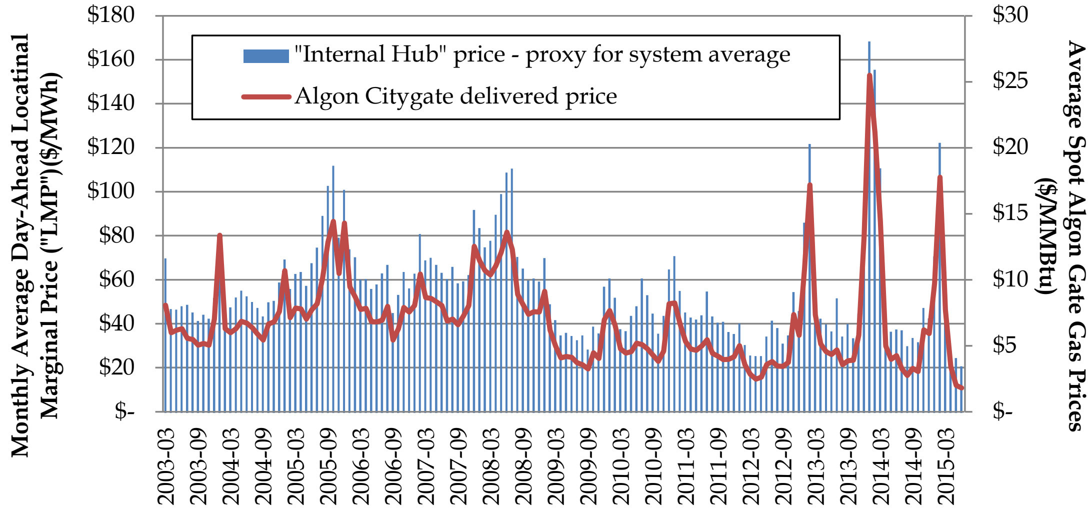
savings, and emissions reductions. As shown in the figure below, New England is highly dependent on natural gas generation. In 2014, approximately 43% of the capacity is currently natural gas-fired generation, increased from 15% in 2020. Consequently, energy prices are highly correlated with natural gas price. With the injection of hydro-based energy through the Project, it can expand New England's supply from fossil fuel and reach a more balanced fuel mix.

Figure 17. Energy production by fuel type in 2000 and 2014



Sources: ISO-NE, 2001 Regional System Plan and Draft 2015 Regional System Plan

Figure 18. Historical New England electricity prices and natural gas prices since start of current LMP-based energy market



Source: ISO-NE (for LMPs) and SNL (for delivered natural gas prices)

Q. Would Northern Pass affect reliability in New England's electricity market?

A. Although I am not an engineer and not here to present technical transmission analysis, I do believe that the Project does improve the resilience of the ISO-NE system to the uncertainties of market design changes, especially if market dynamics speed up or precipitate further retirements. Given the lead time required for the development of new CCGTs (which is the most likely entrant type in the region) and the uncertainties that such resources may face with attracting financing (due to the new performance requirements and risk of penalties under the new capacity market rules), the Project may be an effective insurance against delayed new generation investment.

Q. Does this conclude your testimony?

A. Yes.

5 Curriculum Vitae for Julia Frayer

Julia Frayer is Managing Director at London Economics International LLC ("LEI"). She specializes in economic analysis and evaluation of infrastructure assets, such as power plants, natural gas-related infrastructure, electricity transmission and distribution systems, and utilities, as well as market design and expert economic advisory services for power markets. She has worked extensively in the US, Canada, Europe, and Asia in valuing electricity generation and wires assets, water and wastewater networks, as well as gas transportation assets, and in advising on market rules, innovative rate design, and institutional best practices.

Julia manages LEI's quantitative financial and business practice area. In addition to electric generation sector market power and anti-trust analysis, sample projects include cost of capital estimation; rate-setting analysis; short- and long-term forecasting of wholesale power prices; valuation of generators and vertically-integrated utilities; assessment of retail market design including provider-of-last resort portfolios and contracts; advice on and design of energy sales agreements; and advisory on structuring request for proposals and sale processes for energy assets and derivative contracts. Julia and her team of economists and consultants have developed and applied proprietary real-options based valuation tools, portfolio risk analytics, models of strategic bidding behavior, and sophisticated power system simulation tools, as well as customized econometric models. Julia also leads many of the firm's regulatory economics projects, spanning such diverse issues as cost-benefit analysis, market power mitigation, tariff ratemaking, auction design (including competitive solicitations for procurement), wholesale market rules design, productivity analysis and efficiency benchmarking. Prior to joining LEI, Julia was working as an Investment Banker with Merrill Lynch in New York.

Attachment A

EDUCATION:

Institution	Graduate School of Arts & Sciences, Boston University
Degree(s) or Diploma(s) obtained:	MA in Economics

Institution	School of Arts and Sciences, Boston University
Degree(s) or Diploma(s) obtained:	BA in Economics and International Affairs

SAMPLE OF RELEVANT PROJECT EXPERIENCE:

Date:	2015
Location:	Alberta, Canada
Company:	Private Client
Description:	LEI performed study of climate change policies and renewable investment strategies for the Alberta electricity market. As part of that analysis, Julia and her team of experts simulated the impact of various carbon reduction policies and possible regulations, RPS policies, carbon cap and trade mechanisms, carbon tax, and acceleration of plant retirements were considered. Impact on consumers, reliability of the power system, market efficacy for new investment, sustainability of the market design, socio-economic effects, and implementation issues were considered as part of the comparative evaluation. This study was prepared for review by industry and policymakers.

Date:	2015
Location:	New York, United States
Company:	Private Client
Description:	For a private transmission developer, LEI analyzed the impact of a new transmission project between upstate and downstate New York. LEI used its proprietary energy and capacity models to assess the impact of the proposed transmission line on New York energy and capacity markets over a 20-year horizon. LEI further prepared a forecast of revenues for potential shippers from the results of the simulations.

Date:	2015
Location:	New England, United States
Company:	Private Client
Description:	LEI was hired to conduct a Non-Transmission Alternatives ("NTA") analysis for the two transmission projects, which are components of a larger transmission solution for the Greater Hartford and Central Connecticut ("GHCC") area. The objective of the NTA analysis was to determine the feasibility and viability of other non-transmission resources – such as new generation and new demand-side resources – to be developed in lieu of these two specific transmission projects to relieve transmission reliability concerns. The NTA analysis was to be filed as part of the client's application with the Connecticut Siting Council ("CSC") for each of these transmission projects.

Attachment A

Date:	2014 and 2015
Location:	New England, United States
Company:	Private Client
Description:	LEI was engaged by two New England incumbent utilities to determine the economic viability of non-transmission alternatives ("NTAs") to replace a combination of three transmission solutions designed to address reliability and performance issues in the Greater Boston area starting in 2018. More specifically, LEI's scope of work consisted of determining the least cost combination of technologies that could be integrated to the New England transmission system and provide the same reliability benefits as the proposed transmission lines. A combination of supply-side and demand-side resources were considered for the study, this included: distributed solar PV, utility-scale solar PV, energy efficiency and active demand response, conventional generation (gas CCGT and peakers), as well as energy storage devices. LEI started the analysis by screening prospective NTA technologies based on their technical characteristics, their relevance in the New England market and their technical applicability with regards to the operational criteria required by the grid to address contingency events (i.e., volume of available capacity/energy, time of response, duration of response, flexibility etc.). Next, LEI conducted a comparative cost analysis to estimate the levelized cost per kW-month over the economic life of each of the technologies. Through his selection process, we retained technically feasible NTAs that are materially less expensive than other comparable options at the same locations (substations). Finally the most probable combinations of NTA technologies identified in the selection process were further evaluated based on their probability of materialization taking into account a spectrum of criteria including physical constraints such as land availability, siting issue, financing hurdle, etc.

Date:	2015
Location:	New York, United States
Company:	Private Client
Description:	LEI was hired by a community coalition to investigate the costs and benefits of proposed transmission line projects across New York State. The study included reviewing the proposed projects from each of the applicants to identify key characteristics of each project, as well as modeling the current New York markets to assess the need for new transmission infrastructure.

Date:	2015
Location:	Maine, United States
Company:	Private Client
Description:	LEI was hired by a New England transmission & distribution utility to prepare a two-day workshop for company executives detailing the current state of the New England markets, major players across all sectors of the industry, major investment drivers and investment analysis methodology. LEI staff prepared workshop material and traveled to the client's office to present the material and answer client's questions

Date:	2014 and 2015

Location:	United States
Company:	Private Client
Description:	LEI was asked to conduct an independent rigorous modeling exercise to determine the potential revenues for the proposed transmission project wheeling power from western MISO to eastern MISO (and eventually PJM). LEI evaluated both the revenue opportunities to the investors (e.g., private benefits of the line based on market price differences and the market value of the transmission) as well as social benefits to the MISO system (i.e., wholesale price reductions and capacity market price differences); and evaluated the incremental value of the business strategy of selling the energy (and capacity) out of East MISO to third parties who will serve customers ultimately in PJM. LEI's modeling exercise entailed evaluating intrinsic revenues (originating from power markets), extrinsic revenue (originating from price volatility), along with the green value of the Project (originating from the purchase of low cost renewable energy). LEI's overall analysis was comprehensive and included a series of sensitivity scenarios testing key value drivers.

Date:	2015
Location:	New England, United States
Company:	Main Public Utility Commission
Description:	LEI was engaged by the State of Maine Public Utilities Commission to assist the MPUC in evaluating options for expansion of natural gas supply into Maine (with a view to reducing the cost of gas and power to Maine customers). LEI reviewed and evaluated proposals for firm natural gas transportation service by pipeline developers. These evaluations included LEI's review of commercial terms include in the pipeline Precedent Agreements that underpin capacity expansion projects; review of contract provisions for Firm Transportation Agreements and Negotiated Rate Agreements; and evaluation of the status of the FERC and state-level permitting process for each pipeline proposal. The project also included natural gas network modeling (using GPCM, an industry-standard network model of the North American natural gas system) and power simulation modeling (using LEI's proprietary POOLMod model) to arrive at a quantitative cost-benefit analysis of proposals.

Date:	2014
Location:	United States
Company:	Private Client
Description:	LEI prepared a quantitative analysis to test the efficacy of a proposed cross hedging strategy for a merchant transmission project that will be bringing energy from Canada. The proposed strategy is to use natural gas futures contracts to hedge energy market exposure and revenues. Analysis will include ordinary least squares regressions as well as an error correction model to determine the appropriateness of the hedge.

Date:	2014
Location:	United States
Company:	WIRES

Description:	LEI was engaged by WIRES to prepare a White Paper on Market Resource Alternatives ("MRAs") which provides external parties with a clear understanding of MRAs and a concise description of how MRAs can work effectively alongside transmission investment in US power markets to support market development, reliability, and cost-effective supply.

Date:	2014
Location:	Western United States
Company:	Private Client
Description:	LEI was engaged by a private equity company in association with asset valuation, due diligence support, and market analysis for a wind generation and HVDC transmission project proposing delivering wind-based renewable energy from Wyoming into California.

Date:	2014
Location:	Canada
Company:	Corporate Knights
Description:	LEI was retained by Corporate Knights Inc. to perform a high-level estimation and analysis of potential opportunity for developing clean energy exports from Canadian markets to target US power markets. Julia Frayer presented a preview of her analysis at the ABB Energy and Automation Forum in September 2014.

Date:	2014
Location:	New England, United States
Company:	Private Client
Description:	LEI assisted a New England incumbent utility in evaluating the economic benefits of two solutions aiming to relief the long-time congestion in the metropolitan area. There were two solutions considered: AC-only and AC/DC hybrid solutions. The objective of the economic analysis from the energy market perspective was to examine whether there are any production cost savings or market price ("LMP") impacts from either proposal, and to describe under what conditions (assumptions) these benefits are realize.

Date:	2014
Location:	New England, United States
Company:	Private Client (transmission developer)

Description:	LEI prepared a 10-year energy market price outlook for the New England wholesale power market and forecast the impact of a proposed project on New England market prices. LEI also determined the benefits of the proposed transmission project on employment, economic activity, and tax revenues in New England. LEI utilized the dynamic input-output ("I/O") economic model developed by Regional Economic Models, Inc. ("REMI") to measure the economic benefits to various New England states from the project on employment, economic activity, and tax revenues. LEI separated the economic impact caused by the construction of the project, and the impact caused by the reduction in energy prices due to the commercial operation of the project, taking into account issues such as usage of electricity in residential, commercial, and industrial sectors in the region, and also existing long-term energy contracts that would limit the impact of the project.

Date:	2014
Location:	Ontario, Canada
Company:	Private Client
Description:	LEI assessed the economics of the proposed Lake Erie HVDC transmission project to investors and potential customers, by projecting revenue streams associated with the sale of energy, capacity and other products via transit on the Lake Erie HVDC transmission project ("LEP"). The LEP is a 100-km long 1,000 MW bi-directional HVDC transmission line that will connect the Ontario energy market with the PJM market. LEI prepared a comprehensive report that includes a review of the Ontario and PJM markets, a 20-year (2017 to 2036) market outlook and prices for electricity, capacity and renewable energy credits in Ontario and the relevant zone/s in PJM; the total gross arbitrage value for the energy congestion rents, the capacity revenue potentials for PJM, and the renewable energy credits revenue potential in PJM.

Date:	2014
Location:	New England, United States
Company:	NEPOOL
Description:	LEI was retained by NEPOOOL to provide expert insight in the Federal Energy Regulatory Commission ("FERC") proceed related to Performance Incentives in ISO New England's Forward Capacity Market. LEI submitted a written affidavit to FERC discussing the relative benefits of keeping the capacity product primarily as a standalone planning tool rather than moving the capacity market design closer to that of a real-time energy market. (Docket No. ER14-1050 at FERC)

Date:	2014
Location:	Midwest, United States
Company:	Private Client

Description:	LEI was asked to conduct an independent rigorous modeling exercise to determine the potential revenues for the proposed transmission project wheeling power from western MISO to eastern MISO (and eventually PJM). LEI evaluated both the revenue opportunities to the investors (e.g., private benefits of the line based on market price differences and the market value of the transmission) as well as social benefits to the MISO system (i.e., wholesale price reductions and capacity market price differences); and evaluated the incremental value of the business strategy of selling the energy (and capacity) out of East MISO to third parties who will serve customers ultimately in PJM. LEI's modeling exercise entailed evaluating intrinsic revenues (originating from power markets), extrinsic revenue (originating from price volatility), along with the green value of the Project (originating from the purchase of low cost renewable energy). LEI's overall analysis was comprehensive and included a series of sensitivity scenarios testing key value drivers.

Date:	2013
Location:	Northeast United States
Company:	Private Client
Description:	For a utility in the northeastern US, LEI prepared a cost-benefit analysis of a proposed transmission line with the potential to change existing market arrangements. In the analysis, LEI developed a base case and multiple project cases based on different configurations of the transmission project. Using its proprietary modeling tool, POOLMod, LEI simulated energy and capacity prices in each configuration over a 15-year timeframe, and compared the price differences against various cost allocation scenarios for the transmission line's construction. LEI also tested the statistical significance of the project case results against the base case results, and conducted further analysis on the economic effects of additional renewable generation projects that construction of the transmission line would make possible.

Date:	2013
Location:	Canada
Company:	Private Client
Description:	LEI was retained to provide to assist a private client in assessing the economics of this proposed transmission project and determining additional revenue streams or value adders from the perspective of third-party shippers. LEI was specifically asked to isolate and measure the spot market volatility premium.

Date:	2013
Location:	New England, United States
Company:	Private Client
Description:	LEI conducted a comprehensive review of the NESCOE Gas Electric Phase Three study in order to ensure that the appropriate economic models and techniques were being used to accurately model the hydro and gas solutions. LEI also aided the client in identifying any assumptions and modeling approaches which may be suboptimal, and communicated how these issues can be addressed and improved in future studies.

Attachment A

Date:	2013
Location:	New York, United States
Company:	NRG
Description:	LEI was engaged by NRG to provide an independent review of the economic analysis in two reports: "Report and recommendations comparing repowering of Dunkirk Power LLC and transmission system reinforcements", published by National Grid ("NG") on May 17, 2013, and "NRG Dunkirk Repowering Project Economic Impact Analysis", published by Longwood Energy Group LLC ("LEG") on March 20, 2013. Both reports forecasted market benefits, production cost savings and macroeconomic benefits. LEI's review compared methodologies and assumptions used by each report, and how these may have affected their results; LEI's review was subsequently submitted by NRG to Case 12-E-0577 at the New York Public Service Commission (the "Commission").

Date:	2013
Location:	Western United States
Company:	Duke-American Transmission Company
Description:	Julia was part of a team of economists that performed a macroeconomic analysis to estimate the local economic benefits accruing to taxpayers, residents, and businesses along the 800+mile route during construction of the Zephyr HVDC project, which runs from Wyoming to Colorado, Utah, and Nevada. LEI performed the analysis using the REMI P1+ model.

Date:	2012
Location:	Connecticut, United States
Company:	NRG, Inc.
Description:	Julia provided written testimony and oral testimony at the Connecticut Public Utility Regulatory Authority ("PURA") related to the market power consequences of proposed merger of NU-NSTAR. PURA Docket No. 12-01-07.

Date:	2012
Location:	Maine, United States
Company:	Maine Public Utility Commission
Description:	Julia led a team of researchers at LEI in the preparation of a written report on the state of renewable portfolio standard ("RPS") requirements in Maine and regionally across New England. Julia also testified at the Maine legislature. The report was commissioned by the Maine Public Utility Commission to fulfill a statutory requirement to provide research on the issue of RPS and its impact on generators and consumers.

Date:	2011
Location:	New Hampshire, United States

Attachment A

Company:	Public Service of New Hampshire
Description:	On behalf of Public Service of New Hampshire, Julia testified in front of the new Hampshire Senate Committee on issue of eminent domain generally and more specifically, on the power market context and near term outlook for the New England power market and reasons for the development of a new proposed transmission project known as Northern Pass.

Date:	2011
Location:	New England, United States
Company:	Private Client
Description:	LEI prepared presentation material on the electricity market impacts and the benefits of Northern Pass Transmission project for New Hampshire and New England consumers. In addition, LEI staff assisted the client in preparation of an op-ed piece for dissemination to New Hampshire press outlets. LEI staff also attended an internal company meeting and testified on behalf of the client. Lastly, LEI staff assisted in the preparation for and attended the live New Hampshire Public Radio program "The Exchange" to discuss the benefits of the Northern Pass Transmission over the hour-long live show.

Date:	2011
Location:	United States
Company:	Private Client
Description:	LEI provided extensive late stage development due diligence for investor in four potential merchant transmission investments. LEI prepared three presentations analyzing four proposed merchant HVDC transmission projects across the US. Analysis included detailing the development roadmap for HVDC projects and the current status of the proposed projects, identifying potential competitive threats from other similar competing transmission lines and proposed local generation, and examining the renewable needs and willingness to pay of utilities in the "sink".

Date:	2010 - 2013
Location:	New York, United States
Company:	Transmission Developers, Inc. ("TDI")
Description:	Julia led the detailed cost-benefit analysis and macroeconomic impact analysis in support of the Champlain Hudson Power Express ("CHPE") application for siting approval at the New York Department of Public Service ("DPS"). LEI's analysis on economic effects was the cornerstone of the settlement agreement reached between TDI and a number of New York agencies. Julia acted as independent expert on behalf of TDI and prepared updated study results on energy market impacts, capacity market impacts and also macroeconomic benefits stemming from the operation of the CHPE project. Julia's testimony was used in the DPS proceeding in the summer of 2012. Julia continues to support TDI on various market and regulatory issues in 2013.

Date:	2010 – 2013

Attachment A

Location:	Southwestern United States
Company:	Tres Amigas
Description:	Julia and her team assisted Tres Amigas LLC, a start-up company on the revenue forecasting and modeling for the second stage financing. The start-up company aims to develop, own and operate a unique three-way AC/DC transmission facility located in New Mexico. In 2010, for the feasibility analysis stage, LEI provided extensive transmission evaluation, financial modeling, price forecasting, and market analysis for the markets, including the Arizona/New Mexico/Southern Nevada sub region of the Western Electricity Coordinating Council, the Electric Reliability Council of Texas, and the Southwest Power Pool. LEI's analysis support over $15 million of development stage funding. LEI continues to serve as economic advisor to Tres Amigas, as it seeks debt and equity financing to support construction of Phase I.

Date:	2010 – 2011
Location:	Maine, United States
Company:	Maine Public Utilities Commission
Description:	LEI advised Maine Public Utilities Commission on methodologies for transmission cost allocation by comparing and contrasting alternative planning approaches and pricing models employed within the US and one international jurisdiction, the United Kingdom. The final report provided a 'strawman' recommendation for an effective cost allocation methodology, which was used by the Maine PUC to guide it in its filings at FERC related to Order 1000 and the preceding NOPR on the same issue.

Date:	2009-2011
Location:	New England, United States
Company:	Private Client
Description:	Julia and her team assisted the client with certain matters pertaining to FERC investigation. Specifically, the scope of this retention includes economic and market analysis in support of a market participant in ISO New England's day ahead load response program ("DALRP"). Julia also provided affidavits and deposed in connection with FERC investigation of behind-the-fence industrial generator and participation in a wholesale power market in New England. Julia helped the client to respond to assertions of market manipulation and estimate market benefit provided through its participation in demand response program.

Date:	2009-2010
Location:	Maine, United States
Company:	Maine Public Utilities Commission
Description:	Julia and the LEI team are currently assisting the Commission on the RFP related to the procurement of electricity in response to statutory mandates and state policy preferences. LEI provided economic analyses of bid proposals by estimating the benefits and costs to the ratepayers, and supported Commission staff in negotiations with short-listed bidders.

Date:	2009
Location:	Eastern United States

Company:	Private Client
Description:	LEI advised a major transmission company on financial implications of proposed new 400kV transmission line to New York City and Connecticut. LEI analyzed the impact of new transmission, assuming it delivered 100% carbon-free energy, on electricity prices and emissions levels in New York and New England.

Date:	2009
Location:	Maine, United States
Company:	Maine Public Utilities Commission
Description:	As the team leader of this project, Julia assisted the Maine Public Utilities Commission in developing an electric resource adequacy plan to aid MPUC in the development of a strategy for the pursuit of the long-term contracts. LEI submitted a report that builds up a set of recommendations for a long-term investment strategy based on an analysis of the current supply-demand situation, a review of the existing wholesale market rules for energy and the Forward Capacity Market, an examination of historical price trends, and review of the investment needs assessments prepared by the utilities and ISO-NE, as well as relevant sub-regional planning studies.

Date:	2006
Location:	Connecticut, United States
Company:	Connecticut Department of Public Utility Control
Description:	Julia has evaluated measures needed to reduce Federally Mandated Congestion Charges (“FMCC”) in Connecticut. Together with the LEI team she also performed an economic evaluation of the New England and Connecticut energy markets using LEI proprietary production cost model, POOLMod. Julia testified at the Connecticut Department of Public Utility Control (“DPUC”) regarding the RFP process, RFP documentation, and contract template. Julia also testified on evaluation of project bids in comparison to anticipated market outcome. Julia’s analysis supported hundreds of millions of dollars of investments.

Date:	2004-2005
Location:	Connecticut, United States
Company:	Connecticut Department of Public Utility Control
Description:	In her affidavits in 2004 and 2005 before the Connecticut Department of Utility Control, Julia described the procurement processes of Connecticut Power and Light Company (“CL&P”) TSO. Her testimony outlined best practice and procurement processes for DPUC to adopt in order to have the most efficient and competitive process which would result in the lowest price possible for the electricity consumers under CL&P’s TSO.

Date:	2001
Location:	United States
Company:	Private Client

Attachment A

Description:	LEI conducted an indicative valuation of a proposed new transmission line, known as the International Transmission Line. LEI forecasted the revenues associated with the project and combined this revenue forecast with the estimated costs of the project to arrive at an estimate of the net present value of the project and return on investment.

SAMPLE OF RELEVANT SPEAKING ENGAGEMENTS:

When	Description
July 30, 2015	Julia Frayer "Implications of Energy Infrastructure Investment on Local Economies in New England", REMI E3 Conference 2015: Energy, the Environment and the Economy, Amherst, Massachusetts, United States
April 8, 2015	Julia Frayer "Perspectives on future trade opportunities between Canada and the US, and benefits to US consumers" EUCI US/Canada Cross Border Power Summit Conference, Boston, Massachusetts, United States
April 1, 2015	Julia Frayer "Are transmission expansions and upgrades compatible with both small and large scale clean energy?" Panelist. Southwest Clean Energy Transmission Summit, Albuquerque, New Mexico, United States
June 18, 2014	Julia Frayer "International Views and Addressing the Need for More Underground Transmission in the US" Panelist. Platts 2014 Transmission Planning and Development Conference: Ensuring Grid Reliability, Planning Timelines, and a Robust Market's Relationship with New Build, Arlington, Virginia, United States
Sept 23, 2013	Julia Frayer "System Operator's Response to 1000 – How Can the Various Regions Work Together?" Moderator. Platts 2013 Transmission Planning and Development Conference, Washington DC, United States
Jan 11, 2013	Julia Frayer "Merchant Transmission: Planning and Development and Lessons Learned from North America", Integrated Transmission Planning and Delivery, Imperial College - Workshop for OFGEM, London, United Kingdom
Mar 16, 2012	Julia Frayer, Shawn Carraher, and Yifei Zhang, "Best Practices for Transmission Asset Valuation", Transmission Grid Conference, London, United Kingdom
Mar 31, 2004	Frayer, Julia "Alternative to LMP pricing for transmission: a case study of the ICRP approach used by National Grid Company in the UK." Speaker, Electric Power Conference 2004, Baltimore, Maryland
Nov 28, 2001	Frayer, Julia "Evaluating the Electron Highway" Speaker, IPPSO 2001 Conference, Richmond Hill, Ontario (Canada)