APPENDIX B – ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

APPENDIX B-1 – ADDENDUM TO THE KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

ADDENDUM TO THE KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

In recognition of the comments and feedback NTE Connecticut ("NTE") and PA Consulting Group ("PA") have received from residents of the Town of Killingly related to PA's report entitled, ***Killingly Energy Center: An Analysis of Need and Economic & Environmental Impacts****, PA has prepared the following addendum. This addendum does not change the analysis nor findings presented in the original PA report. Rather, this addendum provides additional detail on the models used (IMPLAN and JEDI), inputs that were used to develop PA's estimate of economic impacts resulting from the Killingly Energy Center's ("KEC") construction and ongoing operations, and additional detail on PA's findings.*

The models that PA used in its economic impacts analysis are the IMPLAN – Impact Analysis for Planning – and JEDI – Jobs and Economic Development Impacts – models. Both are industry standard models used to analyze economic impacts resulting from capital projects, such as building and operating a power plant. The IMPLAN model was used to assess the economic impacts resulting from the Killingly Energy Center's ("KEC") effect on wholesale electricity costs to Connecticut ratepayers. The JEDI model was used to assess the economic impacts from KEC's construction and operations.

PA's modeling methodology analyzed economic impacts across three categories: direct, indirect and induced impacts. Direct impacts reflect those effects resulting from KEC's direct expenditures. (For example, KEC hiring workers.) Indirect impacts reflect supply chain effects from KEC's direct expenditures. (For example, KEC workers buying groceries, eating at restaurants, staying at hotels, etc.) Lastly, induced impacts reflect effects from increased household income due to direct and indirect impacts, and wholesale electricity cost savings. (For example, spending by employees of a grocery store, restaurant, hotel, and/or spending by Connecticut electricity ratepayers etc.)

IMPLAN has been in use for more than 30 years and was originally commercialized by the Agricultural Department at the University of Minnesota. IMPLAN is used to assess economic impacts related to a wide variety of capital projects by federal and state agencies and private industry, including the U.S. Department of Agriculture, U.S. Department of Interior, U.S. Army Corps of Engineers, and U.S. Coast Guard. In addition to being used to assess the economic impacts of power plants, IMPLAN has also been used to assess impacts from baseball stadiums, forestry, factories (e.g. Tesla's 'Gigafactory'), etc.

JEDI was developed by the National Renewable Energy Laboratory ("NREL"), a Department of Energy laboratory. JEDI was created specifically to assess the economic impacts of power plant construction and operations, and has been in use by the power industry for 15 years.

The primary inputs to the JEDI model – projected expenditures (i.e. costs) in Connecticut – are summarized below for the construction (Table 1) and operations (Table 2) phases. As discussed in PA's original report, KEC's total equipment and construction costs are projected to be $537 million. Of that amount $142 million, 26% of the total project cost, is projected to be spent in Connecticut – as shown in Table 1.

Table 1: Connecticut Share of Total Expected Construction Costs

Expenditure Type	Connecticut Share of Total Cost ($millions)	Connecticut Share of Total Cost (%)
Materials	**$10**	**5%**
Power Generation	$0	0%
Plant Equipment	$10	5%
Plant Construction Labor	**$104**	**65%**
Other[1]	**$28**	**43%**
Total	**$142**	**26%**

Tables 1 and 2 present the Connecticut share of KEC's construction and operations costs in both dollars, 'Connecticut Share of Total Cost ($millions)', and as a percentage of the total cost, 'Connecticut Share of

[1] Includes costs associated with general facilities, engineering/design, construction insurance, land, permitting fees, transmission grid connection, spare parts, and sales tax (materials and equipment purchases).

Total Cost (%)'. For example, PA's analysis does not assume any of KEC's power generation equipment (e.g. combustion and steam turbines) is purchased in Connecticut. Therefore, the 'Connecticut Share of Total Cost (%)' is zero, and there is no direct impact to the state of Connecticut from KEC's power generation equipment purchases. However, direct onsite labor is expected to be primarily performed by Connecticut-based workers, which is reflected in the $104 million in labor costs shown in Table 1. This $104 million value represents 65% of KEC's total costs for plant construction labor. Similarly, in Table 2, 85% of KEC's costs associated with 'Labor (incl. Services)' are projected to be spent in Connecticut. Based on PA's discussions with NTE Connecticut, the expectation is that many of the onsite jobs associated with this labor expenditure will be filled by residents of the Town of Killingly and the neighboring towns.

Table 2: Connecticut Share of Annual Expected Fixed Operation Costs

Expenditure Type	Connecticut Share of Total Cost ($millions)	Connecticut Share of Total Cost (%)
Labor (incl. Services)[2]	$5	85%
Total	**$5**	**85%**

The primary input to the IMPLAN model is the projected electricity cost savings to Connecticut ratepayers from KEC's operations. PA's analysis projects KEC's operations to result in an annual average decrease of approximately 10% in wholesale electricity costs, all else equal, during the initial five years of KEC's operations. This equates to an average of approximately $215 million per year in wholesale electricity cost savings to Connecticut ratepayers.

The economic impacts of the expenditures presented in Table 1 (Connecticut Share of Total Expected Construction Costs) and Table 2 **(**Connecticut Share of Annual Expected Fixed Operation Costs), and the wholesale electricity cost savings to ratepayers as discussed above, is shown in Table 3 on the following page. Table 3 is the same as Table 2-3 in PA's original report (page 8), and illustrates the total economic impacts in terms of: (i) Employment (i.e. jobs), (ii) Earnings (i.e. wages); and (iii) economic output attributable to KEC to the state of Connecticut. These impacts are presented for both the construction period (2017 through mid-2020), and the initial five years of KEC's operations (mid-2020 through 2024)

For each category below (i.e. Employment Impact' (i.e. jobs created), 'Earnings Impact' (i.e. wages created), and 'Economic Output') the economic impacts from the expenditures presented in Table 1 are reflected in the 'Construction Period' lines. Similarly, the economic impacts from the expenditures presented in Table 2 are reflected in the 'Facility Operations' line items. The economic impacts from the wholesale electricity cost savings are reflected in the 'Cost Savings to Customer' line items. (The "Total Impacts', 'Total Outputs' lines in Table 3 reflect direct, indirect and induced impacts.)

[2] Includes $2-3 million in annual services costs.

Table 3: Total Economic Impacts on the State of Connecticut – Direct, Indirect and Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Employment Impact (FTEs per year)								
Construction Period	180	515	386	51	-	-	-	-
Facility Operations	-	-	-	62	74	74	74	74
Cost Savings to Customer	-	-	-	291	956	1,200	1,319	1,300
Total Employment Impact	**180**	**515**	**386**	**404**	**1,030**	**1,274**	**1,393**	**1,374**
Earnings Impact ($ - millions)								
Construction Period	25	73	56	8	-	-	-	-
Facility Operations	-	-	-	6	7	8	8	8
Cost Savings to Customer	-	-	-	18	62	79	89	90
Total Earnings Impact	**25**	**73**	**56**	**32**	**69**	**87**	**97**	**98**
Economic Output ($ - millions)								
Construction Period	36	106	82	11	-	-	-	-
Facility Operations	-	-	-	13	17	17	17	18
Cost Savings to Customer	-	-	-	50	166	213	240	241
Total Economic Output	**36**	**106**	**82**	**74**	**183**	**230**	**257**	**259**

As discussed in PA's original report, KEC is projected to contribute to more than $1 billion of increased economic output from 2017-24. The $1 billion reflects the sum of the values in the 'Total Economic Output' line item in Table 3 above, beginning with $36 million in 2017 and ending with $259 million in 2024. The $215 million per year in electricity cost savings to Connecticut ratepayers is projected to result in an average of $180 million per year in increased economic output during KEC's first five years of operations. (PA's analysis assumes that electricity cost savings represent an increase in household income, and that for every $1.00 increase in household income Connecticut electricity ratepayers will spend approximately $0.85. This is why $215 million in electricity cost savings results in a slightly lower economic output of $180 million.) The average of $180 million per year is based on annual economic output (as shown in the 'Cost Savings to Customer' line item) of $50 million in 2020, $166 million in 2021, $213 million in 2022, $240 million in 2023 and $241 million in 2024.

Table 4: Construction Period and Facility Operations: Breakout of Jobs and Earnings Impacts – Direct, Indirect and Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Direct Employment Impact (FTEs per year)								
Construction Period	95	273	204	27	-	-	-	-
Facility Operations	-	-	-	23	28	28	28	28
Indirect & Induced Employment Impact (FTEs per year)								
Construction Period	85	242	181	24	-	-	-	-
Facility Operations	-	-	-	38	46	46	46	46
Total Employment Impact	**180**	**515**	**386**	**113**	**74**	**74**	**74**	**74**
Direct Earnings Impact ($ - millions)								
Construction Period	18	53	40	5	-	-	-	-
Facility Operations	-	-	-	2	3	3	3	3
Indirect & Induced Earnings Impact ($ - millions)								
Construction Period	7	21	16	2	-	-	-	-
Facility Operations	-	-	-	4	5	5	5	5
Total Earnings Impact	**25**	**73**	**56**	**14**	**7**	**8**	**8**	**8**

As presented in PA's original report, in addition to the economic impacts on the state of Connecticut, KEC will also have economic impacts in and around the Town of Killingly. Table 4 is the same as Table 2-4 in PA's original report (page 9), and the values in Table 4 are included in the values presented in Table 3. (Similarly, Table 2-4 values in PA's original report are included in the values presented in Table 2-3.) The purpose of Table 4 is to highlight the direct employment and earnings impacts from KEC's construction and operations, which will originate in the Town of Killingly. These impacts will be driven by the direct onsite jobs created during construction and operations, illustrated in the upper portion of Table 4 under the 'Direct Employment Impact (FTEs per year)' heading. Construction jobs are projected to average 240 during the

height of construction (2018-19), with 25-30 long-term jobs created to support KEC's operations. These direct employment impacts result in associated wage creation and impacts, labeled as 'Direct Earnings Impact ($ - millions)' in Table 4, of $130 million from 2017 through 2024, with those impacts projected to be realized in and around the Town of Killingly. (The $130 million is based on $18 million of 'Construction Period' earnings in 2017 and ending with $3 million of 'Facility Operations' earnings in 2024.)

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United States headquarters
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405 Lexington Avenue,
New York, NY 10174
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APPENDIX B-2 – KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

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CONTENTS

1 EXECUTIVE SUMMARY

The following report has been prepared by PA Consulting Group ("PA") at the request of NTE Connecticut ("NTE") to analyze the need for, and the potential economic and environmental benefits of, the Killingly Energy Center ("KEC"). KEC is a planned 500 MW natural gas-fired electric generating facility to be located in the Town of Killingly, Connecticut. KEC plans to begin construction in 2017 and enter commercial operations in 2020, at which point it will be one of the most efficient operating electric generating facilities in Connecticut.

PA's analysis relied on a series of industry standard and proprietary models to assess (i) the need for the facility and (ii) project the economic and environmental benefits of KEC.

The need for KEC in the state of Connecticut and the overall New England market was based on PA's modeling of the Forward Capacity Auction ("FCA") 11. PA's modeling of FCA 11, scheduled to be held in February 2017, projects KEC to clear approximately 500 MW. Clearing its capacity in FCA 11 will demonstrate that KEC is needed for the reliability of the electricity market in Connecticut and the wider New England market.

The economic benefits (e.g. jobs, wages, and total economic output) were developed using the JEDI and IMPLAN models, and the environmental benefits (e.g. decreases in emissions such as CO_2, SO_2 and NO_X) were developed using PA's proprietary electricity market models. In addition to a reduction in emissions such as CO_2, SO_2 and NO_X, KEC is projected to result in positive economic benefits during both its construction (2017-20) and operating (2020+) phases. At the height of its construction in 2018, KEC will directly employ nearly 300 workers with annual wages of more than $50 million, and it will create more than 500 jobs and $70 million in earnings including the indirect and induced impacts. After construction has been completed and the plant commences operations, KEC will provide more than 25 direct full-time jobs with annual wages of $3 million – not including the indirect and induced jobs and earnings – and will pay significant annual property taxes to the Town of Killingly.

The primary impacts of KEC on the Town of Killingly and state of Connecticut are summarized below.

The Town of Killingly

- An average of 240 direct onsite construction jobs per year during the peak years of construction (2018-19) and more than 25 operating jobs in the long term (2020+) will be created in the Town of Killingly;
- These direct jobs will create an average of $45 million per year in wages during the peak years of construction (2018-19) and $3 million per year in long-term wages; and
- Significant annual property taxes to the Town of Killingly.

The State of Connecticut

- An average of 1,100 long-term jobs created from 2020 – 2024;
- $535 million in total wage creation from 2017 – 2024; and
- More than $1 billion in total economic output from 2017 – 2024.

The remainder of this report is structured into two main sections. The first section describes PA's methodology, analysis, and findings related to KEC's projected economic and environmental benefits. The

second section describes PA's methodology, analysis, and findings related to KEC's need for reliability in the New England electricity market, along with the project-specific details.

2 IMPACTS ANALYSIS

This section examines the economic and environmental benefits from KEC's construction and operations to the state of Connecticut and the Town of Killingly. As discussed below, KEC is projected to have both positive economic impacts, in the form of job and wage creation and increased economic activity, and positive environmental impacts from a reduction in emissions (e.g. CO_2, NOx and SO_2).

2.1 Overview of Connecticut and the Town of Killingly

The state of Connecticut has approximately 3.5 million people with a gross state product of approximately $260 billion and a per capita income of $65,000. The Town of Killingly (located in northeastern Connecticut) has a population of approximately 17,000 with an estimated per capita income of approximately $27,000. The top employment industries include education services, healthcare and social assistance (27%), manufacturing (16%), and retail trade (15%). Killingly's unemployment rate is estimated at over 9%.

Spanning 50 square miles with 7,000 households, Killingly's population density is 360 people per mile. The town is managed by a Town Council, made up of nine elected members with two-year terms. Approximately 2,800 students attend school in the town, from pre-kindergarten through Grade 12.

2.2 Assessment of economic benefits

KEC is projected to provide economic benefits to the state of Connecticut and the Town of Killingly during both its construction and operating periods. These economic benefits are expected to be realized in the three areas outlined below.

- KEC's construction – equipment, materials, and labor used during construction and state sales tax, permitting fees, and other activities.
- KEC's operations – fixed and variable costs associated with the materials and labor needed to operate the facility as well as annual property taxes to the Town of Killingly.
- Electricity cost savings to Connecticut ratepayers – KEC's entry will result in lower wholesale capacity and energy prices, thereby resulting in electricity cost savings to Connecticut ratepayers. Further detail on power market cost savings are included in Section 2.3.1.

For each of these areas, economic benefits are measured according to three factors: (i) job creation, (ii) wage creation, and (iii) economic output.

2.2.1 Methodology

To estimate the economic benefits, PA's analysis used an input-output (I-O) analysis. I-O analysis accounts for inter-industry relationships within a city, state, or expanded area, and employs the resulting economic activity multipliers to estimate how the local and regional economies are affected by a given investment. In this case, that investment is the construction and subsequent operations of the KEC facility.

Multiplier analysis is based on the notion of feedback through I-O linkages among firms and households who interact in regional markets. Firms buy and sell goods and services to other firms and pay wages to households. In turn, households buy goods from firms within the economic region. Therefore, the economic benefits of KEC extends to other local businesses through direct purchases and from purchases of locally produced goods and services that arise from the income derived by the employment that is created. Further benefits occur because of feedback effects – where other local firms require more labor and inputs to meet rising demand for their output, which has been stimulated by KEC's construction and operation.

The economic benefit of KEC's construction and operation can be categorized across three effects:

- **Direct** – jobs, income, output and fiscal benefits that are created directly by the construction and operations of KEC. The jobs (and other benefits) created may be short-term, as in the case of construction jobs, or long-term, such as the operations and maintenance positions that exist throughout the life of the facility.
- **Indirect** – jobs, income, output and fiscal benefits that are created throughout the supply chain and that are spawned by the direct investment to build and operate the facility. Indirect jobs include the jobs created to provide the materials, goods, and services required by the construction and operation of KEC, as well as the jobs created to provide the goods and services paid for with the wages from the direct jobs.
- **Induced** – jobs, salaries and wages, and output and fiscal benefits created by household spending of electricity cost savings or of income earned either directly from KEC or indirectly from businesses that are benefitted by KEC.

There is significant complexity involved in the calculation of these effects, particularly in the calculation of the indirect and induced effects, but a comprehensive estimate of economic benefits require all three. These estimates are also sensitive to the set of assumptions considered in the analysis, principally assumptions regarding the leakage of economic activity to outside of Connecticut. In addition, a series of variables, including changes to the price of electricity, will influence the multiplier impact analysis and, therefore, have been considered in tandem to assess the contribution of KEC to the local and regional economies.

2.2.2 Input-output models employed

The job creation, salaries and wages, and overall economic benefit of KEC has been analyzed using KEC's project-specific costs and two input-output models: IMPLAN and the National Renewable Energy Lab's Jobs and Economic Development Impact model ("JEDI").

IMPLAN is an economic analysis tool that takes data from multiple government sources and employs an estimation method based on industry accounts or an I-O Matrix that allows using multipliers to estimate how changes in income and spending benefit the local economy. IMPLAN estimates are generated by interacting the direct economic benefit of KEC with the Regional Input-Output Modeling System (RIMS II) multipliers for Connecticut. The U.S. Bureau of Economic Analysis ("BEA") provides these multipliers.

The JEDI model estimates the economic benefit of constructing and operating power generation plants at the state level. The JEDI model also uses an I-O methodology and was built utilizing economic data from IMPLAN as well as interviews with industry experts and project developers. The JEDI model allows estimating of the economic benefit of power generation investment in a state including local labor, services, materials, other components, fuel, and other inputs. The model also allows adjusting the portion of project investment that occurs locally.

2.2.3 Construction cost assumptions

Below is a high-level description of KEC's equipment and construction costs, which total $537 million. Details of the specific cost structure for KEC have been omitted due to their commercially sensitive nature.

Equipment

- Combustion Turbines and Generators
- Heat Recovery Steam Generators
- Exhaust Stacks
- Steam Turbine Generators
- Cooling and Related Systems
- Switchyard

Total Equipment Cost Estimate: $318 Million

Construction and Other Costs

- Development
- Design
- Construction

Total Construction Cost Estimate: $219 Million

2.3 Projected economic benefits

The construction, operations, and electricity ratepayer savings resulting from KEC's entry will create jobs, wages, and increased economic activity and output in the state of Connecticut and Town of Killingly. The economic benefit projections in this section include the direct, indirect, and induced effects of KEC's (i) construction period, (ii) facility operations, and (iii) electricity ratepayer savings (i.e. cost savings to customer) on Connecticut's economy.

2.3.1 Electricity cost savings to Connecticut customers

The electricity cost savings to Connecticut ratepayers, which are an input to the economic impacts input-output models discussed in Section 2.2, have been forecasted using PA's internal power market models. PA calculated the cost savings using its proprietary electricity market and capacity market simulation models, which simulated (i) the New England electricity market and the operations of the power plants within it, and (ii) the New England capacity auction. PA utilizes AURORA^{xmp} along with its proprietary stochastic model to assess both electricity markets and specific generator operations and economics. PA's capacity market model forecasts capacity prices based on its forecasts of (i) existing and new capacity, and (ii) FCA 11 demand curve parameters. These cost savings were determined by comparing Connecticut's total energy and capacity costs with and without KEC's entry into the market (in 2020).

PA's analysis found that KEC's entry would result in lower energy and capacity costs for Connecticut ratepayers. With the participation of KEC in New England's upcoming capacity auction, FCA 11, PA projects capacity prices for Connecticut to be approximately 10% lower than if KEC did not enter the market. Similarly, energy prices are projected to be 1% lower with KEC in the market, as it displaces less efficient generation in the market. The impact of these combined capacity and energy price decreases from KEC's entry is summarized in Table 2-3.

2.3.2 Total impacts to Connecticut employment, income, and economic output

Table 2-3 illustrates the total (i.e. direct, indirect, and induced) jobs, employee earnings, and economic output attributable to KEC on the state of Connecticut. The construction of KEC will result in significant investment and construction activity in Connecticut from 2017 to 2020, and the initial five years of operation will produce substantial energy and capacity cost savings to electricity ratepayers.

Table 2-3: Total Economic Impacts on the State of Connecticut – Direct, Indirect, and Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Employment Impact (FTEs per year)								
Construction Period	180	515	386	51	-	-	-	-
Facility Operations	-	-	-	62	74	74	74	74
Cost Savings to Customer	-	-	-	291	956	1,200	1,319	1,300
Total Employment Impact	**180**	**515**	**386**	**404**	**1,030**	**1,274**	**1,393**	**1,374**
Earnings Impact ($ - millions)								
Construction Period	25	73	56	8	-	-	-	-
Facility Operations	-	-	-	6	7	8	8	8
Cost Savings to Customer	-	-	-	18	62	79	89	90
Total Earnings Impact	**25**	**73**	**56**	**32**	**69**	**87**	**97**	**98**
Economic Output ($ - millions)								
Construction Period	36	106	82	11	-	-	-	-
Facility Operations	-	-	-	13	17	17	17	18
Cost Savings to Customer	-	-	-	50	166	213	240	241
Total Economic Output	**36**	**106**	**82**	**74**	**183**	**230**	**257**	**259**

The economic benefits of KEC on the state of Connecticut, including direct, indirect, and inducted impacts, are summarized as follows.

- **Jobs** – During the peak years of construction (2018-19), KEC will create an average of 450 full-time jobs per year (including an average of 240 direct onsite jobs per year). After construction is completed, KEC's ongoing operations will create an average of 70 long-term jobs (including an average of more than 25 direct onsite jobs per year). Furthermore, the electricity cost savings to ratepayers will create an average of more than 1,000 additional jobs annually form 2020-2024.
- **Salaries and wages** – The construction of KEC will support the creation of approximately $160 million in salary and wages to Connecticut employees from 2017-2020 (including $115 million to direct onsite employees). Salaries and wages earned by Connecticut employees and generated from KEC's operations from 2020-2024 total approximately $35 million (including $13 million to direct onsite employees). Additionally, from 2020-2024, the electricity cost savings of Connecticut ratepayers will result in $335 million in additional induced income. Cumulatively, these impacts will result in nearly $535 million in wage creation from 2017-2024.
- **Economic output** – KEC is projected to result in more than $1 billion of increased economic output from 2017-24. During the construction period, 2017-2020, economic output is projected to total $235 million. KEC's operations are projected to contribute an additional $80 million, with electricity cost savings to ratepayers projected to contribute nearly $180 million per year in increased economic activity from 2020-2024.

In addition to economic impacts on the state of Connecticut, KEC will also bring economic benefits to the Town of Killingly, driven in particular by the direct onsite jobs created during construction and operation. Table 2-4 provides a breakdown of the jobs and earnings created by the construction and operation of KEC, isolating the direct onsite jobs and resulting income from the indirect and induced impacts. KEC's construction is projected to create an average of 240 direct onsite construction jobs during 2018-19, and once operations begin in 2020, KEC is expected to create more than 25 long-term jobs. Wages associated

with these jobs are projected to be $45 million per year in 2018-19 and $3 million per year in the long term. In addition, KEC is projected to pay a significant amount in property taxes each year to the Town of Killingly.

Table 2-4: Construction and Operations Jobs and Earnings Impacts – Direct, and Indirect & Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Direct Employment Impact (FTEs per year)								
Construction Period	95	273	204	27	-	-	-	-
Facility Operations	-	-	-	23	28	28	28	28
Indirect & Induced Employment Impact (FTEs per year)								
Construction Period	85	242	181	24	-	-	-	-
Facility Operations	-	-	-	38	46	46	46	46
Total Employment Impact	**180**	**515**	**386**	**113**	**74**	**74**	**74**	**74**
Direct Earnings Impact ($ - millions)								
Construction Period	18	53	40	5	-	-	-	-
Facility Operations	-	-	-	2	3	3	3	3
Indirect & Induced Earnings Impact ($ - millions)								
Construction Period	7	21	16	2	-	-	-	-
Facility Operations	-	-	-	4	5	5	5	5
Total Earnings Impact	**25**	**73**	**56**	**14**	**7**	**8**	**8**	**8**

2.4 Assessment of environmental benefits

In addition to the economic benefits discussed in the previous section, KEC will also have a positive environmental impact on the state of Connecticut and the surrounding region. More specifically, KEC's entry will result in a decrease in the annual amount of emissions by New England power plants due to KEC operating ahead of (i.e. displacing) older, inefficient power plants in the market (e.g. coal, steam natural gas/fuel oil). This section describes PA's modeling methodology, analysis, and findings related to reductions in New England CO_2, SO_2, and NO_X emissions as a result of KEC.

2.4.1 Methodology

This subsection provides an overview of the emissions reductions likely to result from KEC's entry into the New England market. Using a methodology similar to that used to determine the capacity and energy cost savings discussed in Section 2.2, PA determined the annual emission reductions from KEC's entry by simulating the ISO-NE power market with and without KEC. The analysis was performed using PA's proprietary electricity market model, which simulates the operations of power plants within ISO-NE and adjacent power markets (e.g. New York). PA also utilizes AURORA^{xmp} for its production cost modeling in order to dispatch generation units to minimize total system cost and project incremental compensation required to maintain reliability.

2.5 Projected emissions reductions

Table 2-5 below illustrates the environmental benefits, via pollutant emissions reductions, from KEC's entry. From 2020-2024, the initial five years of KEC's operations, region-wide emissions of carbon dioxide ("CO_2") is projected to decrease by 1.5 million tons, while nitrogen oxide ("NO_X") and sulfur dioxide ("SO_2") are projected to decrease by 3,500 tons and 1,900 tons, respectively. The cumulative decrease in CO_2 is equivalent to planting 35,000,000 trees.[1]

[1] US Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator

Table 2-5: New England and New York Emission Reductions ($C0_2$ in 000's of tons; NO_X and SO_2 in tons)

Pollutant	2020	2021	2022	2023	2024
CO_2	(243)	(311)	(360)	(307)	(334)
NOx	(536)	(640)	(870)	(824)	(847)
SO_2	(229)	(406)	(458)	(424)	(441)

The reduction in emissions is primarily driven by KEC's high operating efficiency, which in technical terms equates to a low full load heat rate. (A full load heat rate is a measurement of a power plant's efficiency in converting feedstock (e.g. natural gas) into electricity at maximum operating output.) More specifically, as a highly efficient natural gas-fired electricity generating facility, KEC requires less fuel input (e.g. natural gas) per MWh of electricity produced than nearly all of existing natural gas, fuel oil and coal-fired power plants in New England. As such, when KEC produces electricity it will move ahead of (i.e.) displace less efficient (and less environmentally-friendly) forms of electricity generation that are currently operating in the market.

These market-wide emission reductions should not be taken as limiting the ability of the state of Connecticut to meet CO_2 emission reduction targets. As a participant in the Regional Greenhouse Gas Initiative ("RGGI"), all thermal power plants greater than 25 MW located within Connecticut (as well as the eight other participatory states) are subject to CO_2 emissions caps. As such, the addition of KEC will not impact the overall emissions reduction goals of RGGI given its emissions are also accounted for under the RGGI cap. KEC is likely to lead to an overall decrease in regional CO_2 emissions given the high operating efficiency of the facility, and may lead to an overall less costly compliance trajectory under the RGGI program. In addition, PA projects KEC will have either no impact or, more likely, a positive impact on Connecticut's ability to meet its emissions reduction targets set forth in the Environmental Protection Agency's ("EPA") Clean Power Plan ("CPP"). Whether KEC contributes to the state's compliance capability depends on how Connecticut ultimately decides to comply with the CPP. If Connecticut chooses to exclude new power plants from its compliance plan, then KEC will not be subject to CPP and, therefore, its development will have no impact on the state's ability to comply. If the state's compliance plan does include new power plants, then the entry of the highly efficient KEC would enhance Connecticut's ability to comply with the CPP.

3 NEEDS ANALYSIS AND PROJECT DETAILS

The following section outlines PA's analysis of (i) the need for KEC, (ii) how KEC contributes to the electric reliability of Connecticut and the overall New England electricity system, (iii) KEC's consistency with the Connecticut Department of Energy and Environmental Protection's long-term energy policy, and (iv) KEC's project details.

3.1 Standards for the determination of need

Load-serving entities ("LSE") located within the state of Connecticut are members of ISO-NE, an independent, non-profit Regional Transmission Organization ("RTO") serving Connecticut, Massachusetts, New Hampshire, Rhode Island, Vermont and portions of Maine. Among other items, ISO-NE operates the region's transmission network and administers the Federal Energy Regulatory Commission ("FERC") approved wholesale energy, ancillary, and capacity markets. In 1997, ISO-NE was created by NEPOOL market participants to operate the regional electricity system, create and administer the wholesale markets, and ensure open access to transmission. (See Figure 3-1 below for an illustration of ISO-NE footprint.) In 2005, FERC Order 2000 designated ISO-NE as an RTO; and as an RTO, ISO-NE assumed the additional responsibility for system planning.

Figure 3-1: Town of Killingly's Location in ISO-NE

ISO-NE accomplishes system planning for reliability via the Forward Capacity Market ("FCM") capacity procurement mechanism, approved by FERC in 2006. As members of ISO-NE, Connecticut LSEs rely upon ISO-NE's FCM capacity procurement mechanism to meet projected peak electricity demand plus a target amount of reserves (i.e., extra capacity). As described further in this section, it is through the FCM that ISO-NE determines the reliability-driven need for new capacity resources like KEC.

3.1.1 Governing statues, policy and regulation

In 1996, in accordance with FERC Orders 888 and 889, state regulators and LSEs throughout the New England region began the process of electricity market deregulation, and Connecticut's Department of Public Utility Control ("DPUC") began formal participation in the region's process of deregulation with the enactment of the Public Act No. 98-28. Subsequently, in 1998, Connecticut adopted an order approving retail choice for the state. Retail choice allows Connecticut electricity ratepayers the option to select a competitive retailer to supply their electricity needs, while still relying on the local electric utility for distribution service. Currently, there are two major distribution companies under the retail choice program operating in Connecticut. Connecticut Light & Power (dba Eversource) manages the distribution system for approximately 70% of Connecticut. United Illuminating Company, serving southwestern Connecticut, serves approximately 15% of Connecticut. The remaining 15% of the state is served by smaller distribution companies who are not in the retail choice territories. The town of Killingly is served by Eversource.

3.2 Determination of need analysis

The FCM capacity procurement mechanism is used by ISO-NE to ensure the regional electricity market has enough capacity resources to reliably meet current and future electricity demand. Under the FCM, Forward Capacity Auctions ("FCA") are used as a market-based approach to determine system-wide and localized needs for both existing and new capacity through a competitive auction process. This process is designed to select the appropriate amount of existing and new capacity resources that are needed for system-wide and local reliability while simultaneously maximizing social surplus. The capacity resources are selected by clearing the FCA. Therefore, capacity resources that clear the FCA are, by definition, needed for reliability.

3.3 Forward capacity market overview

FCAs are conducted three-years prior to the capacity commitment period (i.e., Delivery Year, or "DY") for which it is being held. The FCA is a descending clock auction whereby the auction starting price is reduced in each round until the amount of remaining capacity is equal to the value that ISO-NE places on additional excess capacity, based on its demand curve parameters. Capacity resources participating in the FCA do not submit sell offers; existing capacity resources that wish to withdraw from the auction must submit a de-list bid, which is subject to a reliability review. In addition to the FCA, ISO-NE holds annual, seasonal and monthly reconfiguration auctions in order to adjust the amount of capacity needed and to provide auction participants the opportunity to calibrate their forward capacity obligations.

The capacity that is required to meet ISO-NE's future system-wide demand is called the Installed Capacity Requirement ("ICR"). The ICR is the minimum amount of capacity required for ISO-NE to meet its resource adequacy planning criterion. Additionally, the FCM takes into account locational capacity needs to ensure that regional zones have sufficient capacity to maintain reliability when transmission constraints prevent the delivery of electricity to any particular capacity zone. Capacity requirements vary from year to year. For FCA 11, ISO-NE proposes to model two transmission-constrained zones: an import-constrained Southeastern New England Zone (Rhode Island and eastern Massachusetts) and an export-constrained Northern New England Zone (Maine, Vermont, and New Hampshire). The Connecticut capacity zone ("CT Zone"), where KEC will be located, and the Western Massachusetts zone will be included as part of the unconstrained Rest-of-Pool capacity zone ("ROP Zone").

For each FCA, capacity resources receive a capacity supply obligation ("CSO") of at least one year, which requires the capacity resource to bid into the energy market. In return, cleared capacity resources receive the applicable clearing price for that FCA (and can be financially penalized if they do not deliver on the

assigned capacity obligation). ISO-NE's next FCA is for the 2020/2021 DY ("FCA 11"), which will be held in February 2017. This auction will determine the capacity that is needed for reliability in ISO-NE during the 2020/2021 DY. KEC plans to participate in the auction for FCA 11.

3.3.1 Methodology

Since FCA 11 will not occur until February 2017, PA prepared an analysis of KEC's impacts within the ISO-NE wholesale electricity market, including (i) capacity projections for FCA 11, (ii) impacts on Connecticut electricity reliability, and (iii) impacts on Connecticut electricity ratepayer costs.

Using PA's proprietary FCM Simulation Model, within the context of PA's broader wholesale energy market analysis of the ISO-NE region and the aforementioned modeling architecture, PA's FCA capacity price forecast was developed based on its forecasts of (i) supply, including existing and new capacity; and (ii) demand, namely PA's projected FCA 11 demand curve and associated parameters as of June 2016.

3.3.2 Modeling assumptions

The supply curve for FCA 11 depends on several assumptions, including underlying cost and bidding behavior, retirement decisions of existing capacity, installed capacity requirements ("ICR") based on reliability criteria, as well as the cost of new entry for new capacity. KEC is projected to bid approximately 500 MW into the ROP Zone.

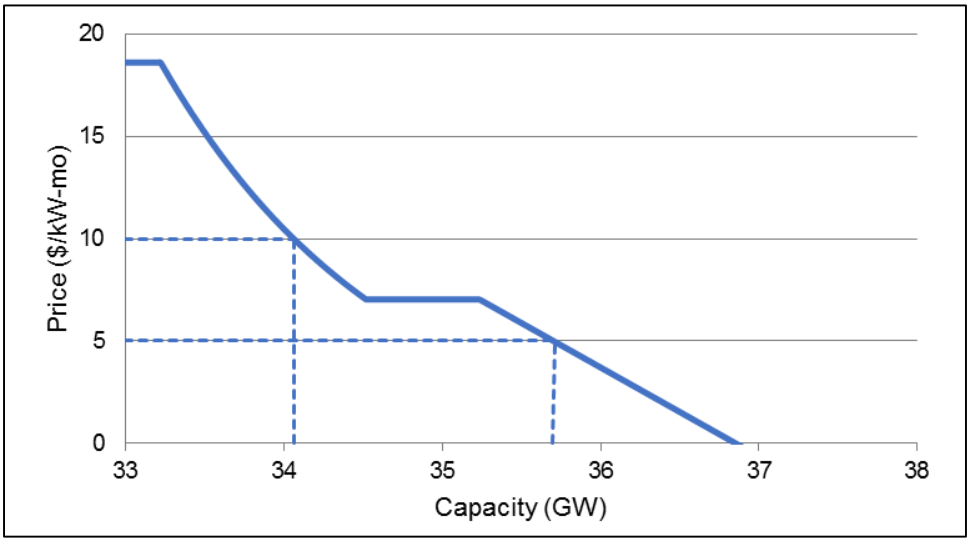
PA's view of demand assumes that ISO-NE will transition, as is currently proposed, from a linear sloped demand curve to a convex sloped demand curve in time for FCA 11. ISO-NE plans to transition to a fully convex curve within three years (depending on peak demand growth and the associated impact on ICR), which means that the curve for FCA 11 is only partially convex. Specifically, for FCA 11, the portion of the demand curve corresponding to prices above $7.03/kW-mo (i.e. the FCA 10 clearing price) is convex, whereas the portion of the demand curve corresponding prices below $7.03/kW-mo is linear. The two portions are connected by a flat "shelf" of 722 MW of capacity priced at a static $7.03/kW-mo.

In addition to a partially convex sloped system-wide demand curve, ISO-NE will for the first time implement a sloped demand curve for each transmission constrained capacity zone (e.g., NNE and SENE in FCA 11), which will replace the vertical demand curves used in prior auctions. Since PA projects the Connecticut Zone to be modeled as part of the ROP Zone for the duration of the study period, the zonal demand curve changes will not impact KEC's projections.

3.4 Projected FCA 11 results

Figure 3-2 shows an illustrative demand curve for FCA 11 and a hypothetical illustration of how capacity prices are derived. All else equal, as additional capacity clears the auction the clearing price will be lower, resulting in savings for ratepayers and greater social surplus. The figure below illustrates this concept.

Figure 3-2: FCA 11 Illustrative Price Calculation



For FCA 11, PA projects total cleared capacity of approximately 35.5 GW resulting in a clearing price of $6.19/kW-mo. At this clearing price, KEC is projected to clear the auction.

3.5 Findings on the determination of need

Based on the aforementioned analysis, PA projects KEC will clear FCA 11 at a price of $6.19/kW-mo. As previously discussed, by definition, if KEC clears FCA 11, then ISO-NE (and, by proxy, Connecticut LSEs that are participants in ISO-NE) will have determined KEC to be needed for the reliability of Connecticut and the wider New England market.

3.6 Fuel supply

KEC plans to use both firm natural gas transport and ultra-low sulfur diesel ("ULSD") as a backup fuel for its fuel supply needs.

KEC is contracting for firm natural gas fuel supply utilizing a firm delivered natural gas contract structure. Under the firm delivered natural gas contract structure, NTE enters into a natural gas fuel supply agreement with a single fuel supplier which provides interstate pipeline transportation, natural gas commodity, and balancing service bundled into one firm delivered natural gas fuel supply. The supplier holds a firm obligation to deliver natural gas regardless of market conditions; however, there could be circumstances where even firm natural gas pipeline transportation is curtailed due to operational flow orders or other operation events on the interstate pipeline even though a firm obligation exists. In this circumstance, KEC continues to have a delivery obligation to ISO-NE and thus must generate as required to maintain system integrity on the electric grid.

Therefore, back-up fuel is required in order to meet the capacity and delivery obligations of ISO-NE as these delivery obligations are not excused even in the event of curtailment of firm natural gas fuel supply. From an operations reliability standpoint this should advantageously position the facility versus other power plants in Connecticut that mostly rely on either interruptible natural gas transport or backup ULSD, but not both.

By having both a firm natural gas contract and ULSD backup KEC would be able to operate in virtually any situation.

KEC's planned firm natural gas transport contract will provide up to 95,000 MMBtu/day for seven years, starting in 2020. This is enough natural gas to support KEC's operations at maximum output for an entire day. KEC's use of ULSD will only be allowed when natural gas is unavailable (likely due to an extreme gas demand event) and for up to a maximum of 720 hours per year of operations. However it is expected that KEC would operate using ULSD for only a handful of hours at a time, and not likely in every year.

3.7 Transmission interconnection and power delivery

KEC will connect to the existing 345 kV electric transmission line (Lake Road to Card) located adjacent to the property's eastern boundary. Electrical equipment adjacent to the facility will convert (i.e. step up) the generated electricity from approximately 20 kV to 345 kV in order to provide electricity at the same voltage as the existing electric transmission circuit. A switchyard (configured as a three-breaker ring-bus) will be constructed on the portion of the property south of Lake Road to allow the transmission lines from KEC to interconnect directly with the existing transmission system.

3.8 Consistency with state plans

As part of Connecticut's 2014 Integrated Resources Plan ("IRP"), the Connecticut Department of Energy and Environmental Protection ("DEEP") has proposed several capacity resourcing strategies that it believes will help the state of Connecticut reach the goal of achieving a reliable, clean, and cost-effective pool of energy supply. Chief among these strategies is the goal of ensuring Connecticut has enough capacity to meet peak winter electricity demand in a clean and cost-effective manner.

The development of KEC supports both parts of this strategy. Not only would KEC add approximately 500 MW of reliable electricity generation to Connecticut – KEC's firm natural gas contract (see Section 3.6) and ULSD backup virtually guarantee KEC will be available to operate under almost any circumstance – but with natural gas prices at near-historic lows (and by using state-of-the-art turbine technology) it would do so in a cost-effective manner. When KEC enters the market in 2020 it is likely to be one of only a handful of facilities in New England with both firm natural gas and ULSD backup, and it would be 25% more efficient at generating electricity than today's average Connecticut power plant.

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United States headquarters
45th Floor, Chrysler Building,
405 Lexington Avenue,
New York, NY 10174
Tel: +1 212 973 5900

paconsulting.com

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