

Economic Impact Assessment

Long Island – New York City Offshore Wind Project

Contract No. 4500191884

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November 1, 2010



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Executive Summary

The Long Island - New York City Offshore Wind Collaborative¹ commissioned AWS Truepower (AWST) and Camoin Associates to conduct an economic impact assessment of the proposed Long Island - New York City Offshore Wind Project (“Project”). The Project, planned to be installed 13 to 15 miles southeast of the Rockaway Peninsula, is proposed to range in size from 350 to 700 megawatts (MW) and it is assumed that the construction and installation phase will last three years. The Study Area for the economic impact model used in this analysis is comprised of the following nine New York counties: Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, and Westchester.

Construction and Installation Phase

During each of the three years of Project development, construction and installation activities are expected to generate the following economic impact on the Study Area.² Impacts were calculated for the 350 MW and 700 MW Project size to provide a range of anticipated impact.

- **350 MW Project:** \$450 million in new sales at Study Area firms each year. This corresponds to the creation of 2,300 jobs paying \$170 million annually in wages.
- **700 MW Project:** \$900 million in new sales each year, corresponding to the creation of 4,700 new jobs paying \$330 million annually in wages.

Operation and Maintenance Phase

¹ The New York Power Authority, Long Island Power Authority and Con Edison jointly funded this study.

² The results of the economic impact model were rounded in an effort to simplify the narrative. For more detailed results, see tables in Appendix A.

The operation and maintenance of the Project will have the following economic impact on the Study Area for the operational life of the Project:

- **350 MW Project:** results in the creation of 85 new jobs paying \$5 million in wages annually.
- **700 MW Project:** results in the creation of 170 new jobs paying \$11 million in wages annually.

Total Economic Impact

Assuming three years of construction and installation and 20 years of operation, the total economic impact of the Project on the Study Area will be approximately³:

- **350 MW Project:** \$1 billion in sales, 8,700 job-years and \$610 million in wages (expressed in present-year dollars).
- **700 MW Project:** \$3 billion in sales, 17,000 job-years and \$1 billion in wages.

Port Survey

To support the economic impact analysis, AWST conducted a high-level desktop assessment of the ports located in New York and New Jersey near the Study Area. Based upon the results of this preliminary evaluation, the Howland Hook Marine Terminal, located on Staten Island, is expected to be the most viable New York State option to host the Project's construction-related onshore activities. In addition, there are several other alternative port facilities, located both in New York and New Jersey, which could also potentially be utilized for

³ The results of the economic impact model were rounded in an effort to simplify the narrative. For more detailed results, see tables in Appendix A.

the Project. The Collaborative plans to initiate discussions with the Port Authority of New York and New Jersey for additional port evaluation.

Introduction

The Long Island - New York City Offshore Wind Collaborative⁴ commissioned AWS Truepower (AWST) and Camoin Associates (“Project Team”) to conduct an economic impact assessment of the proposed Long Island – New York City Offshore Wind Project (“Project”). The Project is proposed to range in size from 350 to 700 megawatts (MW) and be located in the Atlantic Ocean, approximately 13 to 15 miles southeast of the Rockaway Peninsula.

The Collaborative is currently gathering background information as part of an internal review of the Project by stakeholders of the LI-NYC Offshore Project. This report is intended to provide decision makers with a high-level look at the potential economic impact of the Project on downstate New York, including jobs, wages, and economic output generated by the Project. The Study Area for the economic impact model used in this analysis is comprised of the following nine New York counties: Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, and Westchester (see map in Figure 1 below).

⁴ The New York Power Authority, Long Island Power Authority, Con Edison jointly funded this study.

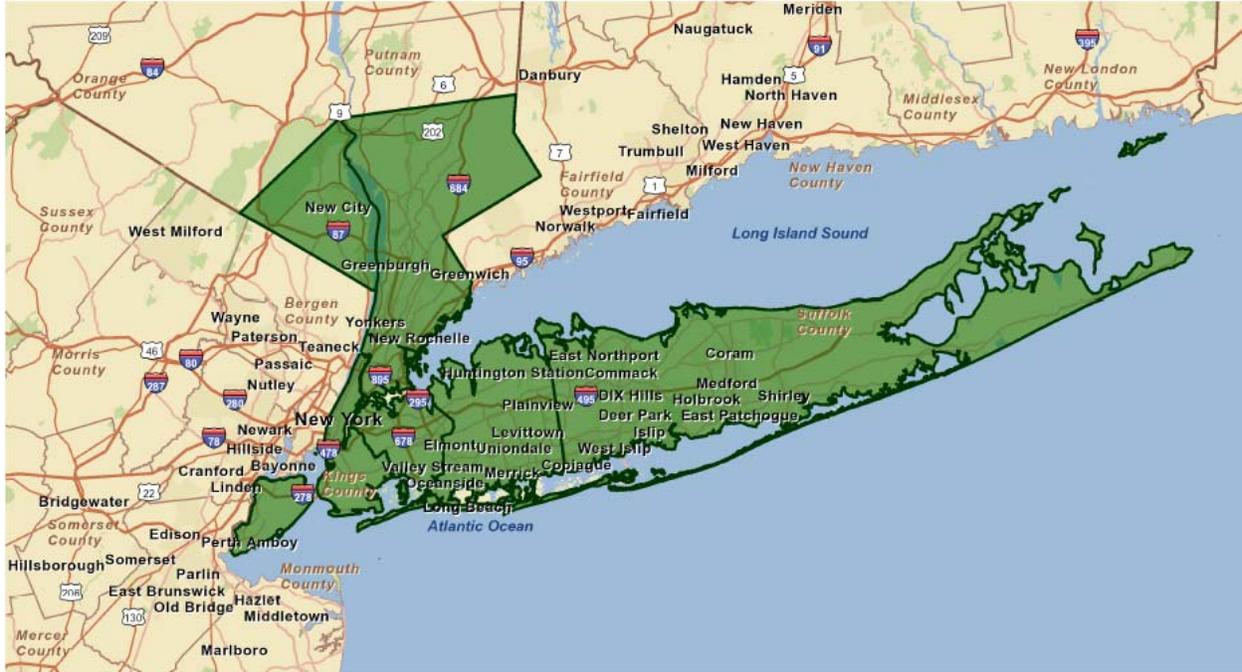


Figure 1– Map of the Study Area for the LI-NYC offshore wind project economic impact analysis.

AWS Truepower, LLC

AWST is an international leader and innovator in wind and solar energy consulting services. AWST’s staff of engineers, meteorologists, modelers, and environmental specialists has worked on the design and assessment of over 40,000 MW of wind projects, both on land and offshore. Services offered by AWST span virtually the full life cycle of project planning, implementation, and evaluation: project management, feasibility studies, site identification, resource assessment, wind mapping and micrositing, project design and analysis, wind technology assessments, energy production prediction, engineering review and due diligence, transmission screening and interconnection analysis, environmental and regulatory review, financial analysis, short-term production forecasting, plant performance assessment, and outreach activities.

Camoin Associates, Inc. and Advanced Energy Economics

For over 11 years, Camoin Associates has been providing assistance to a variety of institutional stakeholders to identify economic potential and to craft

strategies for achieving optimal economic results. Camoin Associates has extensive experience providing support to municipalities in creating strategies, policies and programs to support investment and job creation, as well as advising businesses and developers in capitalizing on funding, financing and tax incentive programs established to encourage private investment. Camoin Associate's service mix has been carefully designed to provide start-to-finish economic development solutions for communities and businesses of all sizes. Camoin recently established a new division called Advanced Energy Economics, which specifically focuses on evaluating the economic development potential and economic impacts of energy-related projects.

Methodology and Assumptions

In order to conduct an economic impact analysis of the Project, it is first necessary to estimate how much the Project will cost to construct and how much of that cost will be sourced locally (meaning materials and labor will be provided by firms in the nine-county Study Area shown in the map in Figure 1). It is assumed that the locally-sourced portion of the Project cost represents economic activity that would not otherwise occur in the Study Area if not for the Project because renewable power would have to be imported from elsewhere (Upstate New York, other nearby states, etc.) in order for New York City and Long Island to meet their renewable power goals. These policy goals themselves have negative cost implications for utility customers, which have not been subtracted for purposes of this analysis because those negative impacts will exist whether the Project moves forward or not. This report illustrates the level of economic activity that the Study Area can retain due to this Project, rather than having to send local dollars outside the Study Area to meet the renewable energy policy goals that have been established independent of the Project.

The total per MW installation cost associated with the Project is estimated at \$5.5 million.⁵ The table below breaks this per MW cost down by component.⁶

⁵ An average construction and installation cost of \$5.5 million per megawatt was estimated for the LI-NYC offshore project; this value is based upon a memo submitted by AWS Truepower to

In addition to the costs associated with the construction and installation of the wind farm, there will also be costs associated with the system upgrades necessary to get the power to the customers. As detailed in the *Joint Con Edison-LIPA Offshore Wind Power Integration Project Feasibility Assessment* (March 2009), the cost to perform system upgrades for a 350 MW project would be \$415 million and \$821 million for a 700 MW project.

The following table shows the breakdown of the total per MW installation cost that is assumed to be sourced by local firms within the Study Area, including the cost of the required system upgrades in each scenario.

Construction Phase - Economic Activity Occurring Within the Study Area Per Megawatt						
Component	Percent of Total Cost	Cost Per MW		Percent Occuring in Study Area	Cost Per MW Occurring in Study Area	
		350 MW	700 MW		350 MW	700 MW
Wind Turbines	45%	\$ 2,475,000	\$ 2,475,000	10%	\$ 247,500	\$ 247,500
Installation	7%	\$ 385,000	\$ 385,000	30%	\$ 115,500	\$ 115,500
Interconnection	8%	\$ 440,000	\$ 440,000	30%	\$ 132,000	\$ 132,000
Collection System	13%	\$ 715,000	\$ 715,000	30%	\$ 214,500	\$ 214,500
Foundations	25%	\$ 1,375,000	\$ 1,375,000	90%	\$ 1,237,500	\$ 1,237,500
Other	2%	\$ 110,000	\$ 110,000	50%	\$ 55,000	\$ 55,000
SubTotal		\$ 5,500,000	\$ 5,500,000	36%	\$ 2,002,000	\$ 2,002,000
System Upgrades		\$ 1,186,000	\$ 1,173,000	50%	\$ 593,000	\$ 586,500
Total		\$ 6,686,000	\$ 6,673,000	39%	\$ 2,595,000	\$ 2,588,500

Source: AWS Truepower, Camoin Associates, Con Edison and LIPA.

The following explains the rationale behind the assumptions shown in the table above:

the LI-NYC Offshore Collaborative on July 29, 2009. The memo cites a cost range of \$4.5-\$6.0 million per megawatt for recent offshore projects constructed in comparable water depths. The average value of \$5.25 million as was adjusted by applying a 10% regional adder to approximately half the project costs to account for increased construction and material costs in the LI-NYC area.

⁶ The percentages are assumed to remain the same as those presented on page 154 of *New York's Offshore Wind Energy Development Potential in the Great Lakes: Feasibility Study* provided to NYSERDA by AWST in April 2010.

- **Wind Turbines:** Production of most components of an offshore wind turbine requires highly specialized labor and facilities. Unless a turbine manufacturer is specifically brought into the area, or mandated to source parts locally as part of the supply agreement, it is expected that the majority of the turbine components will originate from outside the Study Area. It is assumed that the tower is the only part of the turbine that may be sourced from a firm or firms in the Study Area, which is roughly 10% of the turbine cost.
- **Installation:** The majority of the offshore activities will be conducted by an experienced offshore turbine installation company or a crew deployed by the manufacturer itself; in either case these teams are not likely to be from within the Study Area. It is also unlikely that the turbine installation vessels (TIVs) required by the installation team will be sourced by firms within the Study Area. It is assumed that 30% of the installation cost can be sourced locally, which means that local labor will be utilized for supporting onshore activities, (unloading, loading, and staging components) as well as a limited amount of the activities offshore. Additionally, given the industrial resources in the region, any unforeseen work (e.g. vessel or crane repairs, foundation repairs, etc.) will most likely also occur within the Study Area.
- **Interconnection:** Worldwide, there are only a few manufacturers who can fabricate the armored undersea cables that are used for offshore wind farm inter-array cabling and transmission, none of which are located within the Study Area. Because such a large portion of the cost of constructing the interconnection is attributable to the undersea cables and the use of specialized vessels and crew to install the transmission line to the point of interconnection, we assume that only 30% of these costs will be paid to local firms.
- **Collection System:** As with the interconnection costs, the bulk of the cost of the collection system is attributable to the undersea cables and the use

of specialized vessels and crew to install them. If a concerted effort is made to source the substation design work, equipment, and materials locally, then it is reasonable to assume that 30% of the costs would be captured by firms within the Study Area.

- **Foundations:** Though it may be somewhat dependent upon the foundation type that is chosen--concrete gravity or steel-based (e.g. monopile, jackets, multimember)--the construction of the foundations likely represents one of the highest value categories for the Study Area. The materials and skilled labor required to construct and install the foundations are present in the Study Area, although it is reasonable to assume that some of the design work may be done outside of the area, which results in the assumption that 90% of this cost will be captured by local firms.
- **Other:** This category encompasses miscellaneous costs such as environmental analyses, project engineering and project management. While some of these services may be provided by firms outside the Study Area, we assume that half the work will be conducted by firms within the Study Area.
- **System Upgrades:** Much of the design, project management and materials required to complete the necessary system upgrades will come from outside of the Study Area, but almost all of the labor for actual construction will be sourced by local utilities and contractors. Therefore, we assume that 50% of the costs will be captured by firms within the Study Area.

For purposes of this analysis, the Project is assumed to take three years to construct⁷, whether it is 350 MW or 700 MW in size. The table below shows the

⁷ A three year construction/installation phase has been assumed to simplify the analysis. Please note that the actual length of this phase will be dependent upon the size of the Project (a 350 MW project size may be constructed in less than three years, while a 700 MW may take longer), among other variables.

direct economic activity generated in the Study Area during the construction and installation phase, as well as the annual direct economic activity based on the three year build-out assumption. The annual economic activity is approximately \$300 million for the 350 MW Project and \$600 million for the 700 MW Project.

Construction Phase - Economic Activity Occurring Within the Study Area			
Project Size	Study Area Economic Activity Per MW	Study Area Economic Activity (Total)	Annual Study Area Economic Activity
350 MW	\$ 2,595,000	\$ 908,250,000	\$ 302,750,000
700 MW	\$ 2,588,500	\$ 1,811,950,000	\$ 603,983,000

Note: Construction of Project is assumed to take three years.

In addition, the on-going operations and maintenance of the Project are assumed to generate a positive economic impact in the Study Area. Based on consultation with wind turbine manufacturers and companies specializing in offshore wind farm installation, an estimate of the number of jobs created for operations and maintenance was developed and is shown in the table below.

Operation and Maintenance - Total Employment				
Project Size (MW)	MW per Turbine	Number of Turbines	Crew Required Per	Total Employment
350	3.6	97	0.36	35
700	3.6	194	0.36	70

The job creation estimates in the table above are comprised of wind turbine technicians and vessel crews and support staff. Interviews with wind turbine manufacturers yielded an estimate of four technicians spending a full work week per year per turbine for regular maintenance and system reviews. The following table shows the full time equivalent (FTE) technician positions that will be required to service the Project once it is operational.

Operation and Maintenance - Technical Staff					
Project Size (MW)	MW per Turbine	Number of Turbines	Man Hours Per Turbine	Number Man Hours	FTE
350	3.6	97	160	15,556	8
700	3.6	194	160	31,111	16

Assumes 2,000 man hours per year.

The remainder of the operation and maintenance jobs is assumed to be comprised of vessel crews and support staff as shown in the table below.

Operation and Maintenance - Support Staff			
Project Size (MW)	Total O&M Employment	Technical Staff	Support Staff
350	35	8	27
700	70	16	54

Results of Economic Impact Analysis

The estimates of direct economic activity generated during construction and installation and the operation and maintenance jobs calculated in the previous section were used as the direct inputs for the economic impact model. Camoin Associates used the input-output model designed by Economic Modeling Specialists, Inc. (EMSI). EMSI allows the analyst to input the amount of new direct economic activity (spending or jobs) occurring within the study area and uses the direct inputs to estimate the spillover effects that the net new spending or jobs have as these new dollars circulate through the Study Area economy. This is captured in the indirect impacts and is commonly referred to as the “multiplier effect.”

Construction and Installation Phase

During each of the three years of Project development, construction and installation activities are expected to generate the following economic impact on the Study Area⁸:

- **350 MW Project:** \$450 million in new sales at Study Area firms each year. This corresponds to the creation of 2,300 jobs paying \$170 million annually in wages.
- **700 MW Project:** \$900 million in new sales each year, corresponding to the creation of 4,700 new jobs paying \$330 million annually in wages.

Operation and Maintenance Phase

The operation and maintenance of the Project will have the following economic impact on the Study Area for the operational life of the Project:

- **350 MW Project:** results in the creation of 85 new jobs paying \$5 million in wages annually.
- **700 MW Project:** results in the creation of 170 new jobs paying \$11 million in wages annually.

Total Economic Impact

Assuming three years of construction and installation and 20 years of operation, the total economic impact of the Project on the Study Area will be approximately⁹:

⁸ The results of the economic impact model were rounded in an effort to simplify the narrative. For more detailed results, see tables in Appendix A.

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- **350 MW Project:** \$1 billion in sales, 8,700 job-years and \$610 million in wages (expressed in present-year dollars).
- **700 MW Project:** \$3 billion in sales, 17,000 job-years and \$1 billion in wages.

Port Survey

AWST conducted a high-level desktop evaluation of the New York and New Jersey ports located near the proposed Project area to provide supporting information for the assumptions that form the basis for the economic impact analysis. The goal of this assessment was to identify potential candidate ports for hosting the onshore activities associated with the installation, operation, and maintenance of an offshore wind farm. Using publicly available data, the port facilities in the region were evaluated based on the typical logistical and operational requirements for offshore wind farm installations. These requirements include available storage/construction areas, vessel draft and vertical clearance (air draft) specifications, accessibility, and existing usage, among others. The specific criteria used to evaluate port facilities for this survey are listed below:

- Construction and component storage area of approximately 60,000–75,000m² (646,000–807,000 ft²);
- Warehouse area of 1,000–2,500m² (11,000–27,000 ft²) is desirable but not essential;
- Minimum dockside (quayside) draft depth of 5m (16.4 ft);
- Length of dedicated dockside access of at least 100m (preferably 200m);
- Minimum load bearing capacity of at least 2 tons/m² for the construction and storage areas;
- Truck load bearing capacity of no less than 12 tons.

A sizeable amount of available area along the dock, also referred to as the quayside, for construction/staging makes it easier for the activities associated

with the wind farm installation to be isolated from the normal port operations. Ideally, the area on the quayside will allow for the possibility to load preassembled rotors onto the installation vessels, an approach taken by some offshore turbine installers. The preassembly method which requires the most quayside space is known as the “star configuration,” whereby all of the blades are attached to a vertically-oriented hub. This approach requires a quayside staging area that is, at minimum, slightly larger than the turbine’s rotor diameter. The amount of area that will be necessary for component storage will be dependent upon the installation approach. Typically, turbine components are delivered regularly to the port throughout the installation process in small subsets of the total number of turbines; the components are put into short-term storage, assembled/staged, and then installed offshore, making room for more components to be delivered. If long-term storage of the turbine components is necessary, more storage area, in addition to the area cited above, may be necessary.

The port facilities in the downstate NY and northern NJ region regularly receive large sea-going freight transport vessels, so it is anticipated that the slips are well maintained. These ports typically have drafts that are much deeper than 5 meters (16.4 feet), the typical minimum requirement for offshore wind farm construction vessels. Given the weight of the turbine components, as well as the weight of cranes necessary to move the turbine components, the load bearing capacity of the quayside is of great importance. Furthermore, increasing the load bearing capability of a port’s quay is one of the most costly upgrades that can be made to a port. Considering the weight and volume of freight that passes through the port facilities in this region, the quays are expected to be in relatively good condition and possess sufficient load bearing capacity to satisfy the Project’s requirements. Additionally, all of the facilities are located in industrial areas, which lends itself to the 24/7 operations that are common during the construction phase of the installation process.

The clearance between the construction vessels and overhead structures, also known as air draft, along the shipping approach is another factor that needs to be considered when evaluating port facilities in this region. Air draft

requirements are an important design consideration not only for the selection of a TIV, but also for the configuration of the equipment onboard. Preassembled turbine towers and rotors in the “rabbit ear” configuration (two blades attached to the nacelle at 10 and 2 o’clock) can extend well above the deck of the installation vessel. Both the Verrazano–Narrows and the Bayonne Bridges allow for vessels with relatively high air drafts, 69.5m and 46m respectively. However, if a TIV is unable to reach a given port due to height restrictions, an equally viable approach involves using multiple feeder barges to transport the components, while the TIV remains at the offshore Project area. The feeder barges, which have much lower air draft requirements, continuously make trips between the port facility and the Project area, supplying the TIV with all the components for each turbine. This type of installation approach may be necessary if the Project were to utilize an installation vessel that is comparable in size to purpose–built TIVs such as the MPI Resolution, which has an air draft of approximately 67m (220 ft).

Based upon the results of this preliminary analysis, the most feasible potential host port located in New York State (NYS) is the Howland Hook Marine Terminal (see Figure 2 below), located on the northwest end of Staten Island. This facility primarily receives large cargo container transport vessels; accordingly, it is likely that the existing infrastructure will meet the Project’s requirements. The existing quay is about 760m (2,500 ft) long, with draft depths ranging from 11–14m (36–46 ft). The open storage area along the quayside is approximately 595,000m² (6,400,000 ft²), which should allow the port’s operations to continue alongside the Project’s onshore activities. This facility also features 18,600m² (200,000 ft²) of warehouse space. Furthermore, the Howland facility is presently undergoing an expansion into an adjacent property; this expansion is expected to significantly increase the available area for open and warehouse storage. Construction vessels will need to pass under both the Verrazano–Narrows and the Bayonne Bridges to access this facility.



Figure 2 – *Left*: Overview of the port facilities in the upper portion of New York Bay. *Right*: Map of the Howland Hook Marine Terminal facility. (Source: The Port Authority of New York and New Jersey 2010 Port Guide)

There are also several alternative NYS sites that could potentially be utilized, though the layout and size of these locations are not as advantageous as the Howland Hook facility. The alternative NYS sites include the Brooklyn Port Authority Marine Terminal, the Red Hook Container Terminal, and the South Brooklyn Marine Terminal. Additionally, there are a number of large seaports nearby in New Jersey that would likely be suitable to serve as port facilities for the Project, including the Port Newark–Elizabeth Marine Terminal, the Port Jersey Terminal, Global Marine Terminal, and the Peninsula at Bayonne Harbor (formerly the Military Ocean Terminal at Bayonne). However, if a NJ port were to be utilized for the LI–NYC offshore project, the economic impact to the Study Area will likely differ from the results of the present economic analysis due to the supporting assumption that the Project would be hosted by a NY port. Along with the Howland Hook Terminal, these facilities represent the best options in the region to support the Project’s onshore activities because they regularly receive large freight transport vessels; as such, it is likely that their existing infrastructure will meet or exceed the Project’s requirements. If none of the identified ports are available to host the Project, there are other facilities within the region that may also be of use, though they may require a significant investment to improve the existing infrastructure.

The availability of these large port facilities for the Project will be dependent upon their existing obligations, as well as their willingness to be flexible in accommodating all aspects of an offshore wind project's needs such as scheduling, storage space, security requirements (e.g. International Ship and Port Facility Security rules, fencing, security personnel), and so on. However, the opportunity to host a construction project over two or three years offers a stable source of income that may be regarded as a welcome supplement to a port's normal revenue stream. Trade statistics from the New York and New Jersey Port Authority indicate that imports and exports decreased notably in 2009, most likely due to the recent economic downturn. This decrease in freight traffic may be indicative of a present underutilization of the region's facilities, though it is difficult to predict what the condition of the economic climate will be when the Project is being constructed.

Provided that one of the aforementioned port facilities is available to host the Project's onshore activities, it is likely that infrastructure upgrade costs will be minimal.¹⁰ At a more advanced stage of the port evaluation process, it is recommended that site visits to the candidate ports be conducted to help envision the logistics associated with the Project's onshore operations.

Conclusion

The economic impact analysis for the Project estimated that during the construction phase, between \$450 to \$900 million in new sales will be generated in the Study Area annually, and approximately 2,300 to 4,700 new jobs paying \$170 to \$330 million in annual wages will be created. During the

¹⁰ The suitability of a port facility to host the onshore activities will be dependent upon a number of factors specific to the Project (e.g. vessel size, installation approach, turbine and foundation choice, etc.); consequently, it will be important to reassess the evaluation criteria as the Project gains further definition.

operational phase of the Project, 85 to 170 new jobs will be created in the Study Area, paying \$5 to \$11 million in wages annually.

The total economic impact to the Study Area during Project development and throughout the Project's operational life is estimated to be between \$1 billion and \$3 billion in sales, 8,700 to 17,000 job-years created and \$610 million to \$1 billion in wages.

The results of a high-level survey of the ports in New York and New Jersey near the Study Area indicate that suitable facilities exist that could host the Project's onshore activities with minimal infrastructure upgrade costs. The actual investment necessary for infrastructure improvements will be dependent upon the availability and condition of existing facilities in the area. These findings support the assumptions upon which the economic impact analysis is built.

Appendix A

What is economic impact analysis?

The purpose of conducting an economic impact study is to ascertain the total cumulative changes in employment, earnings and output in a given economy due to some initial “change in final demand”. To understand the meaning of “change in final demand”, consider the installation of a new widget manufacturer in Anytown, USA. The widget manufacturer sells \$1 million worth of its widgets per year exclusively to consumers in Canada. Therefore, the annual change in final demand in the United States is \$1 million because dollars are flowing in from outside the United States and are therefore “new” dollars in the economy.

This change in final demand translates into the first round of buying and selling that occurs in an economy. For example, the widget manufacturer must buy its inputs of production (electricity, steel, etc.), must lease or purchase property and pay its workers. This first round is commonly referred to as the “Direct Effects” of the change in final demand and is the basis of additional rounds of buying and selling described below.

To continue this example, the widget manufacturer’s vendors (the supplier of electricity and the supplier of steel) will enjoy additional output (i.e. sales) that will sustain their businesses and cause them to make additional purchases in the economy. The steel producer will need more pig iron and the electric company will purchase additional power from generation entities. In this second round, some of those additional purchases will be made in the US economy and some will “leak out”. What remains will cause a third round (with leakage) and a fourth (and so on) in ever-diminishing rounds of spending. These sets of industry-to-industry purchases are referred to as the “Indirect Effects” of the change in final demand.

Finally, the widget manufacturer has employees who will naturally spend their wages. As with the Indirect Effects, the wages spent will either be for local

goods and services or will “leak” out of the economy. The purchases of local goods and services will then stimulate other local economic activity; such effects are referred to as the “Induced Effects” of the change in final demand.

Therefore, the total economic impact resulting from the new widget manufacturer is the initial \$1 million of new money (i.e. Direct Effects) flowing in the US economy, plus the Indirect Effects and the Induced Effects. The ratio between Direct Effects and Total Effects (the sum of Indirect and Induced Effects) is called the “multiplier effect” and is often reported as a dollar-of-impact per dollar-of-change. Therefore, a multiplier of 2.4 means that for every dollar (\$1) of change in final demand, an additional \$1.40 of indirect and induced economic activity occurs for a total of \$2.40.

Key information for the reader to retain is that this type of analysis requires rigorous and careful consideration of the geography selected (i.e. how the “local economy” is defined) and the implications of the geography on the computation of the change in final demand. If this analysis wanted to consider the impact of the widget manufacturer on the entire North American continent, it would have to conclude that the change in final demand is zero and therefore the economic impact is zero. This is because the \$1 million of widgets being purchased by Canadians is not causing total North American demand to increase by \$1 million. Presumably, those Canadian purchasers will have \$1 million less to spend on other items and the effects of additional widget production will be cancelled out by a commensurate reduction in the purchases of other goods and services.

Changes in final demand, and therefore Direct Effects, can occur in a number of circumstances. The above example is easiest to understand: the effect of a manufacturer producing locally but selling globally. If, however, 100% of domestic demand for a good is being met by foreign suppliers (say, DVD players being imported into the US from Korea and Japan), locating a manufacturer of DVD players in the US will cause a change in final demand because all of those dollars currently leaving the US economy will instead remain. A situation can be envisioned whereby a producer is serving both local

and foreign demand, and an effects analysis would have to be careful in calculating how many “new” dollars the producer would be causing to occur domestically.

Non-Rounded Results of Economic Impact Model for the Project

Camoin Associates used the input-output model designed by Economic Modeling Specialists, Inc. (EMSI). EMSI allows the analyst to input the amount of new Direct Effects (spending or jobs) occurring within a given study area and estimates the multiplier effect of the change on that study area.

The report body presents the results of the economic impact model in rounded numbers in an effort to simplify the reading of the document. The following tables contain the exact numbers produced by the input-output model for the Project for informational purposes.

Construction and Installation Phase

The tables below show that the Project will have the following annual impact on the Study Area during the construction and installation phase, which is assumed to last for three years:

- **350 MW Project:** The construction and installation of the Project will result in approximately \$451 million in sales at Study Area businesses each year. This economic activity corresponds to the creation of roughly 2,300 jobs paying \$168 million in wages.
- **700 MW Project:** Approximately \$900 million in new sales each year, corresponding to the creation of 4,700 new jobs paying \$335 million annually in wages.

Construction Phase - Annual Sales				
Project Size	Direct	Multiplier	Indirect	Total
350 MW	\$ 302,750,000	1.49	\$ 148,347,500	\$ 451,097,500
700MW	\$ 603,983,333	1.49	\$ 295,951,833	\$ 899,935,167
<i>Source: EMSI, Camoin Associates</i>				
Construction Phase - Annual Jobs				
Project Size	Direct	Multiplier	Indirect	Total
350 MW	1,388	1.68	944	2,331
700 MW	2,768	1.68	1,883	4,651
<i>Source: EMSI, Camoin Associates</i>				
Construction Phase - Annual Wages				
Project Size	Direct	Multiplier	Indirect	Total
350 MW	\$ 108,385,161	1.55	\$ 59,611,839	\$ 167,997,000
700 MW	\$ 216,114,194	1.55	\$ 118,862,806	\$ 334,977,000
<i>Source: EMSI, Camoin Associates</i>				

The sales shown in the indirect category include money spent by installers during the construction period on lodging, food, etc. The jobs shown in the direct category are the Study Area jobs associated with construction and installation of the wind farm itself, which includes any manufacturing jobs required to produce the components that will be sourced locally (tower and foundation). The indirect jobs are all other jobs created as a result of the Project's development and are spread out across virtually all sectors of the economy, from manufacturing to retail and service jobs.

Ongoing Operation and Maintenance

The tables below show that the Project will have the following impact on the Study Area throughout the operational life of the Project:

- **350 MW Project:** results in the creation of 85 new jobs paying \$5.4 million annually in wages.
- **700 MW Project:** results in the creation of 170 new jobs paying \$10.8 million annually in wages.

Operation and Maintenance Phase - Annual Jobs				
Project Size	Direct	Multiplier	Indirect	Total
350 MW	35	2.42	50	85
700 MW	70	2.42	99	169
<i>Source: EMSI, Camoin Associates</i>				
Operation and Maintenance Phase - Annual Wages				
Project Size	Direct	Multiplier	Indirect	Total
350 MW	\$ 2,273,222	2.39	\$ 3,159,778	\$ 5,433,000
700 MW	\$ 4,546,025	2.39	\$ 6,318,975	\$ 10,865,000
<i>Source: EMSI, Camoin Associates</i>				

The jobs shown in the direct category are the on-site operation and maintenance jobs. The indirect jobs in this case are also spread out across a wide variety of sectors, including retail, health care, local government, transportation and logistics and many others.

The sales multiplier shows the relationship between the dollars spent on construction of the Project in the Study Area and the dollars spent at other businesses in the Study Area as businesses and employees make purchases in the local economy. The jobs multipliers show the relationship between the jobs at the Project and the jobs created at other businesses in the Study Area. The earnings multipliers show the relationship between wages paid to workers (and business income) at the Project and earnings accrued outside the Project but in the Study Area. The multipliers are different because these relationships are different. For example, the ratio of spending in dollars on construction at the Project to dollars spent at other businesses in the Study Area is not the same as the ratio of workers at the Project to workers at other businesses in the Study Area – they are apples and oranges. We view the economic impact through different lenses (sales, jobs, or earnings), each with its own multiplier.

The multipliers for the Operation and Maintenance Phase are higher than the Construction Phase because a higher proportion of spending is retained locally in the Operation and Maintenance Phase.