Exhibits

Table

4.0 ALTERNATIVES ANALYSIS

The following alternatives to the proposed action are described and evaluated: no action, alternative Project location, alternative Project design/layout, alternative energy production technologies, alternative turbine technology, alternative Project size/magnitude, and alternative Project timing. These alternatives offer a potential range and scope of development that could reasonably be undertaken by the Applicant for comparative analysis and consideration. The no action alternative, which is required for consideration under SEQRA, represents the environmental conditions that would exist if current land use and activities were to continue as is.

In addition, alternative mitigation options are discussed based on the anticipated impacts described in Section 2.0.

4.1 No Action

The no action alternative assumes that the Project would not be built. The Project Area would remain as forest land, some active agricultural land, residential property and vacant land, and Project-related adverse impacts would be averted. Similarly, the Project's positive environmental and economic impacts described in Section 1.4, Project Purpose, Need, and Benefits, would also not be realized. Further, if this Project were not developed, potentially negative impacts from the lack of economic development activities in the Project Area, such as continued decline in farming activity, or the development of other, less desirable land uses could ensue.

Within the affected environment, the following positive environmental impacts associated with adding a new renewable energy source to the NYISO electric power system would not occur:

- Reduction of reliance on fossil fuels and eliminating the associated impacts of refining and transporting these fuels and disposing of pollutant byproducts;
- Reduction of air emissions, specifically displacement of 108 tons of NOx and 455 tons of SO_2 during Project operation; and
- Reduction of greenhouse gases, specifically displacement of 86,960 tons of CO_2 during Project operation.

In addition, if the no action alternative was selected, the lack of economic development activity in the Project Area could result in undesirable impacts in the following areas of the affected environment:

- Loss of increased revenues to local taxing jurisdictions of over $640,000 per annum;
- Loss of lease revenues for participating landowners of over $500,000 per annum;
- Loss of income from operation and maintenance jobs of over $500,000 per annum;
- Loss of payments to Project neighbors of over $100,000 per annum; and

- Loss of income from approximately 150 construction jobs.

As there are significant economic pressures on farmers in western New York, the trend is to convert open space to other uses, such as manufacturing, housing development and similar intensive uses in order to generate additional income. Though these practices may be permitted under local zoning ordinances, these more intensive land uses replace agriculture, eliminate open space, alter the character of the community, and significantly increase the burden and costs on communities for services such as schools, roads, fire and emergency response, water and sewer, etc.

Given the short-term nature of anticipated construction impacts, and the generally minor long-term impacts of Project operation compared to the significant environmental and economic benefits that the Project would generate, the no action alternative is not preferred. Specifically, the no action alternative is not preferred because:

- it fails to meet the Project purpose, need, and benefits;
- it does not further the goal of the New York State RPS of increasing the percentage of renewable electricity purchased by New York consumers from 19 percent to at least 25 percent by 2013;
- it precludes the specific Project-related benefits from occurring in the community; and
- there are potential adverse impacts associated with the no action alternative, as summarized above.

4.2 Alternative Project Location

Under 6 NYCRR § 617.9(b)(5)(v)(g), site alternatives addressed in an Environmental Impact Statement may be limited to parcels owned by, or under option to, a private project sponsor. The Applicant does not own, or have under option/lease, any parcels other than the ones that a) constitute the Project Site; b) a number of parcels (non-contiguous) in the Town of Sheridan and Pomfret; and c) a number of parcels in the Town of Arkwright that are not contiguous with the current Project Site. The additional non-contiguous parcels currently under option/lease in Arkwright and neighboring towns are not sufficient for development of a wind energy project at this time; further, use of those parcels would impact the area similarly to those included in the Project Site. Therefore, there is no requirement to evaluate any alternative project locations other than those listed above. Nonetheless, this section provides background information on the selection of the Project Site by the Applicant and by Horizon Wind Energy ("Horizon," parent company of the Applicant) to facilitate understanding of the criteria employed.

Alternative site location analysis occurs very early in the planning process for wind power projects. Because sites suitable for wind energy development in New York are limited, there is a great deal of competition among companies for potential development sites. In order to secure the right to develop in an area, a developer must obtain adequate land control and expend considerable funds in transmission, meteorological, and environmental studies. This requires a significant expenditure of limited financial and human resources. Therefore, a very careful screening process is employed.

The selection of wind farm locations is affected by several factors which allow a project to operate in a technically and economically viable manner. These factors include the following:

- Adequate wind resource that allows for the operation of utility-scale wind turbines;
- Proximity and sufficient access to an adequate electric transmission/bulk power source;
- Contiguous areas of available land resource;
- Compatible land use;
- Willing land lease participants and host communities;
- Limited sensitive ecological issues;
- Sufficient distance from major population centers; and
- Compliance with local, state, and federal laws and regulations (i.e., setbacks, avoidance areas, maximum wind turbine height).

Horizon researched Chautauqua County beginning in late 2002. Horizon decided not to pursue a project in southwestern Chautauqua County because (a) other developers had secured land rights and/or were actively developing in the areas of Ripley, South Ripley and Westfield; and (b) initial fatal flaw analyses of the 230-kV transmission line in the Lake Erie area indicated the possibility of pre-existing instability on the transmission line. Horizon also decided not to pursue a project to the west of Arkwright due to a combination of factors (distance from the 230-kV line mentioned above and an apparently less vigorous wind resource).

Initial wind studies did indicate that significant wind resources could exist in the County further north and east, in the Towns of Stockton, Arkwright, Sheridan, and Pomfret. Although these three towns appeared from a high level analysis to have a strong wind resource, wind development in the town's of Ripley and Westfield to the south and west had given rise to concerns about wind energy development. Residents in Westfield and Ripley, and later in Arkwright and its surroundings, expressed concerns about the impacts on bird migration. Many of the concerns appeared to stem from unfamiliarity with wind energy, lack of information, and insufficient or inadequate environmental impact studies.

Beginning in 2004, the Applicant invested considerable financial and human resources on education and outreach. These efforts were designed to educate the local community about the benefits of the Project and ensure that landowners, neighbors, and local leaders were informed about wind energy. The Applicant coordinated many events for people in and around the Project Area, including bus tours to the Maple Ridge Wind Farm, several direct mail campaigns, and multiple open houses. Additionally, the Applicant participated in forums, workshops, and panel discussions about wind power sponsored by local groups like Rotary, Chautauqua County, Southern Tier West Planning Federation, the towns of Arkwright and Pomfret, and the League of Women Voters.

Also in 2004, Horizon installed meteorological towers in Stockton, Arkwright and Pomfret, and conducted extensive bird studies. A met tower was not installed in Sheridan due to the presence of the Dunkirk airport and its likely impact on the installation of wind turbines in that town.

With almost one year's worth of met data from the region confirming the original view that sufficient wind resources were present to merit further investigation, in 2005, the Applicant made a request to the NYISO to interconnect 79.9 MW of wind generating capacity to the grid. An Interconnection Feasibility Study was performed by the NYISO in 2006 that indicated that, although the capacity on the Dunkirk-Falconer line was limited, it should be feasible to interconnect 79.9 MW, in accordance with the NYISO's minimum interconnect standards at the proposed Project substation and POI switchyard in the Town of Pomfret near the western extent of the property. Further, more detailed study currently conducted by the NYISO at the Applicant's behest, the System Reliability Impact Study (SRIS) has confirmed the findings of the Feasibility Study.

In parallel with Horizon's due diligence process investigating the wind energy potential of northern Chautauqua County, the Town of Arkwright was researching the potential for wind energy and passed a wind ordinance (Local Law No 2 of 2007, Appendix O). A public opinion poll was conducted by Siena College in 2007 that showed that 79.2 percent of people in Arkwright supported the development of a wind farm in their area. As a result of this survey, the Town of Arkwright passing its wind ordinance, and the favorable wind resource in Arkwright, the Applicant decided to focus on siting wind turbines in the Town of Arkwright.

Extensive landowner and site visits, and a Critical Issues (fatal flaw) Analyses confirmed that optimal roughly 80 MW project (40 to 50 turbines) suggested by the wind map prepared by AWS Truewind could be developed. Finally, the Applicant worked with landowners to acquire an adequate amount of land to support the 79.9 MW proposed.

The Applicant selected the proposed Project Site within Arkwright for development because it possesses a quality wind resource close to an electric transmission line. Other site characteristics include relatively low population density, highly receptive landowners and neighbors, compatible existing land uses, and relatively few sensitive ecological and cultural resources. These factors combine to make the Project Site desirable from the standpoint of wind energy development.

The analysis of other potential sites screened out many potential turbine locations in the Town due to the following constraints:

- Lack of wind resource in the eastern and western extremities of the Town due to low elevation;

- Incompatible land uses; for example, the NYSDEC State Wildlife Management Areas on Dibble Hill and the Chautauqua County hiking trail; and
- Setbacks from microwave paths, communication towers, homes, roads, and other structures.

The Applicant did not identify any other site in the region (other than ones already under development for a wind project) that possessed the same combination of desirable features, and that avoided the types of constraints listed above.

As pointed out in Section 1.4, Project Purpose, Need, and Benefits, New York State has established a green power market with the intention of supplying the State with roughly 9.8 million MWh of renewable energy from large-scale generation facilities. Economic models suggest that wind power will provide over two thirds of this new supply of renewable energy–the equivalent of roughly 3,300 MW. Of the roughly 8,000 MW of wind energy projects that have made requests to the NYISO to interconnect to the grid, not every project will ultimately be constructed and many will be downsized. As such, meeting the State's requirement suggests that every technically feasible site, including this Project, should be seriously considered.

4.3 Alternative Project Design/Layout

In arriving at the Project layout, the Applicant developed a number of different configurations over the course of six months. Each version incorporated wholesale or minor adjustments based on the criteria outlined below. As stated in Section 1.5.1, numerous criteria are considered when creating a Project layout. Primary siting criteria include:

- Exposure to adequate wind resource;
- Setbacks from and impacts on homes, structures, roads, and property lines;
- Sufficient spacing between turbines to maximize power production and minimize turbulence effects;
- Adherence to agricultural protection measures;
- Setbacks from gas wells;
- Avoidance of environmental, cultural, and other sensitive resources;
- Avoidance of unstable land forms and other engineering constraints;
- Landowner preferences; and
- Sensitivity to viewshed and noise issues.

The first iteration of the Project layout was based upon a review of desktop constraint information and wind resource data and contained significantly more turbines than the current layout. This layout was refined after initial desktop engineering and environmental work to account for wetlands and other significant natural resource areas were completed in February of 2007. Further iterations were performed as project boundaries shifted to take into consideration the impacts of previous rounds of analysis and their affect on setbacks, spacing between turbines, meteorological data, and landowner acceptability. Similarly, later iterations took into account that some landowners with windy land and/or easement land between wind parcels chose not to participate, causing the Applicant to remove turbines on those lands, as well as turbines on neighboring lands due to setback or collection line requirements. The Applicant kept all turbine locations within the boundary of the Town of Arkwright. Possible turbine locations outside of Arkwright were either too few (Town of Charlotte) or development was not regulated by a local wind ordinance (Town of Sheridan).

A wetlands investigation was conducted by Tetra Tech – NEA in the early fall of 2007 which resulted in additional changes to the layout based on field identified wetlands and waterbodies. Tetra Tech – NEA also conducted a Phase IA cultural study in the fall of 2007, which necessitated the removal of one turbine and the relocation of two others in order to avoid impacts to cultural resources. Additionally, layout changes were made as a result of a sound analysis resulting in the removal of two turbines and the movement of two turbines away from potentially sensitive receptors. For example, some turbines were removed north of Cable Road, others were moved northeast away from Cable Road and still others were shifted south away from Straight Road based on a detailed review of the sound study produced by Hessler Associates.

Efficiencies in access road design were another common reason for Project layout changes. As discussed in Section 1.0, URS Corporation developed a transportation plan and road design for the Project from their Buffalo, New York office. As a leader in the field of engineering and a major environmental contractor to the U.S. Department of Energy, URS has worked extensively on the designs and engineering of other wind projects both in New York and across the United States. Additionally, URS has worked on many large, local transportation projects, including the Seneca Yard in Lackawanna, New York, which involved both transportation and site work. This experience made URS uniquely suited to produce the road design and transportation study for the Project Site. URS designed a road layout to follow existing farm, logging, and gas well roads whenever possible to minimize disturbance to environmental or cultural resources. Additional, URS designed access road paths to accommodate the requirements associated with turbine delivery and crane movement (accounting for necessary turning radii and road width); however, refinements to their location, length, and number helped reduce Project costs and environmental impacts resulting from construction of both these temporary and permanent access roads.

Each consecutive iteration of the layout minimized environmental impacts or adjusted for engineering constraints, while preserving the Project's energy efficiency and thereby its economic viability. As a result, the preferred Project layout presented in this DEIS incorporates the most optimized, known impact avoidance measures of all the alternatives considered. The mitigation options presented in Section 2.0 of this DEIS reflect the reduced need for mitigation due to impact avoidance.

The Project layout as proposed has been engineered to capture the area's wind resource, while minimizing wake effects on downwind turbines. However, optimal siting of the turbines from a wind resource perspective has been inevitably compromised somewhat by landowner agreements; federal, state, and local regulations; community considerations; and the need to protect sensitive resources such as forest habitat, wetlands, and agricultural land. The layout as proposed reflects a carefully achieved balance of energy production and environmental protection. Relocation of any turbines in a tightly-constrained project area has a ripple effect, in that the location of other turbines would have to be re-examined and possibly changed to maintain an efficient/workable Project design. Therefore, reduction of environmental impacts in one location could result in increased impact in another location and/or reduced power generation. In the case of visual impact, removal or relocation of one or two individual turbines from a 47-turbine layout is unlikely to result in a significant change in project visibility and visual impact from most locations.

Permanent access road widths will be the minimum necessary to maintain the Project and have been sited in consultation with Ag & Markets guidelines to minimize loss of agricultural land and impacts on farming operations. To minimize the visual impacts associated with the electrical collection system, all on-site utility interconnects will be placed underground except for portions of the collection system where belowground installation is not feasible from an engineering or economic point of view, or when it could result in significant safety or environmental impacts. For example, overhead lines will be used along Farrington Road (to avoid cutting though a heavily forested area adjacent to Dibble Hill Wildlife Management Area) and for 3.5 miles between the wind turbines and the National Grid transmission line (due to the distance and amperage).

Alternative locations for the Project laydown areas were also evaluated through a similar process as described above for the Project layout.

The Project substation and POI switchyard are proposed to be sited on the eastern side of the Dunkirk-Falconer 115-kV line, southeast of the junction of Route 60 and Route 83, as shown in Figure 1.1-2 and Appendix B. Final adjustments to the detailed substation and interconnect plans will be made during the NYISO Facility Study and final design review with National Grid and their system protection engineers. Consequently, alternative Project designs were likely to pose equal or greater risk of adverse environmental, engineering, or community acceptability impacts and thus were rejected.

4.4 Alternative Energy Production Technologies

The purpose of the proposed Project is to create a profitable, economically viable wind-powered energy facility that will provide a significant source of renewable energy to the New York power grid. An important component of that purpose is to be compliant with the PSC "Order Approving Renewable Portfolio Standard Policy," issued September 24, 2004 (PSC 2004). This

Order calls for NYSERDA to purchase renewable energy attributes from qualifying facilities to spur an increase in renewable energy used in the state to 25 percent by the year 2013. The Applicant proposes to construct a facility that generates electricity by converting the energy in the wind to electricity. Such a facility is clearly a qualifying facility for the RPS, and therefore, eligible to bid to receive payment from NYSERDA for up to 95 percent of the renewable energy attributes it produces. The following section describes other technologies that comply with the RPS. These technologies are reviewed for purposes of completeness. None are reasonable alternatives to the selected technology, because none would fulfill the Applicant's purpose of constructing and operating a wind energy generation facility. However, all could, potentially, comply with the RPS.

Hydroelectric Energy

Conventional hydroelectric generating stations are typically operated in one of two methods, namely "store-and-release" or "run-of-river." Store-and-release facilities impound water behind a dam, forming a reservoir. Run-of-river facilities are systems in which the discharge of water from the facility equals the inflow at any instant time. The amount of water flowing through the turbines is determined by the available water in the river.

Seventy-four percent of New York's hydro capacity is at the NYPA St. Lawrence and Niagara "store-and-release" facilities. According to the New York Department of Public Service (DPS), "development of large hydroelectric projects in New York is essentially complete."

The RPS treats as eligible only two categories of hydroelectric resources: 1) new low-impact hydro, defined as new facilities of up to 30 MW, as long as they are run-of-river, with no new storage impoundment; and 2) the incremental production associated with upgrades to existing facilities, as long as no new impoundments are created. The Applicant does not own any existing hydroelectric facilities, so expansion of an existing facility would not be an alternative reasonably available to the Applicant.

According to the DPS, the potential RPS-eligible in-state hydroelectric development between now and 2013 is 43.3 MW, equating to 220,622 MWh/year, "… *if the appropriate economic conditions existed.*" To reach this amount would require numerous run-of-river facilities—as demonstrated by the fact that, in 2006, NYSERDA awarded renewable energy contracts for ten hydro projects, averaging less than 1 MW per project.

The Applicant does not own or have any access or rights to hydroelectric facilities. However, the Applicant can produce almost an equivalent amount of wind energy from the Project, as the total estimated potential generation for the entire state of New York by 2013 from eligible hydro projects, at a significantly lower development, permitting, interconnection, and construction cost.

Biomass Energy

The term biomass includes a wide-variety of closed-loop and open-loop organic energy resources. Closed-loop resources, which can be either woody (i.e., willow or hybrid poplars) or herbaceous (i.e., switchgrass), are those that are grown exclusively for the purpose of being consumed as an energy feedstock. Open-loop resources are typically either woody residues produced as byproducts in the wood processing industry or clean, non-treated, woody waste materials intercepted from the municipal solid waste stream.

A variety of technologies can be used to produce electricity from biomass. In some cases, a particular biomass resource is more suitable for conversion to electricity using a particular technology. Primary types of energy conversion technologies from biomass are presented below:

1. Customer-Sited Biomass Combined Heat and Power
2. Co-firing Biomass with Coal
3. Biomass Gasification
4. Direct-Fire

The opportunities to produce electricity using the above biomass technologies are discussed herein.

<u>Customer-Sited Biomass Combined Heat and Power (CHP)</u>

As implied by the title, this technology is typically employed at “customer” facilities, generally wood processing plants (especially in the pulp and paper industry) that have large electricity and steam needs and a captive supply of biomass residues. Opportunities also exist in some food products manufacturing facilities.

The typical scale of CHP technology is 1 to 30 MW. It is estimated by the DPS that the market potential for new biomass CHP in New York is 18 MW by 2009 and 40.5 MW by 2013 spread over several mills.

Given the fact that the Applicant is not a facility owner or operator in the pulp and paper or food industries, the small size of these facilities relative to the Project and the targets of the RPS, and the difficulty in negotiating stand-by agreements with the local utility, customer-sited biomass CHP would not be a reasonable alternative for the Applicant even if it could fulfill the Applicant’s purpose of constructing a wind energy generation facility.

<u>Co-firing Biomass with Coal</u>

For companies that generate electricity from coal, it is possible to directly displace a portion of the coal used in the combustion process with biomass. The typical application for co-firing coal with biomass is in larger base-load electricity generators. Biomass can be blended with coal on the coal-pile (mixed feed), or injected through a separate biomass transfer system.

With 10.7 MW of active co-firing capacity at Greenidge Station in Yates County, an additional (currently unused) 11 MW of co-firing capacity at two other plants, in Chenango and Steuben Counties, respectively, and a 10-MW co-firing system at the Dunkirk Station, in Chautauqua County, co-firing biomass with coal is a minor activity in New York. This alternative is not open to the Applicant because the Applicant is not an owner or operator of coal generation facilities.

Biomass Gasification

Biomass gasification is a thermal conversion technology that converts solid biomass fuel into a combustible gas. Gasification applies air to the biomass feedstock in a high temperature reactor to produce the product gas, which can then be used to generate electricity from standard gas turbines or in a combined cycle unit. Biomass gasifiers have the potential to be up to twice as efficient as conventional boilers to generate electricity. A typical scale of biomass gasification is from 5 MW to 40 MW.

However, biomass gasification is still considered an emerging technology with only a few gasifiers in operation in the United States, and no commercial biomass gasification operations in New York State. Given that, biomass gasification is not considered to be a reasonable, commercially available alternative technology.

Direct-Fire, Stand-Alone Wood-Fired Power Plants

The technology consists of combustion of wood fuel directly to produce power, which is sold in the wholesale market. Although this technology is in widespread use nationally, efficiency is typically low (17 to 24 percent) relative to most other types of power plants. The typical scale of this technology is 1 to 50 MW.

Direct-fire, wood-fired power plants produce solid waste and air emissions. The ash requires disposal either by being spread over land, or in a landfill. If the wood fuel is treated with compounds, such as chromium, chlorine, and arsenic, the ash produced may have a higher concentration of hazardous materials resulting in greater environmental risks associated with disposal. The air emissions from biomass in combustion technology will vary depending on the properties of the wood, but will in all cases require emissions control technologies. Unless the amount of biomass combusted is replaced by the applicable amount of biomass growth (i.e., closed-loop), this technology results in CO_2 emissions, both at the generation facility and from collecting and transporting the biomass and the solid waste. The available supply of suitable biomass fuels in any given geographic area is limited.

New York currently has two operating direct-fire, stand-alone wood-fired power plants in operation—an 18-MW plant in Chateaugay, Franklin County, and a 21-MW plant in Lyonsdale, Lewis County. Even though both facilities have been operating for a number of years and would have been expected to have paid off their financing, both facilities were able to demonstrate that they needed RPS funds to continue economical operation. Since these facilities were constructed, there has been a significant increase in the cost of key materials used in boiler house and turbine construction (most recently due to the war in Iraq and economic growth in China and India), leading to a more difficult competitive environment.

In recognition that RPS objectives include (a) promoting a cleaner and healthier environment, improved air quality, and a reduction of greenhouse gases and (b) a competitive green energy price, and given the potential for increased costs due to the Regional Greenhouse Gas Initiative, generating renewable energy at direct-fired, stand-alone wood/biomass power plants would not be a reasonable alternative for the Applicant, even if it fulfilled the Applicant's purpose of generating energy from wind.

Biofuels

In addition to the biomass generation technologies mentioned above, a variety of other fuels—ethanol, methanol, and biodiesel—can be made from biomass resources. Biofuels are primarily used to fuel vehicles and, although they can fuel engines or fuel cells for electricity generation, both biofuels and fuel cells are considered emerging technologies and, as such, are not a reasonable viable alternative for the Applicant to use for commercial scale electric power generation.

Biogas Energy

Landfill Gas

Landfill gas (LFG) is generated when organic materials in municipal solid waste landfills naturally decompose by bacteria. The gas is approximately 50 percent methane, the primary component of natural gas. The other 50 percent of the gas is predominantly CO_2, with small amounts of NOx, and trace levels of non-methane organic compounds. LFG generation typically begins after waste disposal and can continue for 20 or 30 years after the landfill is closed. LFG can be used for on-site electricity generation, a use widely practiced throughout the United States with approximately 330 landfill gas-to-energy facilities currently in operation.

Reciprocating engines are the most common technology used to generate electricity from LFG. Engine models used at landfills range in size from approximately 0.5 to 3 MW. The engines are generally used in projects with capacities ranging from 0.8 to 6 MW (many with more than one engine).

Landfill gas-to-electricity projects have been in operation at large landfills in New York for the past 20 years. There are approximately 15 in operation in the State, with a total generating capacity of approximately 65 MW, ranging in size from 1 MW to 11.2 MW and averaging 4.33 MW. The USEPA identifies New York as having potential for 17 additional landfill gas-to-energy sites through 2013. The potential sites are spread across the state. LFG generation is not a reasonable alternative for the Applicant, both because it will not fulfill the Applicant's purpose of generating electricity from wind, and also because it cannot be applied at a scale even approaching the scale of the Project. Further, the Applicant is less well positioned to develop these projects than local engineering or packaging firms, LFG developers, engine manufacturers or the landfill owner operator itself.

Methane Digesters

A methane digester system, commonly referred to as an anaerobic digester, can be used for manure waste management on farms, or to process methane waste at wastewater treatment facilities. At farm locations, digesters promote the decomposition of manure into methane gas. The manure is fed into an anaerobic (without oxygen) tank where bacteria convert the organic matter into methane, which is collected under a plastic dome or hard cover. The gas is piped into an engine generator to generate electricity for farm use, with any excess sold into the grid.

The DPS projected the potential level of development of manure digesters in New York based on, among other things, the number of dairy farms and milk cows in the state. It was estimated that approximately 44 MW of potential generating capacity could be operating by 2013. The State University of New York at Morrisville announced a manure digester project that would produce approximately 1 MWh per cow per year. It is appropriate for large farms to install manure digesters, initially with the support of organizations like NYSERDA, for the purposes of controlling odors and pollution and to produce electricity for on-site consumption. The technology is not a reasonable alternative generation technology for the Applicant, however, because of its small scale and distributed nature. A single wind turbine can produce up to 5,000 times the energy per year per acre used as a manure digester/dairy farm combination.

Photovoltaics

Photovoltaic (or PV) systems, commonly known as "solar cells," convert light energy directly into electricity. Today's PV devices convert 7 to 17 percent of light energy into electric energy.

The largest drawback to solar power today is price, with electricity from PV systems costing about 30 cents per kilowatt-hour (c/kWh). Another drawback to PVs is that they only generate electricity during daylight, and are most efficient when the sun is shining. On a small scale, therefore, energy storage systems are required.

There are three main applications for solar energy in commercial use:

- *Residential*. A typical residential system can average 3 kilowatt (kW) installed capacity, and take advantage of utility net metering. Net metering permits the customer to spin their meter backwards when the solar electric system produces more power than is consumed at the home, and to receive retail credit for this power.
- *Commercial/Industrial sited systems*. These systems are designed to maximize solar energy and capacity output. These systems, with an average installed capacity of 200 kW, will generally be sized so that they produce power "behind the meter" for the

customer, and not export any power to the utility grid since they are not eligible for retail net metering. Although the customer is not exporting power to the grid, the electric and capacity benefits produced by these systems reduce the customer load, and therefore, directly off-set demands on the power grid.

- *Building integrated photovoltaic systems*. These systems typically are vertically oriented on facades with orientations between east and west in a southerly direction. These systems will typically provide lower levels of solar output, due to orientation, but can provide building material cost reductions (for glazing or cladding materials) that can partially or wholly off-set the power production penalty. To take advantage of this benefit, building integrated systems are therefore most likely to be installed in new construction applications. These systems are primarily sized to meet loads on the customer's side of the meter.

PV technologies remain a very small generation source in the current state energy mix (generating together considerably less than the output of the smallest wind farm in the state). The market development and application of solar technologies will be greatly affected by cost factors and the availability of sites. Solar technologies are best suited for generation near points of electricity use, because solar will be much more competitive with retail electricity rates of up to 15 c/kWh than with wholesale rates of 6.5 c/kWh. Deployable spaces include roofs, facades, parking lots, and exclusion zones (i.e., along roadways). The DPS estimates that New York's PV potential development is 18.7 MW by 2013. Due to the reasons outlined above, PVs are not a reasonable alternative for the Applicant.

Ocean Energy

Generating technologies that derive electrical power from the world's oceans include tidal energy, wave energy, and ocean thermal energy conversion. Tidal energy takes the highly predictable nature of the tides and converts its kinetic energy into electricity by placing turbine equipment in offshore areas. It is only practical at those sites where energy is concentrated in the form of large tides and where the geography is suitable for tidal plant construction. These conditions are not commonplace, but several locations in Maine and Alaska have been identified as having the greatest potential in the United States. The first tidal energy turbine project in the United States was installed in 2006 as a demonstration project in New York's East River. Most of the efforts in this field are taking place in Europe. In 2003, the world's first offshore tidal energy turbine was built in the United Kingdom. Many devices have been invented to harness the waves' power, but few have been tested. Of those that have, most have only been in artificial wave tanks.

Ocean thermal energy conversion converts the temperature difference between the ocean's surface and at depth into electricity. This is done by using the warmer water to heat a working fluid which evaporates at pressure and operates a turbine. Conditions require a temperature difference of at least 36ºF, at a depth of around 1,000 meters for the process to work, meaning there is no real potential in and around New York. Further, these technologies are still under development and are not expected to become commercially available in the foreseeable future. Due to the reasons outlined above, ocean energy is not a reasonable alternative for the Applicant.

Summary

To summarize, the Applicant's purpose is to generate electricity from wind. Even if the Applicant's purpose were broader—to generate renewable energy from any technology that could qualify under the New York State RPS—the alternative technologies open to the Applicant to meet such broader purpose are limited, and none are reasonable alternatives for the Applicant at the current time given the Applicant's capabilities. The Applicant has no existing coal facilities that can be co-fired with biomass and no portfolio of hydroelectric facilities that can be developed or expanded. The Applicant is not a large dairy farmer, an engineering contractor, landfill developer or landfill owner/operator. The ocean energy, biofuel and biogasifier fields are not well developed and not necessarily suitable for power generation in New York. The photovoltaic market in New York is very small and is generally limited to residential and commercial behind-the-meter applications.

4.5 Alternative Turbine Technology

Exhibit 4.5-1 and Table 4.5-1 compares various wind turbine technologies on the basis of the relative scale and size of commercially used units and their typical sizes. Although larger versions of all models shown have been produced, the diagram illustrates the average sizes of versions that have been implemented on a substantial scale with hundreds of units installed. Several types of wind energy conversion technologies were evaluated for the Project. However, for the application of utility scale electrical power generation, the technology that has demonstrated itself as the most reliable and commercially viable is the 3-bladed, upwind, horizontal axis, propeller-type wind turbine as shown in Exhibit 4.5-1 (turbines labeled (c) and (d)). The Project contemplates the use of the most successful class of wind turbines which are megawatt-class wind turbines. The choice of this type of turbine also minimizes overall impacts, since there are fewer turbines, a smaller overall Project footprint, less visual impact, and less potential for avian or bat impacts due to a smaller total Rotor Swept Area and a lower RPM.

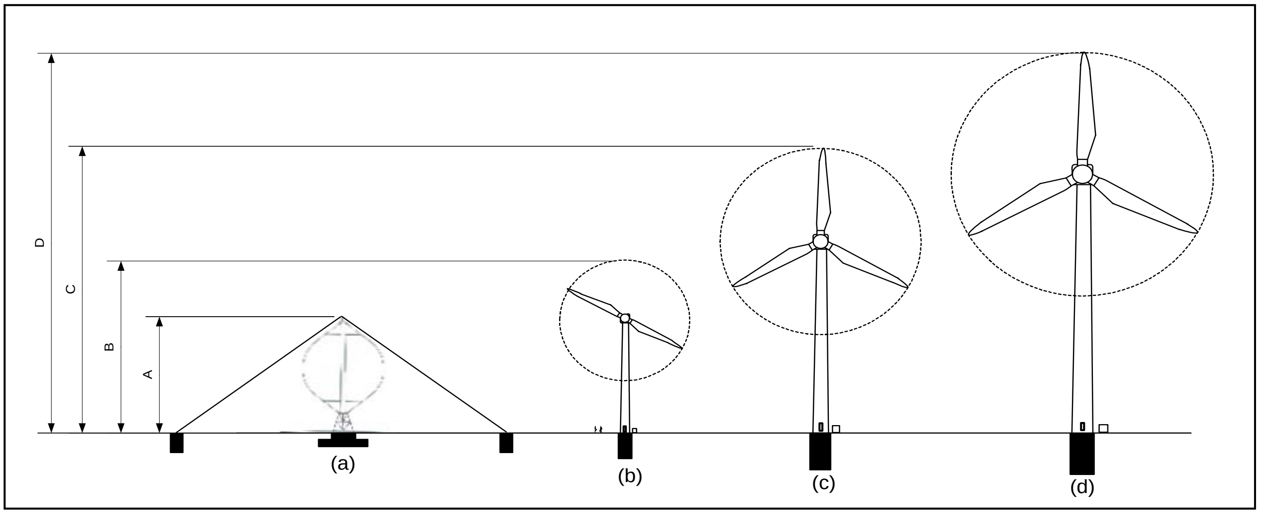

Exhibit 4.5-1 Comparison of Various Wind Turbine Technologies

Table 4.5-1. Comparison of Various Wind Turbines

	Type	Typical Generator Size	Typical Size	Typical Rotational Speed
a	Darrieus Rotor	50-100 kW	A - 100-150 ft.	50-70 RPM
b	2-bladed (downwind)	50-200 kW	B - 150-200 ft.	60-90 RPM
c	3-bladed (upwind)	500-1,000 kW	C - 240-300 ft.	28-30 RPM
d	3-bladed (upwind)	1,500-3,000 kW	D - 300-475 ft.	9-25 RPM

Vertical Axis Darrieus Wind Turbines

The most widely used vertical axis wind turbine (VAWT) was invented in the 1920s by French engineer DGM Darrieus. It is called the Darrieus Wind Turbine, Darrieus Rotor and commonly dubbed the "eggbeater." Exhibit 4.5-1 illustrates both the eggbeater (vertical axis) and the propeller types (horizontal axis - HAWT) of wind turbines. The Project will utilize the horizontal axis type of wind turbines.

Exhibit 4.5-2 FloWind Vertical Axis (Darrieus Wind Turbine) Located on Thorp Prairie, near Ellensburg, WA

The Darrieus turbine was experimented with and used in a number of wind power projects in the 1970s and 1980s, including projects in California. Exhibit 4.5-2 illustrates an example of a Darrieus turbine in Washington State.

Despite years of diligent design, experimentation and application, the Darrieus turbine never reached the level of full commercial maturity and success that horizontal axis turbines have due to inherent design disadvantages. Over the years, the 3-bladed horizontal axis wind turbine has proven to be the most reliable, efficient, and commercially viable wind power technology.

A few of the advantages of propeller type wind turbines over the eggbeaters are discussed in further detail below.

Higher Wind Speeds Higher Above the Ground:
Darrieus rotors are generally designed with much of their swept area close to the ground compared to HAWTs. As the wind speed generally increases with the height aboveground, HAWTs benefit from having higher wind speeds and higher wind energy incident to their rotor plane that can be extracted.

Cut-in Wind Speed:
VAWTs require a higher level of wind speed to actually start spinning compared to HAWTs. Older VAWT machines were generally "motored-up" by using the generator as a motor to start-up. HAWTs do not require as much wind speed for start-up and most have the advantage of variable pitch blades, which allow the turbine to simply change blade pitch to start-up. Modern HAWTs do not use the generator to motor-up the rotor.

Variable Pitch:
Most all modern HAWTs have mechanisms which pitch the blades along their axis to change the blade angle to catch the wind. Variable pitch allows the turbine to maximize and control power output. VAWTs generally do not have variable pitching capability and rely on stall regulation. This results in less efficient energy capture by VAWTs.

Avian Hazards – Guy Wires:
VAWTs are generally constructed with guy wires, which have been shown to be a greater hazard to birds than turbines themselves, as they are much more difficult for birds to see and avoid. The HAWTs contemplated for the Project use free-standing tubular steel towers and do not require guy wires.

Turbine Footprint:
VAWTs are generally fitted with four sets of guy wires which span out from the top of the central tower and are anchored in foundations as shown in Exhibit 4.5-2. Including the tower base foundation, VAWTs require a total of five foundations all spread apart. The result is that the overall footprint and disturbed area for a VAWT is larger than that for a comparably sized HAWT. HAWTs on free-standing towers use only one main foundation and have a relatively small overall footprint in comparison.

Fatigue Life Cycles:
Due to their design, VAWTs have higher fatigue cycles than HAWTs. As the rotor blades rotate through one full revolution, they pass upwind, downwind, and through two neutral zones (directly upwind of the tower and directly downwind of the tower). In contrast, the rotor blades on a HAWT do not pass through similar upwind/downwind neutral zones. As a result, VAWTs are

subjected to a far higher number of fatigue load cycles compared to HAWTs, which past operating history shows has resulted in far more frequent mechanical failures and breakdowns on VAWTs.

Two-Bladed, Downwind Wind Turbines

The most widely used vertical 2-bladed wind turbines were of the downwind variety and were in the size range of 50 to 200 kW. They are referred to as downwind since the blades are downwind of the supporting tower structure. Although there is continued experimentation with prototype wind turbines of this design of a larger scale (300 to 500 kW), they have not proven to be reliable and commercially viable units.

The 2-bladed turbines require a higher rotational speed to reach optimal aerodynamic efficiency compared to a 3-bladed turbine. The 2-bladed rotors are also more difficult to balance, and this combined with the downwind tower shadow results in higher fatigue loads and higher noise compared to the 3-bladed design. As shown in Exhibit 4.5-3, 2-bladed downwind turbines use guy wires with associated avian and agricultural impacts.

Exhibit 4.5-3 Two-Bladed Downwind Wind Turbine

Smaller Wind Turbines

Over the past 20 to 30 years, wind turbines have become larger and more efficient. The Applicant considered using smaller turbines in the 600 to 1,000 kW range for the Project; however, this is both less cost-effective and would result in a far higher total number of turbines, a larger Project footprint, and an overall higher impact to the surrounding environment. Use of 600 to 1,000 kW turbines would result in up to twice as many total turbines and a greater total Rotor Swept Area to produce the same amount of energy. For example, the total height of the typical 660-kW turbine is about 73 percent of the total height of the typical 1,500-kW turbine, while its total output is only 44 percent of the output of the 1,500-kW turbine. As the growth trend of the wind energy industry has continued, smaller machines have become less cost-efficient. Use of multi-megawatt class turbines result in lower energy prices than sub-megawatt-class turbines.

Using more turbines to produce the same amount of energy also results in more turbine foundations, which results in more land area being disturbed. Potential operational impacts (e.g., noise, avian mortality) could also increase with a larger number of smaller machines. In terms of visibility and visual impact, while smaller turbines might be marginally less visible, they would still be very tall structures and their higher density/greater number could actually increase the Project's visual impact. On the lower end of the spectrum (1 MW and below), the following concerns have also led to the decision to avoid siting a smaller turbine size at the Project Site.

- **Decrease in Land Owner Royalties** – Each landowner in the Project Site will receive royalties (based on a percentage of energy generated) from the operation of the turbine on their land. The landowners expect and depend on the amount of revenue that can be generated from a multi-megawatt turbine. The decrease in royalty (it would decrease by over 50 percent) from a smaller turbine would represent a substantial economic hit to each participating landowner in the Project and likely a re-consideration regarding the benefits of participating in the Project.

- **Long-Term Maintenance** – As noted in Exhibit 4.5-1, technological innovation in the wind turbine industry has trended toward larger (and hence more efficient) turbines since the 1970s (e.g., whereas the average turbine size in 1995 was 600 kW, the average turbine size in 2007 is 1.6 MW). Accordingly, turbine manufacturers' attention is focused on contemporary technology rather than yesterday's technology. Similar to patterns observed in other technology-based industries, turbine manufacturers will discontinue support for less popular models, hence making operational maintenance more expensive and less reliable for turbines below 1 MW.

- **Potential Increased Avian Impact** – Smaller turbines (less than 1 MW) operate at higher RPMs than the larger multi-megawatt range of turbine. The body of data from existing post-construction studies of wind turbines ranging in size from 660 kW to 3.0 MW suggest that for a site with an equivalent number of turbines, the potential for negative avian impact decreases as the average RPM of the turbine decreases (though the same body of data also suggest that minimizing avian impact is more strongly correlated with responsible siting practices than RPM considerations).

Alternative Multi-Megawatt Turbines

The Applicant initially considered nine potential turbine models produced by five manufacturers. Turbine sizes ranged from 1.5 MW with 77-meter rotor diameters to 3 MW and 100-meter rotor diameters.

The Applicant rejected the extreme ends of the spectrum (below 1.5 MW or above 3 MW), based largely on limited availability in the marketplace or unfavorable pricing/economics in the current timeframe. Given the limited land in the Project Area and the constraints previously mentioned, a 1-MW turbine would have reduced the Project output by almost 30 percent without reducing the access road or collection line length or making any significant difference to the footprint of the substation. This would reduce the Project's return and concomitant environmental benefits, while maintaining essentially the same Project costs. This would result in increased energy price in order to accommodate these circumstances. On the larger end of the spectrum (3 MW and beyond), one specific concern has led to the decision to avoid siting larger turbines at the Project Site. For larger turbine models, the size of the components associated with currently available 3+ MW turbines exceed the logistical constraints (road width, bridge height, etc.) that exist when transporting these components to the site. For this reason, current applications of 3+ MW turbines are currently all offshore applications where road constraints like turning radii, bridge heights, and overhead wire heights do not apply.

A further important constraint that must be considered when assessing the viability of potential Project alternatives is the current supply and demand equation that exists for wind turbines. As suggested in a National Renewable Energy Lab paper titled "A Preliminary Examination of the Supply and Demand Balance of Renewable Energy" (dated October 2007 and authored by Blair Swezey, Jorn Abakken, and Lori Bird), global demand for renewable energy equipment is leading to supply shortages for wind turbines. This means long lead times for wind turbines and high upfront costs to secure wind turbines early enough within the development period to assure a project's ultimate viability.

As a result, the approximate size of the turbines must be identified very early in the development process to allow plans to be made to procure turbines in time for construction. The consequence is that the approximate turbine size was locked in early on in order to allow the NYISO and National Grid to study the impacts of a certain size project on the reliability of the electric grid. The turbine size and the number of turbine sites dictate the size of the project studied, and a smaller turbine alternative becomes less viable (smaller turbines would require more turbine sites to have the same impact in the system studies).

When evaluating the remaining turbines for noise impacts, the Applicant chose the Vestas V-90, as this turbine enables the Applicant to utilize the full available potential transmission capacity given all the constraints. However, due to high demand placed on the turbine manufacturing industry, there is a possibility that this particular turbine may not be available at the time of procurement. The Applicant will utilize a turbine of similar specifications (the GE 1.5 sle and Vestas V-82 are under consideration, and a sound analysis has been conducted for both turbines in Appendix I and in Section 2.7 this DEIS) if the Vestas V-90 is not available and will maintain compliance with the 420-foot height limit specified in the Arkwright local law.

Alternative Turbine Tower Design and Size

The Project Site, as with most places in New York State, has positive wind shear, which means that the average wind velocity increases along with the height of the wind turbine tower. One hundred meter towers are the highest towers available commercially and require the use of larger more expensive cranes to erect turbines. However, local height restrictions from the Town of Arkwright eliminate the possibility of using a 100-meter tower in conjuction with a Vestas V-90 unit. Using towers less than roughly 80 meters is not favored due to weaker energy production at lower heights, although the Applicant may use a slightly shorter tower for a limited number of sites, if required. As such, the Applicant has chosen to use predominantly 80-meter towers for the Project.

In terms of other Project components, the Project will use tubular steel towers instead of lattice and free-standing meteorological towers instead of guyed structures. Both of these preferred structures are believed to reduce potential avian and bat collisions and have fewer visual and agricultural land impacts.

4.6 Alternative Project Scale and Magnitude

The Applicant is doing business in a wholesale electric market that is highly competitive and extremely price-sensitive. Commercial wind farms produce two main commercial products: a) the commodity electric energy; and b) “environmental attributes” that are generated along with each unit of electricity. Wind farms can also sell their “capacity,” but the revenue from such sales is typically no more than 2 percent of total revenue. As currently designed, New York State’s RPS is such that there is a single buyer, NYSERDA, for the environmental attributes that would be produced for RPS compliance. The Request for Proposal (RFP) process allows NYSERDA to compare all renewable energy projects and to contract with only the lowest cost providers that have the largest relative New York content. Given the economies of scale involved in the development and construction of a wind project, all other things being equal, a larger scale project produces lower cost energy. As such, increases in the Project’s costs, or scale reductions below a certain point, reduce its likelihood of winning a NYSERDA contract, or any other contract for renewable energy in the region, and thus eventually being built. Of the proposed wind projects in the NYISO transmission study queue, the average scale is roughly 100 MW, which suggests that the Project needs to maintain its current scale to remain economically viable and capable of contributing significantly to state renewable energy production mandates.

The Applicant has explored increasing the Project’s scale. As discussed in the previous sections, Project components of alternative size and number were considered. Also, as described in the previous sections, the Applicant reduced the number of turbines to mitigate impacts on sensitive environmental, agricultural, and cultural resources more effectively, while achieving a reasonable balance with the desired energy production goals that ensure economic viability.

Further reductions in the Project’s scale would also proportionately reduce local economic benefits and fail to utilize the capacity available in the nearby transmission system to the extent possible. In addition, fewer host landowners and adjacent neighbors would realize direct economic benefits from participating in the Project and PILOT and mitigation/host community agreements with the host taxing jurisdictions, as well as construction expenditures (which are typically developed on a “per megawatt” or “per turbine” basis) would be reduced.

4.7 Alternative Project Timing

The Project cannot be constructed until the SEQR process is complete, a wind energy permit has been issued by the Town of Arkwright, and the required wetlands permits issued by the

USACE and the NYSDEC. It is not expected that these permits will be issued, or that an interconnection agreement will be executed, until late 2008 or early 2009, making construction in 2008 impossible. The Project may be constructed in 2009 if the Applicant receives its permits and regulatory approvals in time, if the Applicant can secure the turbines and other long lead time equipment, and if the System Upgrade and Attachment Facilities can be identified and agreed to by the NYISO and the interconnecting transmission owner in the required timeframe. If any of these events do not occur in time, the Applicant will seek to complete construction in 2010. Once the Applicant has committed to the purchase of the turbines and other major equipment, the Interconnection Agreement has been signed and the permits issued, economics dictate that the Project be constructed as soon as feasible.

4.8 Alternative Mitigation Strategies

Section 2.0 describes the anticipated environmental impacts and corresponding mitigation measures for each resource based on the preferred Project layout. The selection of specific Project facility locations was based on a comprehensive process. The Applicant placed a high priority on defining the environmental resource and land use constraint areas within the proposed Project Area and avoiding these areas where possible. Constraint areas that could not be avoided are limited in impact based on micro-siting decisions, the use of tailored design features or construction techniques, and timing of construction activities. Mitigation measures have been proposed where unavoidable impacts exist and are described at the end of each resource discussion in Section 2.0.

The selected mitigation strategies were developed by the Applicant in coordination with agency staff, local officials, and affected stakeholders. They are generally site-specific in nature and attempt to locally compensate for anticipated impacts. A range of options were considered by the applicant when developing its proposed mitigation measures. Ultimately, the mitigation plan is a product of matching Project requirements with all applicable laws and regulations. Reasonable mitigation measures were established that minimize impacts both during construction and operation of the wind energy station and allow for flexibility to adapt to unforeseen impact conditions that may be encountered.