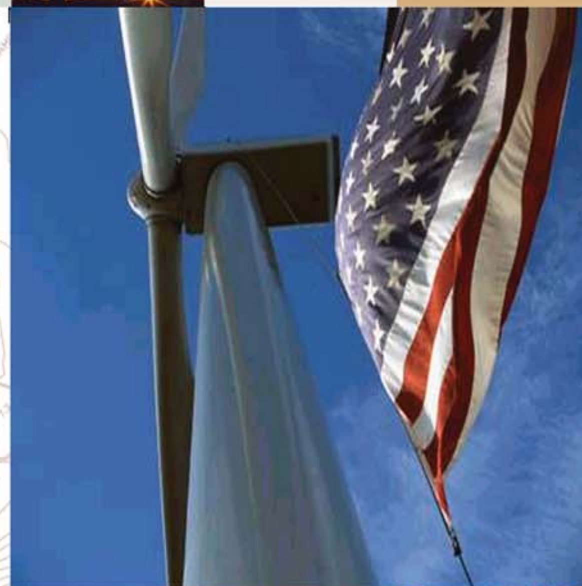



Wind Turbine Feasibility Study




Prepared For:

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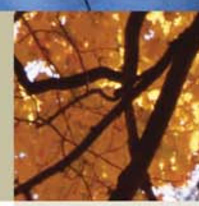

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IPSWICH MUNICIPAL LIGHT DEPARTMENT
WIND TURBINE FEASIBILITY STUDY

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REPORT OVERVIEW

The Town of Ipswich has a history of electrical generation which dates back over a hundred years. In keeping with this history and desire for sound financial and environmental planning, the Ipswich Municipal Light Department is proposing to erect a wind turbine electric generator and accessory improvements on a small portion of the municipally owned property at the end of Town Farm Road.

The Ipswich Municipal Light Department hired Meridian Associates to help access whether or not it is feasible and prudent to install a wind turbine to meet some of its electricity supply needs and hedge some of the risks and uncertainties inherent in future pricing of the wholesale power markets.

Our team has demonstrable expertise and recent success in permitting complex projects in environmentally sensitive areas. Each member of the team brought specific relevant skills to help leverage the realization of Ipswich's goal to assess the efficacy of building a wind turbine facility at the northerly end of Town Farm Road.

The project team consists of:

- **Ipswich Municipal Light Department** performed project reviews as the owner and provided key information regarding the proposed turbine site, transmission line upgrades, and projections for future costs for electric power.

- **Meridian Associates, Inc**. served as the prime consultant and team leader, providing oversight and direction to the other firms and serving as the primary liaison to Ipswich. MAI also produced the concept site plan and construction cost estimate.

- **Heartwood Group, Inc**. in conjunction with **W.A. Vachon & Associates, Inc**. and **E.F. McCarthy & Associates** performed the Wind Resource Assessment and Economic Feasibility Analysis.

- **Weston and Sampson Engineers, Inc**. performed the foundation assessment and provided cost estimates for the foundation.

- **DeRosa Environmental Consulting, Inc**. led the environmental study for the Preliminary Avian Impact overview.

Mr. Tim Henry and Mr. Bill Ford from the Ipswich Municipal Light Department provided guidance on the project. Specifically they instructed that the project should include the construction of only one wind turbine, that it be a MW scale wind turbine, that it be owned and funded by Ipswich Municipal Light Department, and while we should consider other revenue streams from the project such as that from Renewable Energy Certificates (RECs), ideally the project should provide positive cash flows and financial returns from avoided future power purchases only, without the need to depend on the long term stability of REC markets.

On a single turbine installation, both the consulting team and the client felt it is important to be conservative in minimizing the risks of the project by working with proven machines from strong manufacturers that have an active service and maintenance presence in the Northeastern United States. With the approval of Mr. Ford and Mr. Henry, we imposed the additional restraint on the project to evaluate only wind turbine generators with a proven track record in many installations that meet those criteria.

The following is the summary of our findings. These are discussed in greater detail in the various sections of our report. We trust the information presented will equip the Town with sound decision support as it further considers its potential investment in a wind turbine generator (WTG).

- It is feasible to deliver to and erect a WTG on the proposed site at the end of Town Farm Road. Modest site improvements, most significantly regrading and reconstruction of the site access drive, will be required.

- Off site improvements, including new utility poles and overhead cabling, will be required in Town Farm Road to transmit power from the WTG to the municipal distribution system in the vicinity of Ready Farm Way.

- The capital cost of the WTG could range from \$3.054M to \$3.926M depending on the manufacturer and model selected and other variables such as foundation costs. These capital costs include design and permitting; equipment purchase, delivery and erection; and ancillary construction and improvements.

- Candidate WTG's considered in this study include several models manufactured by General Electric and Vestas, established manufacturers of proven, mature, and commercially available WTGs.

- Based on wind studies conducted, the proposed site is considered a low-end IEC Class 2 wind site having an annual average wind speed of 5.6 to 5.8 m/s.

- Preliminary analyses show that the site can potentially produce sufficient wind generated energy to make the project economically feasible. However, due to various technical, economic, regulatory, and policy uncertainties, the analysis does not produce a clear and certain "GO" signal.

- The financial viability of the project is highly contingent on financing. Potential 0% financing available to public entities pursuant to the Energy Policy Act of 2005 offers the highest probability of the project being profitable. The WTG does not appear to be financially viable under a conventional financing scenario (i.e. 6%).

- Based on offsetting wholesale costs only, economic analyses show that the proposed WTG would have approximately a 50% probability of delivering positive financial returns based on MMWEC forecasted wholesale energy costs and 0% financing.

- Recent experience indicates that the long-term wholesale electricity costs projected by MMWEC may be low. Applying a -10/+50% variation to the forecasted MMWEC energy costs, the probability of the WTG generating positive financial returns increases to approximately 75%.

- The average expected net positive cash flow from offsetting wholesale power purchases over the lifetime of the proposed project assuming 0% financing and assuming MMWEC projected power costs are correct would be $6,500

- The average expected net positive cash flow from offsetting wholesale power purchases over the lifetime of the proposed project assuming 0% financing and assuming MMWEC projected power costs may vary by -10% to +50% would be $511,500

- The sale of NEPOOL GIS Renewable Energy Certificates (RECs) would significantly improve the WTG's financial return.

- Projecting levelized costs over the life of the project for the two most promising machines and assuming 0% financing, there is a 77.7% to 79.4% probability that electricity produced by the Wind Turbine Generator would cost between 6.1 and 7.8 cents per kWh.

- In addition to providing the potential return on investment the WTG would hedge against future fuel price volatility allowing the Town to more accurately predict and stabilize its future electric costs, and mitigate the environmental impact of generating electricity.

For purposes of financial modeling we were conservative in our estimates. We feel that as a technology still considered innovative, it is important that wind projects not be sold to a public entity with expectations that are not conservative. We believe it would be far better for a wind project to exceed expectations and forecasts than to under perform in meeting public expectations.

It should be highlighted that because early financial analysis showed the project would not be feasible under conventional financing terms, the summary models assume the availability of 0% financing through mechanisms available in the recently passed Energy Policy Act of 2005. Prior to proceeding with the project, it would be advisable that the Ipswich Municipal Light Department determine that such financing would indeed be available to the project.

In preparing this report we ran a million simulations of each model assuming variations in capital costs of the project, O&M costs and other variables that will impact the financial returns of the project. We then provided a statistical analysis of the probability of any of those outcomes of an investment in a wind turbine generator. This has been done both assuming that the MMWEC price forecasts of June 2005 are accurate and also in a separate model allowing for increases in wholesale electric rates above those projected by MMWEC.

We want to highlight the significant benefits of financial hedging provided by wind energy, which is a zero fuel cost generating resource. Hedging against volatility in future energy pricing is a key benefit of any well planned wind energy project.

Energy pricing is now so volatile that near term price estimates from the Massachusetts Municipal Wholesale Electric Company have almost doubled in just a few months. Recent local news articles suggest that in the town of Danvers, residential electricity prices will be increasing 23% in October 05, in Peabody rates will be increasing 19% in November 05 and Massachusetts Electric Company customers will see residential rates increase 27.5% in November 05.
In this environment, an effort at projecting avoided power purchase costs twenty or more years in the future is challenging.

With no fuel costs, the most significant components of pricing power from a wind generation project are the capital costs and Operation and Maintenance (O&M) costs. Capital costs are relatively easy to project. O&M costs for the machines considered are also significantly easier to project with confidence than attempting to project wholesale electric prices or fossil fuel costs twenty years into the future.

Our project team is not able to project long term energy pricing from conventional resources with confidence. However we are very confident that the cost of electricity from a wind turbine generator is far more predictable than costs from conventional generation resources. We are also absolutely sure that the environmental impacts of such a generator are negligible compared to other electricity generators. Thus, if environmental stewardship and stabilization of future energy costs are valued by the ratepayers and citizens of Ipswich, serious consideration of the proposed investment in a wind turbine generator should be made.

We appreciate the opportunity to submit this Analysis and look forward to working with the Ipswich Municipal Light Department to promote sustainable power in Ipswich through public awareness, regulatory permitting, and design services to stabilize electric utility rates and increase the supply of electricity utilizing renewable wind resources.

DESCRIPTION OF PROPOSED PROJECT

The Ipswich Municipal Light Department has to provide highly reliable power supply to the town twenty-four hours a day, every day of the year. It is also charged with providing power to the community at reasonable prices. With energy prices escalating and future energy prices increasingly uncertain, hedging future price volatility with a wind generator is a very prudent consideration for any utility operating in an area with reasonably good wind resources.

For a wind turbine with a good track record of operation, project capital costs, as well as operation and maintenance costs, can be projected with a relatively high level of confidence. With no fuel costs, long term power costs from a wind turbine can thus be determined with a much higher degree of certainty than projections of future wholesale power costs from the grid.

However single installations of utility scale WTGs are rare due to a number of factors. First and foremost, demand for renewable energy resources in the utility sector has been small. Only in the past five years has a steady and growing demand for new wind and other renewables been experienced. Secondly, single WTG project economics have not been competitive in the past in large part because opportunities to capture the economic value of the reduced air pollution, reduced climate change emissions, and local economic benefits associated with wind projects have historically been uncommon. With the introduction of Renewable Portfolio Standards and other economic incentives, that factor has improved recently. The primary reason that single WTG projects are not common is that they lose the economies of scale associated with multi-turbine projects in the construction, associated infrastructure upgrades and operations and maintenance. That latter consideration influences the economics of this proposed project

However, with the maturing of the wind industry, falling prices and increased efficiencies of wind turbines, increased wind turbine reliability, the advent of retail competition in the Massachusetts electricity market, the institution of a Renewable Portfolio Standard (RPS) for retail electricity providers and growing acknowledgement of the need for action to mitigate climate change, demand for wind energy is rising rapidly.

Worldwide, wind power is the fastest growing segment of the energy market and wind generated electricity is proving to be economically competitive with conventional power in many situations with few of the environmental liabilities of more conventional power sources.

The Renewable Energy Credit markets enabled by the RPS standards have led to financial returns that are often as high as or higher than the value of the electricity produced. In Massachusetts for the last year or more, RECs have traded well over 4 cents per kWh. Factoring this economic benefit into the analysis of wind projects has often been a key part of financing wind projects. The advent of Renewable Portfolio Standards and green power marketing has created a new business environment for the owners of new wind generators participating in the so-called green power or RPS compliance markets. This additional tangible financial value for a wind or other qualifying renewable energy project has attracted a number of serious project developers to Massachusetts and New England.

Owning and operating a wind generator could also address any needs that Ipswich Municipal Light Department may have for RPS compliance based on the other generation resources in the utility's supply mix.

Typically, wind projects provide power at the wholesale level to the conventional electrical power grid. In these cases, wind turbines receive wholesale rates for the power they produce in a manner quite similar to other independent power producers. Wind power development in the United States has typically been in the form of projects comprising scores of large turbines (1000 kW rate or more) installed at rural sites chosen for maximum wind resource potential, great distances from populated areas, and proximity to transmission lines. The electricity produced from these projects has typically been sold into the wholesale electricity market under twenty plus year power purchase agreements with credit worthy investor-owned utilities. Developers achieve significant economies of scale with these large installations and are able to obtain commercial financing for these projects secured by the revenue from the utility wholesale power purchase agreement. These projects are typically structured with an owner or "equity participant" that can use the available federal incentives such as Production Tax Credit (PTC) and accelerated depreciation to enhance the financial performance of the project.[1]

In the U. S. the utility-scale, wind market has seen approximately 7,000 MW of wind power approximately 9200 MW of nameplate wind capacity. Most installations are between 100 and 200 MW and sell the power directly into the grid based on long-term PPAs.

The project under consideration here is quite different. With the return on investment determined by wholesale power prices and the site determined in advance by Ipswich Municipal Light Department, the challenge is to determine if the wind resource that exists at the site is adequate to create a viable project.

The economic feasibility of the project rests not only on whether or not the wholesale value of the electricity is sufficiently high to offset the investment cost of installing wind turbines, but also in installed, with approximately 2500 MW to be installed during CY05, bringing the US total to determining the relative value of an investment that is a hedge against future escalation in the wholesale power markets. The price stabilization offered by this hedge could be a very significant benefit, especially in the increasingly volatile energy markets that have emerged in the last year. The value of this hedge needs to be determined by Ipswich Municipal Light Department in light of its internal perspectives on market risk.

Other factors that may make this project feasible where others might not be include the streamlined permitting process for publicly owned projects and the fact that public institutions are not subject to the same taxation regimes as private projects. These factors along with the anticipated value of Renewable Energy Certificates (RECs) make the timing appropriate to seriously evaluate such renewable energy generation solutions.

[1] The PTC, for which private (i.e., non-public) projects are eligible, is indexed to inflation and is currently $0.019 per kWh of wind electricity generated for the first 10 years of the project life. Equipment capital costs can be depreciated in five years or shorter. This incentive currently expires December 31, 2007.

OVERVIEW OF WIND PROJECT ECONOMICS

For wind power to be economic, a number of positive factors must coincide. While strong wind is clearly a necessity, other factors can significantly improve the economics of a wind project. The legal structure under which the wind project is conceived, financed, and owned has a significant impact in the project's ability to reap economic benefits from these factors as well as Federal and State programs such as Renewable Energy Production Incentive (REPI) and Clean Renewable Energy Bonds (CREBs), as well as the REC markets. In summary these factors are:

1) Capital Mix and Cost of Capital

    With no fuel cost and very low operating and maintenance costs, the economics of wind power rests primarily on the capital cost of the technology and its installation and the underlying terms of the project financing. Wind projects are generally funded with a combination of debt and equity. To the extent a given project has access to a low cost funding source, such as public bonding, the better the project's financial return.

2) Tax Benefit - Production Tax Credit (PTC)

    Private developers of wind projects benefit considerably from a production tax credit (PTC) that is available to wind projects through the Federal Tax Code. For a project to benefit from the PTC, the wind project needs to be owned by an entity that has sufficient tax burden liability to fully utilize the credits. Government-owned projects can not capture this benefit.

3) Low Cost Financing Opportunities - REPI and CREBs

    The Renewable Energy Production Incentive (REPI) is a program administered by the United States Department of Energy (DOE). It was specifically created to assist non-taxpaying entities that include municipalities, Native American tribes, rural co-operatives and others. It was originally intended to provide a Federal payment that is comparable in value to the Production Tax Credit (PTC), where the PTC is a straight tax credit for private, commercial entities that have a tax liability that can be offset by the tax credit. The current value of the PTC is $19/MWh and is indexed to an inflation-related factor. The recent Energy Policy Act of 2005, that was approved and signed by the President in August 2005, reauthorizes the REPI through October 1, 2016.

    The REPI is subject to annual appropriations by Congress. This means that there is no long-term certainty regarding available funds. In addition, over the past several years the program has been severely under-funded, with an average funding level of only $4-5 million/year. This has resulted in a program that cannot be counted on in the creation of project financial pro-formas.

    In response to the ineffectiveness of REPI, public power advocates have sought other incentives. As a result, the recent energy act included Section 1303, Clean Renewable Energy Bonds (CREBs). This section of the bill establishes a new category of tax credit bonds that will provide financing for capital expenditures for certain renewable resource facilities (yet to be clearly defined). Such bonds may be issued by units of government, municipal utilities, rural electric cooperatives, and Native American Tribal governments.

The program provides an 800-million dollar pool of funds. There is a limitation that no more than $500M of the $800M can be expended on governmental entities. The $800M must be shared with a broader group than the REPI and the total dollars may cover all the interest and apply over the full period of the bond issuance. Thus, the funds may be able to support large solar-electric facilities installed by the various qualifying entities, where it is not clear which types of plants qualify. These plants probably include such energy sources corn-to-ethanol, hydro, waste agricultural products and wood chips along with wind and solar. At this time, the recommended manner to model such a program is to assume a zero interest on the full bond issuances – as a lowest-cost financing source.

4) Tax Benefit - Accelerated Depreciation

Private developers of wind projects also benefit from the ability to depreciate the capital investments of wind projects on an accelerated schedule compared to other investments. Again, for a project to benefit from the depreciation offsets the wind project needs to be owned by an entity that has sufficient tax liability that can be reduced by the depreciation.

5) Renewable Energy Credits (REC's)

Owners of renewable generation assets such as wind turbines can benefit considerably from selling Renewable Energy Credits (REC's) in addition to electrons. RECs are a tradable commodity with contracts currently being written both on a very short term basis and in some cases with future purchase and delivery commitments going out as far as ten years or more. Generally the markets have offered higher returns for shorter term contracts and lower returns if the REC buyers are assuming the risks of predicting long term REC values. Driven by the Commonwealth's Renewable Portfolio Standard (RPS), which mandates that each retail power supplier obtain a certain percentage of its total annual energy sales from renewable sources, REC's earned a renewable generation asset owner between $0.020/kWh to $0.045/kWh during the first year and a half of RPS REC market activity. Please see the REC section that follows for additional information.

PROJECT OWNERSHIP AND FINANCING STRUCTURE OPTIONS

Given these various financial impacts and considerations, it makes sense to view the ownership structure for wind energy projects along a traditional public / private ownership structure continuum with associated benefits, costs, and details as follows:

Public Structure	Jointly Structured	Private Structure
(Benefits = low capital cost)		(Benefits = tax offsets)

The Ipswich Utilities Department has provided very clear guidance that public ownership and financing of the project is clearly their preference and the method most likely to win approval in the town. For this and other reasons, this is likely the best solution for an ownership structure. However, the US wind industry has generally been heavily impacted by the availability of the Production Tax Credit and some consideration of that financing mechanism should be at least mentioned in a report of this nature.

Public Structure – Description
In the public structure scenario, the Ipswich Municipal Light Department would finance the entire project at what is assumed to be a cost of capital lower than that available to private developers. Since the project is 100% locally owned, all electricity generated by the project would be fed directly into the utility power mix at no cost above and beyond the cost of the capital and operating and maintenance costs of the turbine.

It is assumed that transaction costs and activities for such an ownership structure would be centered on vendor selection for the capital equipment and the associated operating and maintenance contracts.

Private Structure – Description
From the perspective of the Ipswich Utilities Department, a wind project developed by a private entity would take the form of a long-term (up to 20 years) contract to purchase all the power production from the project (Power Purchase Agreement or PPA) and a long-term land lease agreement under which the private developer secures the right to construct and operate the wind turbine(s) at the site for the long-term (20 years with an option to extend).

Since private developers need a secure stream of income to obtain debt financing, the PPA would need to be based on a known, reliable price over the entire term. Creative price structures might be negotiable. Of course, with such a long-term PPA it is desirable that Ipswich Utilities Department lock in energy costs that are likely to be below market over this time thus saving money.

In the private structure scenario, the entire project would be financed, owned, and operated by a private entity. On one side of the balance sheet, the project would be burdened with a higher cost of debt as well as the need for commercial rates of return on the equity. On the other, it would benefit from the PTC and depreciation tax offsets.

Transaction costs and activities for a private structure ownership structure would be centered on selecting the private developer, negotiating the PPA with the developer, and providing the developer with a long-term lease for the land upon which the wind turbine could be installed.

Public/Private Partnership Structure – Description

In a Public/Private Partnership the Ipswich Municipal Light Department would team up with a private developer in order to take optimal advantage of the public entities lower cost of debt and the private developer's ability to utilize federal tax credits and offsets. It is possible that through such a hybrid structure that the total cost of the project, and thus the resulting cost of electricity to Ipswich Municipal Light Department, would be minimized.

As a hybrid, this structure would most likely require the highest level of legal costs and related transaction costs and activities. In particular, the tax code covering the PTC includes several provisions intended to constrain a private wind project developers ability to “double dip” Federal and state or local incentives (i.e. claim the full PTC and below market financing terms). Likewise, this structure would have to adhere to public procurement regulations adding another layer of complexity to the transaction. Consequently, any public-private partnerships would need to be carefully constructed. A careful analysis of Private/Public Partnership structures would be required to determine if the benefits derived from a hybrid structure outweigh the higher transaction "costs" and activities.

REPORT METHODOLOGY

In order to provide Ipswich Municipal Light Department with a comprehensive analysis of the proposed project the following activities were undertaken:

- Analysis of the available wind resource at the selected site
- Recommendations of suitable wind turbine generators (WTGs)
- Predictions of wind power based on wind resource analysis and WTG recommendations
- Analysis of site conditions that impact project cost
- Projection of project costs
- Projection of operation and maintenance costs
- Projection of electricity prices
- Projection of renewable energy certificate values
- Projection of debt financing costs
- Analysis of economic feasibility
- Consideration of permitting approvals and other pre-construction considerations
- Preliminary analysis of avian impacts
- Analysis of project uncertainties
- Public opinion considerations and impacts
- Conclusions and recommendations

The results of each of these activities are quickly summarized in the next section. More detailed information on each activity is included in a dedicated section as required.

Note: Initial phases of our analysis included modeling the GE WTG at 60 meters. During the cost estimating phase, GE advised that would not be a recommended or economical configuration so further consideration in the cost estimating and economic modeling was discontinued.

SUMMARY OF FINDINGS

A detailed write-up of the following analyses can be found later in this report.

WIND RESOURCE ANALYSIS

Based on wind data at the site recorded by researchers from the University of Massachusetts (UMass) and the data from the National Weather Service, we projected the available wind resource. We found that the wind turbulence values were modest and that the occurrence of peak winds in excess of 125 mph is very rare – occurring only during very infrequent hurricanes. Based on the wind speeds, turbulence intensity and projected peak winds, we estimate that the Ipswich Municipal Light Department site is a low-end IEC Class 2 wind site.

RECOMMENDED WIND TURBINES

Given our experience and discussions with Ipswich Municipal Light Department staff we recommend that Ipswich Municipal Light Department avoid using prototype or unproven wind turbine generators (WTGs) and only consider the purchase of one of the following three proven, mature, commercially available WTGs:

- General Electric Model 1.5sle, 77-m diameter, 1.5-MW
- Vestas Model V80, 80-m diameter, 1.8-MW
- Vestas Model V82, 82-m diameter, 1.65-MW

Each of these WTGs has a history of generally reliable operation at many facilities at sites around the world. All WTGs have three full-span, pitchable, fiberglass blades, sit atop enclosed, tubular towers, and meet the latest Federal Energy Regulatory Commission (FERC) requirements for (a) power factor control, (b) SCADA system accessibility for transmission-system-operator control, and (c) Low Voltage Ride-Through (LVRT) standards recently required by FERC.

Further, we evaluated the potential of using each WTG with a 60-m or 80-m hub height. There is an economic trade-off with respect to hub height. The higher hub heights produce more annual energy due to the stronger winds found at higher heights, but the WTG tower, foundation and installation costs are greater and average annual maintenance costs are slightly greater.

WIND POWER PREDICTIONS

Based on our wind resource analysis and choice of WTGs we projected the wind energy production and 20-year gross revenue generation based on Ipswich Municipal Light Department's projections of the value (i.e., the cost) of on-peak and off-peak power that Ipswich Municipal Light Department would need to purchase if the WTG was not installed. In Table 1, we have summarized the key results of our analyses for the three WTGs selected at two different hub heights. The results are applicable for a vertical wind shear, power-law coefficient of 0.18.

Table 1. Summary of Projections of Annual Net Energy and Gross Revenue Generation from Potential WTGs

Parameter	WTG & Model Number					
	GE 1.5 sle	GE 1.5 sle	Vestas V80	Vestas V80	Vestas V82	Vestas V82
Rated Power, MW	1.5	1.5	1.8	1.8	1.65	1.65
Rotor Diameter, m	77	77	80	80	82	82
Hub Height, m	60	80	60	80	60	80
Net Energy, MWh	2,448	2,779	2,762	3,134	2,782	3,153
Capacity Factor	0.186	0.211	0.175	0.199	0.192	0.218

SITE ASSESSMENT REGARDING CONSTRUCTION

Site Construction, Staging, Access, and Delivery

We assessed the condition of the site and Town Farm Road as well as a delivery route for the turbine. Town Farm Road was deemed to be acceptable for geometrical aspects including overhead and ground clearance. However, the existing access drive to the site is too steep and will need to be re-graded to reduce its slope to less than 10%. It is possible to deliver the equipment and components required for the erection of the proposed turbine to the site via existing roads. The delivery will require some work and modifications to facilitate delivery.

We also investigated site related construction issues. We are proposing to grade the existing access drive to minimize the slope and re-grade the proposed site in the vicinity of the proposed wind turbine generator to provide staging and laydown areas (see Figure 3).

Interconnection and Transmission Infrastructure

The power from the proposed wind turbine generator will be distributed via a new 3-phase line that will be hung on existing and new poles in Town Farm Road. The new system will tie into the existing 3-phase system at Ready Farm Way, approximately 1.1 miles from the site. Figure 2 shows the proposed infrastructure upgrade. Twenty new poles are shown in locations that did not meet either span or alignment criteria.

Preliminary Foundation Assessment

The Weston and Sampson Engineers, Inc. memorandum summarizes their preliminary assessment of subsurface conditions, probable foundation alternatives, estimated ranges of foundation construction costs, and a recommended subsurface investigation program for the next phase of the subject project. Possible foundations range from a spread footing type to the Vestas proprietary “ring shaft” type with an estimated construction cost range from $200,000 to $400,000. The general appearance of the proposed site is that of a remnant glacial drumlin feature. However, the presence of debris piles along the gravel path on top of the hill indicates that all or part of the site may have been used in the past for landfilling. Assuming no landfilling, the subsurface conditions at the site are likely comprised of very dense heterogeneous sand, gravel, silt and clay deposits (glacial till) typical of other glacial drumlin features in the area. However, actual subsurface conditions should be confirmed by a suitable exploration program as part of the next phase of work.

PROJECT COST ESTIMATE

Meridian Associates performed a conceptual site design for the designated location and transmission upgrade. We used the town GIS database as the basis for our design. Representatives of Meridian coordinated with several construction contractors and Town of Ipswich employees to develop cost estimates and substantiate assumptions associated with the capacity of existing transmission lines. Costs were obtained from several sources and used to establish a low and high range cost for each turbine option. The unknowns associated with the turbine foundation are the source of the largest delta in the cost range. The other significant deltas are also site related and are associated with site preparation and the crane pad foundation. Although the site is on a drumlin, the extent of fill or alteration at the site is not currently known. The following table is a summary of estimated costs. Full estimates for each WTG appear in the cost estimate section of this report.

Table 2. Summary Project Cost Estimates

Option	Cost Range (1)	
	Low	High
GE 1.5 at 80m	$3,054,080	$3,381,970
Vestas V80 at 60m	$3,342,560	$3,760,450
Vestas V80 at 80m	$3,617,440	$3,945,330
Vestas V82 at 60m	$3,243,360	$3,661,250
Vestas V82 at 80m	$3,598,200	$3,926,090

Cost includes design and permitting, turbine delivery and erection, site construction, commission, and a 5-year manufacturer's warrantee.

OPERATION AND MAINTENANCE COST PROJECTIONS

We estimated long-term O&M costs using our detailed, proprietary O&M model that is based on projected operations and scheduled maintenance costs. We estimate that any of the candidate WTGs can be maintained for a cost of approximately 12 to 13.5 $/MWh. This is a 20-year, levelized-cost estimate based on (a) a cost inflation factor of 2.5 percent applicable to labor and materials and (b) projected scheduled and unscheduled maintenance costs. Because O&M costs can vary greatly with the type of O&M approach followed by Ipswich Municipal Light Department, it's outside contractors, labor rates, WTG supplier, etc., We further estimated that O&M costs could vary between minus 20 and plus 35% of assumed averages.

PROJECTED ELECTRICITY PRICES

Projected electricity prices used in the financial analysis were provided by the Massachusetts Municipal Wholesale Electric Company (MMWEC) via Ipswich Municipal Light Department. MMWEC is a joint action agency for the consumer-owned, municipal utilities of Massachusetts and provides a wide range of power supply, financial and other services to meet the common needs of its member and project participant municipal utilities. Because the duration of these pricing projections did not match the 20-year expected life of the WTGs, the last four years of projections used in this report's analysis were based on a linear average of the prior sixteen years of MMWEC forecasts. These forecasts were used as the standard in calculating the financial impact of the project.

However, in addition to using unaltered MMWEC forecasts, this report analyzes the financial impact under pricing forecasts that might deviate as much as 10% lower and 50% higher than the original MMWEC data suggest. This additional analysis was conducted in light of recent events and an almost doubling for near term energy costs.

Additional write-ups related to projected energy prices can be found later in this report in a number of sections as appropriate. MMWEC forecasts as supplied by Ipswich Municipal Light Department appear in Appendix E

RENEWABLE ENERGY CERTIFICATES (RECs)

While Ipswich Municipal Light Department clearly stated that the financial analysis of the proposed WTG should not incorporate REC values, RECs values were estimated in order to provide Ipswich Municipal Light Department with an addition measure of value in the proposed WTG project. Two economic scenarios have been forecast for REC values. At the minimum it is assumed that RECs will have a value of \$0.01 kWh and at maximum a value of \$0.024 kWh beginning in 2005. These starting values are then adjusted for inflation at a constant 2% annual rate resulting in values of \$0.016 kWh and \$0.040 kWh in 2029, respectively. As can be seen later in the report RECs do have the ability to cover potential economic shortfalls in the projected project.

DEBT FINANCING COSTS

Debt financing costs were based on an estimate of 6% provided by Kevin Merz, Treasurer/Collector for the Town of Ipswich, as well as 0% as potentially available under the recently enacted Federal Energy Bill. Financial analyses were run under each financing scenario.

ECONOMIC FEASIBILITY ANALYSIS

Given all available data the standalone financial viability of Ipswich Municipal Light Department's wind turbine is clearly predicated on low-cost financing as well as Ipswich Municipal Light Department's desire to hedge the future impact of grid supplied energy costs. The sale of RECs can also significantly improve the proposed project's financials.

If Ipswich Municipal Light Department is able to secure 0% financing under the recently enacted Federal Energy bill, financial models predict that a positive outcome over the life of the proposed WTG project is, on average, possible. However, only one of the examined WTGs will on average, over its expected life, produce energy at an expected cost to Ipswich Municipal Light Department that will be below the expected price Ipswich Municipal Light Department would otherwise pay for electricity from the grid. This result assumes that the future cost of grid supplied energy matches that forecasted by MMWEC. If future energy prices increase above the MMWEC forecast, the financial viability of the project can change dramatically.

PERMITTING APPROVALS AND OTHER PRE-CONSTRUCTION CONSIDERATIONS

A summary of the permitting issues to be considered on the proposed project follows. Due to the location of the project, specific attention was paid in this assessment to avian issues. A write-up of this analysis can be found later in this report.

The Ipswich Wind Turbine project consists of one large, slowly rotating wind turbine generator with approximately 60 or 80-m hub heights. Accordingly, impacts to migrating and/or resident birds species are expected to be minimal. Additional work will be required to investigate the use of the site as part of a comprehensive avian impact study that will be conducted as part of the future regulatory permitting for the project.

PROJECT UNCERTAINTIES

Our objective in this analysis has been to prepare a reasonable assessment of the cost, performance, value, and economic viability of a wind turbine installation. It is important to realize that there are inherent uncertainties in making such projections.

Uncertainty around several of these critical variables can be reduced significantly. The cost of permitting and construction will become known after the permitting and engineering processes are completed and construction bids are available. There is some uncertainty in the projection of O&M costs that will become more certain once Ipswich Municipal Light Department defines its approach to O&M. Capital costs for the project will also become more certain as the project develops and bids are received.

Projecting the financial performance of any investment out over a twenty year time horizon has inherent continuing uncertainties. The future pricing of electricity and inflation rates are by their nature unknowable with certainty. Similarly the long term value of Renewable Energy Certificates is also not possible to project with certainty.

On the positive side, a wind turbine is itself inherently a hedge against unexpected increases in future energy costs. The price stability and independence from fossil-fuel price volatility make the proposed project itself protection against future price uncertainties.

PUBLIC OPINION CONSIDERATIONS AND IMPACTS

Though worldwide wind energy is the fastest growing and most cost competitive sector of the electricity markets today, wind electricity is only now gaining acceptance in New England. As with any early adoption of wind energy, the impacts of the proposed project on the emerging wind industry in New England go well beyond consideration of the economics of the project itself. These larger impacts should be carefully evaluated before proceeding with construction.

Local public opinion and support is critical to the success of any wind project. Regionally, the wind turbine built in the community of Hull has had overwhelmingly positive public support and that town is in the process of planning and building a second generator. Near the center of Boston earlier this year, the International Brotherhood of Electrical Workers was able to permit and build a wind turbine in a very short time with the support of local community groups. In contrast, the Cape Wind project has had significant local opposition which has led to delays and significantly increased costs of the permitting process. Thus we would strongly encourage the Ipswich Municipal Light Department continue to make the appropriate effort to explain the benefits of the project clearly to local residents and garner strong public support for the project as part of the preconstruction process.

SUMMARY CONCLUSION:

This report reflects the results of the feasibility study. The primary economic benefit of a wind turbine generator in the supply mix for Ipswich Municipal Light Department would be in stabilizing future energy pricing for the utility and hedging against future energy price volatility. Ancillary benefits, such as environmental benefits of providing non-polluting wind energy production are hard to quantify economically.

While the financial returns of a wind turbine generator in a site like that proposed are not huge based only on offsetting wholesale power price purchases alone, the likely financial returns including the value of Renewable Energy Credits (RECs) in Massachusetts would be significantly more favorable. While future REC markets over twenty years cannot be guaranteed, neither should they be completely discounted.

Assuming that the benefits outlined in the report are deemed to be favorable based on the risk reward analysis of the Ipswich Municipal Light Department and the town, and that determinations by the town indicate that 0% federal financing is likely to be available for the project, then we can recommend that further pre-development work would be conducted including assessing and gathering local support for the project, securing the necessary permits and approvals and arranging for financing of the project. Like any long term capital investment, the project is not without some risk and uncertainties, which are summarized in the report.

If the findings of this report are not such that they would enable the Ipswich Municipal Light Department to move forward with the project as a municipally owned venture, one further consideration might be to analyze the project as public private joint venture. One of the primary incentives for wind development contained in the Energy Policy Act of 2005 is a very significant production tax credit for wind projects, which would not be available to a publicly owned entity like Ipswich Municipal Light Department. In some other projects, public entities such as Ipswich Municipal Light Department have joint ventured with private developers in a manner that enables that incentive to be utilized in capitalizing the project. Based on instruction our team received from Mr. Henry and Mr. Ford, the assumptions utilized in this study have been that the project will be entirely owned by Ipswich Municipal Light Department, so no analysis of that option was performed as part of this study.

SITE EVALUATION:

Ipswich is located on the North Shore of Massachusetts, approximately 28 miles north of Boston. The town is proposing a wind turbine electric generator on a portion of the municipally owned property adjacent to the sludge composting facility at the end of Town Farm Road.

The proposed site is on a small hill surrounded by salt marshes. There are only eight homes within a 1-mile radius of the proposed turbine, all on Town Farm Road. The closest intersecting street to Town Farm Road is Ready Marsh Way (approximately 1.1 miles from the site). The site is located at 42°42’58” N and 70°50’30” W (See Figure 1).

Site Construction, Staging, Access, and Delivery

We met onsite with Mark Equipment Corp. (MEC) to assess staging, access, erection, and delivery issues for the proposed wind turbine generator. MEC performed the delivery and erection for Hull I and quoted the work for Hull II. MEC assessed the condition of the site and Town Farm Road as well as a delivery route for the turbine. Town Farm Road was deemed to be acceptable for geometrical aspects including overhead and ground clearance. However, the existing access drive to the site is too steep and will need to be re-graded to reduce its slope to less than 10%. It is possible to deliver the equipment and components required for the erection of the proposed turbine to the site via existing roads. The delivery will require some work and modifications to facilitate delivery.

We also met onsite with Methuen Construction to assess site construction issues and costs associated with the proposed site work. As shown in Figure 3, we are proposing to grade the existing access drive to minimize the slope and re-grade the proposed site in the vicinity of the proposed wind turbine generator to provide staging and laydown areas.

Interconnection and Transmission Infrastructure

We met with Scott Waiswillows, Distribution Foreman, Ipswich Municipal Light Department to discuss the existing infrastructure and what up grades would be required to allow power transmission from the proposed wind turbine generator. We walked the route for the proposed upgrade to determine if the existing poles were sufficient to carry the new proposed wires. Scott also determined what type of 3-phase wire would be most cost effective and where the tie-in to the existing system should occur.

The power from the proposed wind turbine generator will be distributed via new 3-phase wire that will be hung on existing and new poles in Town Farm Road. The new system will tie into the existing 3-phase system at Ready Farm Way, approximately 1.1 miles from the site. It was determined that the new 3-phase power could be transmitted via a 3-wire open construction system rather than a bundled Hendrix type 3-phase wire system.

Figure 2 shows the proposed infrastructure upgrade. Twenty new poles are shown in locations that did not meet either span or alignment criteria. Two poles along the proposed route that are currently within the salt marsh will be relocated closer to Town Farm Road, outside of the salt marsh.

Site Location

The proposed project site is an isolated, town-owned, drumlin hill near Ipswich Bay that is adjacent to a former landfill at the end of Town Farm Road located approximately three miles north of Ipswich Center. Figure 1 is a map of the area – indicating the general location of the wind site and the relevant land features in the vicinity.

Figure 1. Map of Northern Portion of Ipswich and Proposed Wind Project Site

Figure 2 - Proposed Transmission Upgrade

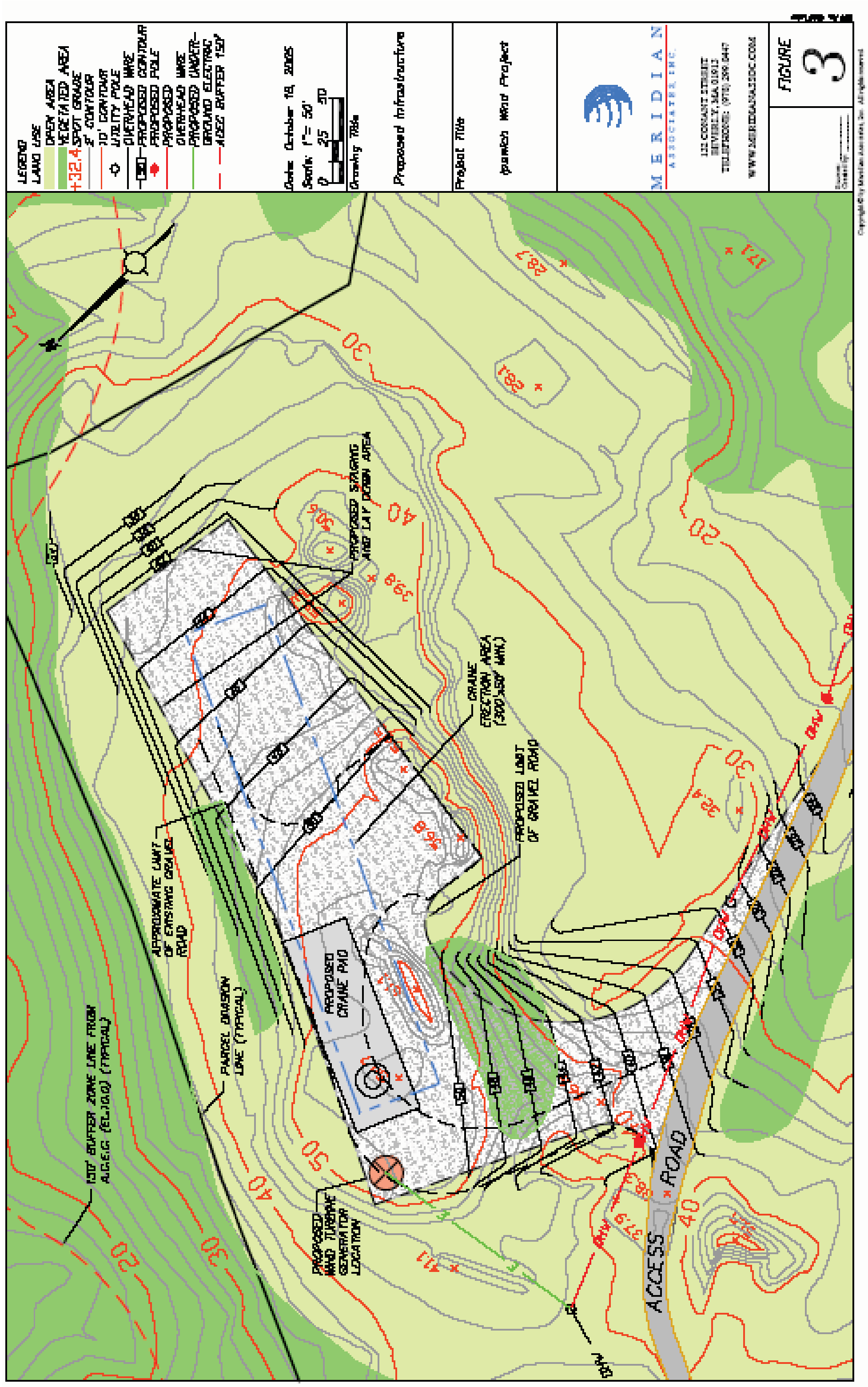


Figure 3 - Proposed Turbine Site

WIND RESOURCE ANALYSIS

Historical, Measured Wind Data

The Renewable Energy Research Laboratory of the University of Massachusetts (UMass) in Amherst, MA measured one year of wind data at the Ipswich site. The data were measured from June 1, 2003 through May 31, 2004. The data set consists of redundant wind speed measurements (i.e., two sensors) at heights of 10, 30 and 39 m above ground level (above ground level), wind direction data at all three heights as well and the measured standard deviations of each sensor output. The calibration factors for each sensor are included in the data sets. The data sets include approximately 98 percent of the possible data measured during the period of record.

In Appendix A, in Tables A-1 through A-7 we have included summaries of the wind speed and direction data measured at the three heights.

Annual Mean Wind Speed

We estimated the long-term wind resource for the site by acquiring the wind records for the period from year 2000 through June 2005 from Logan Airport in Boston (see Table B-1 of Appendix B). Logan Airport has a long-term period of wind records and provides a good long-term database by which to establish which years were good, bad or average wind years. We compared the coincident wind speeds between Logan and the site for the purpose of evaluating two main factors:

1) The correlation of the site winds to those measured at Logan Airport, and
2) The amount by which the site winds, recorded during the measurement period, differed from what is estimated to be the long-term average for the site.

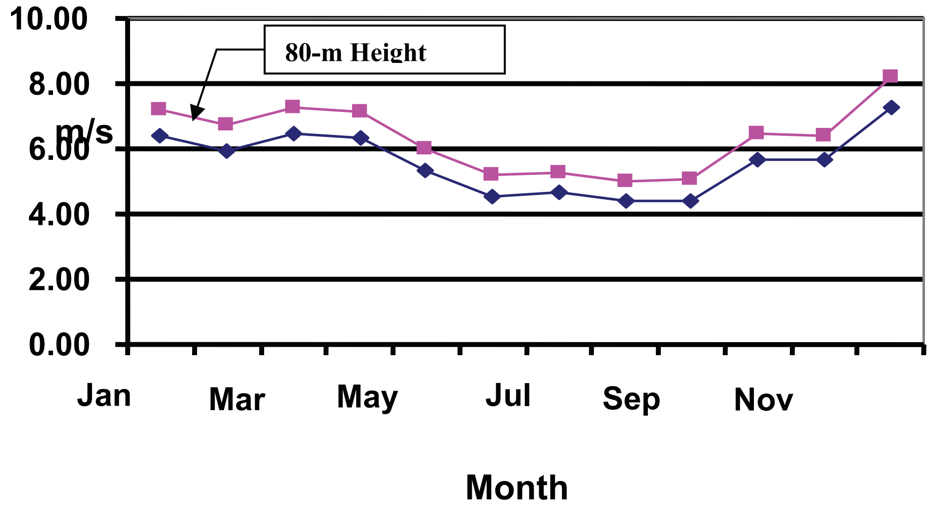
We did not use the hourly wind speeds from Logan because it is expensive to obtain the data from the National Climatic Data Center (the funds are not in the current budget) and the hourly data might not correlate well between the two sites. However, the daily average wind speeds were available via the National Weather Service (NWS) Web Site for Boston. We obtained these data and calculated the daily average wind speeds for the 39-meter level of the Ipswich Municipal Light Department meteorological (met) tower. These were then imported to an Excel Worksheet and the Regression Data Analysis tool was used to determine the correlation coefficient. The results of our analysis yielded an R-Value (correlation factor) of 0.91 and an R-Squared value of 0.832, indicating a very good relationship between these two sites. In Appendix A we have summarized the site met data, while in Appendix B we have listed the met data that we worked up for 60 and 80-m heights.

The annual average wind speed for Logan based on these data is 11.23 mph. The annual average wind speed at Logan Airport for the 12-month measurement period from June 2003 to May 2004 is 11.09 mph. Using a simple ratio approach, we find that the annual average wind speed for the 12-month study period is 1.2 percent lower than what we consider to be the normal or long-term average. We used this adjustment (i.e., +1.2 percent) to create the long-term average wind speed for the Ipswich Municipal Light Department site.

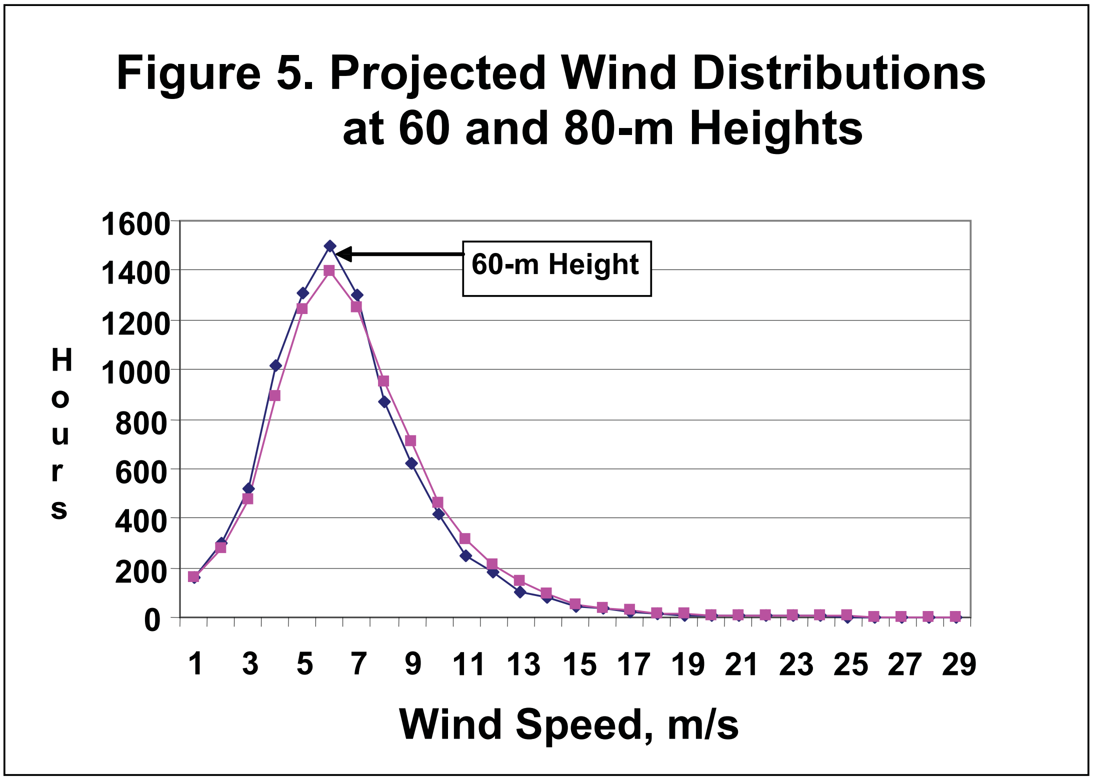
In Figure 4, we have plotted the monthly average wind speeds for a WTG with a 60-m hub height. The estimates assume a shear coefficient of 0.18. Two factors are clear:

- There is a significant increase in average monthly wind speeds for an 80-m height compared to a 60-m height.
- The winds during the months of June through September are approximately the same and are the lowest wind speeds of the year. It can be seen, in the tables in Appendix B, that the wind power delivered during these months is commensurately lower than the other months.

Figure 4. Monthly Average Wind Speeds at IMLD Site - 60 and 80-m Heights



In Figure 5 we have plotted the wind distributions for both 60 and 80-m heights above ground level. The distributions are clear and in the typical bell-shaped Weibull distributions. Note that as the annual average wind speed at a site increases, the wind speed probability distribution shifts to the right. This results in more hours with wind speeds at higher wind turbine output levels and ultimately higher annual wind energy production levels.



Wind Speed Variation with Height – Wind Shear

General
The variation of the horizontal component of wind speed with height above the ground is defined as vertical wind shear or wind shear. Wind shear is described by the following equation:

$$V_2/V_1 = (H_2/H_1)^{alpha}$$

Where:
V_2 and V_1 are the wind speeds at reference heights 2 and 1
H_2 and H_1 are the reference heights 2 and 1 in consistent units (i.e. meters or feet)
Alpha is the power-law wind shear exponent

Wind shear is a function of the frictional effects of the ground surface cover. The wind power law attempts to emulate this change in wind speed with height through use of the power law exponent, or alpha value. One of the major sources of error in wind turbine project theoretical energy estimates is the extrapolation of wind speeds from the measurement level to the wind turbine hub height. We have taken a slightly conservative approach in this extrapolation and believe that it is wise choice in making wind turbine theoretical energy projections.

The power law exponent can range in value from slightly negative (decreasing wind speeds with increasing height, found at some places in California) to values as high as 0.40 in forecast areas. The speedup of the wind as it passes over topographic obstacles such as hills and ridges will also greatly affect the expected change in wind speeds with height above ground level (agl).

The typical alpha value that most engineers are familiar with is the 1/7th power law (alpha = 0.14) which was derived over short grass covered surfaces in the Midwest. Typical alpha values are 0.05 - 0.10 over open hills and ridges; 0.08 - 0.12 over water surfaces; 0.14 - 0.20 over flat terrain with grasses and small bushes; 0.18 - 0.25 over flat or gently rolling terrain with brush and small trees; and 0.25 to 0.45 over heavily wooded area with tall trees. In addition, the wind shear, power-law exponent is not a constant value with height above ground level. The shear value and resulting power law exponent may be very large in lowest 10's of meters above ground level (above ground level), decreasing for higher heights above ground level.

Site Wind Shear

We used the UMass data to examine the relationship in wind speeds between the 10-meter level and the 39-meter level and the 30-meter level as well as the 39-meter. To determine the change in wind speed between the lower level (either 10-meters or 30-meters) and the higher level (39-meters), we only considered those hour pairs when the wind speed at the lower level was 10 mph (4.5 mps) or greater. This removes any bias due to calm wind conditions. The site exhibits very high wind shear with a 47 percent increase between 10-m and 39-m and an 8 percent increase between 30-m and 39-m. This increase is equivalent to a power law (shear) exponent (alpha) value of 0.28. On a sector basis, the wind shear is greatest when the wind is blowing from the Northeast and less when the wind is blowing from other compass directions.

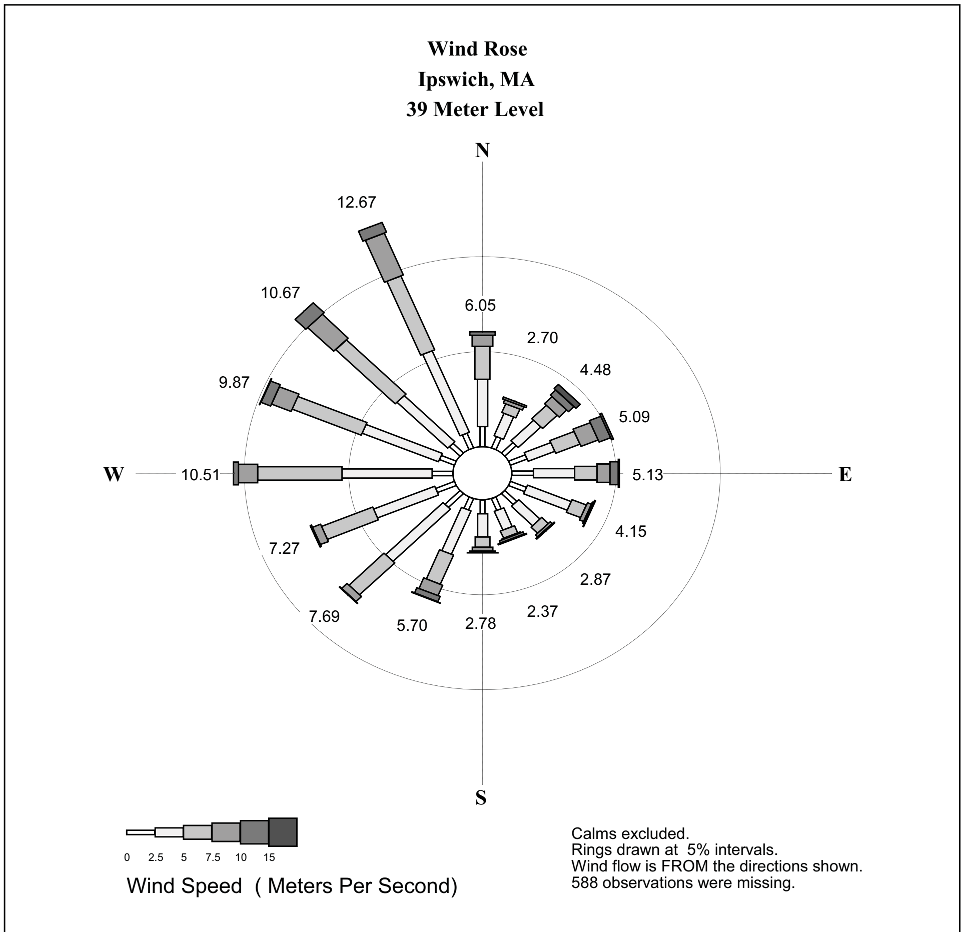
We reviewed the wind shear coefficient at a similar type of site, for similar height ranges, at Halibut Point in Rockport, MA and find the value to be approximately the same. We also reviewed wind measurement data from a U. S. D. O. E. historical, wind measurement tower located on Nantucket Island, where, late in the 1970s, winds were measured at heights of 9.1 m (30 feet), 30 m (98 feet) and 45.7 m (150 feet) above ground level. The data base indicates that the measured wind shear coefficient (alpha) was approximately 0.24 between lower levels and the 45.7-m height. We do not know what type of terrain exists near the Nantucket tower, but by knowing where the tower was located (SE portion of island), we estimate that it may be much like that in and around the Ipswich Municipal Light Department site.

Because we found the alpha value to be so large, we adjusted it downward to reflect what we believe is realistic – resulting in an alpha value of 0.18. The typical value used in many wind studies is 0.14. We believe that a value of 0.18 is prudent for the Ipswich Municipal Light Department project to use a lower power law exponent value of alpha = 0.18 because it is unlikely that a high wind shear value of alpha = 0.28 would be maintained from the top of the tower (39-meters) to the hub height of the wind turbine (up to 80-meters above ground level).

Wind Directional Distribution

The percent of time that different wind speeds occur from different directions is portrayed as a plot called a wind rose. This chart displays both the fraction of the total annual wind energy that occurs in winds from the specific direction as well as the faction of time each year when the wind blows from that sector. In Figure 6 we have plotted the wind direction data in the form of a wind rose (i.e., a polar plot of the wind directional data) for a 39-m height above ground level. The wind rose indicates that the primary direction for the strong winds, that can produce useable power, come from the west and northwest directions, with some reasonable winds from the southwest direction.

Figure 6. Wind Rose at Height of 39m for Ipswich Municipal Light Department Site



PERCENT OCCURRENCE: Wind Speed (Meters Per Second)
LOWER BOUND OF CATEGORY

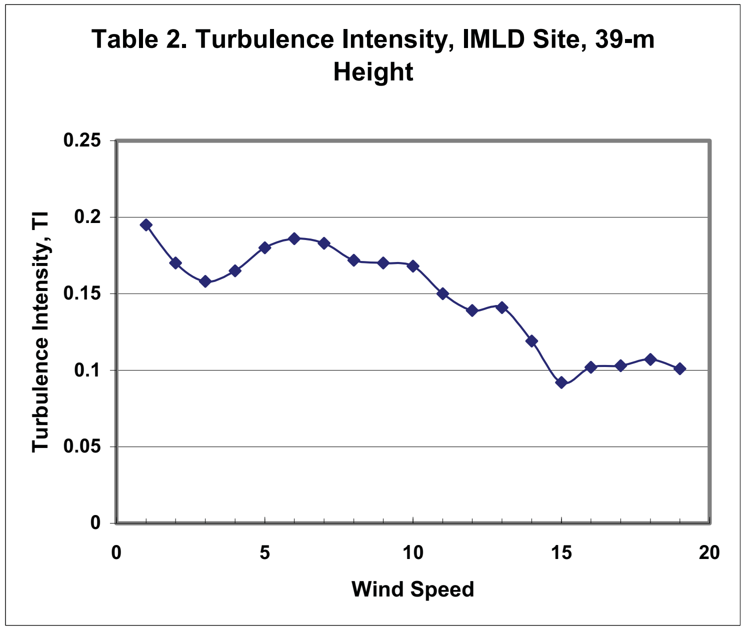
DIR	0	2.5	5	7.5	10	15
N	1.06	2.49	1.74			
NNE	0.65	1.27	0.49			
NE	0.77	1.52	1.00			
ENE	0.86	1.39	1.25			
E	1.03	1.97				
ESE	0.83	2.26				
SE	0.81	1.44				
SSE	0.67	1.06				

Turbulence

We used the UMass data base to compute the wind turbulence intensity (TI) values (standard deviation divided by the mean). We found TI to be moderate and generally within the envelope defined for a Class 2 wind site. In Table 2, we have listed and plotted the TI data that were calculated by Mr. Ed McCarthy – using the UMass wind data base.

Table 2. Ipswich, MA
39-m Wind Speed and Concurrent TI
Data Record: 6/1/2003 to 05/31/04
Wind Speed Frequency and Concurrent TI

Wind Speed (mps)	Frequency of Occurrence		Mean Turbulence Intensity
	Hrs	%	
0-2	1156	13.3	0.356
3	1236	14.2	0.195
4	1542	17.8	0.17
5	1533	17.6	0.158
6	1117	12.9	0.165
7	758	8.7	0.18
8	524	6	0.186
9	294	3.4	0.183
10	201	2.3	0.172
11	113	1.3	0.17
12	78	0.9	0.168
13	44	0.5	0.15
14	34	0.4	0.139
15	13	0.1	0.141
16	11	0.1	0.119
17	6	0.1	0.092
18	8	0.1	0.102
19	6	0.1	0.103
20	5	0.1	0.107
21	8	0.1	0.101
Total Hrs	8687		



For the candidate WTGs that we discuss later, the design TI is greater than that found at the site and the survival peak 5-second wind-speed gust for a Class 2 WTG, such as the GE Model 1.5 sle and the Vestas Model V82, is approximately 132 mph (note that the Vestas Model V80 is designed for higher TI and peak winds). Therefore, we believe that the site is appropriate for Class 2 WTGs in all respects. WTG suppliers will confirm these factors prior to installing a WTG at a site.

Peak Wind Speed

We did not have sufficient measured, site wind data to compute the peak, once in 50-year, 5-second gust used by WTG designers to qualify a site for a WTG. However, by examining wind records from the region, we find that the occurrence of peak winds in excess of 100 mph is very rare – occurring only during very infrequent hurricanes. Based on the wind speeds, turbulence intensity and projected peak winds, we estimate that the Ipswich Municipal Light Department site is low-end IEC Class 2 wind site.

Wakes and Obstructions

Because of the anticipated height of the WTGs (60 or 80 m), and the fact that only one WTG will be installed, we do not expect to have any significant wind-flow affects from upwind structures.

RECOMMENDED WIND TURBINES

Introduction
There are several new types of WTGs on the market that, on paper, may appear to hold promise for application at the Ipswich Municipal Light Department site. Due to our strong desire that the project be successful, we suggest a conservative approach in selecting a WTG. We strongly recommend that the Ipswich Municipal Light Department avoid using prototype or unproven WTGs. Therefore we suggest that Ipswich Municipal Light Department consider the purchase of one of the three proven, mature, commercially available WTGs that we will discuss below and have employed in our earlier projections of annual energy production and gross revenue generation.

The WTGs that we recommend for consideration have a history of generally reliable operation at many sites around the world and we are very familiar with the specific WTGs, the manufacturers, the WTG design features, the WTG problems encountered, how problems were solved, the record of reliability of the WTGs, and how the companies have responded to warranty issues. We believe that the WTGs that we have selected, if properly manufactured, installed and maintained, will be excellent choices for the Ipswich Municipal Light Department site. If formal bids for any or all of the candidate WTGs turn out to be too high to make the project economics work properly, we suggest that Ipswich Municipal Light Department explore using competing WTGs of similar size. If such issues arise, we can suggest specific, other WTGs to examine.

Candidate Wind Turbines
All WTGs that we have selected as candidate units for Ipswich Municipal Light Department have the following common features:

(1) Three full-span, pitchable, fiberglass blades,
(2) A two or three-stage gearbox that speeds up the rotational shaft speed from the rotor speeds of approximately 15 rpm to a generator speed of approximately 1200 or 1800 rpm,
(3) Gearboxes are a combination of a single or dual-stage planetary section with a single high-speed helical-gear stage,
(4) Nacelle (equipment enclosure at top of tower) sits atop an enclosed, tubular tower,
(5) Rotor is upwind of the tower (i.e., upwind WTGs),
(6) Meet the latest Federal Energy Regulatory Commission (FERC) requirements for (a) power factor control, (b) SCADA system accessibility for transmission-system-operator control, and (c) Low Voltage Ride-Through (LVRT) standards recently required by FERC.
(7) WTGs have been certified by a recognized European certifying organization, such as Germanischer-Lloyd or Det Norske Veritas, indicating that they have been thoroughly analyzed and tested and meet a minimum 20-year design life (on paper) for major components and can survive the required peak wind speeds for their class rating without damage.

(8) Manufacturing quality control has been certified to international standards and the manufacturers keep their certifications current.

Below, we summarize the additional important features of each WTG, an estimate of the approximate number of WTGs sold and manufactured along with other relevant factors that we have considered.

General Electric (GE) Wind Model 1.5sle, 77-m dia., 1.5-MW unit (Min. 4500 units sold):
The GE Model 1.5sle is a fully variable-speed WTG that is tailored for Class-2 (medium-speed) wind sites. The variable-speed feature on the GE units allows approximately plus or minus 25 percent rotor speed variation in response to wind gusts and varying wind speeds. This approach relieves mechanical loads and increases the efficiency of energy capture. As a result, the GE Model 1.5sle has a very beneficial power curve (i.e., efficient energy capture).

GE has several different versions of the 1.5-MW WTG, some with 70.5-m diameter rotors and others with different types of blades. At this point in time, as we understand their approach, GE has set up major suppliers and production runs to mass produce the Model 1.5sle at the best price and with the most reliability.

For nearly ten years generic versions of the Model 1.5sle have been built by GE and prior owners of the rights to the WTG design. The first versions of the machine were developed by Tacke – German company that built 600-kW units and larger. In the process, Tacke established a solid technology base in Germany. In parallel, Zond Energy Systems in California designed several variable-speed WTGs and, in 1998, was acquired by Enron. Tacke became insolvent shortly after that and Enron acquired Tacke and blended the Zond and Tacke designs – leading eventually to a 1.5-MW, variable-speed architecture with a 70.5-m diameter rotor – designed for Class 1 (i.e., high-speed, vigorous) wind sites. The same architecture and design features are resident in the GE Model 1.5sle, but the Model 1.5sle has a larger rotor and is rated for Class 2 (more benign) wind sites.

In year 2001 or 2002, Enron went into bankruptcy and had to liquidate assets. Through the courts, GE acquired the rights to the Enron 1.5-MW WTG. GE expanded the envelope of available WTGs rated at 1.5 MW and also made the 77-m diameter, Class 2 WTG available. The generic WTG has been the beneficiary of significant GE product improvement work over the past two to three years - since GE acquired the rights to the WTG. The Model 1.5sle has experienced perhaps the greatest increase in market growth of all WTGs sold today. In the past we have met with GE engineering personnel on several occasions to discuss various operational experiences and design aspects of the GE Model 1.5sle. We believe that, at the right price, the GE Model 1.5 sle would be a good WTG for Ipswich Municipal Light Department.

Vestas Model V80, 80-m dia., 1.8-MW unit (Min. 1200 units sold):
Vestas, currently based in Randers, Denmark (northeast Jutland area), is the largest producer of commercial, utility-scale WTGs in the world. It has been in business since the late 1970s. From our personal experience, we know that Vestas WTGs have generally proven to be rugged and reliable. In addition, Vestas has proven to be a good partner in projects in that they consistently support their warranty obligations in order to please the buyer. Approximately one year ago,

Vestas merged with NEG Micon - the second largest WTG supplier in Denmark. For now, they have merged their product lines and have yet to scale back the variety of WTGs offered.

The Vestas Model V80 is an opti-slip unit that provides approximately plus or minus ten percent variable-speed operation of the rotor - as a means of relieving loads in the same manner as the GE WTG. The design features and general architecture embodied in the V80 have been applied by Vestas since approximately 1990 when they first mass produced the V39 (39-m diameter rotor), 500-kW WTG. Following the introduction of the V39, Vestas mass produced V47s rated at 660 kW, as well as Model V63 and V66 units that are rated at 1.5 to 1.65 MW. We estimate that Vestas has sold more than 7000 Model V47 WTGs on a world-wide basis. Through that experience, Vestas has gained a vast amount of knowledge about the design and effective manufacture and operation of WTGs.

Vestas began selling the V80 approximately five ago. The V80 has been used both on-shore and off-shore. The largest V80 project in the US at the present time is the High Winds Center in Solano County, CA, where there are approximately 92 units installed. The V80 has been used in the 160-MW Danish Horns Reef, offshore wind project – located in the North Sea, west of the western shore of Denmark. At the present time, Vestas is installing several projects in North America that contain Model V80 WTGs.

The V80 is rated at 1.8 MW in the US, but is rated at 2.0 MW in Europe. The difference results from the fact that the European version is a fully variable-speed unit that may have several similar control features to the GE Model 1.5 WTG. To avoid a potential patent conflict with GE in North America, Vestas has applied the opti-slip approach, which doesn't relieve loads as much as the full variable-speed approach. To compensate for this difference, Vestas has derated the V80 in North America to 1.8 MW in order to still achieve a minimum 20-year fatigue life.

In the past we have met with Vestas engineering personnel on several occasions to discus various operational experiences, design and reliability aspects of the Model V80 WTG. From these meetings we are aware that the field installations have operated at high availability. Current V80 WTGs are highly reliable and operate with availabilities of approximately 98 percent.

Vestas Model V82, 82-m diameter, 1.65-MW unit (1500 units):
The Vestas V82 is a simpler WTG than the above-described units because it is (a) not a variable-speed design and (b) does not have blades that rapidly pitch to adjust power in the same manner as the Models 1.5sle and V80. The rotor nominally operates in a constant-speed manner and the blades only pitch periodically to adjust the power curve for optimum production based on various measurements such as power and air density. Thus, rotor blade short-term performance is largely governed by partially stalling the blades in stronger winds.

As discussed above, in 2004 Vestas acquired the rights to the V82 through a company merger with NEG Micon. The V82 is a scale-up of similar WTGs on the same platform. These include the 52, 54 and 72-m diameter WTGs that NEG Micon marketed at rated power levels up to 1.5 MW. Thus, there is a substantial experience base for generically similar WTGs.

Unique features of the V82 include two mass damper features in the design to avoid critical vibrations – one in each blade and one in the top of the tower. The dampers act counter to vibrations and motion of the applicable structure – to reduce motion and loads. So far, the mass dampers appear to be reliable and successful in fulfilling their design goal. This design feature has been employed for approximately four years in the 54 and 72-m diameter WTGs that Vestas markets. Thus, they have a base of experience and learning that would lead to reliable, long-term operation.

The V82 was designed for medium to low wind-speed sites such as that found in Ipswich. It is generally a less costly WTG than the above units, and, because of its large rotor compared to its rated power, will provide the best capacity factor of the WTGs discussed. Based on past pricing at low-to-medium wind sites, the V82 has been included in a number of wind projects in the US Midwestern states where the winds are more modest than at California sites. We understand, from independent field reports, that the Model V82 is a reliable WTG.

Candidate WTG Recommendations

We recommend that, based on supplier costs, Ipswich Municipal Light Department evaluate carefully the potential of using each WTG with a 60-m or 80-m hub height. There is an economic trade-off with respect to hub height. The higher hub heights produce more annual energy due to the stronger winds found at higher heights, but the WTG tower, foundation and installation costs are greater and the average annual maintenance costs are slightly greater (see O&M cost projections).

During the past year, WTGs have seen rapid price increases attributable to (a) steep rises in steel prices, (b) an over-heated wind power market on a worldwide basis (especially the US), and (c) the strong Danish and Euro currencies relative to the dollar. The steel component of the cost will place more emphasis on using a shorter tower, especially in light of the fact that the winds at the Ipswich Municipal Light Department are relatively low and less economic gain is achieved by the taller tower than from more windy sites.

We expect that the prices may stabilize soon - with the strong entry of more WTG suppliers in the US market and the recent passage of the US Energy Policy Act of 2005. The enactment of the recent legislation reduces pressure on the US market in the short run. With an expected Ipswich Municipal Light Department installation in year 2006 or later, there may continue to be pricing pressure as the end of the US Production Tax Credit eligibility period (for private, commercial projects) nears at the end of year 2007.

Because Ipswich Municipal Light Department is not bound by the tax-credit pressure that a private developer experiences, it may make sense for Ipswich Municipal Light Department to seek to phase the installation at a low-pressure period for suppliers, when a supplier may want to smooth out their production and work schedules.

Other Recommendations

(1) Because all cost estimates are preliminary, and the wind project would be public, it is essential that bid packages be prepared in such a way to encourage the most competitive bids possible from reputable turbine manufacturers and contractors. We recommend that Ipswich Municipal Light Department work closely with all potential and credible suppliers prior to the bid package being released so that Ipswich Municipal Light Department reduces the number of major issues that would induce a bidder not to bid.

(2) Because pricing from the recommended suppliers may be high due to market conditions at the time of the bid, we recommend that Ipswich Municipal Light Department also consider discussing the bid with such other emerging WTG suppliers as Gamesa (from Spain, US office in Pennsylvania) and Siemens (formerly Bonus, from Denmark, new office in US), both of which supply WTGs in the size range discussed above.

(3) We recommend that, in writing the bid package, Ipswich Municipal Light Department seek a minimum three-year warranty on the WTG, tower and transformer. Overall, we recommend a five-year warranty, but such a warranty may cause prices to be so high that the project may not be economical. We recommend that the bids should provide an option to Ipswich Municipal Light Department, with an associated price, that allows Ipswich Municipal Light Department, at the end of the warranty period, to have the supplier train at least three of its employees to be capable of carrying out all routine (scheduled) operation and maintenance activities on the WTG – including carrying out all routine diagnostics and resets using an on-board SCADA system that reports to an Ipswich Municipal Light Department monitoring center.

WIND POWER PREDICTIONS

Preliminary Wind Power Feasibility Assessment
Our analysis of anticipated wind power production at the Ipswich Municipal Light Department site is based on our wind resource assessment described earlier. We have employed the WTG manufacturer's power curves and provided estimates of the average wind energy production available on an average hourly basis each month of the year. The detailed spreadsheets employed in our projections of average hourly energy production are included in Appendix B along with our calculations of the economic value of that power based on Ipswich Municipal Light Department's anticipated on-peak and off-peak power costs over the next 20 years.

This section provides a description of how analysts use data on the wind resource at a specific location and the performance specifications for specific wind turbines to estimate annual wind energy production. The specifications for the Model 1.5sle are used to illustrate this process. The projected outputs of other WTGs, described in later sections, were analyzed in the same manner.

General Description of WTG Energy Capture
A wind turbine captures energy from the wind over a range of wind speeds. The wind machine's electricity production at any time is a function of the wind speed at that time. The wind turbine's power curve characterizes its electricity production in kilowatts as a function of the wind speed at the hub height. Figure 7 is the power curve for the GE Model 1.5sle, based on its specifications.

It should be noted that the wind turbine does not begin producing electricity until the wind speed reaches its cut-in wind velocity of approximately 4 m/s (9 mph). The output increases to 1500 kW at a wind speed of approximately 14 m/s after which it holds constant at that value until a wind speed of 25 m/s (55 mph) – the WTG cutout wind speed. It is then set to zero for higher wind speeds in order to protect the WTG from damage caused by high winds. To reduce output power to zero at the high wind speeds, the WTG controller causes the blades to "feather" into the wind such that they produce zero torque to the rotor. Because the WTG is designed for Class 2 winds, it is capable of surviving peak, 5-second gusts of 59 m/s (132 mph) with the blades feathered.

To estimate the annual energy production for the GE 1.5sle, or any other wind turbine, through the use of wind data described earlier, we estimate the distribution of wind speeds between the cut-in and cutout velocities. Given the number of hours per year, or percent of time the winds equal a specific wind speed at a given height above ground level (see Figure 5), multiplied by the wind turbine output at that wind speed (see Figure 7), produces an estimate of the energy production for each wind speed range. We sum the energy estimates for all wind-speed ranges to arrive at the annual total gross energy production estimates (see, for example, Table B-8 for the GE 1.5sle with a 60-m hub height). We then, reduce this estimate due to various inefficiencies and loss factors such as availability, electric line losses, blade soiling, etc. (listed near bottom of Table B-8). We base our estimates on the past performance of a great number of projects and basic research which we have conducted or reviewed. In the case of the Ipswich

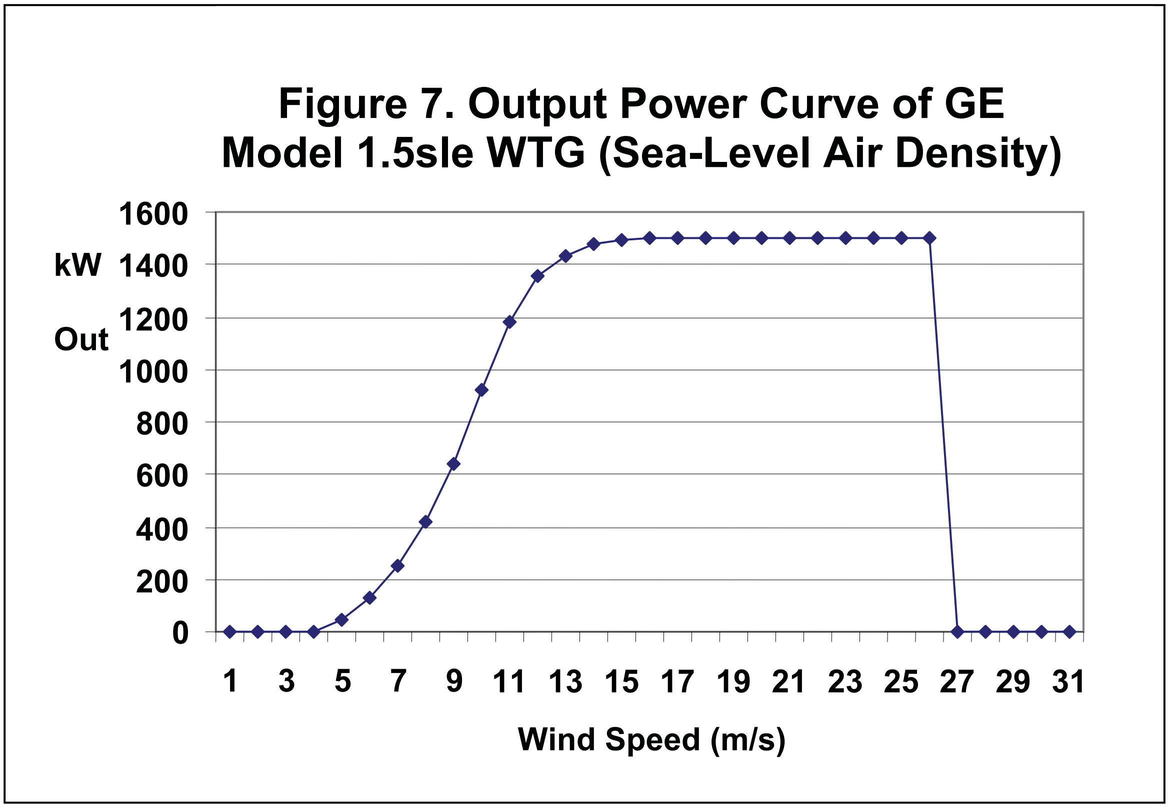
Municipal Light Department, we estimate a net efficiency factor of 89 percent. The efficiency factor is multiplied by the gross energy to result in the prediction for the average net energy production per year for a WTG. We estimate the annual energy production for each WTG in the same manner as also shown in Tables B-9, B-16, B-18, B-22 and B-24 of Appendix B for the other candidate WTGs and different hub heights.

Variations in Output

The actual output of the WTG may vary due to (a) errors (inaccuracies) in our projections for the average year and (b) intra-annual variations in the actual winds due to seasonal weather patterns and climatic swings. Below we discuss these variations with the goal that the estimates that we provide should be considered to be the extremes of the 95-percent confidence interval (i.e., there is a 95 percent probability that the actual production will be within the intervals listed).

Uncertainties: Based on (a) the period of data record, (b) our projections of the adjustment of site data to a long-term, annual-average mean wind speed value, (c) the accuracy of the calibrations of the wind sensors, and (d) the uncertainty in our knowledge of the actual wind shear from a height of 39 m to 60 and 80 m above ground level, we estimated the error bands for our projections to be approximately minus 20 to plus 25 percent.

Intra-Annual Variations: Based on the long-term wind speed records from Logan Airport, we estimate that the intra-annual variations in the site output, based strictly on wind speed variations will be within minus 12 to plus 5 percent of the estimates that we have provided herein.



Using the technique described above, using spreadsheets similar to that shown in Table B-8 and B-9 for the GE Model 1.5 sle (at two hub heights), we estimated the electricity production for the hub heights of 60 and 80 m, respectively. We have carried out the same type of analysis for the other two, candidate WTGs and listed them in Table 3.

In Table 3, we have listed the net annual energy production (in MWh) for three cases – low, average and high production that may arise due to inaccuracies in our projections of the average annual production. We project variations of minus 20 percent to plus 25 percent, with a 95 percent confidence that all inaccuracies will lead to production variations within these bounds. These variations are our best estimates that may arise due to inaccuracies in wind speed measurement and projections. The average estimates can be considered to be the annual energy productions for a zero inaccuracy in our projections (i.e., 50th percentile in error band) in the case of a wind year equal to the long-term average. We also project that there will be additional variations of minus 12/plus 5% due to due to normal inter-annual variations in the wind speeds caused by weather and climatic factors, but that the long-term average of these variations will be nearly zero.

Table 3. Projected Net WTG Energy for Cases Studied, MWh/Year (Average Wind Year)

	WTG, Model Number and Rated Power					
Case Studied	**GE 1.5 sle 1.5 MW**	**GE 1.5 sle 1.5 MW**	**Vestas V80 1.8 MW**	**Vestas V80 1.8 MW**	**Vestas V82 1.65 MW**	**Vestas V82 1.65 MW**
Low Production	1,959	2,223	2,209	2,507	2,226	2,523
Average Production	2,448	2,779	2,762	3,134	2,782	3,153
High Production	3,061	3,473	3,452	3,917	3,478	3,942

Note: Estimates are for an average wind year that may arise due to projection inaccuracies. Additional annual production variations of -12/+5% may occur due to inter-annual wind speed variations from the average wind yr.

PROJECT COST ESTIMATE

Representatives of Meridian coordinated with several construction contractors and Town of Ipswich employees to develop cost estimates. Costs were obtained from several sources and used to establish a low and high range cost for each turbine option. The unknowns associated with the turbine foundation are the source of the largest delta in the cost range. The other significant deltas are also site related and are associated with site preparation and the crane pad foundation. Although the site is on a drumlin, the extent of fill or alteration at the site is not currently known.

Option	Cost Range (1)	
	Low	High
GE 1.5 at 80m	$3,054,080	$3,381,970
Vestas V80 at 60m	$3,342,560	$3,760,450
Vestas V80 at 80m	$3,617,440	$3,945,330
Vestas V82 at 60m	$3,243,360	$3,661,250
Vestas V82 at 80m	$3,598,200	$3,926,090

(1) Cost includes design and permitting, turbine delivery and erection, site construction, commission, and a 5-year manufacturer's warrantee.

Detailed breakdown of projected costs are shown on the following pages.

CAPITAL COST ESTIMATE GE 1.5 at 80m

Phase	Task	Other	Meridian Associates	Methuen Construction	Martins Construction	Weston & Sampson Engineers	Town of Ipswich	PLM	Mark Equipment Corp	Estimate Range: Low	Estimate Range: High	Similar Projects: Hull I (V47)	Similar Projects: Hull II (V80-60m)
Design & Permitting	Public Relations		$16,000 [1,3,5]							$16,000			
	Environmental Studies		$27,500 [1,4,15]							$27,500			
	Engineering Site		$23,000 [1,5]							$23,000			
	Engineering Transmission Line Upgrade							$17,000 [1,6]		$17,000			
	Legal Fees for ZBA		$1,500 [1,19]							$1,500			
	Permitting		$26,000 [1,7,15]							$26,000			
	Subtotal									**$111,000**	**$111,000**	**$0**	**N/A**
Delivery & Erecting	Trucking								$50,000 [1,10]	$50,000	$50,000		
	Heavy Lift Crane			$180,970 [1]					$105,800 [1]	$105,800	$180,970		
	Assist Crane								$9,600 [1]	$9,600			
	Rigging								$24,780 [1]	$24,780			
	Equipment								$11,200 [1]	$11,200			
	Subtotal									**$201,380**	**$230,970**	**$150,000** [14]	**$150,000**
Construction	Site Preparation			$210,229 [2]	$280,000 [1,16]					$280,000 [16]	$306,000 [16]	N/A	N/A
	Erosion Control			$11,000 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Clear & Grub			$43,776 [2]	$10,000 [1,16]					$10,000 [16]	$12,000 [16]	N/A	N/A
	Foundation, incl excavation & backfill			$222,919 [2]	$350,000	$200,000 [1,8]				$200,000 [8]	$400,000 [8]	N/A	$350,000
	Crane Pad			$294,099 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Work on Town Farm Road			$4,300 [1,9]						$0	$4,300	N/A	N/A
	Transmission Line Upgrade						$67,000 [1,13]	$126,000 [1]		$67,000	$126,000	$35,000	$60,000
	Transformer & Pad	$20,000 [12]								$20,000 [12]	$25,000 [12]	N/A	N/A
	Project Procurement		$5,200 [1,5]							$5,200	$5,200	N/A	N/A
	Contract Administration		$10,500 [1,5]							$10,500	$10,500	N/A	N/A
	Survey Layout - As Built		$7,000 [1,5]							$7,000	$7,000	N/A	N/A
	Subtotal									**$609,700**	**$908,000**	**$35,000**	**$410,000**
Purchase	Purchase & Commissioning GE 1.5/80m	$1,700,000 [1,12,18]								$1,700,000	$1,700,000	$585,000	$2,000,000
	FAA Lighting	$7,000 [17]								$7,000	$7,000	N/A	N/A
	SCADA System	$150,000 [17]								$150,000	$150,000	N/A	N/A
	5-yr Warrantee	$275,000 [17]								$275,000	$275,000	N/A	N/A
	Subtotal									**$2,132,000**	**$2,132,000**	**$585,000**	**$2,000,000**
TOTAL										**$3,054,080**	**$3,381,970**	**$770,000**	**$2,560,000**

Footnotes:

1) Included in the Estimate Range Total as Low or High value
2) Used as a check of Martins Construction
3) Heartwood Scope
4) DeRosa Environmental Scope
5) Meridian Associates Scope
6) PLM Scope
7) Meridian Associates, Weston & Sampson Engineers, & DeRosa Environmental Scope
8) Weston & Sampson Engineers provided an estimate range.
9) Mark Brennan did not foresee a need to upgrade Town Farm Road for the delivery turbine and components - based on his site visit and recent experience with Hull I
10) Delivery cost could change - depending on available port of delivery
11) N/A = Not Available
12) Price Quote from GE Wind
13) From Scott Waiswillows, Distribution Foreman, Ipswich Municipal Light Department
14) From Mark Equipment Corp
15) Weston & Sampson Engineers Scope
16) Martins Construction provided an estimate range.
17) Estimate from W. Vachon at Heartwood. GE was unwilling to provide these estimates at this time. GE is in the process of assessing the pricing for delivery in 2008
18) Fees assiciated with bonding have not been estimated at this time
19) $1,500 estimate from Attorney Richard Kallman for the ZBA filing

CAPITAL COST ESTIMATE VESTAS V80 at 60m

Phase	Task	Vestas	Meridian Associates	Methuen Construction	Martins Construction	Weston & Sampson Engineers	Town of Ipswich	PLM	Mark Equipment Corp	Estimate Range		Similar Projects	
										Low	High	Hull I (V47)	Hull II (V80 60m)
Design & Permitting	Public Relations		$16,000 [1,3,5]							$16,000			
	Environmental Studies		$32,500 [1,4,15]							$32,500			
	Engineering Site		$23,000 [1,5]							$23,000			
	Engineering Transmission Line Upgrade							$17,000 [1,6]		$17,000			
	Legal Fees for ZBA		$1,500 [1,18]							$1,500			
	Permitting		$26,000 [1,7,15]							$26,000			
	Subtotal									**$116,000**	**$116,000**	**$0**	**N/A**
Delivery & Erecting	Trucking								$50,000 [1,10]	$50,000	$50,000		
	Heavy Lift Crane			$180,970 [1]					$65,800 [1]	$65,800	$180,970		
	Assist Crane								$9,600 [1]	$9,600			
	Rigging								$24,780 [1]	$24,780			
	Equipment								$11,200 [1]	$11,200			
	Subtotal									**$161,380**	**$230,970**	**$150,000** [14]	**$150,000**
Construction	Site Preparation			$210,229 [2]	$280,000 [1,16]					$280,000 [16]	$306,000 [16]	N/A	N/A
	Erosion Control			$11,000 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Clear & Grub			$43,776 [2]	$10,000 [1,16]					$10,000 [16]	$12,000 [16]	N/A	N/A
	Foundation, incl excavation & backfill	$350,000 [1,8]		$222,919 [2]	$350,000	$150,000 [1]				$150,000	$400,000	N/A	$350,000
	Crane Pad			$294,099 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Work on Town Farm Road			$4,300 [1,9]						$0	$4,300	N/A	N/A
	Transmission Line Upgrade						$67,000 [1,12]	$126,000 [1]		$67,000	$126,000	$35,000	$60,000
	Transformer & Pad	$15,000 [13]								$15,000	$20,000	N/A	N/A
	Project Procurement		$5,200 [1,5]							$5,200	$5,200	N/A	N/A
	Contract Administration		$10,500 [1,5]							$10,500	$10,500	N/A	N/A
	Survey Layout - As Built		$7,000 [1,5]							$7,000	$7,000	N/A	N/A
	Subtotal									**$554,700**	**$903,000**	**$35,000**	**$410,000**
Purchase	Purchase & Commissioning V80/60m	$2,260,000 [1,17]								$2,260,000	$2,260,000	$585,000	$2,000,000
	FAA Lighting	$5,000 [1]								$5,000	$5,000	N/A	N/A
	SCADA System	$135,000 [1]								$135,000	$135,000	N/A	N/A
	5-yr Warrantee	$110,480 [1,16]								$110,480	$110,480	N/A	N/A
	Subtotal									**$2,510,480**	**$2,510,480**	**$585,000**	**$2,000,000**
TOTAL										**$3,342,560**	**$3,760,450**	**$770,000**	**$2,560,000**

Footnotes:

1) Included in the Estimate Range Total as Low or High value
2) Used as a check of Martins Construction
3) Heartwood Scope
4) DeRosa Environmental Scope
5) Meridian Associates Scope
6) PLM Scope
7) Meridian Associates, Weston & Sampson Engineers, & DeRosa Environmental Scope
8) Estimate from Vestas for proprietary foundation
9) Mark Brennan did not foresee a need to upgrade Town Farm Road for the delivery turbine and components - based on his site visit and recent experience with Hull I
10) Delivery cost could change - depending on available port of delivery
11) N/A = Not Available
12) From Scott Waiswillows, Distribution Foreman, Ipswich Municipal Light Department
13) Estimate from Vestas range stated $15k to $20k
14) From Mark Equipment Corp
15) Weston & Sampson Engineers Scope
16) Based on Vestas estimated cost and average MWh from W. Vachon
17) Fees assiciated with bonding have not been estimated at this time
18) $1,500 estimate from Attorney Richard Kallman for the ZBA filing

CAPITAL COST ESTIMATE VESTAS V80 at 78m

Phase	Task	Vestas	Meridian Associates	Methuen Construction	Martins Construction	Weston & Sampson Engineers	Town of Ipswich	PLM	Mark Equipment Corp	Estimate Range		Similar Projects	
										Low	High	Hull I (V47)	Hull II (V80 60m)
Design & Permitting	Public Relations		$16,000 [1,3,5]							$16,000			
	Environmental Studies		$32,500 [1,4,15]							$32,500			
	Engineering Site		$23,000 [1,5]							$23,000			
	Engineering Transmission Line Upgrade							$17,000 [1,6]		$17,000			
	Legal Fees for ZBA		$1,500 [1,18]							$1,500			
	Permitting		$26,000 [1,7,15]							$26,000			
	Subtotal									**$116,000**	**$116,000**	**$0**	**N/A**
Delivery & Erecting	Trucking								$50,000 [1,10]	$50,000	$50,000		
	Heavy Lift Crane			$180,970 [1]					$105,800 [1]	$105,800	$180,970		
	Assist Crane								$9,600 [1]	$9,600			
	Rigging								$24,780 [1]	$24,780			
	Equipment								$11,200 [1]	$11,200			
	Subtotal									**$201,380**	**$230,970**	**$150,000** [14]	**$150,000**
Construction	Site Preparation			$210,229 [2]	$280,000 [1,16]					$280,000 [16]	$306,000 [16]	N/A	N/A
	Erosion Control			$11,000 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Clear & Grub			$43,776 [2]	$10,000 [1,16]					$10,000 [16]	$12,000 [16]	N/A	N/A
	Foundation, incl excavation & backfill	$350,000 [1,8]		$222,919 [2]	$350,000	$200,000 [1]				$200,000	$400,000	N/A	$350,000
	Crane Pad			$294,099 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Work on Town Farm Road			$4,300 [1,9]						$0	$4,300	N/A	N/A
	Transmission Line Upgrade						$67,000 [1,12]	$126,000 [1]		$67,000	$126,000	$35,000	$60,000
	Transformer & Pad	$15,000 [13]								$15,000	$20,000	N/A	N/A
	Project Procurement		$5,200 [1,5]							$5,200	$5,200	N/A	N/A
	Contract Administration		$10,500 [1,5]							$10,500	$10,500	N/A	N/A
	Survey Layout - As Built		$7,000 [1,5]							$7,000	$7,000	N/A	N/A
	Subtotal									**$604,700**	**$903,000**	**$35,000**	**$410,000**
Purchase	Purchase & Commissioning V80/78m	$2,430,000 [1,17]								$2,430,000	$2,430,000	$585,000	$2,000,000
	FAA Lighting	$5,000 [1]								$5,000	$5,000	N/A	N/A
	SCADA System	$135,000 [1]								$135,000	$135,000	N/A	N/A
	5-yr Warrantee	$125,360 [1,16]								$125,360	$125,360	N/A	N/A
	Subtotal									**$2,695,360**	**$2,695,360**	**$585,000**	**$2,000,000**
TOTAL										**$3,617,440**	**$3,945,330**	**$770,000**	**$2,560,000**

Footnotes:

1) Included in the Estimate Range Total as Low or High value
2) Used as a check of Martins Construction
3) Heartwood Scope
4) DeRosa Environmental Scope
5) Meridian Associates Scope
6) PLM Scope
7) Meridian Associates, Weston & Sampson Engineers, & DeRosa Environmental Scope
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11) N/A = Not Available
12) From Scott Waiswillows, Distribution Foreman, Ipswich Municipal Light Department
13) Estimate from Vestas range stated $15k to $20k
14) From Mark Equipment Corp
15) Weston & Sampson Engineers Scope
16) Based on Vestas estimated cost and average MWh from W. Vachon
17) Fees assiciated with bonding have not been estimated at this time
18) $1,500 estimate from Attorney Richard Kallman for the ZBA filing

CAPITAL COST ESTIMATE VESTAS V82 at 60m

Phase	Task	Vestas	Meridian Associates	Methuen Construction	Martins Construction	Weston & Sampson Engineers	Town of Ipswich	PLM	Mark Equipment Corp	Estimate Range		Similar Projects	
										Low	High	Hull I (V47)	Hull II (V80 60m)
Design & Permitting	Public Relations		$16,000 [1,3,5]							$16,000			
	Environmental Studies		$32,500 [1,4,15]							$32,500			
	Engineering Site		$23,000 [1,5]							$23,000			
	Engineering Transmission Line Upgrade							$17,000 [1,6]		$17,000			
	Legal Fees for ZBA		$1,500 [1,18]							$1,500			
	Permitting		$26,000 [1,7,15]							$26,000			
	Subtotal									**$116,000**	**$116,000**	**$0**	**N/A**
Delivery & Erecting	Trucking								$50,000 [1,10]	$50,000	$50,000		
	Heavy Lift Crane			$180,970 [1]					$65,800 [1]	$65,800	$180,970		
	Assist Crane								$9,600 [1]	$9,600			
	Rigging								$24,780 [1]	$24,780			
	Equipment								$11,200 [1]	$11,200			
	Subtotal									**$161,380**	**$230,970**	**$150,000** [14]	**$150,000**
Construction	Site Preparation			$210,229 [2]	$280,000 [1,16]					$280,000 [16]	$306,000 [16]	N/A	N/A
	Erosion Control			$11,000 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Clear & Grub			$43,776 [2]	$10,000 [1,16]					$10,000 [16]	$12,000 [16]	N/A	N/A
	Foundation, incl excavation & backfill	$350,000 [1,8]		$222,919 [2]	$350,000	$150,000 [1]				$150,000	$400,000	N/A	$350,000
	Crane Pad			$294,099 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Work on Town Farm Road			$4,300 [1,9]						$0	$4,300	N/A	N/A
	Transmission Line Upgrade						$67,000 [1,12]	$126,000 [1]		$67,000	$126,000	$35,000	$60,000
	Transformer & Pad	$15,000 [13]								$15,000	$20,000	N/A	N/A
	Project Procurement		$5,200 [1,5]							$5,200	$5,200	N/A	N/A
	Contract Administration		$10,500 [1,5]							$10,500	$10,500	N/A	N/A
	Survey Layout - As Built		$7,000 [1,5]							$7,000	$7,000	N/A	N/A
	Subtotal									**$554,700**	**$903,000**	**$35,000**	**$410,000**
Purchase	Purchase & Commissioning V82/60m	$2,160,000 [1,17]								$2,160,000	$2,160,000	$585,000	$2,000,000
	FAA Lighting	$5,000 [1]								$5,000	$5,000	N/A	N/A
	SCADA System	$135,000 [1]								$135,000	$135,000	N/A	N/A
	5-yr Warrantee	$111,280 [1,16]								$111,280	$111,280	N/A	N/A
	Subtotal									**$2,411,280**	**$2,411,280**	**$585,000**	**$2,000,000**
TOTAL										**$3,243,360**	**$3,661,250**	**$770,000**	**$2,560,000**

Footnotes:

1) Included in the Estimate Range Total as Low or High value
2) Used as a check of Martins Construction
3) Heartwood Scope
4) DeRosa Environmental Scope
5) Meridian Associates Scope
6) PLM Scope
7) Meridian Associates, Weston & Sampson Engineers, & DeRosa Environmental Scope
8) Estimate from Vestas for proprietary foundation
9) Mark Brennan did not foresee a need to upgrade Town Farm Road for the delivery turbine and components - based on his site visit and recent experience with Hull I
10) Delivery cost could change - depending on available port of delivery
11) N/A = Not Available
12) From Scott Waiswillows, Distribution Foreman, Ipswich Municipal Light Department
13) Estimate from Vestas range stated $15k to $20k
14) From Mark Equipment Corp
15) Weston & Sampson Engineers Scope
16) Based on Vestas estimated cost and average MWh from W. Vachon
17) Fees assiciated with bonding have not been estimated at this time
18) $1,500 estimate from Attorney Richard Kallman for the ZBA filing

CAPITAL COST ESTIMATE VESTAS V82 at 80m

Phase	Task	Vestas	Meridian Associates	Methuen Construction	Martins Construction	Weston & Sampson Engineers	Town of Ipswich	PLM	Mark Equipment Corp	Estimate Range		Similar Projects	
										Low	High	Hull I (V47)	Hull II (V80 60m)
Design & Permitting	Public Relations		$16,000 [1,3,5]							$16,000			
	Environmental Studies		$32,500 [1,4,15]							$32,500			
	Engineering Site		$23,000 [1,5]							$23,000			
	Engineering Transmission Line Upgrade							$17,000 [1,6]		$17,000			
	Legal Fees for ZBA		$1,500 [1,18]							$1,500			
	Permitting		$26,000 [1,7,15]							$26,000			
	Subtotal									**$116,000**	**$116,000**	**$0**	**N/A**
Delivery & Erecting	Trucking								$50,000 [1,10]	$50,000	$50,000		
	Heavy Lift Crane			$180,970 [1]					$105,800 [1]	$105,800	$180,970		
	Assist Crane								$9,600 [1]	$9,600			
	Rigging								$24,780 [1]	$24,780			
	Equipment								$11,200 [1]	$11,200			
	Subtotal									**$201,380**	**$230,970**	**$150,000** [14]	**$150,000**
Construction	Site Preparation			$210,229 [2]	$280,000 [1,16]					$280,000 [16]	$306,000 [16]	N/A	N/A
	Erosion Control			$11,000 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Clear & Grub			$43,776 [2]	$10,000 [1,16]					$10,000 [16]	$12,000 [16]	N/A	N/A
	Foundation, incl excavation & backfill	$350,000 [1,8]		$222,919 [2]	$350,000	$200,000 [1]				$200,000	$400,000	N/A	$350,000
	Crane Pad			$294,099 [2]	$5,000 [1,16]					$5,000 [16]	$6,000 [16]	N/A	N/A
	Work on Town Farm Road			$4,300 [1,9]						$0	$4,300	N/A	N/A
	Transmission Line Upgrade						$67,000 [1,12]	$126,000 [1]		$67,000	$126,000	$35,000	$60,000
	Transformer & Pad	$15,000 [13]								$15,000	$20,000	N/A	N/A
	Project Procurement		$5,200 [1,5]							$5,200	$5,200	N/A	N/A
	Contract Administration		$10,500 [1,5]							$10,500	$10,500	N/A	N/A
	Survey Layout - As Built		$7,000 [1,5]							$7,000	$7,000	N/A	N/A
	Subtotal									**$604,700**	**$903,000**	**$35,000**	**$410,000**
Purchase	Purchase & Commissioning V82/80m	$2,410,000 [1,17]								$2,410,000	$2,410,000	$585,000	$2,000,000
	FAA Lighting	$5,000 [1]								$5,000	$5,000	N/A	N/A
	SCADA System	$135,000 [1]								$135,000	$135,000	N/A	N/A
	5-yr Warrantee	$126,120 [1,16]								$126,120	$126,120	N/A	N/A
	Subtotal									**$2,676,120**	**$2,676,120**	**$585,000**	**$2,000,000**
TOTAL										**$3,598,200**	**$3,926,090**	**$770,000**	**$2,560,000**

Footnotes:

1) Included in the Estimate Range Total as Low or High value
2) Used as a check of Martins Construction
3) Heartwood Scope
4) DeRosa Environmental Scope
5) Meridian Associates Scope
6) PLM Scope
7) Meridian Associates, Weston & Sampson Engineers, & DeRosa Environmental Scope
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17) Fees assiciated with bonding have not been estimated at this time
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OPERATION AND MAINTENANCE COST PROJECTIONS

Long-Term Operation and Maintenance (O&M) Costs

To estimate long-term O&M costs, we applied our detailed, proprietary O&M model that is based on projected operations and scheduled maintenance costs. In addition, the cost model for unscheduled maintenance costs is driven by the mean time between failure (MTBF) of key components and the associated repair costs (including crane costs). Our failure-rate projections and repair costs are derived from our proprietary data base for this information that is based on work related to numerous wind farms in California, Texas and Minnesota (see "Long-Term O&M Costs Based on Failure Rates and Repair Costs", by W. A. Vachon, Windpower 2002, American Wind Energy Assoc. Conf., Portland, OR, June 2002).

In Table 4 we have included the detailed 20-year projected costs, derived from the model and applied to the GE Model 1.5sle with an 80-m hub height. The results shown assume a five-year warranty period, a 2.5-percent inflationary cost increases in labor and parts each year, and nominal costs for site management and data reporting. The table indicates the operations and scheduled maintenance costs as the fist line and the unscheduled costs as the second line. The third line is the total of the operations, scheduled and unscheduled costs. The fourth line is the annual O&M cost divided by the nominal, projected net annual energy production for the Ipswich Municipal Light Department site for the GE Model 1.5sle with an 80-m hub height.

Table 4. O&M Cost Projections by Year, single GE Model 1.5 sle, 80-m tower (5-year warranty)

YEAR>>>>>>>>>>>>>>>>>>>>>>>>>>>>	1	2	3	4	5	6	7	8	9	10
Total Scheduled Maint. Cost/Yr, k$	18.0	18.5	18.9	19.4	19.9	21.5	22.0	22.6	23.1	23.7
Total Unscheduled Maint. Cost/Yr, k$	-	-	-	-	-	8.9	9.9	12.3	17.0	21.6
Total Maintenance Cost/Yr, k$	18.0	18.5	18.9	19.4	19.9	30.3	32.0	34.9	40.1	45.4
Tot. Annual Cost, $/MWh	6.5	6.7	6.8	7.0	7.2	10.9	11.5	12.6	14.5	16.4
YEAR>>>>>>>>>>>>>>>>>>>>>>>>>>>>	11	12	13	14	15	16	17	18	19	20
Total Scheduled Maint. Cost/Yr, k$	24.3	24.9	25.6	26.2	26.8	27.5	28.2	28.9	29.6	30.4
Total Unscheduled Maint. Cost/Yr, k$	25.5	28.8	31.5	36.8	40.8	41.1	43.2	46.1	48.1	49.8
Total Maintenance Cost/Yr, k$	49.8	53.8	57.1	63.0	67.7	68.6	71.4	75.0	77.8	80.2
Tot. Annual Cost, $/MWh	18.0	19.4	20.6	22.7	24.4	24.8	25.7	27.0	28.1	28.9

Notes: (1) For shorter warranty period, assume unscheduled maintenance costs at approx. same level for years prior to warranty expiration shown. (2) Projections include 2.5-percent inflation in costs per year.

Two factors should be noted in Table 4:

(1) There are no unscheduled costs in the first five years due to the assumed five-year warranty, the cost of which is assumed to be included in the purchase price of the WTG.
(2) The unscheduled O&M costs begin in year six and become greater than the scheduled costs after year ten, when large, costly items, such as generator or gearbox, need repairs or replacement.

Based on the projections indicated in Table 4, the levelized, annual O&M cost is $12.74/MWh – assuming a 6-percent discount rate and a 4.5-percent interest rate for long-term loans.

In Table 5, we have assembled the comparable total O&M costs for the six candidate WTGs. Based on our detailed annual cost projections, we estimate that any of the candidate WTGs, installed at the Ipswich Municipal Light Department site, can be maintained for a levelized cost of approximately $12 to $13.5 per MWh.

Potential Variations in O&M Costs

In the above projections, we have provided our best estimates based on past experience with WTG O&M and the associated costs. The actual costs for the site may vary greatly with the type of O&M approach followed by Ipswich Municipal Light Department (by either Ipswich Municipal Light Department costs, outside contractor, labor rate, WTG supplier, market conditions, etc.). We estimate that annual O&M costs could vary by as much as minus 20 to plus 35%.

Table 5. Summary Total Annual O&M Cost Estimates for Candidate WTGs

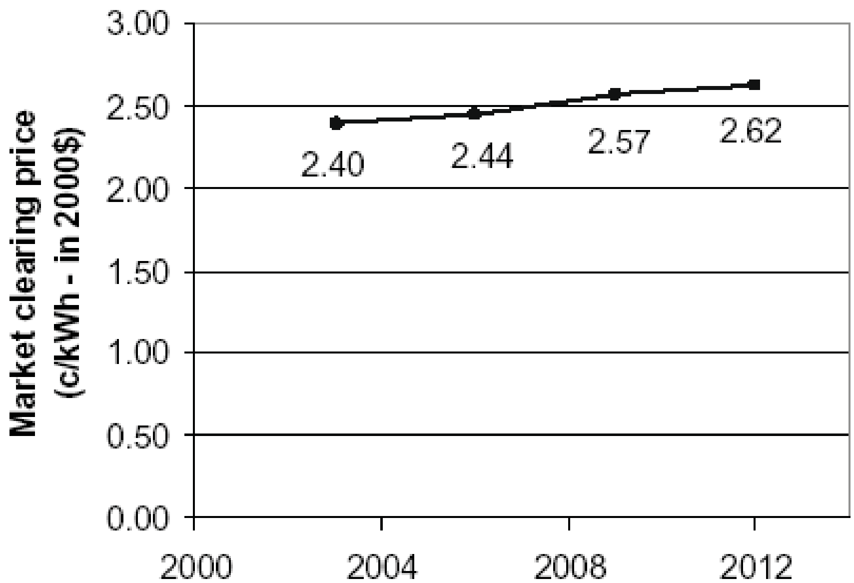
	YEAR									
WTG & Model No. and Hub Height	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
GE 1.5 sle, 60-m hub ht, cost/yr, k$	17.6	18.1	18.5	19.0	19.5	29.7	31.3	34.2	39.3	44.5
GE 1.5 sle, 80-m hub ht, cost//Yr, k$	18.0	18.5	18.9	19.4	19.9	30.3	32.0	34.9	40.1	45.4
Vestas V80, 60-m hub ht, cost/yr, k$	18.4	18.8	19.3	19.8	20.3	31.0	32.6	35.6	40.9	46.3
Vestas V80, 80-m hub ht, cost/yr, k$	18.9	19.4	19.9	20.4	20.9	31.9	33.6	36.6	42.1	47.6
Vestas V82, 60-m hub ht, cost/yr, k$	17.8	18.3	18.7	19.2	19.7	30.0	31.6	34.6	39.7	44.9
Vestas V82, 80-m hub ht, cost/yr, k$	18.2	18.6	19.1	19.6	20.1	30.7	32.3	35.2	40.5	45.8
WTG & Model No. and Hub Height	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
GE 1.5 sle, 60-m hub ht, cost/yr, k$	48.8	52.7	55.9	61.7	66.3	67.3	70.0	73.5	76.2	78.6
GE 1.5 sle, 80-m hub ht, cost//Yr, k$	49.8	53.8	57.1	63.0	67.7	68.6	71.4	75.0	77.8	80.2
Vestas V80, 60-m hub ht, cost/yr, k$	50.8	54.8	58.2	64.2	69.0	70.0	72.8	76.5	79.3	81.8
Vestas V80, 80-m hub ht, cost/yr, k$	52.3	56.5	59.9	66.1	71.1	72.1	75.0	78.7	81.7	84.2
Vestas V82, 60-m hub ht, cost/yr, k$	49.3	53.2	56.5	62.3	67.0	68.0	70.7	74.2	77.0	79.4
Vestas V82, 80-m hub ht, cost/yr, k$	50.3	54.3	57.6	63.6	68.4	69.3	72.1	75.7	78.6	81.0

RENEWABLE ENERGY CERTIFICATES (RECs)

The market for ISO-NE GIS Certificates in New England is young and insufficient sales history exists to make a statistical projection of future prices. Actual certificate prices in the first year and a half of market activity have ranged from \$0.020/kWh to \$0.045/kWh. Two analyses of renewable certificate prices conducted for the Massachusetts Department of Energy Resources suggested that certificate prices would be in the \$0.010 to \$0.045/kWh range between now and 2012.[2]

The first analysis conducted published in December 2000 indicated that certificates for MA RPS compliance would range from \$0.024/kWh to \$0.0262/kWh in price from over the period from 2003 through 2012. See Figure 8 below. These values are expressed in constant 2000 dollars.

Figure 8, Forecast of Market Clearing Prices for RPS-eligible Renewable Energy Certificates



The Base Case of a sensitivity analysis on MA RPS certificate price presented in December 2002 indicated that prices might range from \$0.023/kWh to \$0.026/kWh (Constant 2000\$) in the period between 2003 and 2012. The price of MA GIS Certificates (RECs) is very sensitive to a number of variables including the supply and demand of eligible certificates, the prices in the underlying power market[3] and of new renewable power technologies, the availability of the

[2] Source: Massachusetts RPS: 2002 Cost Analysis Update – Sensitivity Analysis Robert C. Grace, Sustainable Energy Advantage; Karlynn S. Cory. LaCapra Associates. Presented to the MA RPS Advisory Group December 16, 2002

[3] Renewable energy projects have stable capital and operating costs that are independent from the fossil-fuel prices that are an important determinant of the market price for electricity. For this reason, as the market price of conventional power increases, renewable projects will receive more revenue for their power production and can afford to accept lower prices for their GIS certificates.

Federal Production Tax Credit for wind, the status of the Renewable Portfolio Standards in other states in the region, and the costs associated with importing eligible resources into the New England area. If supply is tight and the underlying power market prices are low, certificates might cost between $0.035 and $0.045/kWh. However, if supply exceeds demand and underlying power prices are high, certificate prices could drop to $0.0058/kWh in 2006 and to $0.001/kWh in 2009 and 2012.

In light of this analysis, two economic scenarios have been forecast for Certificate values. At the minimum it is assumed that Certificates will have a value of $0.01 kWh and at maximum a value of $0.024 kWh beginning in 2005. These starting values are then adjusted for inflation at a constant 2% annual rate resulting in values of $0.016/kWh and $0.040/kWh in 2029, respectively.

ECONOMIC FEASIBILITY ANALYSIS

This section focuses on the economic feasibility of the proposed wind project given the cost variables and scenarios previously detailed in this report. It is the intent of this section to give Ipswich Municipal Light Department the ability to make an informed go/no go decision with respect to the proposed project. All analysis has been conducted under a Public Ownership Structure.

Financial Summary:
Given all available data, the financial viability of offsetting Ipswich Municipal Light Department's wholesale power purchases with power from a wind turbine is clearly predicated on low-cost financing, as well as Ipswich Municipal Light Department's desire to hedge the future volatility of wholesale electric costs. The sale of RECs can significantly improve the proposed project's financial prospects.

If Ipswich Municipal Light Department is able to secure 0% financing under the recently enacted Federal Energy bill, financial models predict that a positive outcome over the life of the proposed WTG project is, on average, possible. However, only one of the examined WTGs will on average, over its expected life, produce energy at an expected cost to Ipswich Municipal Light Department that will be below the price Ipswich Municipal Light Department would otherwise pay for electricity from the grid based on the long term wholesale electricity costs projected in the June 2005 forecast prepared by MMWEC (see Appendix E). If future energy prices increase above the MMWEC forecast the financial viability of the project would improve dramatically.

Summary Economic Analysis:
The total Lifetime Costs and total value of the Lifetime Displaced Wholesale Power Purchases were calculated utilizing the expected / average case value for each WTG's total kWh generation, total installed costs, and total O&M costs along with the expected value of wholesale electricity as provided by MMWEC. Financing costs were assumed to run at either Ipswich Municipal Light Department's expected 6% cost of capital or 0% as potentially available under the recently enacted Energy Policy Act of 2005. Calculated amounts for each appear in the table below.

Table 6 Lifetime Costs and Avoided Power Purchase Costs (per MMWEC June 2005 Forecasts)

(#'s in $1,000's)

Make	GE	Vestas	Vestas	Vestas	Vestas
Model	1.5	V80	V80	V82	V82
Height	80m	60m	80m	60m	80m
1 - Lifetime Costs - 0% Financing	3,911	4,237	4,477	4,118	4,422
2 - Lifetime Costs - 6% Financing	6,222	6,792	7,203	6,599	7,133
3 - Lifetime Displaced Purchases	3,893	3,752	4,266	3,924	4,432

As can be seen quite clearly, the total value of Lifetime Displaced Grid Purchases projected by MMWEC (line #3) is only higher than the Lifetime Costs (line 1 and 2) in one case -- the case of the Vestas V82 at 80m hub height. None of the machines evaluated returned a positive return under a 6% financing scenario based only on offsetting MMWEC's projected wholesale power costs alone.

The following summary cash flow statement for each WTG under the **0% financing** scenario shows each of the examined costs and benefit lines and the totals estimated over the life of the WTG. Note: Rounding impacts some numbers relative to the table above.

Table 7 Lifetime Net Cash Flows assuming MMWEC June 2005 Forecasts and 0% Financing

	(#'s in $1,000's - 0% Financing)				
Make	GE	Vestas	Vestas	Vestas	Vestas
Model	1.5	V80	V80	V82	V82
Height	80m	60m	80m	60m	80m
Project Costs	(111)	(116)	(116)	(116)	(116)
Financing Cash Flows	(3,107)	(3,436)	(3,665)	(3,336)	(3,646)
O&M	(942)	(960)	(989)	(932)	(951)
Value Produced Energy	3,893	3,752	4,266	3,924	4,432
Value of Certificates Generated	-	-	-	-	-
Turbine Salvage Value	249	275	293	267	292
Net Lifetime Cash Flows	(18)	(485)	(211)	(194)	10

The following summary cash flow statement for each WTG under the **6% financing** scenario shows each of the examined costs and benefit lines and the totals estimated over the life of the WTG. Note: Rounding impacts some numbers relative to the table above.

Table 8 Lifetime Net Cash Flows assuming MMWEC June 2005 Forecasts and 6% Financing

	(#'s in $1,000's - 6% Financing)				
Make	GE	Vestas	Vestas	Vestas	Vestas
Model	1.5	V80	V80	V82	V82
Height	80m	60m	80m	60m	80m
Project Costs	(111)	(116)	(116)	(116)	(116)
Financing Cash Flows	(5,418)	(5,990)	(6,391)	(5,817)	(6,358)
O&M	(942)	(960)	(989)	(932)	(951)
Value Produced Energy	3,893	3,752	4,266	3,924	4,432
Value of Certificates Generated	-	-	-	-	-
Turbine Salvage Value	249	275	293	267	292
Net Lifetime Cash Flows	(2,329)	(3,040)	(2,937)	(2,675)	(2,702)

While it is clear that the sale of Renewable Energy Credits would improve the financial return of each WTG under all scenarios, the impact of such REC sales is not included in these numbers per the direction of Ipswich Municipal Light Department. Please see the following section on RECs for a discussion on the impact and potential value of such REC sales.

Further, since the financial results under a 6% financing scenario are significantly disadvantageous and it is likely that 0% financing could be obtained due to provisions of the recently passed federal energy bill, no further work under such a funding scenario was conducted.

Detailed Economic Analysis - GE 1.5 - 80m and Vestas V82 - 80m:
While calculating the expected case for each WTG represents an appropriate starting point for economic analysis, basing a final decision on one (i.e. expected / average) or even three (i.e. expected, high, and low) scenarios is inappropriate. Limiting analysis to one to three scenarios does not properly reflect the true range of potential outcomes and thus does not allow Ipswich Municipal Light Department to apply its own acceptable risk profile to the decision making process. Accordingly, statistical simulation analysis was utilized in order to empower Ipswich Municipal Light Department to properly evaluate the potential benefits and costs of the prospective WTGs based on Ipswich Municipal Light Department's internal risk profile.

In comparison to standard "expected, high, low" analysis that only models a three scenarios, the following analysis used a simulation problem solving technique to approximate the probability of many outcomes by running multiple trial runs. Thus, rather than three outputs (i.e. "expected, high, low"), one million simulations were run on both of the two most promising WTG configurations found during the expected case analysis. These simulations were calculated based on assigning error bands to each of the model's variables as follows and using a triangular distribution to generate resulting simulation inputs:

- Project Costs and Yearly Financing Cash Flows (i.e. Capitalized Costs) were error banded with the high/low values developed by Meridian Associates
- O&M Costs were error banded minus 20% to plus 30% from the expected value
- kWh Generation Production was error banded minus 20% to plus 25% from the expected value

The result of the simulation analysis is a probability matrix showing the net expected lifetime cash flows from each of the two machines. The probability matrix shows min, max, as well as the more valuable statistical likelihood of each financial outcome for each machine.

In addition to simulating the three classes of variables noted above, another set of two million simulations was run whereby the Value of Wholesale Power Purchases was added to the variables being simulated and error banded from minus 10% to plus 50% from the values projected by MMWEC in their June projections. Uncertainty in the cost of wholesale power costs has the largest risk impact on the financial viability of the project. Accordingly, it was important to separate this variable and provide two sets of simulations so that the impact of changes in wholesale energy price forecasts can be highlighted.

Simulation Probability Matrix:
Table 9 below is the resulting simulation probability matrix described previously. By way of example only, in reading this matrix in the 0% financing scenario, with NO expected change to MMWEC's wholesale electricity price forecasts, it can be seen that there is a probability of 40% that the GE 1.5 - 80m would lose a minimum of $110,000 over the project life. Likewise, there is a probability of 75% that the V82 - 80m would produce net positive cash of $337,000 or less.

If the MMWEC forecasts are accurate there is more than a 45% probability that the GE 1.5 - 80m would break even or generate positive net cash flow offsetting wholesale power purchases alone and more than 50% probability that the V82 - 80m would do so.

Under the MMWEC price projections, there is a 5% probability that the GE 1.5 - 80m will generate more than $644,000 or more in net cash over it's expected life and a 5% probability that the V82 - 80m would generate a net positive cash flow of $763,000 or more.

Table 9 Net Lifetime Cash Earned / (Spent)
(All numbers in $1,000s)

	0% cost of capital MMWEC Grid Price Forecast		0% cost of capital Grid Energy Forecast -10% to + 50%	
	GE 1.5 80m	Vestas V82 80m	GE 1.5 80m	Vestas V82 80m
Average	(0)	37	528	638
Max	1,199	1,346	3,326	3,777
Min	(1,164)	(1,255)	(1,343)	(1,493)
Percentiles				
5%	(613)	(654)	(463)	(485)
10%	(496)	(522)	(291)	(291)
15%	(408)	(423)	(166)	(150)
20%	(336)	(342)	(61)	(31)
25%	(273)	(271)	34	77
30%	(215)	(206)	123	177
35%	(161)	(145)	208	274
40%	(110)	(88)	292	369
45%	(60)	(32)	377	465
50%	(11)	24	461	562
55%	39	80	550	661
60%	91	138	641	765
65%	145	200	738	876
70%	204	266	844	996
75%	266	337	960	1,127
80%	337	418	1,094	1,278
85%	418	509	1,250	1,457
90%	514	618	1,450	1,684
95%	644	763	1,743	2,016
100%	1,199	1,346	3,326	3,777

In the last two columns of this matrix, forecasted wholesale electric prices are simulated to deviate anywhere from minus 10% to plus 50% from the MMWEC June forecasts. As would be expected, economics for both machines improve significantly under such a simulation with only a 20% probability that either machine would produce negative net cash flow over its life.

Graphs of Net Cash Probability Data:
An additional way to view the previous data tables is to examine histograms of the simulation data for each of the scenarios.

By way of example, the first graph below covers the GE 1.5 at 80m under the MMWEC pricing forecast and shows the probability that the GE 1.5 at 80m hub height will produce a total net cash flow over its 20 year life within the ranges shown on the x axis. For example, there is a 15.4% chance that the total net cash will fall between \$240k and \$480k.

Figure 6 Cash Flow Return Probability - GE 1.5 at 80m - MMWEC power pricing

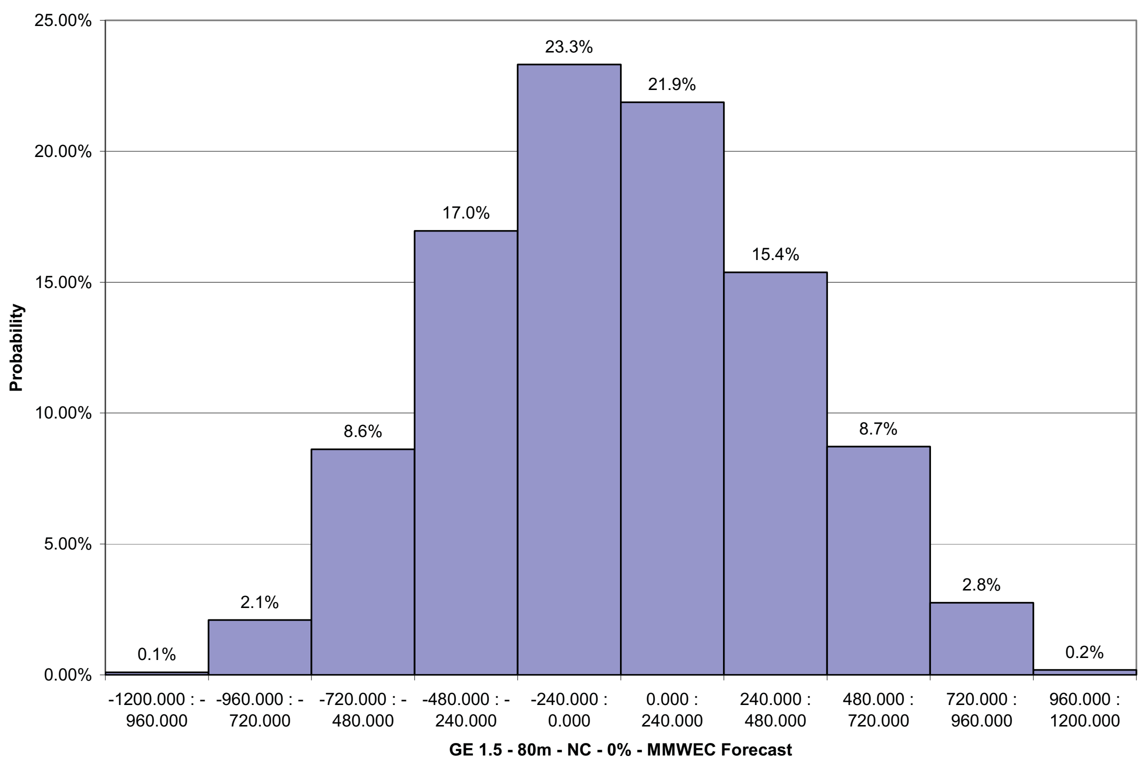


Figure 7 Cash Flow Return Probability - Vestas V82 at 80m - MMWEC power pricing

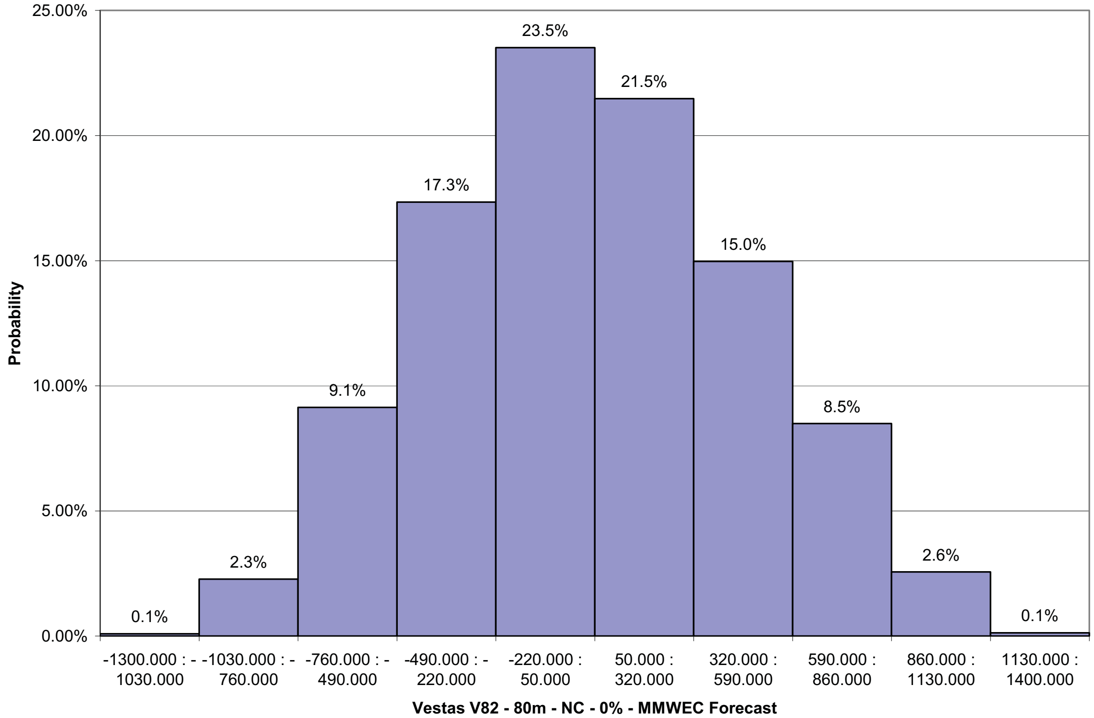


Figure 8 Cash Flow Return Probability – GE 1.5 at 80m - MMWEC power pricing -10/+50%

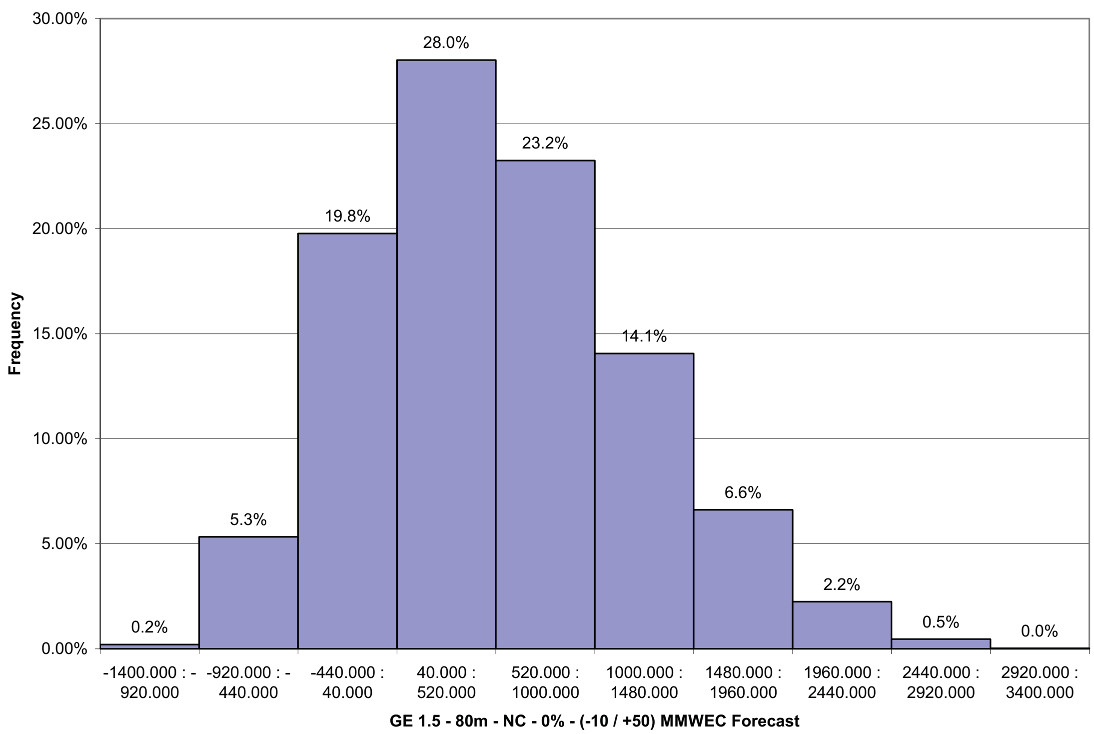
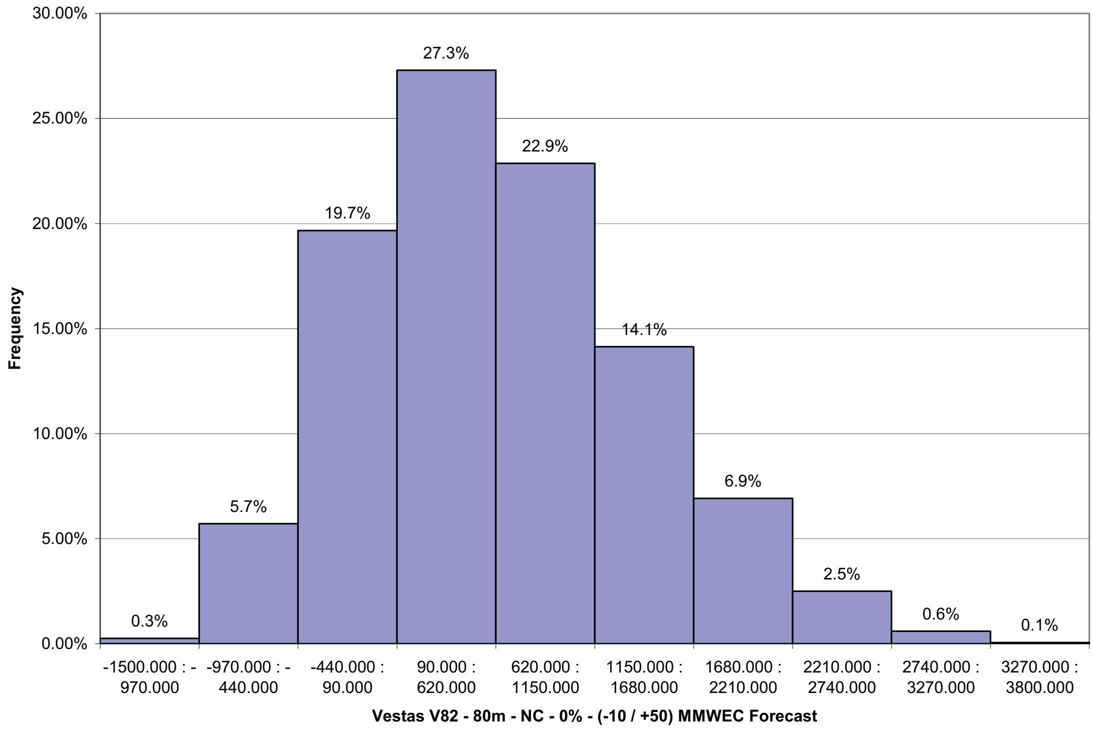


Figure 9 Cash Flow Return Probability – Vestas 82 at 80m - MMWEC power pricing -10/+50%



The Value of Renewable Energy Credits and Hedging:
As the preceding probability matrix clearly shows, the examined WTGs cannot be projected to definitively make financial sense in many cases based only on financial returns from offsetting projected wholesale power purchases.

However, this is only a partial picture of the economic benefit to Ipswich Municipal Light Department since WTGs in Massachusetts can earn valuable revenue from the sale of Renewable Energy Credits (RECs) and unlike owning gas fired generation or purchasing wholesale power from the, a WTG would provide Ipswich Municipal Light Department with a valuable long-term hedging mechanism against significant and unexpected increases in energy prices driven by fuel price increases.

It is outside of the scope of this report to economically quantify the value of a power pricing hedge, from a wind turbine generator.

Accounting for the likely future value of RECs, Ipswich Municipal Light Department does have the possibility to completely offset any reasonably likely cost differential between the cost of the wind turbine generator and the wholesale power purchases that such a generator would offset. Such an economic benefit is quantifiable.

Using the simulated generation estimates for the V82 - 80m as well as the simulated lifetime net cash results for the V82 - 80m we were able to estimate the average required REC prices needed to be sustained over the life of the turbine to provide a breakeven economic outcome in all cases.

Table 11 below shows the average value of RECs over the project lifetime necessary to offset the cash flow shortfall in the various possible financial outcomes derived from running our models based only on offsetting wholesale power purchases at prices projected by MMWEC in their June report.

For example, assuming wholesale power prices stay at the levels projected in the MMWEC June 2005 forecast, the table below shows that there would be a 70% probability of the Vestas V82 at 80 meters generating net positive cash flow if REC values averaged 3 cents per kWh over the life of the project and a 65% probability of the project generating net positive cash flow if REC values averaged 2 cents per kWh over the project life. Again this table shows that the Vestas V82 at 80 meters has a 50% probability of generating net positive cash flow offsetting power purchase alone if the MMWEC June 2005 price projections are accurate.

Table 11 REC value over the project lifetime necessary to offset the cash flow shortfall

	Vestas V82 - 80m		
	Lifetime Net Cash (in $1,000s)	Yearly kWh Generation	Required REC Values (in $ / kWh)
Min	(1,255)	2,523,985	0.025
Percentiles			
5%	(654)	2,733,928	0.012
10%	(522)	2,821,623	0.009
15%	(423)	2,888,635	0.007
20%	(342)	2,945,483	0.006
25%	(271)	2,995,500	0.005
30%	(206)	3,040,546	0.003
35%	(145)	3,081,910	0.002
40%	(88)	3,120,761	0.001
45%	(32)	3,157,102	0.001
50%	24	3,193,362	
55%	80	3,232,035	
60%	138	3,272,660	
65%	200	3,315,596	
70%	266	3,362,232	
75%	337	3,412,847	
80%	418	3,468,581	
85%	509	3,531,979	
90%	618	3,607,447	
95%	763	3,705,188	
100%	1,346	3,941,004	

Forecasts developed based on recent analysis of the REC markets suggests that forecasted REC values will exceed the calculated required values appearing in the last column. Specifically, at a minimum it is assumed that RECs will have a value of $0.01 kWh and at maximum a value of $0.024 kWh beginning in 2005. Adjusted for inflation at a constant 2% annual rate, results in values of $0.016 kWh and $0.040 kWh in 2029, respectively, both of which are in excess of the average values calculated here.

What is perhaps more important to note is that, given current REC prices, Ipswich Municipal Light Department could quite possibly cover any projected lifetime financial shortfall of the project in a relatively short time. Evolution Markets recently reported that as of 9/30/05 RECs in MA were sold for $0.04925 /kWh. Accordingly, if Ipswich Municipal Light Department was able to sell approximately five years of RECs at current REC prices, doing so would cover the 5% percent probability of a cash shortfall of $654,000.

Please see the REC forecast section for additional detail on the projected values of RECs.

Wind Turbine Generator Levelized Lifetime Cost Modeling

The following tables show the simulated levelized lifetime cost of energy production from the two WTG configurations deemed most economically promising in earlier models we ran. These tables show the costs of the WTG produced energy only and do not attempt to compare that to projected wholesale power purchased costs or use these numbers in a financial pro-forma model. Instead, these tables show the probability that levelized lifetime energy costs from the WTGs will fall within the specified range. The project team felt that along with having comparative financial values based on power price projections, having the relatively highly predictable costs from the wind turbine generator as stand alone data could potentially be valuable to the Ipswich Municipal Light Department in evaluating the project.

Table 12 Lifetime Levelized Cost of Wind Energy Produced ($ / kWh)

	0% cost of capital		6% cost of capital	
	GE 1.5 80m	Vestas V82 80m	GE 1.5 80m	Vestas V82 80m
	(All in $ / kWh)			
Average	$ 0.071	$ 0.070	$ 0.112	$ 0.113
Max	$ 0.096	$ 0.095	$ 0.150	$ 0.151
Min	$ 0.053	$ 0.053	$ 0.085	$ 0.085
Percentiles				
5%	$ 0.060	$ 0.060	$ 0.096	$ 0.097
10%	$ 0.062	$ 0.062	$ 0.098	$ 0.099
15%	$ 0.063	$ 0.063	$ 0.100	$ 0.101
20%	$ 0.065	$ 0.064	$ 0.102	$ 0.103
25%	$ 0.066	$ 0.065	$ 0.104	$ 0.105
30%	$ 0.067	$ 0.066	$ 0.106	$ 0.107
35%	$ 0.068	$ 0.067	$ 0.107	$ 0.108
40%	$ 0.068	$ 0.068	$ 0.108	$ 0.110
45%	$ 0.069	$ 0.069	$ 0.110	$ 0.111
50%	$ 0.070	$ 0.070	$ 0.111	$ 0.112
55%	$ 0.071	$ 0.071	$ 0.113	$ 0.114
60%	$ 0.072	$ 0.072	$ 0.114	$ 0.115
65%	$ 0.073	$ 0.073	$ 0.116	$ 0.117
70%	$ 0.074	$ 0.074	$ 0.117	$ 0.118
75%	$ 0.075	$ 0.075	$ 0.119	$ 0.120
80%	$ 0.076	$ 0.076	$ 0.121	$ 0.122
85%	$ 0.078	$ 0.078	$ 0.123	$ 0.124
90%	$ 0.080	$ 0.079	$ 0.126	$ 0.128
95%	$ 0.083	$ 0.082	$ 0.131	$ 0.132
100%	$ 0.096	$ 0.095	$ 0.150	$ 0.151

Figure 10 Probability - Levelized Cost Wind Energy Produced ($ / kWh) GE 1.5 – 80m – 0%

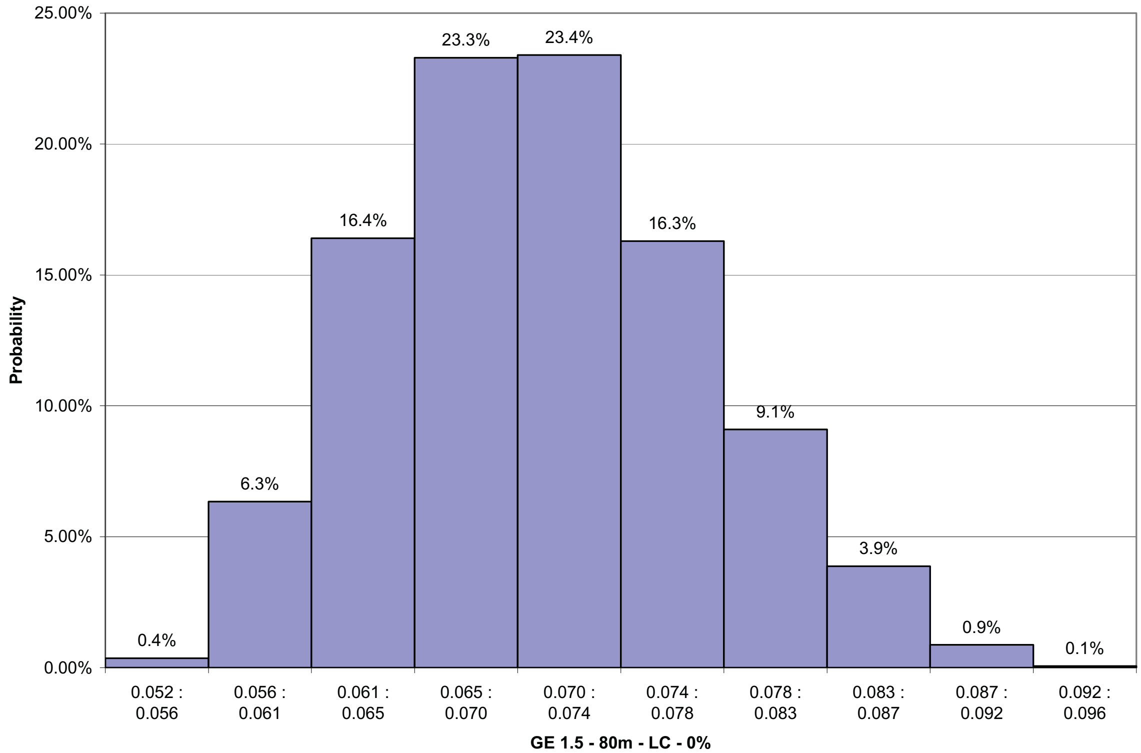


Figure 11 Probability - Levelized Cost Wind Energy Produced ($ / kWh) Vestas V82 – 80m – 0%

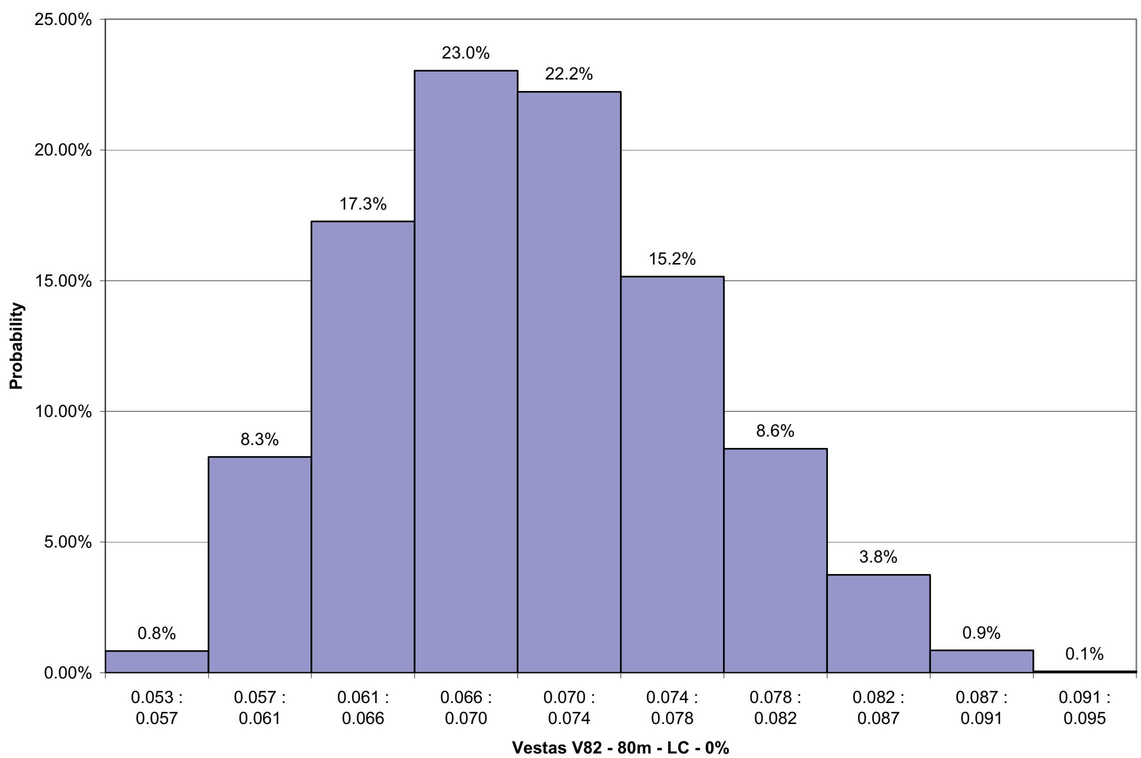


Figure 12 Probability - Levelized Cost Wind Energy Produced ($ / kWh) GE 1.5 – 80m – 0%

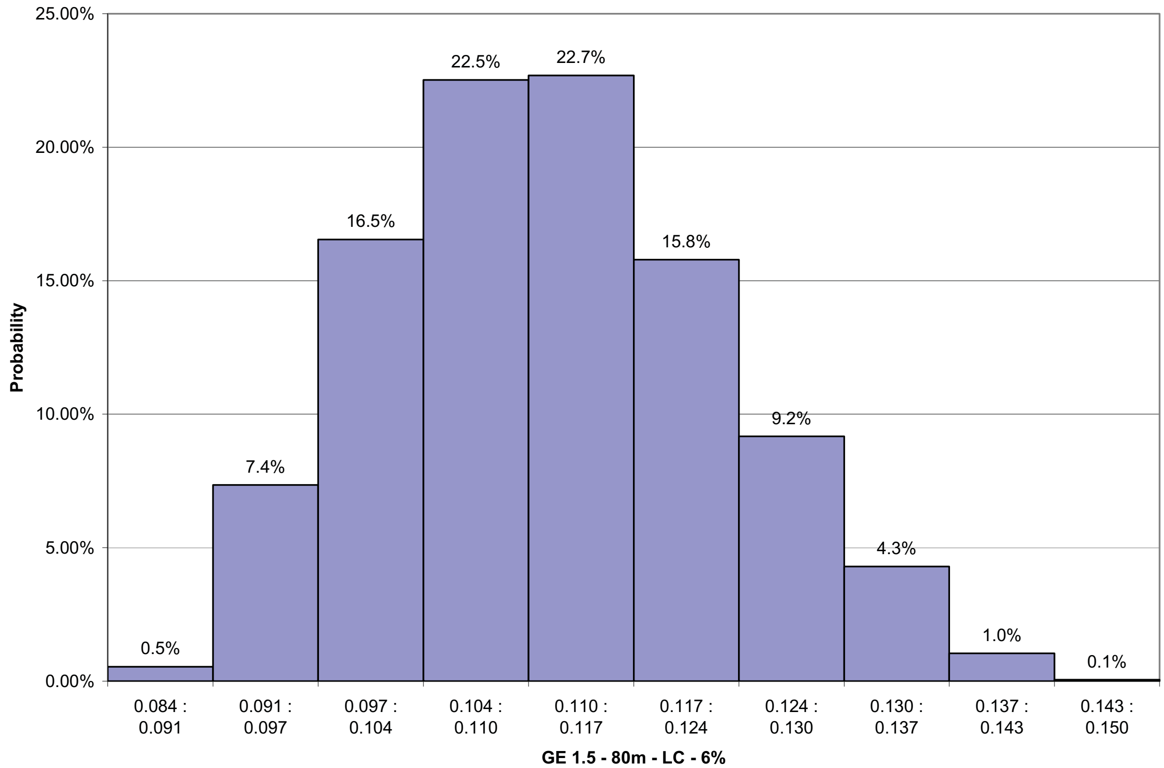
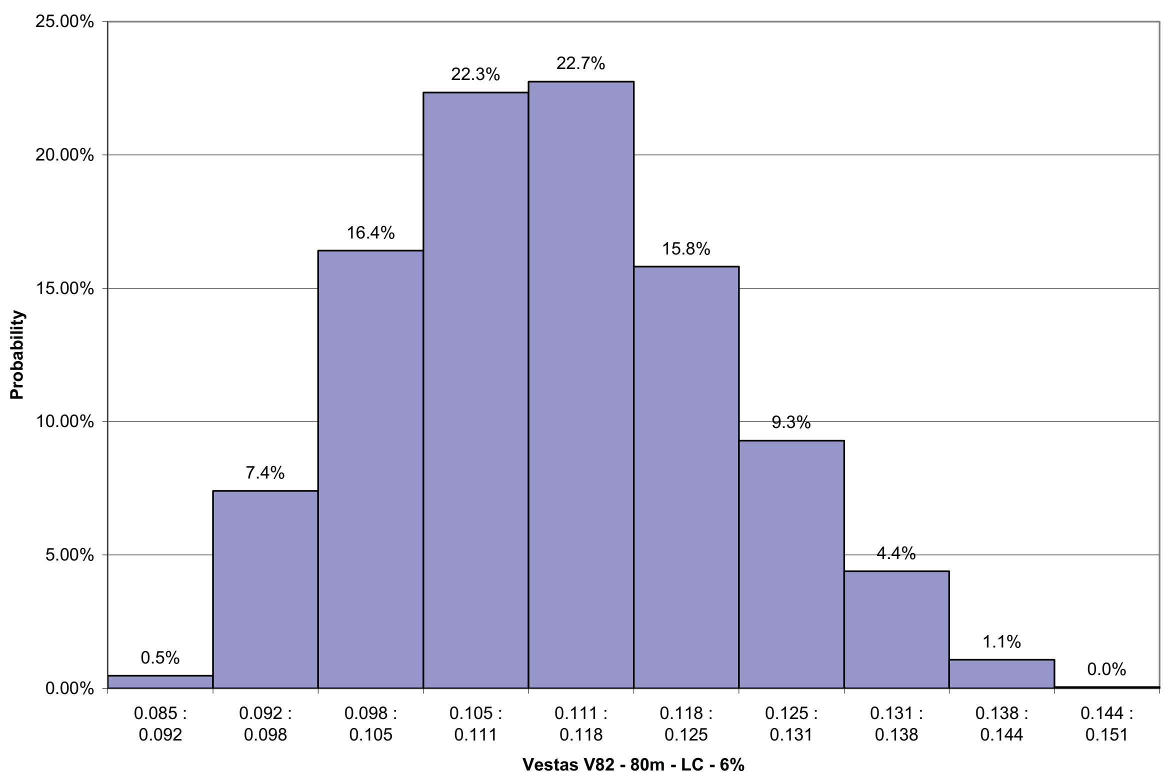


Figure 13 Probability - Levelized Cost Wind Energy Produced ($ / kWh) Vestas V82 – 80m – 6%



PERMITTING APPROVALS AND OTHER PRE-CONSTRUCTION CONSIDERATIONS

The installation of a large wind turbine is regulated by numerous agencies. Such projects also involve public acceptance considerations that may be beyond the scope of regulatory requirements, but which are critically important to address carefully.

Some wind projects like the project in Hull, Massachusetts and the recent installation of a wind turbine at the IBEW 103 headquarters just off of Interstate 93 in Boston have been permitted with remarkable ease and speed. However often in New England, unlike other parts of the country, wind projects face challenges from a small group of active opponents that can derail schedules and add significant costs to the permitting process.

Due to some of the laws regulating wind turbines in Massachusetts, and the ability of opponents of projects to impact the permitting process in significant ways with relative ease and low cost, permitting costs and schedules remain the biggest uncertainty in planning any wind project in the state.

It is hoped that permitting of a public project like this on public land should involve an expedited rather low cost permitting regime, but in wind project permitting, nothing can be assumed with certainty.

In the work for later phases of the project, after identifying the specific requirements of each agency with regulatory oversight, the project team can assist Ipswich Utilities Department in meeting these regulatory requirements through providing the necessary design and research, creating appropriate materials and making appropriate public presentations in order to gain both the regulatory approval and the public support for the project.

Specific agencies that likely have regulatory authority or influence over the project include:

Federal Aviation Administration
Massachusetts Department of Environmental Protection
Massachusetts Board of Building Regulations and Standards

Other Agencies that may be involved include:

Federal Energy Regulatory Commission
Massachusetts Executive Office of Environmental Affairs

The project may require an Environmental Impact Notification under the Massachusetts Environmental Policy Act. The site for the wind turbine should be surveyed to determine if the project might be impacted by wetlands, rare and endangered species protected by the Massachusetts Natural Heritage Act or federal legislation, historic or archeologically significant resources or any other features of the site which might make it inappropriate for development.

Being located on public land, the project should hopefully be expedited regarding local zoning, land use and building regulations and restrictions. It would still be very important to inform the public and local community about the project and hear their opinions on it. Given the location and land use at the site, (a remote site near a sewage sludge composting facility), we hope that objections to siting a wind turbine would be modest. However, with nearby bird and wildlife sanctuaries, we recommend that special consideration be given to wildlife and avian studies.

We have been informed that to date, community response has been positive and while there have been no known opposition to the proposed project, a local group has been formed to encourage the town to move forward in building the wind generator.

As unusual large machines, high in the air, wind turbines tend to attract attention. Surveys have shown that the general public is largely supportive of wind projects. Experience in Hull, Massachusetts and Searsburg, Vermont has shown that public sentiment in the community was generally already favorable to the wind projects before construction. The communities became even more supportive of the projects and technology after the wind turbines were installed and operating. The Hull machine is now a resource that has can be used to help address concerns about proposed wind projects and to assist in gaining community approval and support. There is no better way to make community education real and tangible and hopefully to allay concerns around a proposed project than arranging a guided tour of the Hull facility for anyone wishing to attend.

In spite of their many positive attributes, there are likely to be people with questions and concerns about a wind installation at this site along with those who simply oppose it. Specific public acceptance issues that need to be addressed are visual impact, noise, electromagnetic interference (EMI), air traffic impacts, safety considerations, and possible impacts on bird populations.

Visual Impacts:
Visual impacts are really the most significant concern in any wind project. Typically concerns about visual impact are exaggerated and can be best addressed through presenting clear and accurate photo simulations of the selected turbine and tower superimposed on actual photos of the selected site. Using real photos, the actual dimensions of the machine and publicly available digital mapping information, computer software is available that can create visually accurate simulations of the installation from any selected vantage point. This should be one of the earliest investments in the project moving forward.

While the turbine will clearly be visible from **the Great Neck area**, the visual impact from other locations is likely to be minimal. The existing composting facility on the site already impact views, but a large wind turbine will clearly be more prominent in the view shed.

Noise Impacts:
The Massachusetts Department of Environmental Protection regulates noise emissions. A new sound source cannot raise overall noise levels more than 10 dB over the existing ambient sound levels. Noise is of most concern when nearby residences are very close and the project is located in a particularly quiet area. Using sound data supplied by the turbine manufacturer, as well as readily measured background noise data, accurate assessment of noise impacts can be made as part of the planning and permitting process.

In this particular project, at an isolated location far from any residences, background ambient noise levels are high enough that noise from the wind machine is unlikely to be a concern. There are no nearby neighbors to raise the issue or be concerned. Noise impact assessments should be evaluated in the permitting phase of this project.

Electromagnetic Interference Impacts:
While there have been concerns about EMI impacts from wind projects, these again are usually overstated by those wishing to derail projects. With no residences or other nearby facilities likely to have radio, television or other signals impacted by potential EMI concerns, the impact of this issue on the projects should be negligible.

Air Traffic Impacts:
Though rare, occasionally proposed wind projects can have impacts on air traffic. Review and/or permitting through the Federal Aviation Administration will address any air traffic impacts and restraints.

Impact on Birds and other Wildlife:
A favorite subject for wind project opponents is the impact of wind turbines on birds. The real impact is generally very minimal compared to that of house cats, cars, and buildings. Unless a wind turbine is located on a very densely traveled avian migratory route or is located in a very special nesting area, this issue is typically not a major concern, though it does have to be addressed thoroughly in the permitting process. Bats have recently emerged as another particular concern. Due to the proximity to nearby wildlife areas, avian and other wildlife impact studies should receive special attention on this project.

PRELIMINARY AVIAN IMPACT ASSESSMENT

Study Objectives

The following is a preliminary overview of potential impacts to avian populations that may be incurred as part of the construction of the Ipswich Wind Turbine Project. A more detailed Avian-Wind Turbine Impact Study will be conducted and completed as part of the Implementation/Permitting Phase of the Ipswich Wind Turbine Project. Accordingly, this report will serve to outline the proposed scope of work and set out the subheadings of the major sections of the report and provide a brief description of the proposed work.

Site Evaluation

We will assess the nature of the surrounding areas pertaining to avian and bat use within and around the proposed turbine location. This evaluation will include interviews and contacts with Federal and State ornithologists, and local birders, associated with bird migration (principally raptor migration) and other large bodied bird migration. We will also review previous studies, which focused on avian impacts associated with other similar geographic locations of similar scale projects. The intent of this aspect of the investigation will be to determine the areas utilized by migrating songbirds and raptors near the turbine location.

Breeding Bird Species

A review of Massachusetts Audubon Society Breeding Bird Atlas will be conducted to determine local breeding bird species within and around the turbine site. In this way, we can identify possible species of concern regarding breeding bird use of the turbine site and begin to develop any mitigation strategies (if necessary) regarding impacts to these species as well as their habitat needs.

Migrating Birds

As the proposed Ipswich Wind-Turbine Site is located along the Atlantic flyway migrating songbirds, Canada Geese and raptors will be of primary concern regarding potential impacts to these species. Importantly, the Ipswich Wind-Turbine project is only a single large turbine, not a multi-unit wind farm. The blade speed on these large turbines is very slow compared to earlier wind turbines that were smaller and required large arrays with many individual turbines to generate economically viable quantities of electricity (e.g., Altamont, California). The single wind-turbine proposed for Ipswich will not approach the size and complexity of the Altamont site.

Wintering Birds

Information from the Audubon winter bird counts will be utilized to determine the approximate winter use of the wind-turbine site in Ipswich by wintering birds. We do not expect significant issues with bird use in these areas during this time of the season.

Nocturnal Bird Activity

Using local birder information and information collected from public and private ornithological groups and associations, we will look to determine the possible impacts from the wind turbine on nocturnal migrants (largely passerines) as well as possible impacts to bats.

Special Species: Raptors
Because of impacts from large wind-turbine arrays in western states, raptors have become associated with wind-turbine impacts. Accordingly, we will look in detail at raptor migration routes and areas of use during raptor migration periods as well as resident breeding birds. Based on the outcome of this work possible mitigation measures will be assessed, if necessary to reduce any unlikely impacts to these species.

Use of Information Collected at the Hull MA Wind-Turbine Site
Fortunately, the wind-turbine in Hull, Massachusetts will serve as an excellent model to assess possible impacts from the proposed Ipswich Wind-Turbine Project. The Town of Hull installed a 660 kW wind-turbine during 2001 and has been operating this turbine with great success over the succeeding years. We intend to utilize information regarding this wind-turbine site as a model for the Ipswich project. Hull is located along coastal New England replete with very similar avian habitats and use. Post construction studies and bird kill counts will be very useful in assessing possible impacts to avian species from the proposed Ipswich wind turbine.

Information from Published Sources & Existing Wind Projects
We have reviewed the work of existing wind operations similar to the proposed Ipswich Wind Turbine Project. This work is largely summarized at the New England Wind Forum website (http://www.eere.energy.gov/windandhydro/windpoweringamerica/newengland.asp). As a result of the bird mortality at the Altamont Pass wind complex (e.g., over 5,000 wind generators) during the 1980s much attention has been placed on wind turbines and avian impacts. However, because of the Altamont Pass experience many changes in the wind industry have been made to ameliorate impacts to birds and bats. In particular:

- Turbines are now larger and more widely spaced,
- Towers are now tubular compared to the older lattice construction and as a result do not attract perching birds, and/or, large raptors;
- Better selection of wind generator sites

The Ipswich Wind Turbine project only consists of one large, slowly rotating, generator with (maximum) 262-foot high hubs. Accordingly, impacts to migrating and/or resident birds species are expected to be minimal. Nonetheless, additional work will be conducted to investigate the use of the site as part of the comprehensive avian impact study to be conducted as part of the next phase of this process.

Literature Sources

U.S. Department of Energy, Energy Efficiency & Renewable Energy: Wind & Hydropower Technologies Program.
http://www.eere.energy.gov/windandhydro/windpoweringamerica/newengland.asp
National Wind Coordinating Committee. Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions (Nov. 2004).
National Wind Coordinating Committee. New England Wind Power Siting Workshop (October 21, 2001).
National Wind Coordinating Committee. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. August 2001.
University of Massachusetts. Wind Turbine Siting in an Urban Environment: The Hull, MA 660 KW Turbine.

PROJECT UNCERTAINTIES

Objectives of Analysis
Our objective in this analysis has been to prepare a reasonable and balanced assessment of the cost, performance, value, and ultimately the economic viability of a wind turbine installation for the Ipswich Utilities Department. Given the time and resources devoted to this effort, we have been able to accomplish this task by developing estimates of:

- Wind Resources at the site
- Annual electricity production for three selected WTGs
- Projected schedule and cost for permitting the project
- Installed costs for three selected WTGs
- Value of the electricity produced
- Operations and maintenance costs

Our analyses indicate that a publicly-financed wind turbine for the Ipswich Utilities Department appears economically viable under some scenarios built from combinations of the above assumptions. It is important to realize that there is a chance that the actual cost, performance, and economic viability of a project could fall outside of the scenarios examined if the actual values for critical and uncertain variables falls outside of the ranges considered.

Uncertainty around several of these critical variables can be reduced significantly. However, several of the key variables, particularly future electricity rates are volatile and unknowable over a twenty year time frame and the cost of permitting for a single turbine project could become a significant obstacle if active local opposition to the project develops.

Uncertainties That Will Become Less Uncertain
Some variables such as future power prices and value of RECs are, by their nature, unknowable. Other uncertainties such as the cost of permitting and construction will become known after the permitting and engineering processes are completed and construction bids are available.

<u>Cost of Permitting</u>
The design and permitting budgets are reasonable estimates. As highlighted elsewhere, this variable is highly dependent on the level of support and most especially the level of opposition that any given wind project might receive

<u>Equipment Costs</u>
Due to the delay between planning and implementing any project, there are uncertainties in projecting costs until actual bids received. The wind business has been somewhat volatile with high growth rates and demand, a limited number of reputable manufacturers, changing fortunes with changing production tax credits and other regulatory impacts, changing steel prices and changing international currency exchange rate impacts. The cost of equipment will become certain as bids are received.

Construction and Installation Cost
The specific geotechnical and other conditions at the site will influence the type and cost of foundation required for a wind turbine as well as the assembly techniques that can be used. Many economic factors projecting two years out can influence actual installation costs. Geotechnical testing and analysis, finalizing design and getting real bids will eliminate the uncertainties in this area.

Operations, Maintenance and Administrative Costs:
There is some uncertainty in the projection of O&M costs in a preliminary feasibility study like this one. Precise estimates of these costs cannot be developed without defining various structures and implementation options for O&M over the long term. For purposes of this study, the maintenance cost was calculated using a budgetary quote from the manufacturers for an extended five year warranty and maintenance plan adjusted for inflation over the project life. Periodic additional maintenance and replacement costs were also factored into our financial model. Our projections also assume that project operational structure will be designed so as to have the minimal administrative burdens possible. However, O&M costs can vary greatly with the type of O&M approach followed by Ipswich Municipal Light Department, and can be impacted by outside contractor, labor rates, WTG supplier charges, etc.) The expected O&M cost will become more certain once Ipswich Municipal Light Department defines its expected approach to O&M. It is recommended that bid documents be prepared that encourage additional insight into the costs of long term O&M relationships with manufacturers if available.

Cost of Capital:
As that the project moves forward, it is assumed that Ipswich Municipal Light Department would take the lead in clarifying how the project would be financed. Closer to actual construction, the costs of what would presumably be fixed cost bonding would be more certain.

Currency Exchange Rates:
With the several of the appropriate sized turbines all being manufactured in Europe at the present time, currency exchange rates will undoubtedly influence the initial capital investment costs, as well as ongoing cost for parts involved in future maintenance. Since it is the initial capital investment which will be by far the more significant of these factors, the uncertainty inherent in currency exchange rates is reduced the closer the project gets to actually purchasing and paying for the equipment.

Availability and Appropriateness of Incentives:
Various incentives or subsidies may be appropriate to consider for the project. Some of these may change by the time the project is ready to build. Again this uncertainty is greatly reduced as the project gets closer to reality.

Uncertainty That Will Remain Uncertain
Projecting the financial performance of any investment out over a twenty year time horizon clearly has inherent uncertainties. The following factors are outside of our control and further research will do little to narrow their range of uncertainty. In wind energy investments such as that proposed a few areas in particular are worthy of highlighting:

Future Energy Markets:
Factors such as the future pricing of electricity and inflation rates are by their nature unknowable with 100% certainty. We have developed reasonable ranges for these variables by using projections from the most credible experts doing work in these areas. However, as with all financial investments addressing future energy markets, the assumptions made in this report are subject to global energy supply and demand impacts, changes in energy markets wrought by future technological change, impacts from legislative and regulatory actions and other macro-economic forces impacting energy markets.

On the positive side, a wind turbine is itself inherently a hedge against unexpected increases in future energy costs. The price stability and independence from fossil-fuel price volatility make the proposed project itself protection against future price uncertainties.

Future Value of Renewable Energy Certificates:
We have chosen to err on the conservative side of projecting the value of these certificates. While current prices of Certificates are higher than we have assumed in our analysis, we do not feel it is prudent to assume high certificate prices for the entire project life. We feel that the references cited are very credible and numbers assumed in our analysis are representative of long-term certificate value. Again, the actual future values of these certificates are subject to future economic and political influences that are unknowable.

Reducing Uncertainty
With all these uncertainties in mind, it is the intention of the entire project team to assure that at all phases of the project, appropriate performance from a financial perspective remains highest priority for the project. We strongly recommend having several checkpoints for a go-no go project analysis to assure at all stages, as uncertainty is reduced and further clarity of remaining factors influencing financial performance is gained, that information can be used to assure Ipswich Municipal Light Department is making a prudent investment on behalf of the ratepayers and the town.

CONCLUSIONS AND RECOMMENDATIONS

Wind Resource is Modest, Limiting Financial Returns

An ideal wind generation project would possess a strong wind resource (annual average wind speed 7 m/s or greater) and a favorable site relative to regulatory constraints. The Ipswich Utilities Department appears to be subject to a relatively favorable permitting regime, but its annual average wind speed at 5.6 – 5.8 m/s is rather lower than ideal.

The preceding technical and financial analysis indicates that the standalone financial viability of Ipswich Municipal Light Department's wind turbine based only on offsetting wholesale power purchase costs is clearly predicated on low-cost financing as well as Ipswich Municipal Light Department's desire to hedge the future impact of grid supplied energy costs. The sale of RECs will significantly improve the proposed project's financials.

If Ipswich Municipal Light Department is able to secure 0% financing under the recently enacted Federal Energy bill financial models predict that a positive outcome over the life of the proposed WTG project is, on average, possible. However, only one of the examined WTGs will on average, over its expected life, produce energy at an expected cost to Ipswich Municipal Light Department that will be below the prices Ipswich Municipal Light Department is projected to pay for electricity from the grid based on the June 2005 analysis from MMWEC. If future energy prices increase above the MMWEC forecasts the financial viability of the project improves dramatically.

Modest Winds and Small Scale Limit Private Development Opportunity

In addition to the public financing case described above, we also made some preliminary assessment of the opportunity for development and financing of the project by a private company. Under this type of business arrangement, which dominates the U.S. wind industry today, a private entity would engineer, procure, and construct the wind turbine and sell the electricity produced to the Ipswich Municipal Light Department under a long term contract. Our analysis suggests that with the modest wind resource and only one wind turbine installed at the site, this ownership and financing structure is unlikely to produce the financial returns required by the private sector and still provide significant benefit to the Ipswich Municipal Light Department

Project Goals and Other Factors For Go/No Go Analysis

Unlike a private project in which economic feasibility issues can be evaluated fairly readily based on a straight forward set of economic metrics, determining the feasibility of a public project is more complex and less clear cut. The feasibility of public projects such as this is influenced by the goals that go beyond issues which can be answered by simple return on investment analysis alone.

The Ipswich Municipal Light Department is primarily interested in potential cost saving from the project. The utility and community also benefit from the long term hedge against electricity price inflation provided by the wind project. There may be additional ancillary benefits relating to facility security by having an independent power supply as part of the overall power supply system. And other benefits such as environmental benefits of wind power also likely receive important consideration in a publicly owned project.

Balancing these benefits would be the obligations Ipswich Municipal Light Department takes on owning, operating, maintaining and insuring the equipment installed.

Any wind project in New England at this time could potentially have a positive influence in encouraging public acceptance of wind power. It could also have negative implications for the emerging wind industry if it were generally perceived that the wind turbine wasn't performing adequately in economic or energy production terms. In a relatively modest wind resource area, this negative public perception could potentially be created. The ways in which the public participation in the development of the project are handled could also have impacts beyond the project itself. For these and other reasons, analysis of the potential impacts of the project beyond simple economic feasibility should be an important consideration.

While our preliminary analysis does show that the site can potentially produce enough wind generated electricity to make the project economically feasible, the project economic analysis does not produce a clear and unambiguous "GO" signal. This ambiguity is due in part to the technical, economic, regulatory and policy uncertainties mentioned previously.

Recommendations for Moving Forward

The Project Assessment has been addressed in this report. The project team recommends that if the economic analysis and projections are deemed favorable enough to offset projected future energy prices as well as achieve other Ipswich Municipal Light Department goals such as hedging and environmental stewardship, then Ipswich Municipal Light Department should proceed to a design phase for the project.

We recommend that the economic models be revised and revisited as engineering, permitting and bidding proceed to confirm that the economic assumptions in this report remain valid as more hard numbers become available.

In Closing

Everyone on the project team is grateful for the opportunity to work on this project. We look forward to working with Ipswich Utilities Department in the next phase of the project.

APPENDIX A: WIND DATA

Table A-1: Mean Hourly Wind Speeds
Ipswich, MA

10-M Height above ground level **Wind Speed (mph)**

June 1, 2003 - May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
----	----	----	----	----	----	---- -	----	---	----	----	----	----	----
1	8.7	6.5	7.5	6.3	5.3	4.1	4.5	4.1	3.3	5.8	6.4	8.5	5.9
2	9	7.1	7.1	6.5	5.2	4	3.8	3.6	3.7	5.6	6.7	8.3	5.9
3	8.4	7.1	6.9	7.1	4.8	3.8	3.9	3.5	3.7	5.6	6	8.4	5.7
4	8	7	6.5	6.7	5.5	3.1	3.6	3.7	3.9	6.1	6.1	8.7	5.7
5	7.5	6.7	6.7	7.2	5.5	3.4	3.7	3.8	4.2	5.7	6.5	8.9	5.8
6	6.9	6.6	6.7	7	5.8	4	4.1	3.9	4.2	6	6.5	9.1	5.9
7	7.1	6	6.8	7.3	5.8	4.5	4.6	4.7	4.3	5.8	6.9	8.4	6
8	7.9	6.8	7.3	7.9	6.9	4.8	5.1	5.2	5.1	6.1	7	8.1	6.5
9	9.2	7.4	8.1	8.3	7.7	5.6	5.7	5.4	5.6	6.9	7.2	8.3	7.1
10	9.5	7.5	8.6	8.7	7.7	5.5	6.2	6.2	6	7.4	7.7	9.5	7.5
11	9.9	8.3	9.8	8.8	8.3	6.6	6.8	6.4	5.8	8.3	8.1	9.5	8
12	10.3	8.4	10.4	9.5	9.2	6.8	7.4	6.5	6.5	8.7	8.3	10	8.5
13	9.9	9.6	10.2	9.6	9.1	6.9	7.9	7	6.4	8.7	8.3	9.4	8.6
14	10.3	9.4	10.7	10.1	8.7	7	8.5	7	6.1	8.6	8.5	10.1	8.7
15	9.9	9.6	10.3	9.5	8.7	6.1	8.3	7	6.6	8.1	7.8	9.9	8.5
16	9.3	9.1	9.9	9.1	7.9	5.9	8	6.1	6	7.8	6.5	9.1	7.9
17	8.1	7.7	8.9	8.1	7.6	5.4	6.8	4.7	4.5	6	6.9	8.9	7
18	8	7.5	8.5	7.1	6.8	4.3	5.9	4.1	3.5	5.8	6.8	9.3	6.5
19	7.7	6.6	8.2	6.9	5.5	4.3	5.2	4.5	3.5	5.8	6.6	9	6.1
20	8.3	7.7	7.8	6.6	4.8	4.7	4.7	4.5	3.5	5.2	6	9.4	6.1
21	8.6	7.9	7.4	6.6	4.6	4.7	4.6	4.3	3.6	5.7	6.6	9.5	6.2
22	8.4	7.5	8	6.2	5.1	4.7	4.7	4.4	3.6	5.7	6.8	9.1	6.2
23	9	7.1	7.5	6.1	5.1	4.6	4.7	3.9	3.4	5.7	6.6	9.1	6.1
24	9.1	6.5	7.5	6.7	5.2	4.3	4.3	4.2	3.7	5.9	7	9	6.1
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Mean	8.7	7.6	8.2	7.7	6.5	5	5.5	5	4.6	6.5	7	9.1	6.8
Good Hours	721	682	743	720	743	720	744	744	720	744	720	721	
Missing Hrs	23	14	1	0	1	0	0	0	0	0	0	23	

8722 Hrs of good data 62 Hrs missing data 99.3% Data recovery

Table A-2: Mean Hourly Wind Speeds
Ipswich, MA

30-M Height above ground level **Wind Speed (mph)**

June 1, 2003 - May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
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1	12.4	9.9	11.4	10.6	8.4	7.6	7.3	7.4	6.7	10	10.3	13.6	9.6
2	12.7	10.2	11.2	11.2	8.7	7.9	6.8	6.8	7.3	9.7	10.4	12.9	9.6
3	12.1	10.8	10.8	11.7	8.3	7.8	7	6.9	7.4	10.1	9.4	13	9.6
4	11.4	10.5	10.5	11.3	9.3	6.8	6.7	7.1	8	10.8	9.8	13.8	9.6
5	10.8	10.2	10.8	12	9.3	6.9	6.8	7.4	8.4	10.3	10.2	14.1	9.7
6	10.4	9.8	10.8	12	8.9	7.3	6.8	6.9	8.4	10.7	10	14.1	9.7
7	10.5	9.1	10.7	11.8	9.1	7.8	7	7.6	7.5	10.3	10.6	13	9.6
8	10.7	9.7	11.5	12.1	10.3	8.5	7.5	8.2	8.9	9.4	10.5	11.6	9.9
9	12.1	10.2	11.9	12.2	11.3	9.2	7.9	8.5	9.2	10.1	10.3	11.8	10.4
10	12.7	10.4	12.4	12.9	11.3	9.2	8.5	8.9	9.4	10.5	11	13.4	10.9
11	13.3	11	13.7	12.8	12.1	10.3	9.3	9.4	9.1	11.5	11.4	13.3	11.4
12	13.6	11.7	14.4	13.5	12.8	10.6	10	9.7	9.7	11.9	11.4	14.4	12
13	12.8	13	14.2	13.5	12.6	10.2	11.1	0.2	9.7	12.6	11.5	13.6	12.1
14	12.9	12.6	15	14.2	11.8	10.2	12	0.4	9.4	12.2	11.8	14.4	12.2
15	12.9	13	14.4	13.2	12	9.2	12	0.3	9.7	12	11.4	14.3	12
16	12.1	12.6	13.8	12.8	11.3	8.9	11.6	9.2	9	11.7	10.1	13.9	11.4
17	11.2	11.1	12.9	11.8	11	8.2	10.3	7.4	7.7	10	10.6	13.6	10.5
18	11.6	11.3	12.6	10.9	10.2	7.1	9	7.5	7.1	9.7	10.5	13.9	10.1
19	10.8	10.3	12	10.8	8.8	7.3	8.7	7.9	6.9	9.6	10.4	13.6	9.7
20	11.8	11.5	11.6	10.6	8.4	8	8.1	7.9	6.9	9.4	9.9	13.9	9.8
21	12.2	11.5	10.9	10.4	8	8.4	7.9	7.5	6.9	9.8	9.8	14.3	9.8
22	12.4	11.1	11.7	9.9	8	8.2	7.8	7.3	6.9	9.9	10.2	13.9	9.8
23	12.7	10.7	11.2	10.4	8.1	8.1	8.1	7.2	6.9	9.8	10	14.4	9.8
24	13	10	11.7	10.8	8.3	7.8	7.3	7.2	7.1	10.1	10.6	13.6	9.8
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Mean	12.1	10.9	12.2	11.8	9.9	8.4	8.6	8.1	8.1	10.5	10.5	13.6	10.4
Good Hrs													
	700	675	737	719	743	720	744	744	720	744	720	718	
Missing Hrs													
	44	21	7	1	1	0	0	0	0	0	0	26	

8684 Hrs of good data 100 Hrs missing data 98.9% Data recovery

Table A-3: Mean Hourly Wind Speeds
Ipswich, MA

30-M Height above ground level **Wind Speed (mph)**

June 1, 2003 - May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
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1	12.3	10.2	11.6	10.6	8.5	7.6	7.3	7.3	6.8	9.7	10.2	13.8	9.6
2	12.6	10.1	11.3	11.3	8.7	7.8	6.8	6.8	7.4	9.6	10.3	13	9.6
3	12.1	10.8	11.1	11.8	8.4	7.6	7	6.8	7.5	9.8	9.4	12.9	9.6
4	11.4	10.5	10.7	11.4	9.4	6.8	6.7	7.1	8.1	10.6	9.8	13.8	9.7
5	10.8	10.2	10.8	12.1	9.4	6.8	6.8	7.3	8.5	10.1	10.2	14	9.7
6	10.4	9.7	10.8	12	9	7.3	6.8	6.9	8.4	10.5	10	13.9	9.6
7	10.4	9.1	10.7	11.8	9.1	7.8	7	7.6	7.6	10.1	10.7	13	9.6
8	10.7	9.6	11.4	12.3	10.3	8.4	7.5	8.2	8.9	9.3	10.5	11.6	9.9
9	12.1	10	11.9	12.3	11.4	9.3	8	8.4	9.3	10	10.3	11.6	10.4
10	12.8	10.3	12.5	13	11.3	9.3	8.6	8.9	9.6	10.4	11	13.2	10.9
11	13.3	10.9	13.9	12.9	12.1	10.4	9.4	9.4	9.3	11.5	11.4	13.2	11.4
12	13.6	11.6	14.7	13.4	12.8	10.6	10	9.7	9.9	11.8	11.4	14.2	12
13	13	12.9	14.4	13.6	12.6	10.2	10.9	0.2	9.7	12.4	11.4	13.4	12.1
14	13	12.5	15	14.2	12	10.2	11.9	0.4	9.5	12.1	11.6	14.2	12.2
15	12.9	12.9	14.4	13.4	12.2	9.4	11.9	0.2	9.7	11.9	11.5	14.2	12
16	12.1	12.5	13.8	12.9	11.5	9	11.4	9.1	9	11.6	9.9	13.8	11.4
17	11.2	11.3	13.1	11.8	11.2	8.2	10.3	7.4	7.6	10	10.5	13.5	10.5
18	11.7	11.4	12.8	10.9	10.4	7.2	9.1	7.6	7.1	9.7	10.3	13.9	10.2
19	10.7	10.3	12.1	11	8.9	7.4	8.9	7.9	6.9	9.5	10.1	13.7	9.8
20	11.8	11.5	12	10.7	8.5	8.1	8.2	7.9	7	9.3	9.7	13.9	9.9
21	12.3	11.4	11.1	10.6	8.1	8.6	8	7.5	6.9	9.7	9.8	14.3	9.8
22	12.4	11	11.9	9.8	8	8.4	7.8	7.4	6.9	9.8	10.2	13.9	9.8
23	12.8	10.7	11.4	10.4	8.1	8.2	8.1	7.2	6.9	9.7	9.9	14.4	9.8
24	13	9.9	11.8	10.9	8.3	7.8	7.4	7.3	7.2	10	10.7	13.6	9.8
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Mean	12.1	10.9	12.3	11.9	10	8.4	8.6	8.1	8.2	10.4	10.5	13.5	10.4
Good Hrs													
	700	674	743	720	742	718	741	743	720	743	719	718	
Missing Hrs													
	44	22	1	0	2	2	3	1	0	1	1	26	

8681 Hrs of good data 103 Hrs missing data 98.8% Data recovery

Table A-4: Mean Hourly Wind Speeds
Ipswich, MA

39-M Height above ground level **Wind Speed (mph)**

June 1, 2003 - May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
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1	13.6	11.6	12.4	11.7	9.4	8.7	8.5	8.5	7.8	11.4	11.5	15.2	10.8
2	13.9	11.3	12.1	12.6	9.7	9	8	7.8	8.6	11.1	11.6	14.1	10.8
3	13.3	12.1	12.2	13.1	9.3	9.1	8.3	8.1	8.7	11.4	10.8	14.3	10.9
4	12.5	11.8	11.8	12.7	10.6	8.1	8	8.4	9.2	12	11.1	15	10.9
5	11.9	11.4	12	13.1	10.6	8.2	7.9	8.6	9.6	11.8	11.4	15.6	11
6	11.5	11.2	12	12.9	9.8	8.3	7.7	7.9	9.5	12.4	11.3	15.5	10.8
7	11.5	10.5	11.9	12.7	10	8.6	7.7	8.3	8.7	11.7	11.7	14.5	10.6
8	11.6	11.1	12.4	13	11.1	9.3	8.1	8.9	9.8	10.5	11.5	12.6	10.8
9	12.7	11.1	12.7	13.1	12.1	9.9	8.6	9.2	10.1	10.9	11.2	12.9	11.2
10	13.3	11.1	13.1	13.9	12.1	10	9	9.6	10.2	11.3	11.9	14.3	11.6
11	13.8	11.4	14.5	13.7	12.9	11.1	9.9	9.9	9.9	12.2	12.2	14.2	12.1
12	14.3	12.7	15.1	14.3	13.6	11.3	10.6	0.4	10.5	12.7	12.1	15.4	12.7
13	13.5	13.9	15.1	14.4	13.3	10.8	11.8	1	10.4	13.4	12.2	14.7	12.9
14	13.8	13.5	15.8	15	12.6	10.8	12.8	1.2	10.2	13.1	12.7	15.5	13.1
15	13.7	13.8	15.1	14.1	12.9	9.9	12.8	1.1	10.4	12.9	12.4	15.3	12.9
16	12.9	13.8	14.7	13.7	12.1	9.5	12.3	9.9	9.6	12.7	10.9	15	12.3
17	12.2	12.1	13.7	12.8	11.9	8.8	11.2	8.2	8.4	11.1	11.7	14.9	11.4
18	12.6	12.5	13.7	12	11.1	7.9	10	8.6	8.1	11	11.5	15.3	11.2
19	11.8	11.6	13.1	11.9	9.8	8.3	9.9	9.1	8.1	10.8	11.4	15	10.9
20	12.9	12.9	12.8	11.7	9.5	9	9.3	9.2	8.1	10.7	11.2	15.6	11
21	13.5	12.9	12.1	11.7	9	9.5	9.3	8.8	8.1	11	11.1	15.6	11
22	13.7	12.4	12.9	10.9	8.8	9.6	9	8.4	8.1	11.1	11.3	15.2	10.9
23	13.9	12.3	12.4	11.7	9.2	9.1	9.3	8.5	8.1	11.2	11.2	15.6	11
24	14.2	11.3	11.8	12.1	9.1	9.1	8.6	8.4	8.1	11.3	11.7	15	10.9
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Mean	13	12.1	13.1	12.9	10.8	9.3	9.5	9.1	9.1	11.7	11.6	14.8	11.4
Good Hrs													
	695	677	741	718	743	720	744	743	720	744	720	722	
Missing Hrs													
	49	19	3	2	1	0	0	1	0	0	0	22	

8687 Hrs of good data — 97 Hrs missing data — 98.9% Data recovery

Table A-5: Mean Hourly Values

Ipswich, Mass.
10-m Wind Direction

June 1, 2003 - May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
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1	259	247	225	207	229	209	259	218	224	232	238	260	234
2	263	271	230	218	221	213	245	241	217	241	241	243	237
3	250	277	214	208	215	220	252	231	236	237	255	240	236
4	265	248	221	219	201	216	254	223	222	234	258	242	233
5	267	270	218	198	219	216	245	218	183	240	224	239	228
6	245	288	204	182	197	221	252	230	176	240	227	245	225
7	264	277	203	185	196	209	256	202	176	242	251	221	223
8	270	271	211	178	192	191	230	215	155	243	265	236	221
9	263	262	195	182	206	193	219	207	155	248	249	270	221
10	249	200	187	160	185	179	209	211	158	242	203	258	204
11	281	206	190	163	196	190	213	201	155	232	208	231	206
12	279	215	183	176	191	182	201	215	161	231	229	219	207
13	267	249	187	192	205	182	226	214	162	230	213	241	214
14	276	271	190	189	204	186	222	215	176	219	195	234	215
15	279	272	193	179	198	177	223	214	176	218	206	235	214
16	287	274	199	174	205	197	226	220	188	206	212	232	218
17	296	271	196	190	208	190	225	229	192	236	222	236	224
18	289	270	197	198	202	205	227	218	202	234	218	242	225
19	282	281	208	181	177	208	231	228	216	256	217	243	227
20	285	272	221	180	197	211	229	233	218	233	237	255	231
21	266	286	228	215	192	226	224	241	238	267	256	261	241
22	249	265	234	223	204	240	235	235	229	243	256	257	239
23	272	251	233	218	230	235	238	246	222	234	258	237	239
24	251	227	213	206	221	232	244	251	243	237	257	261	237
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Mean	269	259	208	193	204	205	233	223	195	237	233	243	225
Good Hrs	718	682	743	720	743	720	744	744	720	744	720	719	
Missing Hrs	26	14	1	0	1	0	0	0	0	0	0	25	

8717 Hrs of good data 67 Hrs missing data 99.2% Data recovery

Table A-6: Mean Hourly Values

Ipswich, Mass.
30-m Wind Direction

June 1, 2003 - May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
----	----	----	----	----	----	----	---- -	---	----	----	----	----	----
1	284	259	229	188	220	217	247	229	203	245	235	268	235
2	279	263	232	186	225	216	238	236	204	247	246	265	236
3	282	259	221	213	187	222	243	192	201	247	259	264	232
4	265	251	217	213	202	204	244	231	206	243	245	259	231
5	288	253	212	202	202	201	244	204	187	243	205	257	224
6	263	256	202	183	189	197	255	207	179	242	238	255	222
7	295	281	200	177	189	195	244	201	179	244	236	241	223
8	311	272	203	179	193	189	217	215	143	244	239	242	220
9	274	253	186	186	207	192	220	200	151	238	196	259	213
10	273	211	200	153	187	177	210	211	157	245	206	253	207
11	273	210	192	166	196	190	214	211	152	233	201	233	206
12	271	206	186	180	192	179	202	216	160	232	208	223	205
13	261	252	189	196	207	182	225	205	159	231	203	243	213
14	279	263	193	191	194	186	222	218	168	219	198	247	215
15	270	264	195	181	200	168	224	215	176	208	209	238	212
16	270	265	201	165	217	185	226	222	190	209	215	224	216
17	293	264	199	206	207	181	227	220	191	227	216	251	223
18	293	252	200	192	192	193	228	220	206	227	203	239	220
19	292	276	212	176	177	206	233	213	217	238	211	252	225
20	279	266	214	180	201	211	233	215	210	227	216	263	226
21	280	290	235	221	204	223	225	248	197	229	231	265	237
22	257	268	240	215	193	237	230	217	213	228	242	266	233
23	288	255	237	209	213	227	242	215	206	241	242	256	236
24	275	229	236	200	227	225	240	225	208	224	227	271	232
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Mean	279	255	210	190	201	200	231	216	186	234	222	251	222
Good Hrs													
	700	674	742	720	742	720	744	743	719	744	720	718	
Missing Hrs													
	44	22	2	0	2	0	0	1	1	0	0	26	

8686 Hrs of good data   98 Hrs missing data   98.9% Data recovery

Table A-7: Mean Hourly Values

Ipswich, Mass.
39-m Wind Direction

June 1, 2003 - May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
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1	292	270	232	188	227	214	234	222	193	244	222	269	233
2	278	271	223	175	213	205	227	237	189	248	246	266	231
3	281	259	208	214	188	213	241	200	203	247	236	254	228
4	265	263	208	213	198	203	243	208	184	243	233	261	226
5	287	254	212	197	202	201	244	193	176	239	208	249	221
6	262	256	201	190	189	196	254	206	170	243	227	246	219
7	295	281	197	177	190	182	221	205	168	244	214	240	217
8	310	272	202	178	191	176	216	214	142	243	239	253	218
9	261	250	185	186	206	191	218	199	150	236	219	258	213
10	269	207	199	152	186	176	208	209	156	243	205	239	204
11	269	206	190	165	195	189	212	210	156	231	200	232	204
12	268	230	185	179	190	177	212	214	159	231	207	222	206
13	257	251	188	183	206	180	223	204	158	230	202	241	210
14	284	261	192	190	193	185	220	216	166	217	197	246	214
15	280	263	194	180	199	166	222	213	176	206	208	236	212
16	290	264	199	176	204	183	224	220	188	207	211	223	215
17	293	276	198	204	194	178	225	219	195	226	214	249	222
18	292	250	198	191	189	191	225	218	204	226	206	238	219
19	292	275	211	175	185	204	231	213	215	237	211	250	225
20	280	265	213	178	199	209	207	202	208	226	203	264	221
21	280	289	234	209	201	220	211	228	196	228	232	264	232
22	257	267	234	204	192	221	221	221	210	228	243	265	230
23	288	257	232	208	211	222	250	214	218	241	243	255	236
24	274	232	217	201	221	236	237	218	210	225	239	269	232
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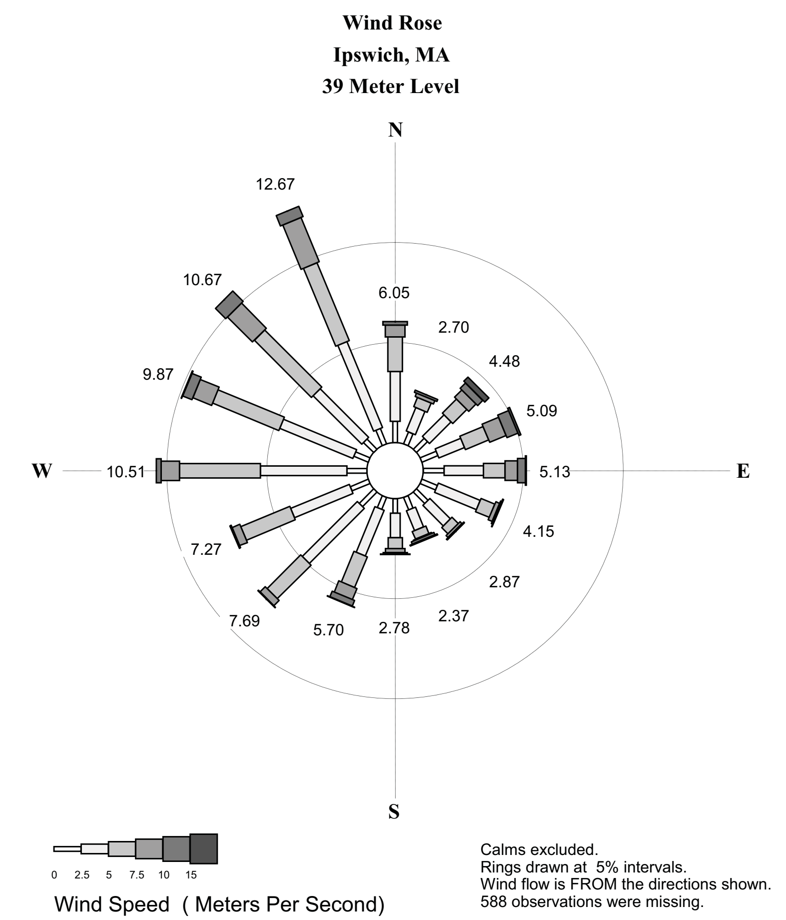
Mean	279	257	206	188	199	197	226	213	183	233	219	250	220
Good Hrs													
	694	677	744	718	742	720	744	744	719	744	720	722	
Missing Hrs													
	50	19	0	2	2	0	0	0	1	0	0	22	

8688 Hrs of good data 96 Hrs missing data 98.9% Data recovery

Figure A-1:



PERCENT OCCURRENCE: Wind Speed (Meters Per Second)
LOWER BOUND OF CATEGORY

DIR	0	2.5	5	7.5	10	15
N	1.06	2.49	1.74	0.58	0.18	0.00
NNE	0.65	1.27	0.49	0.18	0.10	0.00
NE	0.77	1.52	1.00	0.52	0.36	0.30
ENE	0.86	1.39	1.25	0.89	0.60	0.10
E	1.03	1.97	1.08	0.63	0.39	0.05
ESE	0.83	2.26	0.74	0.22	0.06	0.05
SE	0.81	1.44	0.44	0.13	0.05	0.00
SSE	0.67	1.06	0.41	0.05	0.13	0.05

TOTAL OBS = 52116 MISSING OBS = 588

PERCENT OCCURRENCE: Wind Speed (Meters Per Second)
LOWER BOUND OF CATEGORY

DIR	0	2.5	5	7.5	10	15
S	0.72	1.23	0.55	0.20	0.07	0.02
SSW	0.64	2.47	1.66	0.60	0.31	0.02
SW	1.02	3.88	2.38	0.37	0.03	0.00
WSW	0.97	3.16	2.65	0.41	0.07	0.00
W	0.99	4.32	4.05	0.91	0.23	0.00
WNW	0.79	3.94	3.59	1.00	0.51	0.04
NW	0.72	3.42	4.04	1.77	0.72	0.00
NNW	0.84	4.65	4.22	2.40	0.57	0.00

CALM OBS = 0

APPENDIX B: WTG PRODUCTION PROJECTIONS

Table B-1: Logan Airport Wind Speed Measurements
(for correlation and scaling to a long-term average)

Monthly Average Wind Speeds (mph)
Logan Airport

	2000	2001	2002	2003	2004	2005	Average
Jan		10.1	11.7	13.3	13.8	12.3	12.2
Feb	12.1	12.6	11.5	12.3	11.9	10.8	11.9
Mar	12.7	13.5	11.3	11.4	12.7	12.2	12.3
Apr	13.4	10.9	11.8	12.3	12.3	11.3	12.0
May	11.2	11.3	12.1	10	10.6	11.5	11.1
Jun	10.8	10.1	11	9	10.2	9.7	10.1
Jul	10.3	10	10.7	9.7	9.2		10.0
Aug	9.7	9.4	10.2	9.2	9.6		9.6
Sep	10.3	10	10.4	8.8	9.8		9.9
Oct	11.1	12.7	11.4	10.9	11		11.4
Nov	10.9	12	12.5	10.6	11.2		11.4
Dec	13	12.3	12.8	13.6	12.5		12.8
Ann							11.23

Average, June 1, ‘03 - May 31, ‘04: 11.09167
Ratio: Long_term avg/12-mo avg.: 1.012898
....where data in yellow are coincident with UMass, Ipswich measurement period
Adjustment Factor from UMass Avg. to LT Avg. = 1.2%

Table B-2. IMLD Projected Costs for Purchase Power, $/MWh

(Note: Projections for last four years are linear average of prior six years, developed by us)

Year	1	2	3	4	5	6	7	8	9
	2007	2008	2009	2010	2011	2012	2013	2014	2015
All-Hrs	63.98	64.36	65.18	64.02	62.04	60.01	58.52	56.50	58.47
on-peak	71.80	73.12	75.49	74.42	72.10	70.48	68.37	66.30	68.56
on-peak chg,%	NA	1.85%	3.23%	-1.42%	-3.11%	-2.24%	-3.00%	-3.03%	3.40%
Off-peak	56.89	56.51	55.81	54.48	52.75	50.43	49.70	47.70	49.41
off-peak chg,%	NA	-0.67%	-1.24%	-2.38%	-3.18%	-4.39%	-1.45%	-4.03%	3.58%
Year	11	12	13	14	15	16	17	18	19
	2017	2018	2019	2020	2021	2022	2023	2024	2025
All-Hrs	60.57	62.09	62.91	64.80	67.47	69.27	70.97	72.71	74.50
on-peak	70.94	72.87	73.42	75.79	78.99	81.16	83.15	85.18	87.26
on-peak chg,%	1.50%	2.73%	0.75%	3.23%	4.22%	2.75%	2.45%	2.45%	2.45%
Off-peak	51.26	52.41	53.48	54.90	57.11	58.59	60.03	61.51	63.03
off-peak chg,%	1.44%	2.25%	2.04%	2.67%	4.02%	2.59%	2.47%	2.47%	2.47%

Note: Table B-2 Was developed using information provided by MMWEC to Ipswich Municipal Light Department in June 2005. Some projected pricing has since been significantly revised upward by MMWEC, almost doubling the near-term energy costs.

Table B-3. IMLD On-Peak and Off-Peak Monthly Schedule

Assumptions

(1) Avg. Days per month:	30.42
(2) Average weeks per month:	4.35

Hour	Hrs per Avg. Month in Hr Block	On-Peak Hrs/Month	Off-Peak Hrs/Month	% on-Peak
1	30.42	0.00	30.42	0.0%
2	30.42	0.00	30.42	0.0%
3	30.42	0.00	30.42	0.0%
4	30.42	0.00	30.42	0.0%
5	30.42	0.00	30.42	0.0%
6	30.42	0.00	30.42	0.0%
7	30.42	0.00	30.42	0.0%
8	30.42	21.73	8.69	71.4%
9	30.42	21.73	8.69	71.4%
10	30.42	21.73	8.69	71.4%
11	30.42	21.73	8.69	71.4%
12	30.42	21.73	8.69	71.4%
13	30.42	21.73	8.69	71.4%
14	30.42	21.73	8.69	71.4%
15	30.42	21.73	8.69	71.4%
16	30.42	21.73	8.69	71.4%
17	30.42	21.73	8.69	71.4%
18	30.42	21.73	8.69	71.4%
19	30.42	21.73	8.69	71.4%
20	30.42	21.73	8.69	71.4%
21	30.42	21.73	8.69	71.4%
22	30.42	21.73	8.69	71.4%
23	30.42	21.73	8.69	71.4%
24	30.42	0.00	30.42	0.0%

Table B-4: Mean Hourly Wind Speeds
Ipswich, Masschusetts
60-m Wind Speed Estimates (mph) **Shear Alpha = 0.18**
June 1, 2003 through May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	14.9	12.7	13.5	12.8	10.3	9.5	9.3	9.3	8.6	12.4	12.5	16.6	11.8
2	15.2	12.4	13.2	13.7	10.6	9.9	8.8	8.5	9.4	12.1	12.7	15.5	11.8
3	14.5	13.2	13.3	14.3	10.2	9.9	9	8.8	9.5	12.4	11.8	15.7	11.9
4	13.7	12.9	12.9	13.9	11.5	8.9	8.7	9.1	10	13.1	12.1	16.4	11.9
5	13.1	12.5	13.1	14.3	11.6	8.9	8.6	9.4	10.5	12.9	12.5	17.1	12
6	12.6	12.2	13.1	14.1	10.7	9.1	8.4	8.7	10.4	13.5	12.3	16.9	11.8
7	12.6	11.5	13	13.9	10.9	9.4	8.4	9	9.5	12.8	12.8	15.8	11.6
8	12.6	12.1	13.6	14.2	12.2	10.2	8.9	9.8	10.7	11.5	12.6	13.8	11.8
9	13.8	12.1	13.9	14.3	13.2	10.9	9.4	10	11	12	12.2	14.1	12.2
10	14.5	12.2	14.3	15.2	13.2	11	9.9	10.5	11.2	12.3	13	15.6	12.7
11	15.1	12.4	15.8	15	14.1	12.1	10.8	10.9	10.8	13.3	13.3	15.5	13.3
12	15.6	13.9	16.5	15.6	14.8	12.4	11.6	11.3	11.4	13.9	13.2	16.9	13.9
13	14.7	15.2	16.5	15.7	14.5	11.9	12.9	12	11.4	14.7	13.3	16	14.1
14	15.1	14.8	17.3	16.4	13.8	11.9	14	12.3	11.1	14.3	13.8	16.9	14.3
15	14.9	15.1	16.5	15.4	14.1	10.8	14	12.1	11.4	14.1	13.5	16.7	14.1
16	14.1	15.1	16.1	15	13.3	10.4	13.4	10.9	10.5	13.9	11.9	16.4	13.4
17	13.4	13.2	15	14	13	9.6	12.3	9	9.2	12.1	12.8	16.3	12.5
18	13.8	13.7	15	13.1	12.1	8.6	10.9	9.4	8.9	12	12.6	16.7	12.2
19	12.9	12.7	14.3	13	10.7	9	10.9	10	8.9	11.8	12.5	16.4	11.9
20	14.1	14.1	14	12.8	10.3	9.9	10.2	10.1	8.8	11.7	12.3	17	12.1
21	14.7	14.1	13.2	12.8	9.9	10.4	10.1	9.7	8.9	12	12.1	17.1	12.1
22	15	13.6	14.1	11.9	9.7	10.5	9.8	9.2	8.8	12.1	12.4	16.7	11.9
23	15.2	13.4	13.5	12.8	10	10	10.2	9.2	8.9	12.2	12.2	17.1	12
24	15.6	12.4	12.9	13.2	10	10	9.4	9.2	8.9	12.4	12.8	16.3	11.9
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Mean	14.3	13.2	14.4	14.1	11.9	10.2	10.4	9.9	9.9	12.7	12.6	16.2	12.5
Good Hrs													
	695	677	741	718	743	720	744	743	720	744	720	722	
Missing Hrs													
	49	19	3	2	1	0	0	1	0	0	0	22	

8687 Hours of good data   97 Hours of missing data   98.9% Data recovery

Table B-5: Wind Speed Frequency Distribution
Ipswich, Mass.
60-m Wind Speed (m/s) **Shear Alpha = 0.18**
Period of Data Recorded: **June 1, 2003 through May 31, 2004**

Wind Speed	Measd	Full No.	-----	Percent		:	Wind Speed	Measd	Full No.	-----	Percent	
Range (m/s)	Hrs	Hours	Occur	Total	Above	:	Range (m/s)	Hrs	Hours	Occur	Total	Above
.0- .4	157	158.7	1.8	1.8	98.2	:	20.0-20.4	3	3.2	0.2	99.7	0.3
.5- .9	155	156.7	1.8	3.6	96.4	:	20.5-20.9	4	4.2	0.2	99.8	0.2
1.0- 1.4	141	142.6	1.6	5.2	94.8	:	21.0-21.4	2	2.1	0.1	99.8	0.2
1.5- 1.9	222	224.5	2.6	7.8	92.2	:	21.5-21.9	1	1.1	0.1	99.8	0.2
2.0- 2.4	290	293.2	3.3	11.1	88.9	:	22.0-22.4	4	4.1	0.1	99.9	0.1
2.5- 2.9	439	443.9	5.1	16.2	83.8	:	22.5-22.9	5	5	0	99.9	0.1
3.0- 3.4	565	571.3	6.5	22.7	77.3	:	23.0-23.4	1	1	0	99.9	0.1
3.5- 3.9	604	610.8	7	29.7	70.3	:	23.5-23.9	0	0	0	100	0
4.0- 4.4	686	693.7	7.9	37.6	62.4	:	24.0-24.4	0	0	0	100	0
4.5- 4.9	815	824.1	9.4	47	53	:	24.5-24.9	0	0	0	100	0
5.0- 5.4	665	672.5	7.7	54.7	45.3	:	25.0-25.4	0	0	0	100	0
5.5- 5.9	709	717	8.2	62.9	37.1	:	25.5-25.9	0	0	0	100	0
6.0- 6.4	576	582.4	6.6	69.5	30.5	:	26.0-26.4	0	0	0	100	0
6.5- 6.9	444	448.9	5.1	74.7	25.3	:	26.5-26.9	0	0	0	100	0
7.0- 7.4	419	423.7	4.8	79.5	20.5	:	27.0-27.4	0	0	0	100	0
7.5- 7.9	316	319.5	3.6	83.1	16.9	:	27.5-27.9	0	0	0	100	0
8.0- 8.4	299	302.4	3.5	86.6	13.4	:	28.0-28.4	0	0	0	100	0
8.5- 8.9	217	219.4	2.5	89.1	10.9	:	28.5-28.9	0	0	0	100	0
9.0- 9.4	196	198.2	2.3	91.4	8.6	:	29.0-29.4	0	0	0	100	0
9.5- 9.9	140	141.6	1.6	93	7	:	29.5-29.9	0	0	0	100	0
10.0-10.4	106	107.2	1.2	94.2	5.8	:	30.0-30.4	0	0	0	100	0
10.5-10.9	104	105.2	1.2	95.4	4.6	:	30.5-30.9	0	0	0	100	0
11.0-11.4	78	78.9	0.9	96.3	3.7	:	31.0-31.4	0	0	0	100	0
11.5-11.9	47	47.5	0.5	96.8	3.2	:	31.5-31.9	0	0	0	100	0
12.0-12.4	52	52.6	0.6	97.4	2.6	:	32.0-32.4	0	0	0	100	0
12.5-12.9	46	46.5	0.5	98	2	:	32.5-32.9	0	0	0	100	0
13.0-13.4	35	35.4	0.4	98.4	1.6	:	33.0-33.4	0	0	0	100	0
13.5-13.9	19	19.2	0.2	98.6	1.4	:	33.5-33.9	0	0	0	100	0
14.0-14.4	21	21.2	0.2	98.8	1.2	:	34.0-34.4	0	0	0	100	0
14.5-14.9	16	16.2	0.2	99	1	:	34.5-34.9	0	0	0	100	0
15.0-15.4	17	17.2	0.2	99.2	0.8	:	35.0-35.4	0	0	0	100	0
15.5-15.9	13	13.2	0.2	99.4	0.6	:	35.5-35.9	0	0	0	100	0
16.0-16.4	6	6.1	0.1	99.4	0.6	:	36.0-36.4	0	0	0	100	0
16.5-16.9	5	5.1	0.1	99.5	0.5	:	36.5-36.9	0	0	0	100	0
17.0-17.4	7	7.1	0.1	99.6	0.4	:	37.0-37.4	0	0	0	100	0
17.5-17.9	3	3	0	99.6	0.4	:	37.5-37.9	0	0	0	100	0
18.0-18.4	4	4	0	99.7	0.3	:	38.0-38.4	0	0	0	100	0
18.5-18.9	0	0	0	99.7	0.3	:	38.5-38.9	0	0	0	100	0
19.0-19.4	5	5.1	0.1	99.7	0.3	:	39.0-39.4	0	0	0	100	0
19.5-19.9	4	4	0	99.8	0.2	:	39.5-39.9	0	0	0	100	0
Totals	8643	8739.8						20	20.7			

8663 Hours of good data 97 Hrs of missing data 98.9% Data recovery

Table B-6: Mean Hourly Wind Speeds
Ipswich, Mass.
80-m Wind Speeds (mph) **Shear Alpha = 0.18**
Period of record: June 1, 2003 through May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	15.6	13.3	14.2	13.5	10.8	10	9.7	9.8	9	13.1	13.2	17.5	12.4
2	16	13	13.9	14.4	11.1	10.4	9.2	9	9.9	12.7	13.3	16.3	12.4
3	15.3	13.9	14	15.1	10.7	10.4	9.5	9.3	10	13.1	12.4	16.5	12.5
4	14.4	13.6	13.5	14.6	12.1	9.4	9.2	9.6	10.5	13.8	12.8	17.3	12.5
5	13.7	13.2	13.8	15.1	12.2	9.4	9.1	9.8	11	13.6	13.1	18	12.6
6	13.2	12.9	13.8	14.9	11.2	9.6	8.8	9.1	11	14.2	13	17.8	12.4
7	13.2	12.1	13.6	14.7	11.5	9.9	8.9	9.5	10	13.4	13.5	16.7	12.2
8	13.3	12.8	14.3	14.9	12.8	10.7	9.3	10.3	11.3	12.1	13.3	14.5	12.4
9	14.6	12.8	14.7	15.1	13.9	11.4	9.8	10.5	11.6	12.6	12.9	14.8	12.9
10	15.3	12.8	15.1	16	13.9	11.5	10.4	11	11.7	13	13.7	16.4	13.4
11	15.9	13	16.6	15.7	14.8	12.8	11.4	11.4	11.4	14	14	16.4	13.9
12	16.4	14.6	17.3	16.4	15.6	13	12.2	11.9	12	14.6	13.9	17.7	14.6
13	15.5	16	17.4	16.6	15.3	12.5	13.6	12.6	12	15.4	14.1	16.9	14.8
14	15.9	15.5	18.2	17.3	14.5	12.5	14.7	12.9	11.7	15	14.6	17.8	15
15	15.7	15.9	17.4	16.1	14.8	11.4	14.7	12.8	12	14.9	14.2	17.6	14.8
16	14.9	15.8	16.9	15.8	14	10.9	14.1	11.4	11	14.6	12.5	17.2	14.1
17	14.1	13.9	15.8	14.7	13.6	10.1	12.9	9.5	9.7	12.8	13.5	17.2	13.1
18	14.5	14.4	15.8	13.8	12.7	9.1	11.4	9.9	9.4	12.7	13.2	17.6	12.8
19	13.6	13.4	15	13.7	11.2	9.5	11.4	10.5	9.3	12.4	13.1	17.3	12.5
20	14.8	14.9	14.7	13.5	10.9	10.4	10.7	10.6	9.3	12.4	12.9	17.9	12.7
21	15.5	14.9	13.9	13.4	10.4	11	10.6	10.2	9.4	12.6	12.7	18	12.7
22	15.8	14.2	14.8	12.5	10.2	11.1	10.4	9.7	9.3	12.8	13	17.5	12.6
23	16	14.2	14.2	13.5	10.5	10.5	10.7	9.7	9.3	12.8	12.9	18	12.7
24	16.4	13	13.6	13.9	10.5	10.5	9.9	9.6	9.4	13	13.5	17.2	12.5
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Mean	16.1	15	16.3	15.9	13.4	11.6	11.8	11.2	11.3	14.4	14.3	18.4	14.1
Good hours of data:													
	695	677	741	718	743	720	744	743	720	744	720	722	
Missing hours:													
	49	19	3	2	1	0	0	1	0	0	0	22	

8,687 Hours of good data 97 Hours of missing data 98.9% Data recovery

Table B-7: Wind Speed Frequency Distribution
Ipswich, Mass.
80-m Wind Speed (m/s) **Shear Alpha = 0.18**
Period of Data Recorded: **June 1, 2003 through May 31, 2004**

Wind Speed	Meas.	Full No.	-----	Percent		:	Wind Speed	Meas.	Full No.	-----	Percent	
Range (m/s)	Hrs	Hours	Occur	Total	Above	:	Range (m/s)	Hrs	Hours	Occur	Total	Above
.0- .4	157	158.8	1.8	1.8	98.2	:	20.0-20.4	5	5.3	0.3	99.6	0.4
.5- .9	132	133.5	1.5	3.3	96.7	:	20.5-20.9	3	3.2	0.2	99.7	0.3
1.0- 1.4	139	140.6	1.6	4.9	95.1	:	21.0-21.4	3	3.2	0.2	99.7	0.3
1.5- 1.9	193	195.2	2.2	7.2	92.8	:	21.5-21.9	5	5.2	0.2	99.7	0.3
2.0- 2.4	280	283.1	3.2	10.4	89.6	:	22.0-22.4	0	0.2	0.2	99.7	0.3
2.5- 2.9	382	386.3	4.4	14.8	85.2	:	22.5-22.9	2	2.1	0.1	99.8	0.2
3.0- 3.4	501	506.6	5.8	20.6	79.4	:	23.0-23.4	2	2.1	0.1	99.8	0.2
3.5- 3.9	523	528.9	6.0	26.6	73.4	:	23.5-23.9	6	6	0	99.8	0.2
4.0- 4.4	702	709.9	8.1	34.7	65.3	:	24.0-24.4	3	3	0	99.9	0.1
4.5- 4.9	598	604.7	6.9	41.6	58.4	:	24.5-24.9	0	0	0	99.9	0.1
5.0- 5.4	779	787.7	9.0	50.6	49.4	:	25.0-25.4	0	0	0	99.9	0.1
5.5- 5.9	629	636	7.3	57.9	42.1	:	25.5-25.9	0	0	0	100	0
6.0- 6.4	604	610.8	7.0	64.9	35.1	:	26.0-26.4	0	0	0	100	0
6.5- 6.9	516	521.8	6.0	70.8	29.2	:	26.5-26.9	0	0	0	100	0
7.0- 7.4	425	429.8	4.9	75.7	24.3	:	27.0-27.4	0	0	0	100	0
7.5- 7.9	405	409.5	4.7	80.4	19.6	:	27.5-27.9	0	0	0	100	0
8.0- 8.4	297	300.3	3.4	83.8	16.2	:	28.0-28.4	0	0	0	100	0
8.5- 8.9	262	264.9	3.0	86.9	13.1	:	28.5-28.9	0	0	0	100	0
9.0- 9.4	195	197.2	2.3	89.1	10.9	:	29.0-29.4	0	0	0	100	0
9.5- 9.9	196	198.2	2.3	91.4	8.6	:	29.5-29.9	0	0	0	100	0
10.0-10.4	117	118.3	1.4	92.7	7.3	:	30.0-30.4	0	0	0	100	0
10.5-10.9	129	130.4	1.5	94.2	5.8	:	30.5-30.9	0	0	0	100	0
11.0-11.4	84	84.9	1.0	95.2	4.8	:	31.0-31.4	0	0	0	100	0
11.5-11.9	84	84.9	1.0	96.1	3.9	:	31.5-31.9	0	0	0	100	0
12.0-12.4	60	60.7	0.7	96.8	3.2	:	32.0-32.4	0	0	0	100	0
12.5-12.9	41	41.5	0.5	97.3	2.7	:	32.5-32.9	0	0	0	100	0
13.0-13.4	54	54.6	0.6	97.9	2.1	:	33.0-33.4	0	0	0	100	0
13.5-13.9	17	17.2	0.2	98.1	1.9	:	33.5-33.9	0	0	0	100	0
14.0-14.4	33	33.4	0.4	98.5	1.5	:	34.0-34.4	0	0	0	100	0
14.5-14.9	17	17.2	0.2	98.7	1.3	:	34.5-34.9	0	0	0	100	0
15.0-15.4	20	20.2	0.2	98.9	1.1	:	35.0-35.4	0	0	0	100	0
15.5-15.9	14	14.2	0.2	99.1	0.9	:	35.5-35.9	0	0	0	100	0
16.0-16.4	17	17.2	0.2	99.3	0.7	:	36.0-36.4	0	0	0	100	0
16.5-16.9	9	9.1	0.1	99.4	0.6	:	36.5-36.9	0	0	0	100	0
17.0-17.4	5	5.1	0.1	99.5	0.5	:	37.0-37.4	0	0	0	100	0
17.5-17.9	5	5.1	0.1	99.5	0.5	:	37.5-37.9	0	0	0	100	0
18.0-18.4	6	6.1	0.1	99.6	0.4	:	38.0-38.4	0	0	0	100	0
18.5-18.9	3	3	0.0	99.6	0.4	:	38.5-38.9	0	0	0	100	0
19.0-19.4	4	4	0.0	99.7	0.3	:	39.0-39.4	0	0	0	100	0
19.5-19.9	0	0	-	99.7	0.3	:	39.5-39.9	0	0	0	100	0
Totals	8634	8730.9						30.3	30.3			

8663 Hours of good data   97 Hours of missing data   98.9% Data recovery

Mean Annual Wind Speed 5.87 m/s

Table B-8. Output of GE Wind, Model 1.5 sle, 1.5-MW Wind Turbines, 60-m hub ht
Assume: Ipswich Annual Air Density = 1.225

MAJOR ASSUMPTIONS

Wind Turbine

(1) Turbine:	GE 1.5sle, 77 m dia.	
(2) Rating, kW:	1500	
(3) Baseline Air Dens: kg/m^3	1.225	
(4) Actual Site Air Density, kg/m^3	1.225	
(5) Rotor Diameter, m:	77	
(6) Rotor Swept Area, m2:	4,657	
(7) 1.5 sle Hub Height, m:	60	Shear Alpha = 0.18

Wind Speed, m/s	Proba-bility	Hrs/ Year (Avg. Year)	Sea Level Power Output, kW	Site Power Output, kW	Gross Energy Prod'n, kWh
0	Not Applic.	158.7	0	0	0
1	Not Applic.	299.3	0	0	0
2	Not Applic.	517.7	0	0	0
3	Not Applic.	1015.2	0	0	0
4	Not Applic.	1304.5	43	43	56,094
5	Not Applic.	1496.6	131	131	196,055
6	Not Applic.	1299.4	250	250	324,850
7	Not Applic.	872.6	416	416	363,002
8	Not Applic.	621.9	640	640	398,016
9	Not Applic.	417.6	924	924	385,862
10	Not Applic.	248.8	1181	1181	293,833
11	Not Applic.	184.1	1359	1359	250,192
12	Not Applic.	100.1	1436	1470	147,147
13	Not Applic.	81.9	1481	1498	122,686
14	Not Applic.	40.4	1494	1494	60,358
15	Not Applic.	33.4	1500	1500	50,100
16	Not Applic.	19.3	1500	1500	28,950
17	Not Applic.	12.2	1500	1500	18,300
18	Not Applic.	7	1500	1500	10,500
19	Not Applic.	5.1	1500	1500	7,650
20	Not Applic.	7.2	1500	1500	10,800
21	Not Applic.	6.3	1500	1500	9,450
22	Not Applic.	5.2	1500	1500	7,800
23	Not Applic.	6	1500	1500	9,000
24	Not Applic.	0	1500	1500	-
25	Not Applic.	0	1500	1500	0
26	Not Applic.	0	0	0	0
27	Not Applic.	0	0	0	0
28	Not Applic.	0	0	0	0
29	Not Applic.	0	0	0	0
30	Not Applic.	0	0	0	0
Totals or Avg.:	0	8760.5		Gross MW/Yr:	2,751
Site Efficiency Factors:				Availability:	0.97
				Wakes:	1.00
				Line Losses::	0.975
				Icing & Controls:	0.98
				Turbulence:	0.98
				Blade Contamination:	0.98
				Micrositing:	1.00
Net Efficiency Factor:					0.89
				Net MWh/Yr:	**2,448**
Net Annual Capacity Factor:					**0.186**

Table B-9. Output of GE Wind, Model 1.5 sle, 1.5-MW Wind Turbines, 80-m hub ht
Assume: Ipswich Annual Air Density = 1.225

MAJOR ASSUMPTIONS

Wind Turbine

(1) Turbine:	**GE 1.5sle, 77-m dia.**	
(2) Rating, kW:	**1,500**	
(3) Baseline Air Dens: kg/m^3	**1.225**	
(4) Actual Site Air Density, kg/m^3	**1.225**	
(5) Rotor Diameter, m:	**77**	
(6) Rotor Swept Area, m^2:	**4,656.6**	
(7) 1.5 sle Hub Height, m:	**80.0**	**Shear Alpha = 0.18**

Wind Speed, m/s	Proba- bility	Hrs/ Year (Avg. Year)	Sea Level Power Output, kW	Site Power Output, kW	Gross Energy Prod'n, kWh
0	Not Applic.	158.8	0	0.0	-
1	Not Applic.	274.1	0	0.0	-
2	Not Applic.	478.3	0	0.0	-
3	Not Applic.	892.9	0	0.0	-
4	Not Applic.	1,238.8	43.0	43.0	53,268
5	Not Applic.	1,392.4	131.0	131.0	182,404
6	Not Applic.	1,246.8	250.0	250.0	311,700
7	Not Applic.	951.6	416.0	416.0	395,866
8	Not Applic.	709.8	640.0	640.0	454,272
9	Not Applic.	462.1	924.0	924.0	426,980
10	Not Applic.	316.5	1181.0	1181.0	373,787
11	Not Applic.	215.3	1359.0	1359.0	292,593
12	Not Applic.	145.6	1436.0	1470.0	214,032
13	Not Applic.	96.1	1481.0	1498.0	143,958
14	Not Applic.	50.6	1494.0	1494.0	75,596
15	Not Applic.	37.4	1500.0	1500.0	56,100
16	Not Applic.	31.4	1500.0	1500.0	47,100
17	Not Applic.	14.2	1500.0	1500.0	21,300
18	Not Applic.	11.2	1500.0	1500.0	16,800
19	Not Applic.	7.0	1500.0	1500.0	10,500
20	Not Applic.	5.3	1500.0	1500.0	7,950
21	Not Applic.	6.4	1500.0	1500.0	9,600
22	Not Applic.	5.4	1500.0	1500.0	8,100
23	Not Applic.	4.2	1500.0	1500.0	6,300
24	Not Applic.	9.0	1500.0	1500.0	13,500
25	Not Applic.	-	1500.0	1500.0	-
26	Not Applic.	-	0	0.0	-
27	Not Applic.	-	0	0.0	-
28	Not Applic.	-	0	0.0	-
29	Not Applic.	-	0	0.0	-
30	Not Applic.	-	0	0.0	-
Totals or Avg.:	0.0000	8761.2		Gross MW/Yr:	**3,122**
Site Efficiency Factors:				Availability:	0.97
				Wakes:	1.00
				Line Losses::	0.975
				Icing & Controls	0.98
				Turbulence:	0.98
				Blade Contamination:	0.98
				Micrositing:	1.00
Net Efficiency Factor:					**0.890**
				Net MWh/Yr:	**2,779**
Net Annual Capacity Factor:					**0.211**

Table B-10. Projected Mean Net Hourly Average Output (in kW)
From GE Model 1.5 sle, 77-m diameter WTG
Mounted at 60-m hub height Shear Alpha = 0.18
Location: Ipswich, Mass.
Based on period of record: June 1, 2003 through May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	382	265	338	320	187	146	113	123	88	252	270	385	239
2	430	240	290	380	182	173	82	94	113	235	281	359	238
3	372	287	343	405	153	147	93	109	123	237	248	368	240
4	305	271	309	354	226	101	79	109	139	280	280	354	234
5	284	244	330	368	212	109	85	104	180	258	292	449	243
6	256	233	341	421	202	129	85	89	175	288	268	478	247
7	268	219	345	432	227	191	84	115	143	268	321	459	256
8	267	246	392	424	280	203	124	152	172	233	318	389	267
9	353	281	421	437	368	200	113	159	202	260	294	400	291
10	436	313	396	498	342	188	134	167	202	284	334	469	314
11	479	330	459	463	406	240	166	175	185	353	374	446	340
12	512	370	525	468	430	230	185	192	203	380	363	537	366
13	478	436	500	482	396	221	246	232	202	423	361	411	366
14	509	386	572	519	338	226	329	244	194	379	371	477	379
15	482	412	511	474	369	185	315	226	198	344	359	515	366
16	412	418	508	459	314	152	285	171	138	350	294	420	327
17	353	297	414	400	307	124	238	103	100	233	306	476	279
18	377	310	418	313	246	94	153	102	71	225	350	498	263
19	316	258	387	340	173	101	157	129	84	212	315	404	240
20	358	338	385	333	171	123	116	139	85	213	279	482	252
21	401	318	334	310	177	143	137	104	95	229	282	419	246
22	417	324	390	273	134	173	140	118	80	219	317	453	253
23	421	288	335	311	141	183	141	107	89	230	274	424	245
24	446	238	317	342	146	164	122	121	98	243	285	418	245
Mean	388	305	398	397	255	164	155	141	140	276	310	437	281
Good hours of data								Average Annual Capacity Factor:					0.187
	695	677	741	718	743	720	744	743	720	744	720	722	
Missing hours													
	49	19	3	2	1	0	0	1	0	0	0	22	

8687 Hrs of good data 97 Hrs of missing data 0.989 Data recovery

Table B-11. Projected Mean On-Peak Hourly Revenue ($) **Year: 2007**
From GE Model 1.5 sle, 77-m diameter WTG
Mounted at 60-m hub height **Shear Alpha = 0.18**
Location: Ipswich, Mass.

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0
8	466	429	685	741	490	354	217	265	301	407	555	680	5590
9	616	491	736	763	643	349	197	278	353	454	513	699	6091
10	761	546	693	870	597	329	234	292	353	496	583	819	6573
11	836	576	802	808	710	420	290	306	323	616	654	778	7118
12	894	646	917	817	750	402	323	335	354	663	635	937	7674
13	835	761	874	842	691	387	431	406	353	739	630	718	7665
14	889	674	1000	906	590	395	574	426	338	661	649	833	7935
15	842	719	892	828	644	323	551	395	346	601	627	900	7668
16	719	730	888	802	549	265	498	299	242	611	513	733	6849
17	616	519	724	699	537	217	415	179	175	407	535	831	5854
18	658	541	730	548	429	164	267	178	125	393	611	870	5514
19	552	451	675	594	303	176	275	226	147	370	551	705	5024
20	625	590	672	582	298	215	203	243	148	371	487	842	5277
21	700	555	583	541	309	250	239	181	165	399	493	732	5147
22	728	566	682	477	234	303	245	206	140	382	554	791	5308
23	736	502	585	543	246	320	246	187	156	402	479	741	5144
24	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11,476	9,297	12,137	11,362	8,019	4,868	5,202	4,402	4,018	7,974	9,069	12,610	100,433

Table B-12. Projected Mean Off-Peak Hourly Revenue ($) **Year: 2007**
From GE Model 1.5 sle, 77-m diameter WTG
Mounted at 60-m hub height **Shear Alpha = 0.18**
Location: Ipswich, Mass.

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	661	459	584	553	323	252	195	213	153	436	467	666	4962
2	745	416	502	658	315	300	142	162	196	406	487	621	4951
3	644	496	593	702	264	255	161	189	213	409	430	637	4993
4	528	468	535	612	391	175	138	189	241	485	484	612	4857
5	491	422	572	637	366	189	147	181	312	447	505	777	5045
6	443	403	590	728	349	224	147	155	303	498	464	827	5130
7	464	379	596	748	393	331	145	199	247	464	556	794	5316
8	132	121	194	210	139	100	61	75	85	115	157	192	1582
9	174	139	208	216	182	99	56	79	100	128	145	198	1724
10	215	155	196	246	169	93	66	83	100	140	165	232	1861
11	237	163	227	229	201	119	82	87	91	174	185	220	2015
12	253	183	260	231	212	114	91	95	100	188	180	265	2172
13	236	215	247	238	196	109	122	115	100	209	178	203	2170
14	252	191	283	257	167	112	162	121	96	187	184	236	2246
15	238	204	253	234	182	91	156	112	98	170	177	255	2170
16	204	207	251	227	155	75	141	85	68	173	145	208	1939
17	174	147	205	198	152	61	117	51	49	115	151	235	1657
18	186	153	207	155	121	46	75	50	35	111	173	246	1561
19	156	128	191	168	86	50	78	64	42	105	156	200	1422
20	177	167	190	165	84	61	57	69	42	105	138	238	1494
21	198	157	165	153	87	71	68	51	47	113	140	207	1457
22	206	160	193	135	66	86	69	58	40	108	157	224	1502
23	208	142	166	154	70	91	70	53	44	114	136	210	1456
24	771	413	549	592	252	284	212	210	170	420	493	723	5089
Total	7,997	6,087	7,957	8,445	4,923	3,387	2,758	2,743	2,973	5,822	6,452	9,226	68,770

Table B-13. Projected Mean Total Hourly Revenue ($) **Year: 2007**
From GE Model 1.5 sle, 77-m diameter WTG
Mounted at 60-m hub height **Shear Alpha = 0.18**
Location: Ipswich, Mass.

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	661	459	584	553	323	252	195	213	153	436	467	666	4,962
2	745	416	502	658	315	300	142	162	196	406	487	621	4,951
3	644	496	593	702	264	255	161	189	213	409	430	637	4,993
4	528	468	535	612	391	175	138	189	241	485	484	612	4,857
5	491	422	572	637	366	189	147	181	312	447	505	777	5,045
6	443	403	590	728	349	224	147	155	303	498	464	827	5,130
7	464	379	596	748	393	331	145	199	247	464	556	794	5,316
8	598	550	879	951	628	454	278	340	386	522	712	873	7,173
9	791	630	945	979	825	448	252	356	452	582	658	897	7,815
10	977	700	889	1,117	767	422	300	374	452	636	749	1,051	8,434
11	1,073	738	1,029	1,037	911	538	372	392	414	791	839	999	9,132
12	1,147	829	1,177	1,049	963	516	414	430	454	851	815	1,203	9,847
13	1,071	977	1,121	1,081	887	496	552	520	452	949	809	921	9,835
14	1,141	865	1,283	1,163	757	506	736	546	434	849	833	1,069	10,181
15	1,081	923	1,145	1,063	827	414	706	506	444	771	805	1,155	9,839
16	923	937	1,139	1,029	704	340	638	384	310	785	658	941	8,788
17	791	666	929	897	688	278	532	230	224	522	686	1,067	7,511
18	845	694	937	702	550	210	342	228	160	504	785	1,117	7,075
19	708	578	867	763	388	226	352	290	188	474	706	905	6,446
20	803	757	863	747	382	276	260	312	190	476	624	1,081	6,771
21	899	712	749	694	396	320	306	232	212	512	632	939	6,604
22	935	726	875	612	300	388	314	264	180	490	710	1,015	6,811
23	945	644	751	696	316	410	316	240	200	516	614	951	6,600
24	771	413	549	592	252	284	212	210	170	420	493	723	5,089
Total	19,473	15,383	20,094	19,807	12,942	8,255	7,960	7,145	6,991	13,796	15,521	21,836	169,204

Table B-14. Total Annual Gross Revenue From Wind Generation, $
GE Model 1.5 sle (1.5-MW WTG), on 60-m tower

Year	1	2	3	4	5	6	7	8	9	10
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
On-Peak, $	100,433	102,291	105,600	104,100	100,858	98,595	95,641	92,747	95,902	97,771
Off-Peak, $	68,770	68,307	67,462	65,854	63,762	60,962	60,078	57,655	59,721	61,077
Total, $	169,204	170,599	173,062	169,954	164,621	159,557	155,719	150,402	155,623	158,848
Year	11	12	13	14	15	16	17	18	19	20
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
On-Peak, $	99,233	101,941	102,703	106,023	110,502	113,536	116,313	119,158	122,073	125,059
Off-Peak, $	62,451	63,855	65,155	66,894	69,579	71,382	73,143	74,948	76,797	78,692
Total, $	161,684	165,797	167,858	172,917	180,081	184,918	189,456	194,106	198,870	203,751

Table B-15. Total Annual Gross Revenue From Wind Generation, $
GE Model 1.5 sle (1.5-MW WTG), on 80-m tower

Year	1	2	3	4	5	6	7	8	9	10
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
On-Peak, $	112,996	115,087	118,809	117,121	113,475	110,928	107,604	104,348	107,898	110,001
Off-Peak, $	78,133	77,606	76,646	74,820	72,443	69,261	68,257	65,504	67,851	69,392
Total, $	191,129	192,693	195,456	191,941	185,918	180,189	175,862	169,852	175,750	179,393
Year	11	12	13	14	15	16	17	18	19	20
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
On-Peak, $	111,646	114,693	115,549	119,285	124,324	127,738	130,862	134,064	137,343	140702.621
Off-Peak, $	70,953	72,549	74,025	76,000	79,052	81,100	83,101	85,151	87,252	89404.7894
Total, $	182,599	187,241	189,575	195,286	203,376	208,838	213,963	219,215	224,595	230107.41

Table B-16. Output of Vestas Model V80, 1.8-MW Wind Turbine, 60-m Hub Height

MAJOR ASSUMPTIONS

WTG **-with 105.1-dBA Power Curve**

(1) Turbine:	**Vestas V80**
(2) Rating, kW:	**1,800**
(3) Baseline Air Dens: kg/m^3	**1.225**
(4) Actual Site Air Density, kg/m^3	**1.225**
(5) Rotor Diameter, m:	**80**
(6) Rotor Swept Area, m^2:	**5,026.5**
(7)Hub Height, m	**60.00**

Shear Alpha = 0.18

Wind Speed, m/s	Proba-bility	Hrs/ Year (Avg. Year)	Sea Level Power Output, kW	Site Power Output, kW	Gross Energy Prod'n, kWh
0	Not Applic.	158.7	0	0.0	-
1	Not Applic.	299.3	0	0.0	-
2	Not Applic.	517.7	0	0.0	-
3	Not Applic.	1,015.2	0	0.0	-
4	Not Applic.	1,304.5	66.3	66.3	86,488
5	Not Applic.	1,496.6	152.0	152.0	227,483
6	Not Applic.	1,299.4	280.0	280.0	363,832
7	Not Applic.	872.6	457.0	457.0	398,778
8	Not Applic.	621.9	690.0	690.0	429,111
9	Not Applic.	417.6	978.0	978.0	408,413
10	Not Applic.	248.8	1296.0	1296.0	322,445
11	Not Applic.	184.1	1598.0	1598.0	294,192
12	Not Applic.	100.1	1710.0	1710.0	171,171
13	Not Applic.	81.9	1785.0	1770.0	144,963
14	Not Applic.	40.4	1800.0	1800.0	72,720
15	Not Applic.	33.4	1800.0	1800.0	60,120
16	Not Applic.	19.3	1800.0	1800.0	34,740
17	Not Applic.	12.2	1800.0	1800.0	21,960
18	Not Applic.	7.0	1800.0	1800.0	12,600
19	Not Applic.	5.1	1800.0	1800.0	9,180
20	Not Applic.	7.2	1800.0	1800.0	12,960
21	Not Applic.	6.3	1800.0	1800.0	11,340
22	Not Applic.	5.2	1800.0	1800.0	9,360
23	Not Applic.	6.0	1800.0	1800.0	10,800
24	Not Applic.	-	1800.0	1800.0	-
25	Not Applic.	-	1800.0	1800.0	-
26	Not Applic.	-	0	0.0	-
27	Not Applic.	-	0	0.0	-
28	Not Applic.	-	0	0.0	-
29	Not Applic.	-	0	0.0	-
30	Not Applic.	-	0	0.0	-
Totals or Avg.:		8760.5		Gross MW/Yr:	**3,103**
Site Efficiency Factors:				Availability:	0.97
				Wakes:	1.00
				Line Losses::	0.975
				Icing & Controls	0.98
				Turbulence:	0.98
				Blade Contamination:	0.98
				Micrositing:	1.00
Net Efficiency Factor:					**0.890**
				Net MWh/Yr:	**2,762**
Net Annual Capacity Factor:					**0.175**

Table B-17. Projected Mean Net Hourly Average Output (in kW)
From Vestas Model V80, 80-m diameter WTG
Mounted at 60-m hub height **Shear Alpha = 0.18**
Location: Ipswich, Mass. **Turbine Rated Power, kW: 1800**
Based on period of record: June 1, 2003 through May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	434	283	386	365	203	152	107	129	88	276	300	502	269
2	491	257	333	437	192	183	75	92	113	258	318	468	268
3	422	314	398	468	158	148	86	111	130	259	283	481	271
4	342	287	358	400	244	100	72	111	143	311	320	463	262
5	316	261	388	418	234	110	80	102	193	281	332	525	270
6	278	254	396	497	221	133	82	84	186	314	296	559	275
7	293	238	400	505	251	213	80	115	151	293	369	540	287
8	296	267	457	489	313	225	128	162	181	255	364	454	299
9	392	317	496	503	417	219	115	169	213	282	333	467	327
10	493	350	467	583	396	205	136	178	212	311	385	552	356
11	542	374	536	531	464	267	170	184	199	400	434	527	386
12	588	425	614	537	488	250	195	205	222	426	423	633	417
13	556	507	588	564	445	244	264	246	216	488	421	537	423
14	581	436	665	613	373	244	361	259	207	425	429	620	434
15	566	468	580	559	411	194	349	240	212	383	419	614	416
16	482	469	578	536	347	157	314	177	134	393	343	553	374
17	400	327	470	460	338	121	257	105	97	256	359	565	313
18	430	337	469	344	264	91	152	97	59	246	411	585	290
19	350	276	432	385	183	98	163	130	80	230	363	520	267
20	404	368	445	376	187	121	112	142	82	236	320	553	279
21	464	353	377	347	194	145	142	98	92	250	321	541	277
22	472	364	444	303	137	185	143	119	73	238	367	526	281
23	482	318	377	341	145	197	145	104	85	253	316	556	277
24	507	260	363	383	150	176	123	123	97	262	321	490	271
Mean	441	338	459	456	281	174	160	145	144	305	356	535	316
Good hours of data								**Average Annual Capacity Factor:**					**0.176**
	695	677	741	718	743	720	744	743	720	744	720	722	
Missing hours													
	49	19	3	2	1	0	0	1	0	0	0	22	

8687 Hrs of good data 97 Hrs of missing data 98.9% Data recovery

Table B-18. Output of Vestas Model V80, 1.8-MW Wind Turbine, 80-m hub Height

MAJOR ASSUMPTIONS

Wind Turbine	**-with 105.1-dBA Power Curve**	
(1) Turbine:	**Vestas V80**	
(2) Rating, kW:	**1,800**	
(3) Baseline Air Dens: kg/m^3		**1.225**
(4) Actual Site Air Density, kg/m^3		**1.225**
(5) Rotor Diameter, m:		**80**
(6) Rotor Swept Area, m^2:		**5,026.5**
(7)Hub Height, m		**80.00**

Shear Alpha = 0.18

Wind Speed, m/s	**Proba- bility**	**Hrs/ Year (Avg. Year)**	**Sea Level Power Output, kW**	**Site Power Output, kW**	**Gross Energy Prod'n, kWh**
0	Not Applic.	158.8	0	0.0	-
1	Not Applic.	274.1	0	0.0	-
2	Not Applic.	478.3	0	0.0	-
3	Not Applic.	892.9	0	0.0	-
4	Not Applic.	1,238.8	66.3	66.3	82,132
5	Not Applic.	1,392.4	152.0	152.0	211,645
6	Not Applic.	1,246.8	280.0	280.0	349,104
7	Not Applic.	951.6	457.0	457.0	434,881
8	Not Applic.	709.8	690.0	690.0	489,762
9	Not Applic.	462.1	978.0	978.0	451,934
10	Not Applic.	316.5	1296.0	1296.0	410,184
11	Not Applic.	215.3	1598.0	1598.0	344,049
12	Not Applic.	145.6	1710.0	1710.0	248,976
13	Not Applic.	96.1	1785.0	1770.0	170,097
14	Not Applic.	50.6	1800.0	1800.0	91,080
15	Not Applic.	37.4	1800.0	1800.0	67,320
16	Not Applic.	31.4	1800.0	1800.0	56,520
17	Not Applic.	14.2	1800.0	1800.0	25,560
18	Not Applic.	11.2	1800.0	1800.0	20,160
19	Not Applic.	7.0	1800.0	1800.0	12,600
20	Not Applic.	5.3	1800.0	1800.0	9,540
21	Not Applic.	6.4	1800.0	1800.0	11,520
22	Not Applic.	5.4	1800.0	1800.0	9,720
23	Not Applic.	4.2	1800.0	1800.0	7,560
24	Not Applic.	9.0	1800.0	1800.0	16,200
25	Not Applic.	-	1800.0	1800.0	-
26	Not Applic.	-	0	0.0	-
27	Not Applic.	-	0	0.0	-
28	Not Applic.	-	0	0.0	-
29	Not Applic.	-	0	0.0	-
30	Not Applic.	-	0	0.0	-
Totals or Avg.:		8761.2		Gross MW/Yr:	**3,521**
Site Efficiency Factors:				Availability:	0.97
				Wakes:	1.00
				Line Losses::	0.975
				Icing & Control	0.98
				Turbulence:	0.98
			Blade Contamination:		0.98
				Micrositing:	1.00
Net Efficiency Factor:					**0.890**
			Net MWh/Yr:		**3,134**
Net Annual Capacity Factor:					**0.199**

Table B-19. Projected Mean Net Hourly Average Output (in kW)
From Vestas Model V80, 80-m diameter WTG
Mounted at 80-m hub height **Shear Alpha = 0.18**
Location: Ipswich, Mass. **Turbine Rated Power, kW:** **1800**
Based on period of record: June 1, 2003 through May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	491	335	427	413	240	184	133	155	107	319	341	545	308
2	553	306	365	486	229	217	96	112	138	297	355	510	305
3	479	362	435	524	190	180	109	135	153	299	317	525	309
4	391	339	396	455	287	123	91	136	172	355	355	507	301
5	362	309	423	476	271	133	102	126	226	325	372	572	308
6	326	297	436	540	257	160	101	106	217	362	335	613	312
7	337	275	439	556	289	245	100	140	179	341	409	590	325
8	340	313	503	547	358	254	154	192	217	296	406	501	340
9	451	358	540	569	475	248	140	200	250	328	374	514	371
10	557	400	507	646	440	234	165	212	250	361	429	603	400
11	616	423	590	596	521	303	206	218	230	454	479	571	434
12	662	475	674	600	553	287	234	243	253	487	464	685	468
13	619	559	652	622	510	280	315	293	254	547	463	584	475
14	657	489	742	668	432	284	423	306	241	488	469	667	489
15	633	534	665	614	472	227	407	286	244	437	455	662	470
16	531	535	653	593	404	187	368	212	164	444	372	593	421
17	457	376	536	516	395	149	303	127	118	293	386	607	355
18	489	397	537	399	310	111	186	120	75	284	450	635	333
19	407	328	497	435	219	121	197	159	98	265	401	570	308
20	461	432	492	423	215	146	140	174	101	271	353	615	319
21	515	408	428	390	223	174	172	124	113	287	362	591	316
22	534	415	497	347	166	221	173	146	91	275	403	577	320
23	542	368	424	397	176	232	174	129	105	294	345	602	316
24	571	300	404	437	181	209	149	149	118	305	362	528	310
Mean	499	389	511	510	326	204	193	175	171	351	394	582	359
Good hours of data								**Average Annual Capacity Factor:**					**0.199**
	695	677	741	718	743	720	744	743	720	744	720	722	
Missing hours													
	49	19	3	2	1	0	0	1	0	0	0	22	

8687 Hrs of good data 97 Hrs of missing data 98.9% Data recovery

Table B-20. Total Annual Gross Revenue From Wind Generation, $
Vestas Model V80 (1.8 MW), 60-m hub height

Year	1	2	3	4	5	6	7	8	9	10
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
On-Peak, $	107,077	109,058	112,585	110,985	107,530	105,117	101,967	98,882	102,246	104,238
Off-Peak, $	77,283	76,763	75,813	74,006	71,655	68,508	67,515	64,792	67,114	68,637
Total, $	184,360	185,820	188,398	184,991	179,185	173,625	169,482	163,674	169,359	172,876
Year	11	12	13	14	15	16	17	18	19	20
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
On-Peak, $	105,797	108,684	109,496	113,036	117,811	121,046	124,007	127,040	130,148	133,332
Off-Peak, $	70,181	71,760	73,221	75,174	78,192	80,218	82,197	84,225	86,303	88,433
Total, $	175,978	180,444	182,717	188,210	196,003	201,264	206,204	211,266	216,451	221,764

Table B-21. Total Annual Gross Revenue From Wind Generation, $
Vestas Model V80 (1.8 MW), 80-m hub height

Year	1	2	3	4	5	6	7	8	9	10
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
On-Peak, $	$121,774	$124,026	$128,038	$126,219	$122,289	$119,545	$115,963	$112,454	$116,279	$118,545
Off-Peak, $	$87,845	$87,254	$86,174	$84,120	$81,448	$77,871	$76,742	$73,647	$76,286	$78,018
Total, $	$209,619	$211,280	$214,212	$210,339	$203,737	$197,415	$192,705	$186,101	$192,565	$196,563
Year	11	12	13	14	15	16	17	18	19	20
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
On-Peak, $	120,318	123,602	124,525	128,551	133,981	137,660	141,027	144,477	148,011	151,632
Off-Peak, $	79,773	81,567	83,227	85,448	88,879	91,181	93,431	95,736	98,098	100,519
Total, $	200,091	205,169	207,752	213,999	222,860	228,841	234,459	240,213	246,110	252,151

Table B-22. Output of Vestas Model V82, 1.65-MW Wind Turbine, 60-m hub ht

ASSUMPTIONS

Wind Turbine

(1) Turbine:	Vestas V82	
(2) Rating, kW:	1,650	
(3) Baseline Air Dens: kg/m^3		1.225
(4) Actual Site Air Density, kg/m3		1.225
(5) Rotor Diameter, m:		82
(6) Rotor Swept Area, m2:		5,281.0
(7) Hub Height, m:		60.0
(8) Wind Shear Coef., alpha		Not Appl.

Shear Alpha = 0.18

Wind Speed, m/s	Proba-bility	Hrs/ Year (Avg. Year)	Sea Level Power Output, kW	Site Power Output, kW	Gross Energy Prod'n, kWh
0	Not Applicable	158.7	0	0	-
1	Not Applicable	299.3	0	0	-
2	Not Applicable	517.7	0	0	-
3	Not Applicable	1,015.2	0	0	-
4	Not Applicable	1,304.5	28	28	36,526
5	Not Applicable	1,496.6	144	144	215,510
6	Not Applicable	1,299.4	309	309	401,515
7	Not Applicable	872.6	511	511	445,899
8	Not Applicable	621.9	758	758	471,400
9	Not Applicable	417.6	1017	1017	424,699
10	Not Applicable	248.8	1285	1285	319,708
11	Not Applicable	184.1	1504	1504	276,886
12	Not Applicable	100.1	1637	1637	163,864
13	Not Applicable	81.9	1648	1648	134,971
14	Not Applicable	40.4	1650	1650	66,660
15	Not Applicable	33.4	1650	1650	55,110
16	Not Applicable	19.3	1650	1650	31,845
17	Not Applicable	12.2	1650	1650	20,130
18	Not Applicable	7.0	1650	1650	11,550
19	Not Applicable	5.1	1650	1650	8,415
20	Not Applicable	7.2	1650	1650	11,880
21	Not Applicable	6.3	1650	1650	10,395
22	Not Applicable	5.2	1650	1650	8,580
23	Not Applicable	6.0	1650	1650	9,900
24	Not Applicable	-	1650	1650	-
25	Not Applicable	-	1650	1650	-
26	Not Applicable	-	0	0	-
27	Not Applicable	-	0	0	-
28	Not Applicable	-	0	0	-
29	Not Applicable	8,760.5	0	0	-
30	Not Applicable	-	0	0	-
Totals or Avg.:	0.0000	17521.0		Gross MW/Yr:	3,125
Site Efficiency Factors:				Availability:	0.97
				Wakes:	1.00
				Line Losses::	0.975
				Icing& Controls:	0.98
				Turbulence:	0.98
				Blade Contamination:	0.98
				Micrositing:	1.00
Net Efficiency Factor:					**0.890**
				Net MWh/Yr:	**2,782**
Net Annual Capacity Factor:					**0.192**

Table B-23. Projected Mean Net Hourly Average Output (in kW)
From Vestas Model V82, 82-m diameter WTG
Mounted at 60-m hub height **Shear Alpha = 0.18**
Location: Ipswich, Mass. **Turbine Rated Power, kW:** **1650**
Based on period of record: June 1, 2003 through May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	436	303	378	365	217	169	126	146	104	286	301	480	276
2	483	279	328	429	208	197	92	108	130	271	314	451	274
3	427	323	381	456	176	166	106	127	140	272	278	464	276
4	350	303	349	405	257	115	89	128	159	315	312	450	269
5	325	280	367	421	247	126	97	120	203	293	328	502	276
6	290	270	381	467	230	148	98	101	197	325	295	538	278
7	302	248	380	480	260	215	96	132	161	306	356	516	288
8	308	280	432	477	320	224	141	174	196	265	352	436	301
9	399	317	466	491	414	224	131	182	224	293	328	444	326
10	482	346	441	557	389	210	154	194	224	320	378	525	352
11	530	367	514	517	452	266	190	201	207	396	416	499	380
12	570	414	584	524	482	260	217	219	229	423	408	593	410
13	534	490	574	542	447	253	289	264	228	477	405	509	418
14	563	429	642	578	382	259	378	277	216	430	405	576	428
15	544	470	577	537	417	207	365	260	223	389	397	573	413
16	465	471	566	517	359	170	335	195	153	390	325	518	372
17	403	337	469	441	351	138	274	121	110	264	340	528	315
18	426	359	470	354	279	103	173	115	73	260	391	551	296
19	361	296	436	382	199	113	184	150	94	241	351	499	276
20	411	388	430	371	196	136	133	162	97	248	310	536	285
21	452	370	376	339	201	162	162	117	107	262	319	518	282
22	468	369	432	306	154	204	163	138	89	252	353	509	286
23	476	331	375	352	164	210	165	123	102	269	305	530	284
24	503	274	357	383	169	193	138	141	114	275	321	466	278
Mean	438	346	446	446	290	186	179	162	157	313	345	509	**318**
Good hours of data								**Average Annual Capacity Factor:**					**0.193**
	695	677	741	718	743	720	744	743	720	744	720	722	
Missing hours													
	49	19	3	2	1	0	0	1	0	0	0	22	

8687 Hrs of good data 97 Hrs of missing data 98.9% Data recovery

Table B-24. Output of Vestas Model V82, 1.65-MW Wind Turbine, 80-m Hub Height

MAJOR ASSUMPTIONS

Wind Turbine

(1) Turbine:	Vestas V82	
(2) Rating, kW:	1,650	
(3) Baseline Air Dens: kg/m^3		1.225
(4) Actual Site Air Density, kg/m3		1.225
(5) Rotor Diameter, m:		82
(6) Rotor Swept Area, m2:		5,281.0
(7) Hub Height, m:		80.0

Shear Alpha = 0.18

Wind Speed, m/s	Proba-bility	Hrs/ Year (Avg. Year)	Sea Level Power Output, kW	Site Power Output, kW	Gross Energy Prod'n, kWh
0	Not Applicable	158.8	0	0	-
1	Not Applicable	274.1	0	0	-
2	Not Applicable	478.3	0	0	-
3	Not Applicable	892.9	0	0	-
4	Not Applicable	1,238.8	28	28	34,686
5	Not Applicable	1,392.4	144	144	200,506
6	Not Applicable	1,246.8	309	309	385,261
7	Not Applicable	951.6	511	511	486,268
8	Not Applicable	709.8	758	758	538,028
9	Not Applicable	462.1	1017	1017	469,956
10	Not Applicable	316.5	1285	1285	406,703
11	Not Applicable	215.3	1504	1504	323,811
12	Not Applicable	145.6	1637	1637	238,347
13	Not Applicable	96.1	1648	1648	158,373
14	Not Applicable	50.6	1650	1650	83,490
15	Not Applicable	37.4	1650	1650	61,710
16	Not Applicable	31.4	1650	1650	51,810
17	Not Applicable	14.2	1650	1650	23,430
18	Not Applicable	11.2	1650	1650	18,480
19	Not Applicable	7.0	1650	1650	11,550
20	Not Applicable	5.3	1650	1650	8,745
21	Not Applicable	6.4	1650	1650	10,560
22	Not Applicable	5.4	1650	1650	8,910
23	Not Applicable	4.2	1650	1650	6,930
24	Not Applicable	9.0	1650	1650	14,850
25	Not Applicable	-	1650	1650	-
26	Not Applicable	-	0	0	-
27	Not Applicable	-	0	0	-
28	Not Applicable	-	0	0	-
29	Not Applicable	-	0	0	-
30	Not Applicable	-	0	0	-
Totals or Avg.:	0.0000	8761.2		Gross MW/Yr:	3,542
Site Efficiency Factors:				Availability:	0.97
				Wakes:	1.00
				Line Losses::	0.975
				Icing& Controls:	0.98
				Turbulence:	0.98
				Blade Contamination:	0.98
				Micrositing:	1.00
Net Efficiency Factor:					**0.890**
				Net MWh/Yr:	**3,153**
Net Annual Capacity Factor:					**0.218**

Table B-25. Projected Mean Net Hourly Average Output (in kW)
From Vestas Model V82, 82-m diameter WTG
Mounted at 80-m hub height **Shear Alpha = 0.18**
Location: Ipswich, Mass. **Turbine Rated Power, kW:** **1650**
Based on period of record: June 1, 2003 through May 31, 2004

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	435	311	370	363	227	177	136	155	111	291	303	464	279
2	478	291	321	421	217	204	102	116	139	276	311	435	276
3	426	327	368	450	184	175	116	136	146	277	276	450	278
4	355	313	342	407	266	123	98	136	166	317	307	438	272
5	329	291	356	423	251	134	106	130	209	299	326	487	278
6	298	278	373	449	236	155	105	110	203	329	294	522	279
7	306	251	369	468	262	217	105	142	168	314	350	501	288
8	312	288	419	470	322	222	148	180	206	271	348	425	301
9	403	314	448	488	415	223	140	189	230	298	325	432	325
10	477	345	425	544	383	212	164	203	231	325	373	508	349
11	527	365	501	511	446	266	199	210	211	395	406	479	376
12	563	409	566	515	479	262	229	229	232	423	396	567	406
13	522	477	563	528	450	256	302	274	235	471	395	491	414
14	558	425	630	560	388	265	388	286	222	434	392	548	425
15	535	472	580	521	421	213	375	271	226	392	382	547	411
16	452	472	560	505	366	179	345	204	163	389	314	493	370
17	405	341	471	437	360	147	284	128	116	269	325	502	315
18	427	370	474	359	287	110	184	125	80	265	380	530	299
19	367	307	439	379	209	121	195	160	102	247	342	485	279
20	411	397	421	367	199	143	144	174	104	252	304	525	287
21	444	377	376	335	203	172	173	128	115	265	318	503	284
22	466	372	426	307	164	214	173	148	97	258	343	495	289
23	472	337	373	359	175	218	174	133	110	275	296	511	286
24	498	279	352	385	178	201	146	149	121	282	321	446	280
Mean	436	350	438	440	295	192	189	172	164	317	339	491	319

Good hours of data **Average Annual Capacity Factor: 0.193**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Good hours of data	695	677	741	718	743	720	744	743	720	744	720	722
Missing hours	49	19	3	2	1	0	0	1	0	0	0	22

8687 Hrs of good data 97 Hrs of missing data 98.9% Data recovery

Table B-26. Total Annual Gross Revenue From Wind Generation, $
Vestas Model V82 (1.65 MW), 60-m hub height

Year	1	2	3	4	5	6	7	8	9	10
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
On-Peak, $	$114,427	$116,544	$120,313	$118,604	$114,911	$112,332	$108,967	$105,669	$109,264	$111,393
Off-Peak, $	$78,167	$77,640	$76,680	$74,852	$72,475	$69,291	$68,287	$65,533	$67,881	$69,422
Total, $	$192,593	$194,184	$196,993	$193,456	$187,386	$181,623	$177,254	$171,202	$177,145	$180,816
Year	11	12	13	14	15	16	17	18	19	20
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
On-Peak, $	113,059	116,145	117,012	120,795	125,898	129,355	132,519	135,761	139,082	142,484
Off-Peak, $	70,984	72,580	74,058	76,034	79,086	81,135	83,137	85,188	87,290	89,444
Total, $	184,043	188,725	191,070	196,829	204,984	210,490	215,656	220,949	226,372	231,928

Table B-27. Total Annual Gross Revenue From Wind Generation, $
Vestas Model V82 (1.65 MW), 80-m hub height

Year	1	2	3	4	5	6	7	8	9	10
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
On-Peak, $	$128,667	$131,047	$135,285	$133,363	$129,211	$126,311	$122,527	$118,819	$122,861	$125,256
Off-Peak, $	$88,902	$88,304	$87,211	$85,133	$82,429	$78,808	$77,666	$74,533	$77,204	$78,957
Total, $	$217,569	$219,350	$222,497	$218,496	$211,640	$205,119	$200,193	$193,352	$200,065	$204,212
Year	11	12	13	14	15	16	17	18	19	20
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
On-Peak, $	127,129	130,598	131,574	135,827	141,565	145,452	149,010	152,655	156,389	160,215
Off-Peak, $	80,733	82,549	84,229	86,476	89,948	92,279	94,555	96,888	99,279	101,728
Total, $	207,862	213,147	215,803	222,304	231,513	237,731	243,566	249,544	255,668	261,943

APPENDIX C: AWEA SUMMARY: THE ENERGY POLICY ACT OF 2005

The Energy Policy Act of 2005 contains a number of important provisions that will affect the wind industry. This document provides a summary of these provisions along with AWEA analysis.

Specifically, the bill:

- Extends the Production Tax Credit (PTC) for two years through December 31, 2007;
    - Allows a pass through of the PTC for agricultural cooperatives;
    - Creates a new bonding authority for renewable energy projects built by non-taxpaying entities (public power and rural electric cooperatives);
    - Clarifies the 5-year depreciation rule;
    - Contains no restrictions on wind PTC use on land or offshore;
- Provides a number of incentives to encourage construction of new and upgraded transmission lines;
- Provides FERC oversight and enforcement of mandatory non-discriminatory reliability rules;
- Repeals the Public Utility Holding Company Act (PUHCA) allowing for significant merger and acquisition potential in the electric industry;
- Repeals the Public Utility Regulatory Policies Act (PURPA) for areas that participate in ISO or RTO markets.

The full conference report can be found at the following link, and each provision described below can be found easily using the page numbers in the .PDF document.

http://energy.senate.gov/public/_files/ConferenceReport0.pdf

Renewable Energy

Sec. 201 Assessment of renewable energy resources (page 161)

What it says:

Within one year of enactment and every six months after, the Secretary of Energy shall produce a report of renewable resource potential, costs, location, and feasibility. $10 million is authorized (but not necessarily appropriated) for this purpose.

What it does:

We are generally skeptical of the many "homework assignments" in the bill. Unless this is well funded, it will likely consist of little more than assembling existing reports and maps. It is possible that such an assemblage could be a useful and authoritative reference for wind energy sites in state resource procurement proceedings, transmission planning proceedings, and the DOE transmission corridor identification.

Sec. 202 Renewable Energy Production Incentive (page 163)

What it says:

Referred to as REPI, this DOE-administered program provides a federal payment comparable in value to the PTC to non-taxpaying entities including municipalities, tribes, rural co-ops and others. The provision reauthorizes REPI until October 1, 2016

What it does:

REPI is subject to annual appropriations by Congress, meaning there is no long-term certainty regarding available funds, and over the past several years the program has been severely under-funded (average is only $4-5 million/year), resulting in an ineffective program. In response, public power advocates have sought other incentives (see tax section below).

Sec. 203 Federal Purchase Requirement (page 167)

What it says:

The President and Energy Secretary "shall seek to ensure that, to the extent economically feasible and technically practicable," the following amounts of federal electricity purchases are from renewable resources: at least 3 percent in 2007-09, at least 5 percent in 2010-2012, and at least 7.5 percent in 2013 and each year thereafter. The amount of renewable energy calculated is doubled if the energy is produced on federal land for use at a federal facility, or the energy is produced on Indian land.

What it does:

The key sentence here is "to the extent economically feasible and technically practicable;" this language could limit the effect of the provision if any Administration is looking for loopholes through which to avoid compliance with the targets.

Sec. 211 Sense of Congress regarding generation capacity of electricity from renewable resources on public lands (page 192)

What it says:

"It is the Sense of Congress that the Secretary of the Interior should, before the end of the 10-year period beginning on the date of enactment of this Act, seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts of electricity."

What it does:

A “Sense of Congress” means that the Congress believes this is an important issue or that something should be done, but the provision has no binding authority. It appears to be aimed at the Bureau of Land Management which forecasts 2,600 MW of wind development on BLM lands in 10 years and 3,200 MW in 20 years as well as significant geothermal and solar resources. It certainly doesn’t hurt to have Congress support BLM in these efforts.

Natural Gas

Sec. 311. Exportation or importation of Natural Gas (page 270)

What it says:

FERC shall have exclusive authority to approve an application for the siting, construction, expansion, or operation of an LNG terminal.

What it does:

This provision is likely to have a significant long term effect on the availability of natural gas, particularly in areas with pipeline capacity to the Gulf of Mexico. This could affect the market for wind in areas like Texas. It also provides an opportunity for LNG to relieve the strain on high gas price markets like New England where siting resistance is strong.

Access to Federal land

Sec. 368. Energy right-of-way corridors on federal land.

Within two years, USDA, DOE, the Departments of Commerce, Interior, and Defense, in consultation with FERC, Tribes, and States shall designate corridors for oil, hydrogen, gas pipelines and electric transmission in the 11 Western states. They are to develop procedures to expedite applications to develop such facilities.

Clean Power Projects

Sec. 411. Integrated Coal/Renewable Energy System. (page 489)

DOE may provide loan guarantees, subject to appropriations, for IGCC plants combined with wind and other renewable sources that sequesters carbon and provides a source of hydrogen in the Upper Great Plains.

Sec. 503. Indian energy (page 564)

Authorizes a wind and hydro study for the Missouri river basin, with wind from Tribal land and hydro from WAPA.

Research and Development

Sec 925 Electric Transmission and Distribution Programs (page 842)

What it says:

The Secretary shall establish a research program addressing various advanced transmission technologies.

What it does:

Over the long term there are many transmission technologies that could improve grid operations and bring power from distant sources with lower line losses and less need for new rights of way with their associated environmental and landowner impacts. DOE was already working on these so this provision shouldn't have major impact.

Sec. 931 Renewable Energy (page 852)

What it says:

The Secretary shall conduct programs of renewable energy research to increase its efficiency and diversify our energy supply. Specific language related to wind states that the Secretary shall establish a program of research, development, demonstration and application of low speed wind, off shore wind, testing and verification, and distributed wind generation. It authorizes $631 million in renewable energy R&D for 2007, $743 million in 2008, and $852 million in 2009.

What it does:

This provision helps move forward with the important wind research by DOE and NREL. AWEA strongly preferred this language over previously offered language that cut funding and moved it to another office with less wind-related expertise. In reality, authorizations have limited direct impact on the annual budgets at DOE and amount to little more than goals set by Congress. Each year, the President submits to Congress a budget with suggested funding levels for government programs which must then be approved by Congress through the annual appropriations process. AWEA works closely with member companies and DOE each year to ensure sufficient funds are allocated to the wind program.

"Electricity Modernization Act of 2005"

Sec 1211 Electric Reliability Standards (Pages 1080-1096)

What it says:

The provision creates an Electric Reliability Organization (ERO) to create and enforce reliability standards subject to the review of the governments of the U.S., Canada, and Mexico. FERC will oversee the ERO in the U.S. To implement the law, FERC shall issue a final rule within 180 days, or by February 2006. After FERC's rule is final, "any person" may file an application to be the ERO. The ERO must be independent yet assure fair stakeholder representation and balanced decision-making. The ERO may file proposed reliability standards with FERC which will approve them if they are “just, reasonable, not unduly discriminatory or preferential, and in the public interest.” FERC shall give due weight to the technical expertise of the ERO but shall not defer with respect to the effect on competition. The ERO is to provide some deference to proposals from a regional entity organized on an Interconnection-wide basis. The ERO may impose penalties on a user or owner or operator of the grid. The provision urges the President to negotiate international agreements with Canada and Mexico. The provision explicitly does *not* provide the ERO with authority to order the construction of new generation or transmission or to set adequacy or safety standards. States retain authority over adequacy and safety. FERC shall establish a regional advisory body of states to advise the ERO or regional entity and may give deference to this body if it is organized on an Interconnection-wide basis.

What it does:

This provision is the most significant piece of EPAct ’05 for the electric industry. Until now reliability has been voluntary and in the hands of hundreds of different parties all with strong commercial incentives that do not necessarily coincide with reliable operation. After the Northeast blackout of August 2003, pressure for mandatory standards gave many policy makers a good reason to support the energy bill.

We believe the wind industry and the rest of the electric industry will benefit by having mandatory reliability standards. No electric industry participant can afford to have one bad actor take down the grid.

There are two provisions in particular that we believe will benefit the wind industry. The first is the language that for the first time requires all reliability rules to be non-discriminatory. The language is the same as that found in the Federal Power Act and is the basis for most of FERC’s actions affecting transmission access including open access transmission tariffs and interconnection standards. Discriminatory rules are a clear and present danger for the wind industry: AWEA is concerned right now that in the generator interconnection proceeding at FERC many utilities are advocating a higher hurdle for wind than for other resources. We are engaged in discussions with NERC and FERC to resolve this issue, and we expect this new law will help AWEA in these proceedings.

The second provision that helps AWEA is the fact that FERC is given oversight authority over the ERO. FERC has been very supportive of the initiatives of wind and other new technologies in our efforts to attain fair treatment on the grid. While some of the progress at FERC is due to the leadership of former Chairman Pat Wood, we believe any strong enforcer of the Federal Power Act, including new Chairman Kelliher, will be compelled by FERC’s mission to follow a similar course. It also helps to end the divergence between market regulation by FERC and reliability regulation by NERC. EPAct 05 sets up a structure where reliability rules and market rules must be compatible. This will be helpful, for example, in the generator imbalance proceeding at FERC where reliability and economics are inextricably linked.

While the language does not identify the North American Electric Reliability Council (NERC) by name, we expect that it will be anointed as the ERO. NERC has taken the critical step of creating an independent board and this new board has proven in our view to be highly effective and independent. It is still helpful for FERC to retain some leverage over NERC through this application process.

The deference to regional organizations organized on an Interconnection-wide basis provides a good opportunity for the Western Electricity Coordinating Council (WECC), a regional reliability council with whom AWEA has worked successfully in the past on issues such as interconnection standards. The provision is a setback for smaller councils like the Southeastern Electric Reliability Council (SERC), which is also a positive in our view because some regional councils suffer from a lack of independence from the utilities they are now being asked to regulate. We are pleased with the role of Interconnection-wide organizations and state advisory bodies because they are more likely to treat wind and other resources in a nondiscriminatory manner.

Transmission Infrastructure Modernization

Sec. 1221 Siting of interstate electric transmission facilities (page 1096)

What it says:

DOE in consultation with the affected states shall conduct a study of transmission congestion and issue a report designating "national interest electric transmission corridors." This classification is based on the need for reasonably priced electricity, the need to access more supply and diversify energy sources, and effects on energy independence, national defense and homeland security.

FERC may authorize the taking of private property and issue construction permits if a state does not have authority to approve the facilities. This authority is limited to situations where the state does not have authority to consider interstate benefits, the applicant does not qualify for a state permit because it does not serve end-use customers in the state, or the state does not act on the application within one year.

For siting on federal land, DOE shall act as the lead agency for coordinating federal authorizations. DOE shall prepare a single environmental review document which shall be used as the basis for all decisions on the project. Other agencies may appeal to the President who must comply with federal environmental laws.

States may form interstate compacts establishing regional transmission siting agencies. FERC has no siting authority over states that are members of a compact unless the states disagree.

Within 90 days of enactment DOE shall issue a report designating corridors.

What it does:

This provision adds significant pressure to relieve interstate transmission bottlenecks. The primary focus is on constraints on the existing grid where cheaper power is blocked from accessing load centers. But we believe it also clearly allows for the designation of corridors between wind-rich areas and load centers even if there are no generators or congestion there currently. The criteria of energy independence and diverse supplies provide us with this opportunity to address important bottleneck facilities blocking the development of vast wind resources. AWEA's Policy Department has been in touch with the DOE transmission office on this proceeding and we have an opportunity to provide transmission maps and studies to seek designation as national interest transmission corridors which would provide encouragement for states to provide speedy siting approval. Note this provision does not help with cost allocation which is typically the more difficult challenge.

It will be helpful to have DOE in a lead role for siting over federal land and for the environmental review to use the same study. These pieces significantly increase the administrative efficiency of siting new facilities.

Sec. 1222 Third-party finance (page 1114)

What it says:

The Western Area Power Administration (WAPA) and the Southwestern Power Administration (SWPA) are authorized to construct and own on their own or with another party a transmission facility located in the WAPA and SWPA service areas if the Department of Energy determines that the proposed project is located in a national interest electric transmission corridor, will reduce transmission congestion or is needed to meet increased demand for transmission capacity, is consistent with transmission needs identified by a RTO or ISO or a regional reliability organization, will constitute efficient and reliable operation of the transmission grid, and would be operated in conformance with prudent utility practices. Outside funds will be permitted to be used for the transmission project. No more than $100 million total per year can be accepted for use between 2006 and 2015.

What it does:

It could be very helpful to have these entities more actively involved in transmission planning. WAPA in particular serves a 15-state service territory where there are significant wind resources in the West and Upper Midwest. In the West, any significant transmission plans will likely cross some federal land, and this provision along with the lead siting role for DOE will help.

Sec. 1223 Advanced transmission technologies (page 1119)

What it says:

In carrying out the Federal Power Act and the Public Utility Regulatory Policies Act, FERC shall consider advanced technologies that increase the capacity, efficiency, or reliability of an existing or new transmission facility.

What it does:

This is likely to lead to incentives for new technology deployment. In the past FERC has remained technology-neutral. When FERC has ventured into transmission incentives, it has had difficulty weighing in on technology because of its statutory limitations. However, this provision makes it the Commission’s job to encourage these new technologies. Look for this to be added to the transmission incentives rulemaking below.

Sec 1224 Advanced power system technology incentive program (page 1121).

What it says:

Authorizes DOE to create an incentive program to support the deployment of advanced fuel cell, turbine, or hybrid power systems to generate or store electric energy. Subject to the availability of funds, a payment of 1.8 cents per kWh would be paid to the owner for the first 10 million kWh produced in any fiscal year. $10 million is authorized but not necessarily appropriated for this program.

What it does:

Developers of new turbine or storage technologies should consider taking advantage of this opportunity. Its effectiveness will depend on its appropriated funding level.

Transmission Operation Improvements

Sec. 1231 Open access by unregulated transmitting utilities (page 1124)

What it says:

FERC may require open, non-discriminatory access on public power systems at comparable rates, terms, and conditions to what the utility provides for its own use of its system. The provision does not give FERC authority to require the transfer of control to an ISO, RTO, or other Transmission Organization.

What it does:

This provision, known as “FERC-lite,” is a compromise struck between public power systems who did not want to be regulated by FERC, and utilities and other proponents of open access who wanted comparable access to their systems. Most if not all public power systems already have open access tariffs on file with the Commission so this provision mainly solidifies that access.

Sec. 1232 Federal utility participation in Transmission Organizations (page 1127)

What it says:

Federal Power Marketing Agencies including the Tennessee Valley Authority (TVA) and Bonneville Power Administration (BPA) may enter into a contract, agreement, or other arrangement to transfer control to an ISO or RTO. The agreement must allow for withdrawal.

What it does:

This paves the way for BPA and TVA participation in RTOs. While their legal ability to join in the past was disputed, this provision makes it very clear that they are allowed to join and under what terms. In our view, it would benefit grid operation to have TVA join PJM and BPA join Grid West. Larger control areas and RTOs improve reliability and can more readily utilize larger amounts of a variable resource like wind.

Sec. 1233 Native load service obligation (page 1132)

What it says:

Load-serving entities are entitled to use their transmission facilities or firm transmission rights to meet their service obligation and will not be considered to have engaged in undue discrimination or preference. Most existing RTO/ISO rights allocations are grandfathered by the statement that this section does not affect allocation of transmission rights if authorized prior to January 1, 2005. Load-serving entities in CAISO may not be required to convert firm rights to financial rights. If rights have not been allocated, this provision must be "taken into account." Requires FERC to undertake a rulemaking on long-term transmission rights in organized markets.

What it does:

This provision reflects the successful lobbying efforts by large monopoly interests and negatively affects open access. The section will not generally affect PJM, NE ISO, NY ISO, MISO or CAISO. However in CAISO in particular physical rights can be held at the option of the holder and if there are rights that have not been allocated in MISO or other markets, this provision must be taken into account.

AWEA supports long term transmission rights in organized markets because such contracts help secure financable long term power contracts. We plan to participate in the FERC proceeding required by this provision.

Sec 1235. Protection of Transmission Contracts in the Pacific Northwest

What it says:

FERC has no authority to require the conversion of transmission rights to tradable or financial rights.

What it does:

It provides further protections for those who feared contract conversion in the Northwest.

Transmission Rate Reform

Sec. 1241 Transmission infrastructure investment (page 1144)

What it says:

FERC must promulgate a rule that provides incentive transmission rate treatments to promote reliability and reduced transmission congestion. The rule must be designed to

promote capital investment in transmission; provide an adequate rate of return to promote investment; encourage the deployment of transmission technologies to improve the capacity, efficiency and operation of existing transmission facilities; and allow recovery of all prudently incurred costs to comply with mandatory reliability standards and the Act's transmission siting provisions. FERC must provide incentives to each transmitting utility or electric utility that joins a Transmission Organization. FERC must ensure that these transmission incentives are recoverable by the utility.

What it does:

We expect FERC to issue a rulemaking on incentive rates that allows for higher returns for transmission investment and joining RTOs. This may help in some cases, but in many cases, higher rates create opposition to transmission investments, so adding costs through higher returns on equity can actually reduce the chances of transmission construction. We expect Chairman Kelliher to pursue his interest in performance-based regulation through this proceeding but we think this has limited potential in transmission due to a lack of objective performance metrics.

Sec. 1242 Funding new interconnection and transmission upgrades.

What it says:

The Commission may approve a participant funding plan that allocates costs related to transmission upgrades associated with new generator interconnections, whether or not the transmission company is a member of an RTO.

What it does:

Thankfully this provision changes nothing. AWEA and a large coalition of market participants actively opposed the participant funding provision in earlier versions which would have required FERC to accept such proposals. Participant funding is a disincentive to transmission investment and often results in excessive costs imposed on interconnecting generators.

Amendments to PURPA

Sec. 1251 Net metering and additional standards

Electric utilities shall make net metering service available to any electric consumer. States must complete rulemakings within three years.

Sec. 1253 Cogeneration and small power production purchase and sale requirements (page 1163)

What it says:

The Act removes the obligation on utilities to purchase from Qualifying Facilities (QFs) that have access to "competitive markets," that are not existing QFs, or that fail to meet new criteria for QF status. Competitive markets will be determined by FERC based on the existence of non-discriminatory access to what amounts to ISO/RTO markets. PURPA's obligation to sell to a qualifying facility is also repealed if FERC finds competing retail electric suppliers are willing and able to sell to the QF; and the utility is not required by state law to sell electricity in its service territory. These changes are all prospective and do not abrogate existing contracts. FERC is required to ensure that utilities can recover all prudently incurred costs associated with purchases from a QF under PURPA. The language terminates PURPA's 50 percent QF ownership limitation. FERC will undertake a rulemaking for new criteria for QF status that mainly affect cogeneration, but could affect small power production facilities.

What it does:

This is a substantial repeal of PURPA at a time when avoided costs of other resources have risen to a level to make PURPA a significant opportunity for small power production facilities. The competitive market standard is the compromise that was reached between the utilities who sought repeal and supporters of PURPA like AWEA and industrial customers. The theory is that competitive markets give such facilities an opportunity to sell their output, but where such markets do not exist, the protections of PURPA are still necessary. We expect that members of the CAISO, MISO, PJM, NYISO, ISO-NE, and SPP markets will be deemed competitive and utilities who do not participate in ISOs including all utilities in the West outside California, and in the Southeast will not pass this screen for removal of the purchase obligation.

Sec 1254 Interconnection (page 1173)

What it says:

Each electric utility shall make interconnection service for on-site generation available to any consumer the utility serves. The services shall be offered based upon IEEE Standard 1547 for Interconnecting Distributed Resources with Electric Power Systems.

Repeal of the Public Utility Holding Company Act (PUHCA)

Sections 1261-1277 (pages 1177 through 1196)

What it says:

PUHCA is repealed. Utilities must make available books and records FERC determines are appropriate for the protection of utility customers with respect to jurisdictional rates. Authority transfers from the SEC to FERC for these remaining provisions.

What it does:

Under PUHCA, utility investment in systems that were not interconnected was severely limited. As stated by Fitch Ratings, "repeal paves the way for mergers of utilities that do not operate as a single, integrated system as well as for acquisitions of utilities by companies from outside the industry." The advertised public policy benefit of this provision was to infuse needed capital into the industry; especially the transmission sector, and we hope that happens.

Market Transparency, Enforcement, and Consumer Protection

Sec. 1281. Electricity Market Transparency (page 1196)

What it says:

Directs FERC to facilitate price transparency in markets for the sale and transmission of electric energy. FERC may provide for dissemination of information about the availability and prices of wholesale electric energy and transmission. FERC may obtain any such information from any market participant.

What it does:

This provision allows FERC to improve Electric Quarterly Reports or even to establish a public database of transactions and prices. This could cause some administrative burden and raise concerns of confidentiality, but it could also provide important price information for market participants to value energy over time and across regions. The provision could also be read broadly to provide carrots and sticks for RTO participation because RTOs provide such energy and transmission information while other regions arguably warrant further transparency requirements.

Sec. 1282. False statements (page 1200)

No entity shall willingly and knowingly report to any federal agency any information relating to the price of electricity sold at wholesale or the availability of transmission capacity, which the person knew to be false at the time of reporting, with the intent to defraud.

Sec. 1283. Prohibition of energy market manipulation (page 1200)

It shall be unlawful for any entity to employ any manipulative or deceptive device or contrivance in the purchase or sale of energy or transmission capacity.

Sec 1284. Enforcement (page 1201)

FERC is given much stiffer civil and criminal penalty authority up to $1 million.

Sec. 1285. Refund effective date (page 1203)

What it says:

Refund effective date is changed from 60 days after the filing of a complaint to the date of such filing.

What it does:

Sales of energy and transmission have always been subject to refund. The 60 day delay in the effective date was a sore spot during the California energy crisis and was hard to justify in the new market environment.

Sec 1286. Refund Authority (page 1204)

FERC is given refund authority over public power entities that sell into organized markets.

Sec. 1287 Consumer privacy and unfair trade practices (page 1206)

The Federal Trade Commission may issues rules on privacy and on abusive practices such as slamming and cramming in electricity markets.

Sec. 1288 Authority of court to prohibit individuals from serving as officers, directors, and energy traders (page 1208)

Individuals may be banned from serving as officers of electricity trading firms and from trading.

Sec. 1289 Merger review reform (page 1209)

What it says:

Provides for FERC review of the sale or disposition of jurisdictional facilities. The threshold of value of the transaction is increased from $50,000 to $10 million. It extends merger review to the acquisition of generation facilities (in the past, FERC's "hook" had to be a transmission facility). Requires FERC to act on a merger within 180 days unless the agency decides it needs more time. Does not apply to mergers filed with FERC before date of enactment.

What it does:

FERC is likely to continue its recent vigilance on mergers of companies with significant amounts of generation (a few thousand MW or more) in the same geographic area. Where the two companies operate 1000 miles or more apart or where the generation controlled by either of the two companies is lower, the approval will likely be easier. We expect FERC's tried-and-true Delivered Price Test analysis to remain in place.

Sec 1298 (and 1832) Economic dispatch (page 1220 and 1712)

Section 1298 says FERC shall convene boards on a regional basis to study the issue of security constrained economic dispatch and report to Congress. Section 1832 says DOE in consultation with the States shall conduct a study on the benefits of economic dispatch and ways to better incorporate non-utility generation resources.

Energy Policy Tax Incentives

Sec. 1301 Extension and Modification of Renewable Electricity Production Tax Credit (PTC) (page 1222)

What it says:

By simply changing the PTC expiration date to December 31, 2007, the extension leaves in place the PTC's current 1.9 cent per kilowatt-hour value, the annual inflation adjustment provision, and the 10-year term to generate credits following the installation of a wind turbine. The bill does not contain any restrictions on the use of the PTC based on project location, nor does the bill place any limits on proposed off shore wind projects.

The provision includes a technical correction reaffirming that wind turbines are treated as 5-year property for purposes of depreciation. It clears up an ambiguity created by a drafting error included in the bill extending and expanding the PTC in 2004.

What it does:

This extension marks the first time the PTC has been extended before it expired, thus allowing the wind industry to move steadily forward without an every-other-year period of painful job cuts and stalled production brought on by delays in extending the credit. Passage of the PTC in August allows 29 months of steady project development activity.

To put the PTC in context, the energy tax section of the more than 1,700-page bill carries a cost of $14 billion over ten years with renewable energy incentives - at $3.1 billion - accounting for the single largest portion of that total. The coal industry would receive $2.9 billion in tax incentives. The oil & gas industry would gain $1.5 billion, with an additional $1 billion going toward natural gas distribution incentives. Energy efficiency would receive $1.3 billion and clean vehicles and fuels would gain $1.2 billion in incentives.

Sec. 1302 Application of section 45 credit to agricultural cooperatives (page 1235)

What it says:

Provides a one-time pass through of the PTC for farmer-owned cooperatives.

What it does:

This provision is similar to the ethanol producer pass-through enacted in 2004. The provision allows cooperatives (at least half the project must be owned by agriculture producers) to pass the PTC to entities who can utilize the credit effectively.

Sec. 1303 Clean renewable energy bonds. (page 1238)

What it says:

This provision establishes a new category of tax credit bonds--clean renewable energy bonds ("CREBs")—that will provide financing for capital expenditures for certain renewable resource facilities. Such bonds may be issued by units of government, municipal utilities, rural electric cooperatives, and Tribal governments.

What it does:

The total financing available under this program is $800 million. While not a large amount of money, it provides a valuable alternative to the underfunded and ineffective REPI program.

Sec. 1305 Dispositions of transmission property to implement FERC restructuring policy (page 1257)

Continues the tax relief on the sale of transmission assets which, along with the International Transmission Company's recent successful Initial Public Offering, bodes well for the development of Independent Transmission Companies.

Sec. 1308 Electric transmission property treated as 15-year property (page 1286)

What it says:

The depreciation period for high voltage transmission investments that go into service after April 11, 2005 will be shortened from 20 to 15 years.

What it does:

This is a $1.2 billion cost to the Treasury. With the focus on transmission reliability since the 2003 blackout, this provision is intended to encourage more infrastructure investment. In a sector where approximately $6 billion is invested per year, this infusion could help. Unlike the transmission incentives from FERC, the cost of this provision does not create resistance from those who pay transmission rates.

Miscellaneous

1833 Renewable energy on federal land. (page 1712)

Requires Department of Interior to contract with the National Academy of Sciences for a study on the potential for renewable energy production on federal lands including the Outer Continental Shelf and recommend statutory and regulatory mechanisms for developing those resources. A final report is to be submitted to Congress within two years after date of enactment of the bill.

APPENDIX D: ELECTRICITY COST PROJECTIONS FROM MMWEC

From: Jeanette Sypek [mailto:jsypek@mmwec.org]
Sent: Friday, September 23, 2005 10:59 AM
To: Brian Beauregard (E-mail); Brian J. Bullock (E-mail); Christopher A. Cox (E-mail); Coleen M. O'Brien-Pitts (E-mail); Daniel Golubek (E-mail); Diane Dillman (E-mail); Diane Mero (E-mail); Doris Chojnowski (E-mail); Frank Gaffney (E-mail); Gary Babin (E-mail); Gerald Tomasko (E-mail); H. Bradford White Jr. (E-mail); James M. Lavelle (E-mail); John A. MacLeod (E-mail); John Kilgo Jr. (E-mail); John Scirpoli (E-mail); John Tzimorangas (E-mail); Mark T. Kelly (E-mail); Nick Zieja (E-mail); Ralph Iaccarino (E-mail); Robert V. Jolly Jr. (E-mail); Ron Tabroff (E-mail); Savas C. Danos (E-mail); Scott Edwards (E-mail); Sean Hamilton (E-mail); Stanley Herriott (E-mail); Thomas R. Josie (E-mail); Henry, Tim; William J. Wallace (E-mail); William Waters (E-mail); Mark Magyar (E-mail); James C. Moynihan (E-mail)
Cc: John Boudreau
Subject: Projected Average LMP Impact on ISO Interchange Budgets Information

In your Bulk Power Cost Projections dated June 28, 2005, MMWEC had forecasted the average clearing prices as shown in the table below. With the current high prices in the gas and oil markets, MMWEC has revised these projections as seen below. Please keep in mind, the results from pending Hurricane Rita may cause these prices to go up even higher.

Month	June Projection ($/MWh)	Sept. Projection ($/MWh)
October	54.21	105.41
November	56.97	109.84
December	65.38	116.46

AS you can see, the LMP's have approximately doubled. This will greatly impact your monthly ISO Interchange Bills. The above pricing can be used to estimate replacement power costs for those your Select System Power contract and for the Millstone 3 planed outage in October. Please adjust your internal budgets accordingly. Current Bilateral System Power pricing is at $127 /MWh on -peak and $98 /MWh off -peak. If you would like to purchase at these rates, please let me know.

I am in the process of updating your Bulk Power Cost projections for 2006 and you will receive them sometime by the end of October 2005. In these reports, I will include summaries for November and December 2005.

If you have any questions, Please don't hesitate to call me at ext 326.

Massachusetts Municipal Wholesale Electric Company
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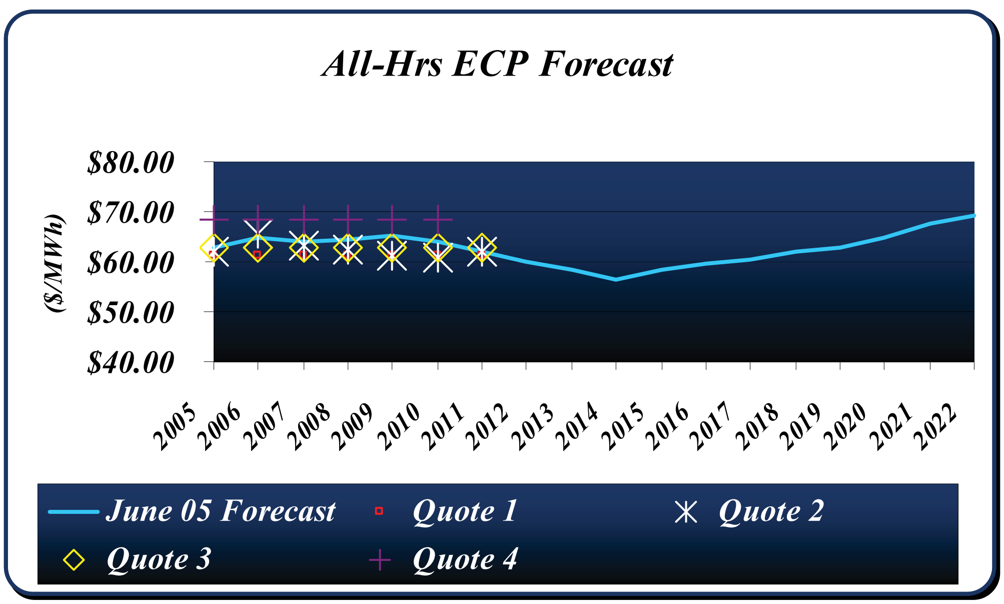
The following table shows a summary of long term power costs projected by MMWEC in their June 2005 Report delivered to Ipswich Municipal Light Department

IMLD Projected Costs for Purchase Power, $/MWh

(Note: Projections for last four years are linear average of prior six years, developed by us)

Year	1	2	3	4	5	6	7	8	9
	2007	2008	2009	2010	2011	2012	2013	2014	2015
All-Hrs	63.98	64.36	65.18	64.02	62.04	60.01	58.52	56.50	58.47
on-peak	71.80	73.12	75.49	74.42	72.10	70.48	68.37	66.30	68.56
on-peak chg,%	NA	1.85%	3.23%	-1.42%	-3.11%	-2.24%	-3.00%	-3.03%	3.40%
Off-peak	56.89	56.51	55.81	54.48	52.75	50.43	49.70	47.70	49.41
off-peak chg,%	NA	-0.67%	-1.24%	-2.38%	-3.18%	-4.39%	-1.45%	-4.03%	3.58%
Year	11	12	13	14	15	16	17	18	19
	2017	2018	2019	2020	2021	2022	2023	2024	2025
All-Hrs	60.57	62.09	62.91	64.80	67.47	69.27	70.97	72.71	74.50
on-peak	70.94	72.87	73.42	75.79	78.99	81.16	83.15	85.18	87.26
on-peak chg,%	1.50%	2.73%	0.75%	3.23%	4.22%	2.75%	2.45%	2.45%	2.45%
Off-peak	51.26	52.41	53.48	54.90	57.11	58.59	60.03	61.51	63.03
off-peak chg,%	1.44%	2.25%	2.04%	2.67%	4.02%	2.59%	2.47%	2.47%	2.47%

Charts from Excel File named "MMWEC RateInfo_Summary_June05.xls"



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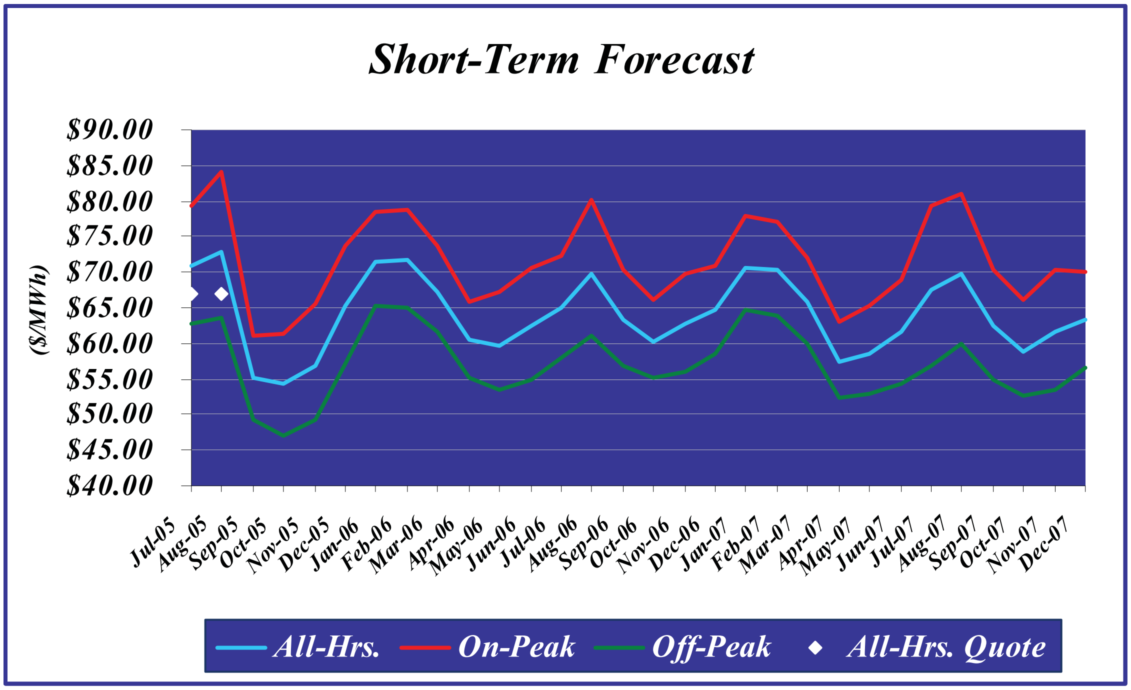

Short-Term Forecast
($/MWh)
$90.00
$85.00
$80.00
$75.00
$70.00
$65.00
$60.00
$55.00
$50.00
$45.00
$40.00
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Jan-06
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Oct-07
Nov-07
Dec-07
All-Hrs.
On-Peak
Off-Peak
All-Hrs. Quote

APPENDIX E: PRELIMINARY GEOTECHNICAL ASSESSMENT

PLEASE SEE NEXT PAGE

Weston & Sampson
ENGINEERS, INC.

MEMORANDUM

FROM: Mark Mitsch

TO: Meridian Associates

DATE: September 6, 2005

PROJECT: WSE Project #205342

SUBJECT: Preliminary Geotechnical Assessment
Proposed Ipswich Wind Turbine Project
Ipswich, Massachusetts

This memorandum summarizes our preliminary assessment of subsurface conditions, probable foundation alternatives, estimated ranges of foundation construction costs and a recommended subsurface investigation program for the subject project. This assessment was conducted in accordance with our Agreement dated August 18, 2005 and your subsequent authorization.

PROPOSED PROJECT AND SITE CONDITIONS

The Town of Ipswich has engaged the Meridian Associates team to assess the feasibility of constructing a wind turbine at the project site located at the north end of Town Farm Road in Ipswich, Massachusetts. The proposed site is an undeveloped area located in the southeast portion of a Town-owned parcel, the majority of which is currently used as a composting facility by a private contractor. The wind turbines being considered for construction at the site range from 60 meters to 80 meters in height and are capable of developing approximately 1.5 to 2.0 megawatts of electrical power.

The site selected by the Town for evaluation is the first rise to the right off the unpaved entrance drive to the composting facility. The site is approximately 1.2 acres in size and the approximate ground surface elevation at the proposed turbine site is El. 50'. The elevation at the proposed turbine site is approximately 30' higher than the surrounding grades in the immediate vicinity.

PROBABLE SUBSURFACE CONDITIONS

Weston & Sampson visited the site on Wednesday, August 24, 2005 to observe site conditions. Access to the site is by a gravel path up the south side of the hill. Vegetation on the site is primarily young pioneer species trees, brush and grasses. The general appearance of the proposed site is that of a remnant glacial drumlin feature. However, the presence of debris piles along the gravel path on top of the hill indicates that all or part of the site may have been used in the past for landfilling. A review of available geologic maps and topographic maps of the area and discussions with representatives of the Town were inconclusive relative to the presence or absence of landfilling activity. Assuming no landfilling, the subsurface conditions at the site are likely comprised of very dense heterogeneous sand, gravel, silt and clay deposits (glacial till) typical of other glacial drumlin features in the area. However, actual subsurface conditions should be confirmed by a suitable exploration program as recommended below.

TURBINE FOUNDATION ALTERNATIVES

Based upon conversations with technical representatives of two leading turbine manufacturers (Vestas and GE Power) and on publicly available information related to existing wind turbine installations, there are a number of foundation design solutions available. Two of the most common are a large spread footing design, and a proprietary shaft design developed for the Vestas turbines. Other foundation systems could include deep driven piles or drilled shafts that are connected to the tower through a structural mat.

The turbine foundation system must resist vertical loads developed by the structure weight and other factors such as ice and snow buildup. However, the primary foundation design requirements are providing sufficient uplift and overturning resistance due to the various combinations of vertical loads, aerodynamic forces on the rotor and hub, extreme wind gusts, and foundation/structural loading due to ground acceleration, velocity and frequency from design seismic conditions.

A typical spread footing for turbine tower support could have a square, circular or octagonal shape. The footing size must be sufficient to assure that the maximum allowable soil bearing capacity is not exceeded at the outside edge of the footing under the most severe design loading conditions and that the resultant of all forces remains in the middle third of the footing width under the design loading conditions. For a 60m to 80m tall tower, the likely footing width or diameter may be in the range of 50 ft. to 80 ft. or more depending on depth of embedment and site-specific loading conditions. The range in footing thickness would likely be three to four feet as required to fit sufficient reinforcing steel to transfer stresses between the outside edge and center of the footing. The depth of embedment (depth from ground surface to the bottom of footing) would likely be in the range of 8 ft. to 12 ft. depending on the design groundwater level and the weight of soil cover over the footing necessary to assure adequate uplift resistance to resist the overturning moment on the structure under design loading conditions.

The Vestas proprietary foundation “ring shaft” is a deep cast-in-place, heavily reinforced, post-tensioned ring beam. Although drawings showing details of this foundation system are available, the system is proprietary and considered confidential. Based on our understanding of the system it appears that the ring shaft design may have been developed to economize on foundation material quantities and costs. For a 60m to 80m tower the ring shaft would likely have an approximately 15 ft. outside diameter and 10 ft. inside diameter. The minimum shaft depth appears to be 30 ft. but could be deeper depending on soil and rock conditions. Ring shaft construction involves the following steps:

- make a suitably sized excavation,
- install an outer vertical corrugated metal pipe (CMP) as the outer form for the shaft,
- backfill the outer CMP with a sand cement slurry,
- position a steel embedment ring (two inches thick by 12 inches wide) at the bottom of the shaft along the inside perimeter of the outer CMP and top template ring at the top of the shaft,
- install approximately 160 vertical high strength steel anchor bolts along the perimeter of the outer CMP bolted to the embedment ring and extending through the top template ring,
- install an inner vertical CMP (inner form for the shaft),
- backfilling inside the inner CMP,
- place concrete between the inner and outer CMPs to form the shaft, and
- tension the anchor bolts.

The ring shaft provides vertical bearing, uplift and overturning resistance via self-weight, active and passive lateral earth resistance and friction/adhesion between the ring and the adjacent foundation soils.

Assuming the subsurface conditions at this site are dense naturally deposited glacial soils without significant thicknesses of man-placed fill or landfill debris present, this site appears suitable for either the spread footing or ring shaft foundation types. The choice of foundation type would then be a matter of economics.

ESTIMATED RANGE OF FOUNDATION COST

Foundation costs for either the spread footing or the ring shaft options include costs related to excavation and backfilling, dewatering and lateral earth support during construction, and the labor and materials needed to construct the foundation system.

The spread footing option is relatively straightforward to construct but requires large amounts of reinforcing steel and concrete. For instance, a 40 ft. by 40 ft. by 4 ft. thick footing requires approximately 237 cubic yards of concrete and reinforcing steel. Additional steel and concrete is necessary for the structural connection to the tower base. By comparison, a 15 ft. OD, 10 ft. ID, 30 ft. deep ring shaft requires approximately 109 cubic yards of concrete and reinforcing steel to construct. On the other hand, the deeper shaft excavation is more likely to require more sophisticated dewatering and excavation support, or perhaps rock excavation to complete. Also, the installation and tensioning of the anchor bolts is somewhat more complex and possibly more skilled-labor intensive than footing construction.

During the course of our evaluation, we received information on probable ranges of foundation costs from a number of sources, and also developed several planning level estimates on our own. Based on this information, and absent any site specific considerations that would dictate otherwise, it appears that a spread footing type design would be more economical for this project.

Based upon the spread footing design, and assuming representative local unit pricing for the work involved, we believe that $150,000 to $200,000 reflects the probable range of construction cost for the turbine foundation and we would recommend using this range for planning purposes. The Probable cost range for the "ring shaft" foundation should be $200,000 to $400,000.

RECOMMENDED SUBSURFACE EXPLORATION PROGRAM

A clear understanding of subsurface soil, rock and groundwater conditions is required to properly assess foundation requirements. Based on the anticipated size of the turbine tower and probable foundation systems, a minimum of three test borings at the site is recommended. The borings should be drilled to at least 60 ft. below ground surface, or to 15 ft. into bedrock, whichever occurs first.

Drilling should be conducted using drive-and-wash casing drilling methods with standard split-spoon sampling. Minimum 4-inch diameter steel casing should be driven using a 300-lb. hammer falling freely for 24-inches. The number of casing blows per foot should be observed and recorded for each foot of casing penetration. Standard split-spoon sampling should be conducted at 5-ft. intervals of depth with the first sample taken at ground surface. Split-spoon samples should also be obtained whenever casing advancement behavior indicates a change in soil stratum.

If refusal conditions are encountered during drilling, the boring should be continued using NX-size diamond-bit double barrel rock coring methods. Refusal is defined as less than one inch of casing penetration after 100 blows of the 300-lb. casing hammer or less than one inch of split-spoon sampler penetration after 50 blows of the 140-lb. standard split-spoon hammer. Minimum core run lengths should be five feet. Rock coring may indicate bedrock or boulders in a soil matrix. The minimum depth of coring into bedrock should be 15 ft. As noted above, the borings should be advanced to at least 60 ft. below ground surface or to 15 ft. into bedrock, whichever occurs first. In the unlikely event that the soil conditions at 60 ft. are not considered suitable for foundation support, the borings should either be continued or a decision made to abandon the site for further consideration for the wind turbine.

CLOSING

We have enjoyed participating in this interesting project and hope to continue working with you on subsequent phases of the project. Please do not hesitate to contact us if you have any questions or require additional information.

APPENDIX F: TEAM BIOS

Donald E. Bowen, Jr. PLS - Principal
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Meridian Associates, Inc. is a multi-disciplinary firm offering consulting services to corporate, commercial, industrial, institutional and public sector clients. These services encompass the complete land development process from initial site acquisition studies to final compliance certifications. As a principal at Meridian Associates, Inc., Mr. Bowen offers diversified technical and managerial skills to his clients. His experience encompasses innovative management techniques, report preparation, site evaluation and land planning. In addition to corporate responsibilities, Mr. Bowen is directly responsible for the firm's land survey operations. He has conducted numerous boundary retracement surveys, title insurance surveys, Land Court surveys, site detail/topographic surveys, as well as, performed complete construction layout for residential, commercial and industrial projects and aerial control services. Mr. Bowen has also represented clients at local, state and federal levels in many aspects of the regulatory permitting processes. He continually upgrades field and office standards associated with land boundary issues utilizing state of the art technologies.

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Mr. O'Neill has extensive experience in the consulting engineering industry, largely focused on public infrastructure and facilities. Mr. O'Neill is well versed in the management, planning, design, permitting, and construction of public infrastructure improvements including roadways, sidewalks, streetscape, traffic signals, utility systems, parks and recreational facilities, parking facilities, and site development, buildings, and building systems.

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Fred Unger has worked as an engineering consultant, strategic business planning consultant and a successful developer and builder of environmentally responsible buildings and real estate projects. As a business owner for over twenty years and as project manager for Edwards and Kelcey, one of the nation's largest engineering firms, Fred has widely varied experience in project development and project management. He has represented facility owners on very high profile projects. As a project manager on hundreds of projects, including some with diverse stakeholders with divergent agendas, he has the experience to guide projects to successful completion. Having been active in local government, Fred's experience on both sides of land use planning issues, along with his experience with the financial concerns of municipal government, bring insight to private and public projects alike. He has authored articles on green building and renewable energy and been a speaker at numerous renewable energy conferences. He serves on the Board of Directors of the Northeast Sustainable Energy Association.

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David Kopans, CPA, CMA is an experienced senior executive and advisor to publicly traded, startup, and early-stage companies. David has overseen the issuance of $40 million in Common Stock, Preferred Stock, and Convertible Secured Debentures. He holds a dual-degree BA from Brown University and a dual-degree MBA with Honors from the NYU Stern School of Business. He started his career at what is now PricewaterhouseCoopers, auditing publicly traded companies. His experience brings a level of financial sophistication often lacking in the analysis of renewable energy opportunities. Along with financial due diligence, David offers creative financial solutions, helping to craft new ideas and mechanisms that enables projects which might otherwise not be viable to succeed.

William Vachon - Wind Resource and Wind Turbine Analyst
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W. A. Vachon and Associates, Inc. (WAVA) is an engineering consulting company that specializes in wind energy project and wind turbine assessments. Since 1984, it has provided wind resource evaluations, project feasibility studies, engineering systems analysis and design, research, technical due diligence studies of wind turbines and projects, technical document reviews and financial analysis. The company focuses on understanding and assessing all technical aspects of projects that affect the pro forma - including wind turbine and project design features, production, equipment reliability/availability, warranty, the project maintenance plan and O&M costs. In addition, the company evaluates and solves problems when projects are performing at lower levels than expected. WAVA has worked for a wide variety of institutional lenders, electric utilities, developers, investors (owners), legal firms and government programs involved in wind energy. For utilities, lenders and owner, the company has often acted as Independent Engineer or Owners Engineer. Prior to establishing the company, between 1977 and 1984 William Vachon was employed as an energy consultant at Arthur D. Little, Inc. (ADL) where he headed the Systems Dynamic Unit. For 14 years prior to that Mr. Vachon was employed by the C. S. Draper Laboratory (an MIT-affiliated, teaching laboratory) as a design and measurement research engineer.

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Ed McCarthy, a Certified Consulting Meteorologist (CCM), is the principal of Edward F. McCarthy & Associates, a firm specializing in meteorological services to the wind energy industry and widely recognized as one of the leading experts in this field. Mr. McCarthy provides these services to a wide range of clients, private developers and government agencies, both nationally and internationally. His experience includes working for US Windpower, later Kenetech, Inc. for ten years from 1984-94 and as a private consultant for twelve years from 1994 to Present.

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Michael is a twenty-six year veteran in the renewable energy arena and thoroughly understands the technologies, policy issues, regulatory constraints, incentives and emerging challenges and opportunities as well as anyone in New England. Michael has served on the Board of the Northeast Sustainable Energy Association and the steering committee for the National Wind Coordinating Committee. He has testified before the US House Commerce Subcommittee on Energy and Power on renewable energy in a restructured electricity industry. Michael has extensive consulting and staff experience with: AllEnergy, Union of Concerned Scientists, NYSERDA, RIREF, MRET, CSG, and SEBANE as well as numerous universities, energy project developers, investors and others working in renewable energy. Michael has worked as a consultant to dominant REC aggregators and marketers at NEPOOL and has as much understanding as anyone in the nation on Renewable Energy Credit markets and Renewable Energy Portfolio Standards. He has been the lead author and analyst for numerous renewable energy reports and a speaker at numerous Renewable Energy Conferences. Early in his career he worked as an Application Engineer at UTC Fuel Cells. He holds a BS in Chemical Engineering and an MS in Environmental Engineering both from Rensselaer Polytechnic Institute.

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Mr. Ouimet provides expertise in the management of design and construction for engineering projects related to civil/environmental infrastructure, stormwater and surface water management, solid waste, environmental assessment and remediation, and other areas. He specializes in design-build delivery, and has expertise in a variety of project delivery methods from program management to construction management-at-risk. Mr. Ouimet has personally directed the successful completion of more than $30 million of civil/environmental projects, and he has played a critical role in the completion of dozens of other projects. His project experience ranges from small consulting assignments, such as pollution prevention audits at industrial facilities, to large integrated projects with multiple stakeholders, such as a $50 million design/build landfill closure project involving groundwater remediation; stormwater storage, conveyance and treatment; waste relocation; large scale earthwork, and engineered landfill covers.

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DeRosa Environmental Consulting, Inc., provides consulting services in the design, permitting and construction oversight for wetland restoration and replication, wildlife ponds, as well as stormwater management projects. Michael J. DeRosa, President is also a Licensed Site Professional (LSP Lic. No. 3452) under the MADEP Waste Site Cleanup Program. We have certified many vernal pools within the Commonwealth of Massachusetts and have reviewed vernal pool projects for municipalities with the Commonwealth, as well. We routinely provide consulting services to engineering firms regarding rare and endangered species investigation and mitigation and assist in the design of proposed residential and commercial development in order to ameliorate impacts to rare and endangered species habitats. We have also conducted dune restoration projects and other coastal mitigation efforts. We have filed numerous Notice of Intent (NOI) Applications under the Massachusetts Wetlands Protection Act on behalf of clients with work proposed within inland and coastal wetland resource areas.