association to protect
AMHERST ISLAND

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Engineering and Economic Risk Analysis of the Algonquin Power Company Amherst Island Wind Energy Generating System[1, 2]

EXECUTIVE SUMMARY

An engineering and economic analysis of the Amherst Island wind energy project is presented. Algonquin Power announced that the 75 MW project will generate 247 GWh per annum. This we dispute. The sound pressure level assessment of turbine noise at island homes, written by a consulting company for Algonquin Power, asserts that the project will comply with the Ontario wind turbine noise regulations. This also we dispute.

Other significant risk factors include: cost over-run associated with building on an island; the likelihood that the current rate regime will be maintained over the 20-year contract period; the omission of decommissioning costs from the project cost; mitigation measures to protect the natural and cultural heritage of the island; mitigation measures required to obtain "net benefit permits" for species at risk from the Ministry of Natural Resources; potential law-suits aimed at turbine hosts for devaluation of neighbouring property; the lack of a road-use agreement and an emergency response plan; resistance to the present ill-conceived and ill-prepared project by the community, Loyalist Township and the County of Lennox and Addington; IESO control of grid access.

The annual energy generation analysis in this report is based upon the seven-year performance of the province-wide system of wind energy generating systems and the relative wind resource from the provincial wind atlas. The most probable energy generation by the 75 MW Amherst Island project is an initial 170 GWh per annum, about two-thirds of Algonquin's projection. This generation will then decline by up to 3%/annum for a 20-year average of about half of Algonquin's projection.

[1] A copy of an earlier 2013 report, with appendices and references is available at: http://www.protectamherstisland.ca/issues/economics/

[2] While every effort has been made to verify the facts, original references are given in the 2013 report so that fact-checking can be done. One of the authors is on the mailing list of renewable energy publications and receives regular up-dates from the European and North American press. Three earlier versions of this report, following the complete 2010-2011, 2011-2012 and 2012-2013 annual IESO wind energy generation data sets, respectively, were submitted to the Directors and Management Team of Algonquin Power. These earlier versions were not challenged.

The proposed Amherst Island project has a very high spatial density, 2.5x that recommended by engineers at Harvard and John Hopkins Universities and the University of Texas. This will result in significant turbulent wake loss of power output from downwind turbines, increased turbine noise and increased mechanical stress on downwind turbine components.

The capital cost, without an allowance for decommissioning, is given as $230 million. A conservative estimate of the decommissioning cost, net of salvage, is $70 million, for a total cost of $300 million. With our prediction for the annual energy generation and the assumption of bank lending for 80% of the project cost at 5.0%, the internal rate of return is negative 4.5%. For a company with a market capitalization of $1.7 billion, to tie up $300 million of debt and equity with a negative return is a considerable burden.

Associated with the high density of the project is the close proximity of turbines to island homes. The noise assessment report, prepared by Hatch for Algonquin Power, lists 100 island homes with a predicted sound pressure level between 38.5 and 40 dBA; 40 dBA is the noise limit for wind speeds up to 6 metre/sec. We have determined instead that the sound pressure level at 28 of those homes will exceed 40 dBA. Additionally, atmospheric conditions not considered in the Hatch assessment will add to the sound pressure level (noise) at all of the receptors. Turbine noise will be non-compliant at many homes.

Shadow-flicker from the rotating blades is a further problem.   The nature of the site plan makes it inevitable that shadow-flicker will exceed European regulations and guidelines at about 50 homes on the island.

The continuing reporting of 247 GWh/year to APCo's investors and the certainty of high turbine noise and shadow flicker at homes present a moral dilemma to the Directors of Algonquin Power. Furthermore, this engineering and financial analysis raises the question of APCo's Directors' responsibility to its investors.

INTRODUCTION

This report is concerned with the proposed Algonquin Power Company (APCo) 75MW wind energy project for Amherst Island for which the Ontario Power Authority (OPA) has made a contractual offer under the renewable energy FIT-1 program. The purpose of the report is to describe to those with engineering and finance credentials the reasons that the development will result in a negative internal rate of return over the life of the contract. In addition, other risk factors are described.

In the February 25th 2011 news release announcing the contract with the Ontario Power Authority APCo stated that the project would generate 247 GWh per year. **In order to generate this energy, the project would require an annual capacity factor (average power generated divided by the nameplate power) of 38%, a capacity factor never yet achieved in Ontario.** In order to optimise the capacity factor in a marginal wind environment, APCo is planning to use so-called high-efficiency Siemens 2.3 MW turbines with 113 metre diameter blades.

In order to predict the annual capacity factor for the Amherst Island project, the annual capacity factors of all Ontario projects operating for at least one year up to the end of June 2013 have been determined. The prediction then focussed on the nearby Wolfe Island project, the comparative wind resource determined from the Ontario wind atlas and a comparison of the power output specifications for the turbines in use on Wolfe Island and those proposed for Amherst Island..

By means of justifiable estimates of revenue, borrowing costs, operating expenses, de-commissioning costs and salvage value, the internal rate of return (IRR) has been predicted.

CAPACITY FACTOR OF ONTARIO WIND GENERATING SYSTEMS

The Independent Energy System Operator (IESO) publishes hourly power generation from the major Ontario wind-energy generating systems. The annual average capacity factor for each of these systems has been collected together in Table 3 in Appendix A[3] of the 2013 APAI report[1], going back as far as 2006. The capacity factor is the primary factor in determining the viability of a wind-energy generating system. The annual average capacity factor is defined as the annual average power output of the system divided by the nameplate power.
Notably, there has never been a capacity factor of 38%. The maximum is 36%, the minimum is 24% and the average is 30%.

For the wind-energy generating systems there are variations from year to year. This is largely because the annual-average wind speed varies from year to year, as does, for instance, the annual average temperature and precipitation. In turn,

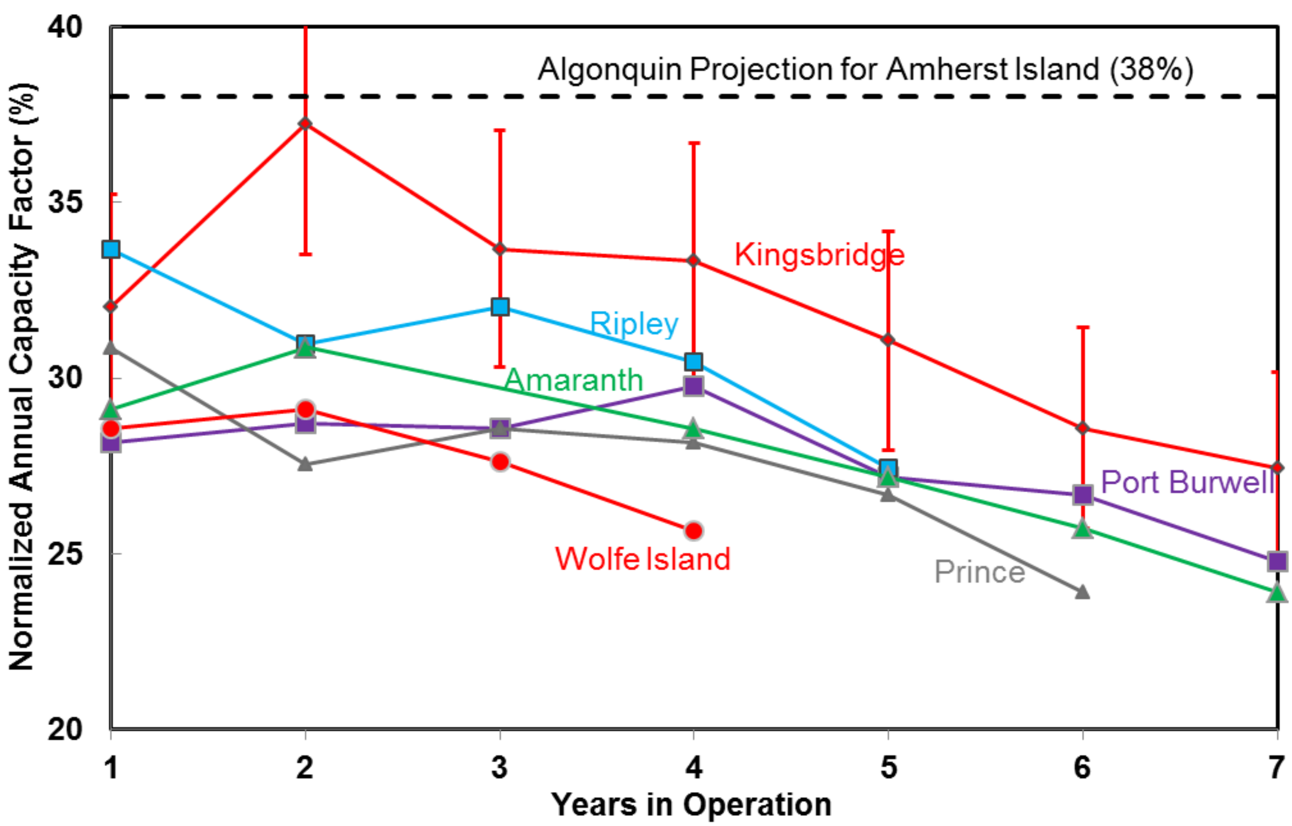
[3] All appendices refer to those in the 2013 report.

the output of a wind turbine magnifies this variation in average wind speed[4]. The capacity factors can be normalized to remove this variation, as outlined in Appendix B. Figure 1 shows the normalized capacity factor for those Ontario systems that have been in operation for 4 years or more.

Typically, these systems start within the first year or two at a capacity factor of about 30% (Kingsbridge, on the shore of Lake Huron, was an exception). Subsequently the capacity factors decline. This decline is about 1% per year or a relative decline of 3% per year. This augurs very badly for a generating system costed on the basis of a 20-year contract.

All of the analysis is based upon publically available wind energy generating system power output data provided by IESO

Figure 1: Normalized Capacity Factor for Ontario Wind Energy Generating Systems as a Function of Years of Service



Of course Ontario is not the only place with disappointing output from its wind-energy generating systems.

- The Muir report from the UK showed a 24% capacity factor for the UK system over the period November 2008 to December 2010.

[4] For a wide range of wind speed the power output varies as the cube of the wind speed.

- The New York State system, to the south of Amherst Island, had capacity factors of 19% for 2009 and 23% for 2010.
- An analysis from Europe showed that over the years 2003 to 2007 the capacity factor of the EU15 56 GW system was 21%.

This current report is not the only one to show the capacity factor declining with time. In an extensive analysis of the Danish wind energy system Paul-Frederik Bach found an average decline of just 0.3% per annum. Conversely, in his analysis of the Danish wind-energy system over the years 2004 to 2010 Wayne Gulden found an average decline of 1.5% per annum; Gulden normalized the capacity factors for the annual average wind speed. Gulden used the same technique to demonstrate that the Mars Hill installation in Maine, USA, is showing a declining capacity factor of a conservative 2.1% per annum. More recently, Hughes[5] has found, after correcting for the wind resource, that the overall UK system capacity factor declined from 24% at year 1 to 15% at year 10 to 11% at year 15. This is the same 1%/year decline that is demonstrated for the Ontario systems in Figure 1. Hughes analysis for the Danish on-shore system agrees with Bach's finding of 0.3%/year over a 15 year period. (However, he also finds that the Danish off-shore system declined at 1.7%/year over a 15 year period, from 39% at year 0 to 15% at year 10!)

One obvious problem with many wind-energy systems in Ontario is the high density of the turbines. In the words of Rolf Miller, Director of Wind Assessment at Chicago-based Acciona Windpower, turbines are being "shoe-horned in" in Ontario. The latest research from John Hopkins University recommends a separation of turbines of 15 blade diameters to avoid turbulent wake loss and hence loss of capacity factor. For a modern 2.3 MW turbine with a 90 metre blade diameter this recommendation corresponds to a density of about 0.5 turbine/ km^2. The Wolfe Island project, as an example, corresponds to 1 turbine/ km^2, twice the recommended density which goes part way to explaining its poor performance[6]. However, this is only one possible cause of poor performance and does not explain the decrease in normalized capacity factor with time.

PREDICTION OF CAPACITY FACTOR FOR AMHERST ISLAND

Amherst Island is a poor site for a wind-energy generating system because of the poor wind resource, the small area available and the increased capital expenditure required to build on an island. Helimax, a consulting company, studied possible sites in Ontario for the Ontario Power Authority and Amherst Island did not even make the list of 60 sites considered.

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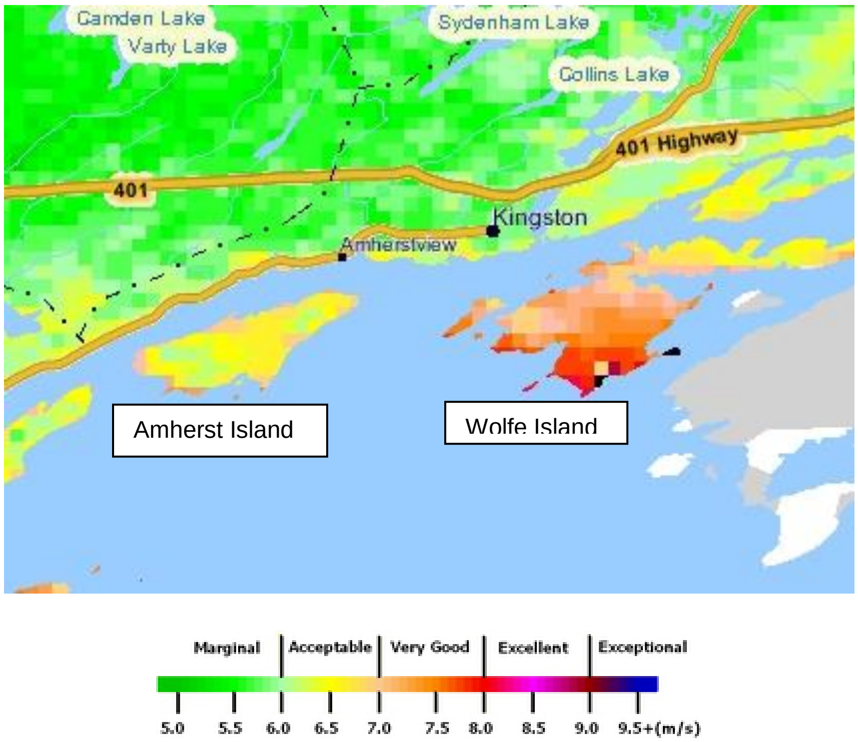
[5] Professor Gordon Hughes was a senior advisor on energy and environmental policy at the World Bank until 2001.

[6] The effect of the high density of the Wolfe Island project is quite apparent: in modest wind speeds the down-wind turbines rotate more slowly than the up-wind turbines!

A prediction for the capacity factor of a wind-energy development on Amherst Island can be made on the basis of the 4 years of operation of the nearby Wolfe Island wind-energy system. Figure 2 is extracted from The Ontario Wind Atlas, again publically available. On the right in shades of orange to red (very good wind resource) is Wolfe Island and on the left Amherst Island (acceptable wind resource). The wind speeds are those appropriate for a turbine hub height at 80 metres.

Figure 2: Ontario Wind Atlas for Eastern Lake Ontario.



For the system at the western end of Wolfe Island, the average wind speed is 7.5 metres/sec and for Amherst Island the average wind speed is 6.5 metres/sec. As discussed in Appendix B of the 2013 report the power generated by a wind turbine varies with the cube of the wind speed. Compared with a turbine on Wolfe Island the power output of a similar turbine on Amherst Island would be reduced to $(6.5/7.5)^3$ or 65%. Therefore, based upon the initial capacity factor of 28% for Wolfe Island, the expected capacity factor would be 18%, less than one half APCo's stated capacity factor.

APCo plans to improve this by using the modern generation of so-called high-efficiency turbines. In the most recent design and operation report prepared for APCo by Stantec Consulting Ltd., the Siemens 2.3 - 113 2.3 MW turbine is proposed, together with an 99.5 metre tower. With an average wind speed gradient parameter of 0.20 ± 0.05, appropriate for North America, the extra tower height will add (4.5 ± 1)% to the average wind speed, increasing it to 6.8 metres/sec This is in line with the prediction of the Ontario wind atlas.

This extra wind speed will allow a 14%[7] increase in the power output. As shown in Appendix C, the use of the Siemens 2.3 - 113 will produce a 35% increase in the power output. Putting these two together, the Siemens 2.3-113 turbine on a 99.5 metre tower will increase the capacity factor by 54%[8], from 18% to 28%.

However, as shown in Appendix D, wake loss will be a serious problem for the Amherst Island project, more serious even than for the Wolfe Island project.

A best estimate is that the initial capacity factor will be 26%.

The use of the newer turbine and the high tower will just about compensate for the poor wind resource and the high turbine density on Amherst Island, but at a cost, $3.0 million/MW versus $2.07 million/MW for Wolfe Island[9].

It is also expected that this capacity factor will decrease with time in accordance with the 1% per year decline.

APCo has stated that they have encouraging wind resource data for Amherst Island. Canadian Hydro Developers claimed similar encouraging data for Wolfe Island. The initial prediction for Wolfe Island was a capacity factor of 40%[10]. Even after 6 months of operation a spokes-person for TransAlta, the new owner of the project, claimed that the annual capacity factor would be 34%, as opposed to the actual normalized capacity factor of 28%.

In making a prediction for Amherst Island it is sensible to take the approach described above: use the by-now measured 4 years of capacity factor numbers for Wolfe Island, then compare the Ontario Wind Atlas data for the two islands and the power output specifications for the turbines in use on Wolfe Island and planned for the Amherst Island development.

FINANCIAL ANALYSIS OF THE AMHERST ISLAND PROJECT

Development Costs

APCo is estimating the capital cost to be $230 million. This reflects the high cost of the high-efficiency turbines, the cost of an underwater cable, docks on the

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[7] $1.045^3 = 1.14$

[8] $1.14 \times 1.35 = 1.54$

[9] The $2.07 million/MW was the initial estimate for the capital cost. This was increased to $2.27 million/MW after approval to build was received from the Ontario government and to $2.4 million/MW part way into construction. The increase was attributed partly to bad weather and partly to the difficulty of building on an island. A similar cost over-run will increase the APCo development to $3.6 million/MW.

[10] Ian Baines, the initial developer, in a talk given to SWITCH (a green energy promotion organization) in Kingston, Ontario.

mainland and island, and the difficulty of building on an island with poor infrastructure.

Decommissioning Costs

The Ministry of the Environment requires that all renewable energy projects be decommissioned at the end of the contract period. Mr. Sean Fairfield, Senior Manager, Algonquin Power, has written a letter dated April 8th, 2013 to Loyalist Township to assure the Township that Windlectric will cover the full cost of decommissioning the Amherst Island wind project[11]. More recently he has been giving assurances that salvage value will cover the cost of decommissioning. This assurance is not justified and is patently untrue.

Mr. John Foster, after project completion, estimated that the capital cost of the Wolfe Island wind project was equally divided between the cost of the turbines and ancillary equipment and the cost of the on-site construction. The Amherst Island wind project is also an island project and therefore it is reasonable to put the cost of construction at $100 million or more. Decommissioning is the mirror image of commissioning or on-site construction. Therefore, the cost of decommissioning could also be about $100 million or more.

More recently, Clark Consulting Services Ltd. has produced an economic study of the Algonquin Power Amherst Island project. The pre-build cost of construction is estimated to be $75 million. To be conservative, this lower figure is used for the decommissioning cost.

The salvage value of the project is estimated to be $6.3 million, as justified in Appendix E. Therefore the net cost of decommissioning will be about $70 million.[12]

Financial Carrying Costs

Investment banks will normally lend up to 80% of the capital cost at an interest rate of 5% to 8% (current rates) over a 10-year term. An October 2012 report from TD Securities announced that the cost of capital for Algonquin Power was 7.2%. In May 2014 the renewable energy manager at a major Canadian bank stated that his bank had recently funded a low-risk wind project at 5.0%[13]. In the analysis to follow, the 5.0% rate has been assumed. In view of what is happening in Europe, rates could be higher and loan terms shorter in the future. In the light of recent rules set by the Basel Committee on Banking Supervision, long-term financing is being regulated out of business.

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[11] To quote: “The project developer (Windlectric Inc. – a subsidiary of Algonquin Power Co.) is responsible (not the landowners) for all financial issues (including safety and decommissioning costs) regarding the proposed construction and operation.”

[12] There are reports of significantly lower estimates for decommissioning. However, this is an island project with nowhere to dispose of concrete, rock fill, turbine blades and much else. Even recyclable material will need to be removed from turbine sites and barged to the mainland and on to recycling centres.

[13] Private conversation; Bank of Canada rate (1.8%) + risk (2.0%) + ``swap`` (1.2%).

Operations and Maintenance Costs
Estimating the cost of operations and maintenance (O & M) is difficult: there is virtually no experience of operating industrial wind turbines beyond 10 years. As a result, robust operational data remain relatively scarce. The International Energy Agency puts O & M costs in the range $10 to $30/MWh. Taking an average of $20/MWh and an assumed 26% capacity factor adds $46,000/MW per annum. A recent major report, the Wind Energy Operations and Maintenance Report, puts the cost of operation and maintenance at US$27/MWh, at the top end of the IEA estimate. In addition, major maintenance has been found to be very expensive. For example, gearboxes expected to fail after 20 years are failing after 7 or 8 years; blade surfaces deteriorate and interior cracks appear; crane costs are US$0.25 million per in and out.

There is the additional cost of benefit to landowners ($5,000/MW per annum), cost of insurance ($3000/MW per annum) and municipal taxes and benefit payments ($7000/MW per annum), all estimates.

Anticipated Revenues
Based on an initial FIT tariff of $135/MWh[14] various revenue projections can be made depending on the capacity factor. For example, at a 26% capacity factor the annual revenue is $310,000/MW. At the suggested APCo capacity factor of 38%, the annual revenue could be $450,000/MW.

Return on Investment
A sensitivity analysis was conducted to determine the range of outcomes from different cost and revenue possibilities based on assumptions concerning the capacity factor. The standard financial model for judging the viability of a project is the combination of net present value (NPV) and internal rate of return (IRR). This has been done for the variables considered above. The depreciation has been assumed aggressive to avoid tax payments over the term of the debt financing. The corporate tax rate has been set at 27%. Conservatively, we have used debt financing of 5.0% and an O & M cost of $20/MWh. The benchmark rate of return has been set at 7.5%.

The conclusion of the analysis is that with realistic parameters for a wind energy generating system on Amherst Island and conservative costs and expenses there will not be any return for investors. In fact, even without allowing for the by-now well demonstrated capacity factor decline of 1%/year, the internal rate of return is estimated to be zero. Factoring in the annual capacity factor decline, which now

[14] The initial FIT is $135/MWh with an inflation factor; the inflation factor is 20% of the consumer price index and starts one year from the start of operation. As this factor accounts for inflation it has not been built into the analysis. Note however, that a FIT of $255/MWh is required for the project to be viable.

appears to be well-founded, the internal rate of return is estimated to be negative 4.5%.

In order to receive an IRR of 7.5% under the optimistic finance rate of 5.0% and an O & M cost of $20/MWh, and the predicted long-term 20% average capacity factor would require a feed-in-tariff of $255/MWh. This is not going to happen. Alternately, the total cost, including the net decommissioning cost, would have to be reduced to $145 million; again this is impossible.

Table 1: Net Present Value and Internal Rate of Return

Three Annual Capacity Factor (CF) Scenarios			
	APAI Year-One Scenario: 26% CF	APAI Long-Term Scenario: 20% CF	APCo Scenario: 38% CF
Optimistic Costs: 5.0% Loan Rate; $20/MWh O&M; Investor Cost: $60 million			
NPV (Equity)	**($100,000,000)**	**($145,000,000)**	**($23,000,000)**
IRR (Equity)	**-0.5%**	**- 4.5%**	**5.5%**

NB: The NPV (Equity) and IRR (Equity) refer to return to the equity holders for the levered case with 80% bank financing. The NPV in Table 1 is relative to a benchmark return of 7.5%. Numbers in brackets are negative.

TURBINE NOISE

The Ontario Ministry of the Environment has set a sound pressure level limit of 40 dBA for turbine noise at a non-participating receptor (home). Projects are approved on the basis of the prediction of noise at receptors by means of ISO 9613-2, a protocol designed by the International Standards Organization. Inputs to the prediction include the sound power level of the turbine, reflection and absorption of sound by the ground through a ground parameter, and absorption of sound by the atmosphere. In turn, ISO 9613-2 is based upon the International Electrotechnical Commission standard IEC 61400-11.

Turbine manufacturers measure the sound power of their turbine and, as any engineer will comprehend, assign an uncertainty to the measurement. For example, the sound power level may be $L_{average}$ = 105 dBA and the uncertainty σ = 1.5 dBA. The IEC standard then specifies that the declared sound power level is $L_d = L_{average} + 1.645\sigma$, or 107.5 dBA in this example.

On behalf of Algonquin Power, Hatch Engineering has made the noise predictions with the measured sound power level and not the declared sound power level of the turbines. Hatch has done this because in the past all acoustics consultants have done the same and the Ministry of the Environment has allowed them to do so. However, the Chatham-Kent Environmental Review Tribunal left no doubt that 40 dBA is the real noise limit and actual turbine noise may not exceed this level.

APAI has reviewed the Hatch noise assessment report, part of the final Renewable Energy Approval document submitted by Algonquin Power to the Ministry of the Environment in January 2014. With no other change apart from the use of the declared sound power level rather than the measured sound power level, APAI finds that turbine noise at 28 homes will exceed 40 dBA[15].

Things are worse:

- As noted above, the proposed site plan has the turbines packed with a high density. Most of the turbines will be turning in the turbulent wake of an up-wind turbine. This enhances turbine noise, particularly at low frequency, as well as decreasing power output and adding stress.
- At night-time, particularly in the summer, the wind-speed gradient can be large. This can enhance turbine noise by 5 dBA.

Both of these impacts are understandable: In turbulent air and in a wind-speed gradient the angle of attack of the blade relative to the flowing air is continuously varying with no possibility of optimizing the angle of attack.

On May 11th 2012, Ms. Doris Dumais, Director of Environmental Assessment Access, wrote to APAI concerning turbine noise compliance. An extract reads as follows:

"The Ministry has a variety of tools in its current compliance strategy to ensure that wind farms operate in compliance with approvals. This includes options of voluntary abatement, or mandatory abatements by way of issuing an order if the company is not voluntarily complying. Abatement conditions may vary from site to site and can include continued noise monitoring, implementation of a noise reduction plan or the shutting down of turbines."

SUMMARY OF RISK FACTORS

In addition to numerous adverse environmental impacts, health effects and socio-economic factors associated with this project, the key risk factors for investors and Directors are:

- the initial capacity factor likely to be achieved (not 38%, more likely 26%) and the observed decline in capacity factor over time;
- the initial cost of development;

[15] For a full account of the APAI response to the Hatch noise assessment report, see: http://www.protectamherstisland.ca/wp-content/uploads/2013/07/Final-APAI-Noise-Response-with-Appendices-A-B.pdf

- the cost of the commitment required by the Ontario government and accepted by Algonquin Power to decommission the project;
- cost over-run due to the uncertain difficulties of building on an island;
- the cost of O&M over a 20-year period;
- the likelihood that the current rate regime will be maintained (unlikely given the current Ontario fiscal situation and the precedents set in Europe);
- The possibility that mitigation measures will be necessary to obtain "net benefit" permits from the Ministry of Natural Resources during the bird migratory season, through the winter in proximity to the owl woods and during the breeding season for grassland species-at-risk;
- the cost of replacement bobolink habitat;[16]
- the moral obligation to satisfy internationally accepted standards for shadow flicker, so far ignored by APCo (see Appendix H); presently 48 homes are out of compliance with the European standard for shadow flicker – this project would not go ahead if it was in Europe[17];
- the certainty that turbine noise will be out of compliance at a number of non-participating receptors;
- the problem with ice throw, so far ignored by APCo (see Appendix G);
- the inability of APCo to produce a road use agreement that is acceptable to the community and the municipality;
- potential lawsuits aimed at land-owners hosting turbines, for devaluation of neighbouring property;
- the risk of a turbine fire on an island with a dry micro-climate, a volunteer fire service and limited fire-fighting equipment. APCo has not produced an emergency services plan, a communication plan, or a traffic management plan;
- to date, APCo does not have permits to construct docks on the mainland or on the island, or to lay down the underwater cable.
- statements by both Loyalist Township and the County of Lennox and Addington that APCo was premature in submitting its Renewable Energy Approval documents.

CONCLUSION

This report demonstrates the high probability that the proposed wind energy generating system on Amherst Island cannot be financially viable. The predicted internal rate of return (IRR) is negative 4.5% and the net present value, relative to a benchmark 7.5% IRR, is negative $145 million. The reasons include:

- from the experience of other wind energy generating systems in Ontario it is estimated that, even with modern turbines, an Amherst Island system

[16] The Kingston Field Naturalists, in their submission to EBR 011-9446, estimate that 1000 hectares will need to be set aside (purchased or leased) and maintained for the life of the contract.

[17] http://www.protectamherstisland.ca/issues/noise-and-shadow-flicker/

would have an initial capacity factor of about 26%, well below the claim of 38% by APCo;
- a capacity factor decrease of up to 1% per annum as the system ages suggests that the long term capacity factor will be 20% or below;
- the available land area is less than half that required to avoid turbulent wake loss.

Analysis of the turbine sound power level specifications, enhanced sound emission from operation in turbulent air and night-time wind speed gradients, sound propagation through the atmosphere and by ground reflection demonstrate that turbine noise at many homes will be non-compliant with the provincial 40 dBA limit.

There are significant risk factors associated with the project including the high initial development and decommissioning costs, the prospect of cost over-run, the uncertainty of long-term operation and maintenance, the continuity of the generous feed-in-tariff program, the potential mitigation measures needed to protect species-at-risk.

It is a heavy burden for a company with a market capitalization of $1.7 billion to tie up $300 million, equity and debt, for 20 years for a negative rate of return. To the present authors the continuing pursuit of the project appears to be a classic example of a company mesmerized by sunk costs and peer pressure.

Finally, it remains a mystery why Algonquin Power would commit $300 million to a 75 MW wind energy project on an island with a marginal wind resource when Algonquin itself and other companies are buying operating projects of far greater value. To give two recent news reports as examples:
- The 150 MW Elk River Wind Farm in Kansas was built in 2005 for $200 million and has achieved a capacity factor of 42%.[18]
- The 300 MW $600 million Blackspring Ridge Wind Project was dedicated a few days ago. It is in Vulcan County in high-wind-resource southern Alberta.[19]

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Acknowledgments

The assistance from colleagues with a professional background in finance is very much appreciated.

[18] http://www.forbes.com/sites/jamesconca/2014/07/19/wind-turbines-could-rule-tornado-alley/
[19] http://www.edf-en.ca/press-display/post/74/EDF-EN-Canada-and-Enbridge-Dedicate-the-300-megawa