

Evaluation of Opportunities and Barriers to Wind Power Exports from the Maritime Provinces to the US Northeast

Prepared for:

Canadian Wind Energy Association

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Market Analysis Outline

- Executive Summary
- Introduction and Purpose of the Project
- Wind Potential in the Maritimes
- Demand for Renewable Energy in New England
- Estimate of the Value of Wind Energy in New England
- Analysis of Market for Exports
- Review of Key Market Barriers
- Conclusions

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Introduction

- Canadian Wind Energy Association (CanWEA) engaged Power Advisory to analyze the market for wind power exports from Canada's Maritime Provinces to the U.S. Northeast.
- The RFP for this project identified two fundamental questions:
  1) What is the export and import potential for wind energy between the Maritime Provinces and the US Northeast; and
  2) What are the key market issues that will drive these imports and exports?
- Briefly, the answers to these two questions are
  1) Current total export potential for wind power is limited to 1,000 MW because of transmission limitations (and capacity is lower than that if the lines are being used for non-wind power transactions). The total potential for trade is much greater than that; a rough estimate is that New England will need about 2,500 MW of wind power by 2020 (assuming conservatively that other renewable resources provide over 50% of the region's requirements for renewable energy), and the Maritime Provinces could supply a significant fraction of that if the physical system were upgraded to allow it.
  2) The key market issues driving demand in New England are the amounts of renewable energy required and the rules setting out what suppliers are eligible to meet the requirements. From the viewpoint of the Maritime Provinces, the key market issues are access to transmission, both its physical availability and its cost; prices paid in New England for both energy and the environmental attributes of the wind power; the rules and administration needed to participate in the electricity markets; and the ability of the system operators to integrate cost-effectively the wind power.
- This report presents the analysis leading to these answers.

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Methodology

- The research and analysis performed for this project into the markets or market fundamentals in the Maritime Provinces and New England was supplemented by available studies and a survey of CanWEA members in the Atlantic Caucus.
  - ✓ A CanWEA Steering Committee for the study provided feedback on and some confirmation of Power Advisory's assumptions used for the quantitative analyses.
  - ✓ Power Advisory used its standard financial model to assess the financial viability of wind projects in the Maritime Provinces.
- For this study Power Advisory surveyed all members of the Atlantic Caucus of CanWEA and conducted followed up by interviews with key members and with representatives of other important institutions like governments and system operators. These surveys and interviews told us how developers view the New England market for renewables, what they see as barriers to enhancing trade with New England, and some feedback on suggestions for addressing the barriers.

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Wind power potential in the Maritime Provinces

- The wind resource in the Maritime Provinces can support significant amounts of wind power development. A study by a Danish consultant concluded that 5,500 to 7,500 MW of wind could be economic in the Maritime Provinces. That is greater than the peak load in the region.
- The current system can integrate about 2,100 MW without transmission upgrades.
  - ✓ New Brunswick could integrate up to 1,500 MW (although under some configurations even that amount will require upgrades) and Nova Scotia about 600 MW (although it would have to rely on New Brunswick for some balancing services for about 24 hours a year.)
  - ✓ Because of its variability, integrating wind power requires having resources that can be used to balance the system – that is, ensure that supply and demand are evenly matched at all times – when the output of the wind resources varies. Balancing resources are limited, and additional balancing requirements impose additional costs.
- Integrating much more wind power than these amounts would require some, or all, of several measures:
  - ✓ Upgrades of transmission within and between the provinces;
  - ✓ Increased transmission capacity for exports of wind power from the Maritime Provinces; and
  - ✓ Better coordination between system operators in the Maritime Provinces and neighboring jurisdictions.

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The renewable energy market in New England

- Demand for renewable energy in New England is driven by the renewable portfolio standards (RPS) in each state. The RPS requires that a certain (and growing) fraction of total electricity supplied to consumers come from renewable resources.
- It is expected that local sources in New England will not be sufficient to meet the needs of all the state RPS programs. All but one RPS program use a tradeable certificate (called a renewable energy certificate, or REC) representing the environmental characteristics of the renewable energy.
- Wind power from the Maritime Provinces can qualify to provide RECs if the power is also delivered. One seller from the Maritime Provinces already does so.
- The value in New England of wind power from the Maritime Provinces is the sum of its REC value and its value in the New England electricity market.
  - The ceiling for the value of RECs is set by the alternative compliance payment, the amount that an electricity supplier must pay if it does not have enough RECs. Power Advisory estimated that the total value in the New England market of wind power from the Maritime Provinces at such times would be about US$113 per MWh in 2010.
  - The floor for the value of RECs is the cost of the New England renewable generation needed to meet the RPS. Power Advisory estimated that the value in the New England market if there are sufficient RECs is about US$98 per MWh in 2010 (low cost estimate).

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The market for exports from the Maritime Provinces

- The physical aspects of exports from the Maritime Provinces are
  - ✓ Wind power exports from any of the Maritime Provinces must go through New Brunswick.
  - ✓ If not originating in New Brunswick, the exports pay two transmission tariffs, one in the province of origin and one in New Brunswick. This is referred to as rate pancaking.
  - ✓ Physical transfer capacity from New Brunswick to New England is limited and is almost entirely occupied through long-term reservations. However, capacity is often available on a short-term (daily) basis.
  - ✓ Power can also be wheeled through Québec to New England, but the additional transmission tariff typically makes such sales uneconomic.
  - ✓ Proposed transmission projects in New England could increase the transfer capacity.
- The commercial aspects of exports from the Maritime Provinces are
  - ✓ The preferred mode of commercial access is through a marketer or agent.
    - Buyers will need a bundled product, best handled by an agent.
    - Participation, scheduling and settlement in the New Brunswick and New England markets are complex and require specialized expertise and continuous trading operations to minimize imbalance penalties.
  - ✓ Given the nature of the market, sellers of renewable energy from the Maritime Provinces will have to bear some contract risks.
    - The risk for the price differentials between a New England pricing hub and the border point of injection into the ISO-NE system.
    - Most buyers are generally prevented by regulation from contracting for longer than three years, so the sellers have some price risk beyond the end of the contract. (These rules are being relaxed for purchases of renewable energy, but so far only for those from in-state resources.)

Key market barriers

- The most commonly cited barriers to electricity exports from the Maritime Provinces relate to transmission:
  - ✓ Capacity is limited on the existing interties and most of it is tied up under long-term transmission rights reservations.
  - ✓ Transmission tariffs are high, especially when exporting from Nova Scotia or PEI.
  - ✓ Access to transmission requires market participation, which is costly and complex.
- Other barriers relate to risk:
  - ✓ Risk of changes in the rules allowing generators in the Maritime Provinces to access New England markets for both energy and RECs.
  - ✓ Contracting risk, including price risks and the inability to find buyers willing to offer reasonable contract terms for sales of 10 years or greater.
- Some developers noted that Canadian projects that are exporting power are not eligible for ecoEnergy incentives while renewable generation in the United States does get incentives from the government.

Recommendations: Transmission barriers

- System operators should pursue further opportunities for integration and coordination of their systems to allow increased electricity interchanges with the existing physical system or with relatively inexpensive upgrades.
- Additional transmission could be built to enable additional wind generation for export to ISO-NE. The cost/value analysis suggests that ISO-NE market prices need to increase to support this transmission investment unless the costs of these facilities are going to be shared with (borne by) other customers based on the broader societal benefits of wind generation. Potential exporters from the Maritime Provinces should commission or support studies to show that the overall benefits of importing wind power are greater than the cost of associated transmission upgrades.
  - ✓ A long-term perspective is needed when evaluating the benefits of these transmission system investments. In particular, there is a meaningful risk of higher energy prices when the economy rebounds. Furthermore, New England has an increasing demand for renewable and low-carbon generation.
- Eliminate rate pancaking by adopting uniform transmission tariffs in all the Maritime Provinces or in some other way.

Recommendations: Market barriers

- The market needs one or more entities who can be an aggregator which will take on the role(s) of agent or marketer for wind project developers seeking to sell to New England. This entity would, for a fee, be responsible for all the administration and coordination of the required transactions in the markets. The entity could be private or a government-related entity, such as a Crown corporation.
  - ✓ While there are currently parties that provide this service on a fee for service basis, wind power developers appear to lack information regarding the terms and pricing for such a service. This along with uncertainty and lack of information regarding the New England market represents a barrier to smaller developers considering and ultimately pursuing such sales. As such, one possibility is for an entity such as NB Power Genco to provide this service under a formal tariff or posted rate.
- Work within existing intergovernmental structures, such as the New England Governors/Eastern Canadian Premiers group, to identify uncertainties and barriers that governments can address, such as uncertainty about the rules and the limited duration of power purchase agreements available from New England buyers.
- Promote the importance to both the Maritime Provinces and New England of a stable market and a stable relationship allowing the economic use of Maritime Provinces resources to meet needs in New England.

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CanWEA engaged Power Advisory to analyze the market for wind power exports from Canada's Maritime Provinces to the U.S. Northeast

- Given that New England is directly connected with the Maritimes through two interties with New Brunswick; can also be accessed through Québec; and there are proposals for direct transmission connections between New England and Nova Scotia, the focus of this evaluation is the electricity market operated by the Independent System Operator – New England (ISO-NE) and the renewable portfolio standards administered by the various New England states.
- The Canadian Wind Energy Association RFP which was issued for this project identified two fundamental questions: (1) What is the export and import potential for wind energy between the Maritime Provinces and the US Northeast; and (2) what are the key market issues that will drive these imports and exports?
- This report presents Power Advisory's analysis of this export opportunity, the renewable energy policies that establish the demand for this wind generation, and the barriers to the realization of the opportunity offered.
- This Report has an Executive Summary and seven chapters, the first of which is this Introduction. The second chapter draws on existing literature to estimate the economic potential for wind power in the Maritime Provinces. Chapter 3 analyzes the demand for renewable energy in New England, seen as an important market for wind power exports from the Maritime Provinces. The next chapter estimates the value of wind energy in New England. Chapter 5 analyzes the market for wind power exports along three lines: physical access for wind energy from the Maritime Provinces to New England; access to the New England market to sell environmental attributes of the wind energy and the major commercial terms available from buyers in New England. The next chapter provides an assessment of market barriers, drawing on a survey of and interviews with members of the CanWEA Atlantic Caucus and other important players. Finally, Chapter 7 contains some conclusions and general recommendations.

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Renewable energy from Eastern Canada has been identified as a potential supply for New England's renewable energy requirements.

- In its *2008 Regional Electricity Outlook*, ISO-NE noted: "To inform policymakers about their options for meeting RPS standards, a review of the current and possible renewable resources in New England is first necessary. Beyond this, an assessment of the potential resources located in eastern Canada and available for export will be needed. Next, an economic analysis must be conducted of these resources to evaluate their cost of development, the amount of electricity they would produce, and their value in reducing carbon or meeting state RPSs. The ISO also must address issues associated with connecting to the grid and dispatching these resources, which often run intermittently." (p. 14)
- ISO-NE also noted that "New England and Canada have a longstanding electricity trading relationship, and New England has been an importer of Canadian electricity for decades. It is logical for the two regions to explore greater electricity trade. New England's growing requirements for renewable and non-carbon emitting resources are well aligned with the new wind, hydro, and nuclear resources in various stages of development in eastern Canada. But because a comprehensive approach for developing generation resources likely will require long-term agreements between sellers in Canada and buyers in New England, policymakers and regulators need to assess the potential costs and benefits of such arrangements for consumers." (p. 14.)
- Based on this interest, CanWEA's assessment is timely.

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Recent studies provided the basis for the assessment of wind potential in the Maritime Provinces.

- This assessment draws on four recent studies:
  1. The NBSO study "The Electric Power System in New Brunswick: A Discussion Paper on Potential Generation and Transmission Developments", prepared for the New Brunswick Department of Energy, published in December 2008[1]. (Referred to as "Discussion Paper".)
  2. The EA Energy Analyses report "Large Scale Wind Power in New Brunswick: A Regional Scenario Study Towards 2023" (dated August, 2008) done for the NBSO and the New Brunswick Department of Energy[2]. (Referred to as "EA Report".)
  3. The "Nova Scotia Wind Integration Study" completed by Hatch Energy for the Nova Scotia Department of Energy, published in 2008[3].
  4. The New Brunswick System Operator's (NBSO) Wind Power Integration Study, published in 2007[4]. (Referred to as "Wind Integration Study".)
- The EA Study drew on an analysis from Yves Gagnon of the University of Moncton[5].

1. New Brunswick System Operator, The Electric Power System in New Brunswick: A Discussion Paper on Potential Generation and Transmission Developments", December 2007, www.nbso.ca/Public/_private/NBSO%20Discussion%20Paper%20Final%20Pre-release%20Dec%2012,%2020.pdf
2. EA Energy Analyses, "Large Scale Wind Power in New Brunswick: A regional Scenario Study Towards 2023", August 2008, www.nbso.ca/public/_private/Summary%20report%20-%20Final%20August%202008.pdf
3. Hatch Energy, "Nova Scotia Wind Integration Study," 2008, www.gov.ns.ca/energy/resources/EM/Wind/NS-Wind-Integration-Study-FINAL.pdf
4. New Brunswick System Operator, Wind Power Integration Study, May 2007, www.nbso.ca/Public/en/docs-EN/Notices/NBSO%20Wind%20Study%20Project%20Final%20Summary%20Report%20May%202007.pdf)
5. Yves Gagnon, "Market For Wind Power in New Brunswick", NBSO 2008Energy Conference, May 2008, www.nbso.ca//Public/en/docs-EN/Presentations/Day%202/7%20%20%20%20YVES%20GAGNON%20(Community%20Wind%20Power%20in%20New%20Brunswick).pdf)"

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The EA Report assumed potential wind resources in the Maritime Provinces of 16,500 MW.

- The major assumptions of the EA Report included:
  - ✓ Each Maritime Province has a wind power potential of 500 MW at a 40% capacity factor, 500 MW at 38% capacity factor, etc., up to a total potential for each province of 5,500 MW. The EA study considered these to be conservative estimates of potential, given that the study by Yves Gagnon cited total potential wind power of 41,000 MW for the Maritime Provinces.
  - ✓ Electricity demand for the region as a whole (including the Maritime Provinces and New England) will grow at 1.3% per year from 2010 to 2025, for a total increase over that period of 25%. Growth is forecast to be slightly faster in New England than in the Maritime Provinces.
  - ✓ No new coal plants can be sited in New England; there is limited refurbishment of existing coal-fired generation plants. But from 2015 to 2025, 5% of the thermal generation is retired every year.
  - ✓ There are 3,600 MW of new nuclear plants in New England.
  - ✓ Existing and planned CO_2 regulation is followed and future regulation develops along current trends.
  - ✓ Fuel price assumptions are given in the table below. Essentially, they assume a continuation of prices seen in the first months of 2008. An alternate case of $60/bbl and equivalent gas prices was also run.

EA Fuel Price Assumptions			
Year	Oil (US%/bbl)	Gas (US$/Mbtu)	Coal (US$/ton)
2008	123	12.4	91
2015	116	11.1	86
2025	123	11.6	90

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The EA Report used an economic model to determine how much of the wind power potential was economic under its assumptions.

- The EA Report said that construction costs for wind turbines are likely to be lower in the Maritime Provinces than in New England.
  - The Maritime Provinces have good wind resources in relatively flat and open locations, where construction is easier. The resources in New England tend to be located on ridges, which have higher access costs because they are more remote and also present harder environments for construction.
- The EA Report analyzed four scenarios on the intensity of promotion of wind power investment.
- Under its most ambitious scenario (called the pro-active scenario), the Report concluded that 5,500-7,500 MW of wind could be economic in the Maritime Provinces.
  - ✓ The EA Report found that this amount of wind can be economic under both its reference scenario and at the alternate US Energy Information Agency (EIA) forecast of $60 per barrel.
  - ✓ In the pro-active scenario, the total output (New England and Maritime Provinces) of CO_2 does not reach its caps, because wind power is so much cheaper than fossil resources that it becomes the preferred energy source and delivers 18% of the energy in New England.
  - ✓ In the alternative fossil fuel price case, the economics of the wind generation rely more heavily on carbon taxes or renewable energy credits than they do at the higher oil price.

The EA report found that integrating the 5,500 – 7,500 MW of economic wind power would require major changes to the electricity supply system.

- The EA report recognizes that only a limited part of the total of 5,500-7,500 MW of wind power can be integrated into the Maritime Provinces system and exported to the United States without major change in several areas.
  - ✓ EA pointed out that installing that much wind power will require a firm commitment at the political and operating level in all of the relevant jurisdictions: all of the Maritime Provinces, New England, and Québec.
    - "In order to maximise the value of wind power in the electricity market and to provide balancing power at reasonable costs, a high level of cooperation between the markets in the Maritimes Area and the neighbouring systems of New England and Québec is essential."
    - "The integration of large amount of wind power in the Maritimes is not possible without a close cooperation with the neighbouring systems on balancing, market rules, utilization of interconnections and the establishing of new transmission lines."
  - ✓ This study's economic analysis showed that it would be economic to build new transmission to New England to integrate more wind power in the Maritime Provinces.
- Power Advisory believes that the EA study is valuable in pointing out that large-scale integration of wind power in the Maritime Provinces cannot occur without major changes in all electricity systems in the region. These changes would include "Improving the integration of the electricity markets in the Maritimes and the neighbouring systems of New England and Quebec…"

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The NBSO's Wind Integration Study focused on the costs of integrating intermittent capacity.

- The NBSO is responsible for dispatch of generation in New Brunswick and Northern Maine and for operation of the New Brunswick transmission system. It is the reliability coordinator for the entire Maritimes region and for Northern Maine.
  - ✓ Northern Maine is connected to New England only through New Brunswick.
- The NBSO considered the cost of integrating about 1,000-1,500 MW of wind power into the Maritimes control area (including Northern Maine) by 2016, equal to 16-24% of the forecast peak load.
- According to the NBSO the increased amount of wind, its intermittency and its low forecastability create additional costs for schedule balancing, regulation capacity, load following capacity, and load following unit commitment and dispatch.
- These costs rise as the amount of wind to be integrated rises because more (and more expensive) resources must be used to provide these ancillary services.
- The total costs of integrating wind power in the NBSO system would be
  - ✓ $4.36/MWh for 400 MW of wind,
  - ✓ $4.71/MWh for 600 MW of wind and
  - ✓ $7.36/MWh for 800 MW of wind.
  - ✓ The largest component of these costs is for hour to hour schedule balancing. It was computed as $3.41 per MWh with 400 MW of wind power integrated into the system, $3.45 with 600 MW of wind, and $5.95 for 800 MW of wind.
  - ✓ These costs are compared to the mandatory Open Access Transmission Tariff costs of $3.33 per MWh at a 100% capacity factor (or about $8.88 per MWh at a 37.5% capacity factor).

Integration costs for variable generators can be high.

- NBSO also compared the additional ancillary services costs to the total cost of wind generation, which it calculated at $80 per MWh, so the additional ancillary services costs could add more than 5% to the total cost of wind power.
- The NBSO observed in the Wind Integration Study that these costs could be reduced by:
  - ✓ Enlarging the size of the market, making the amount to be integrated smaller as a fraction of the whole.
  - ✓ More geographic diversity of wind generation, making the total amount of wind power available less uncertain.
  - ✓ Better wind power forecasting and better coordination between the NBSO and ISO-NE as has happened recently with moving to half-hourly intertie scheduling.
- The NBSO imposed charges on intermittent generation to cover these additional costs.
- However, more recently the NBSO has moved to mitigate the impact of these charges.
  - ✓ In its most recent tariff, the NBSO has a charge of only $0.25 per MWh for intermittent generation, to be effective on April 1, 2009.
  - ✓ Further, if the intermittent generator can arrange for dynamic scheduling with a customer outside of New Brunswick, these additional balancing charges do not apply.
    - Dynamic scheduling is discussed further on the next page.
  - ✓ The NBSO also offers to aggregate the results of all intermittent generators and charge them imbalance charges only for the aggregate, giving them the benefit of their diversity.

The NBSO Discussion Paper considered methods of improving grid integration and looked at several scenarios of increased generation.

- In the Discussion Paper, the NBSO considered the possibilities of obtaining regulating energy from neighboring utilities when there was not sufficient regulating energy in New Brunswick.
  - ✓ Balancing wind energy would be greatly facilitated by a dynamic scheduling agreement. Under such an agreement, the export scheduled from a generator, such as a wind farm, varies with the generator output. This can transfer all or part of the balancing responsibility to the recipient of the wind energy. Such an agreement with ISO-NE would help to balance the wind energy.
  - ✓ A balancing agreement with Hydro Québec could either be simply to provide balancing energy or, if the wind energy is being exported to Québec, could be a dynamic scheduling agreement.
- To accommodate the additional wind energy, the NBSO also said that it would need new control strategies, such as the ability to curtail the output of wind farms.
- The NBSO Discussion Paper looked at seven scenarios, including one or two new nuclear units, a new gas-fired generator at Canaport, injection of hydroelectric power from the Lower Churchill Project in Labrador, various levels of large-scale wind generation in New Brunswick and additional large-scale wind generation in PEI and Nova Scotia.
- The Discussion Paper considered whether the existing transmission system is adequate to integrate the additional supply.
  - ✓ Unlike the EA study, the NBSO did not assume that transmission internal to New Brunswick would be adequate for any scenario of wind generation.

The NBSO Discussion Paper analyzed a range of scenarios of potential generation additions to the Maritime Provinces electricity supply system.

- The Discussion Paper analyzed three cases for wind power in New Brunswick: 1,500 MW, 3,000 MW and 4,500 MW. The analysis was in terms of transmission system adequacy. To consider transmission system adequacy, the NBSO must also consider the impact on generation, both the generation used for load following and system balancing (impacted by the variability of wind) and the generation that would be displaced by increased energy from wind power.
  - ✓ The NBSO found that the internal transmission system may need to be reinforced in order to integrate 1,500 MW of wind. Under some system conditions, the operation of some generating stations would become problematic. At full wind output in light load periods, if flows on the New Brunswick-New England intertie are restricted, wind power generation may have to be curtailed.
  - ✓ The integration of 3,000 MW of wind would require major reinforcement of the New Brunswick transmission system.
  - ✓ Accommodating more than 1,500 MW of wind should be coordinated with transmission reinforcements to New England or it would cause widespread generation curtailment in New Brunswick.
  - ✓ For more than 3,000 MW of wind, there would have to be corresponding increases to the interface capacity with New England. Adding that much wind generation in New Brunswick could also require further strengthening of the New Brunswick internal transmission system.
  - ✓ A level of 1,000 – 2,000 MW of wind power is the most cost-effective in terms of balancing and regulation. Higher levels of wind power would create periods when almost all other generation would need to be shut down, but operating reserves would still need to be available.

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The Discussion Paper analyzed the conditions for adding more wind in PEI

- For PEI, the Discussion Paper analyzed a scenario of 500 MW of wind power capacity on the Island.
- PEI has historically imported electricity at all times to serve its load of 100-220 MW. Only backup generation was located on the Island until the recent advent of wind farms.
- With 500 MW of wind power on the Island, PEI would become an energy exporter, probably for at least one-third of the time. The exports would be as much as 400 MW if all the wind generation was running at a time of low load.
- The existing interconnection between New Brunswick and PEI can export 124 MW, which could be upgraded to 200 MW without new transmission lines.
  - ✓ PEI's largest electric utility, Maritime Electric Company Limited (MECL), is exploring upgrades needed to allow exports of up to 400 MW.
- The NBSO study raised several issues created by such a change in PEI:
  - ✓ From an energy balancing perspective, wind generation in PEI is the same as wind generation in New Brunswick. Since the system's balancing capacity is limited, every MW of wind power imported from PEI reduces by 1 MW the amount of New Brunswick wind power that can be balanced.
  - ✓ Because its load is small and because it has always been an importer, PEI has not had to balance its own load and has not had responsibility for supply reliability. If it becomes a large generator, it will require closer coordination between MECL and NBSO.
  - ✓ Variability in wind power output from PEI would be felt directly on the New Brunswick-New England interface. To maintain stability, NBSO would have to reduce exports to New England at some times, creating a cost that PEI wind generators would have to bear.

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The Discussion Paper analyzed the conditions for adding more wind in Nova Scotia

- The NBSO drew on the Hatch study for Nova Scotia.
- The Hatch study was performed in the context of determining whether the Nova Scotia wind resource and the electricity system integration capacity would support sufficient wind to meet the province's renewable energy standard (RES) of 5% of energy from new renewable sources by 2010 and 10% by 2013. The Hatch study was also asked to look beyond the 2013 standard to determine whether additional resources are available and could be integrated.
  - ✓ The Hatch study concluded that the RES could be met with 311 MW of wind power capacity in 2010 and 581 MW of wind power capacity in 2013 and that…
  - ✓ Nova Scotia can use its own generation resources for balancing and load following for all but about 24 hours per year.
- Beyond 2013, the province has wind resources which could continue to 781 and 981 MW of wind power.
  - ✓ But integrating such resources would require more detailed study of the high voltage transmission system and gaining additional operating experience with increased wind power penetration in Nova Scotia.
  - ✓ Depending on the location within the province of the wind generation, it could also require a new 345kV transmission line.
- The incremental cost of the wind generation (over a base case where total wind capacity in the province is fixed at its present level of 61 MW) is about $10 million in 2010 and $25 million in 2020 for the 311 MW case. For the 581 MW case, the total cost is about $18 million in 2013, when the capacity is first installed, but by 2020 there is no significant difference in total cost relative to the base case.

Adding wind power in Nova Scotia can have implications for New Brunswick

- The NBSO Discussion Paper noted some issues for NBSO of any move towards 1,000 MW of wind power in Nova Scotia:
  - ✓ Variability in wind power output from Nova Scotia would be felt directly on the New Brunswick-New England interface. To maintain stability, NBSO would have to reduce exports to New England at some times.
  - ✓ For the 24 hours a year that Nova Scotia cannot rely on its own resources for balancing, it will have to draw on New Brunswick resources. There should be discussions between Nova Scotia Power Inc. (NSPI) and NBSO to determine the cost of these resources and responsibility for the costs.
  - ✓ Increasing the interchange between Nova Scotia and New Brunswick requires further study and could result in a need for transmission upgrades.

Existing transfer limits from New Brunswick constrain the ability to export the output of large-scale wind farms.

- The table below shows the interconnection transfer capability between New Brunswick and all of the neighboring systems.
- Two transmission lines from New Brunswick to New England terminate in Orrington, Maine (near Bangor) and carry the 1,000 MW to New England. From Orrington, the current limit on transfers south is 1,200 MW. If all generation in the Bangor area is operating at a time of low demand in Bangor, the flow south can be constrained to below 500 MW, which would reduce the ability to transfer wind energy from New Brunswick into southern or central New England markets.

	Interconnection Transfer Capability Between New Brunswick and Neighbors	
Neighboring System	Transfer Capability from New Brunswick (MW)	Transfer Capability to New Brunswick (MW)
Quebéc	1,000	720
New England (Orrington, ME)	550	1000
Nova Scotia	350	300
PEI	124	222
Northern Maine	90	100
Eastern Maine	15	15

Source: NBSO Discussion Paper

Notes:

Transfer capability from New England varies with system conditions

Transfer capability to and from Nova Scotia is constrained by Nova Scotia system.

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Conclusions on wind power potential in the Maritime Provinces

- The Maritime Provinces have sufficient wind resources to generate a large amount of economic wind power.
- The present physical system in New Brunswick can integrate up to about 1,500 MW of wind power but would require some internal upgrades under some conditions.
- The present physical system in Nova Scotia can integrate almost 600 MW of wind power, but it would have to rely on balancing from New Brunswick for about 24 hours a year.
- Integrating wind power in PEI requires balancing entirely from another province.
- Further integration of large-scale wind power in the Maritime Provinces will require some, or all, of several measures:
  - ✓ Upgrades of transmission within and between the provinces;
  - ✓ Increased transmission capacity for exports of wind power from the Maritime Provinces for amounts of wind power beyond its capacity to absorb; and
  - ✓ Better coordination between system operators in the Maritime Provinces and its neighbors.

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Renewable Portfolio Standards (RPS) are the primary policy used in the New England states to promote the development of renewable energy

- Each of the New England states has an RPS. An RPS requires electric utilities and other retail electric providers to meet a specified minimum percentage (or absolute amount) of customer load with eligible sources of renewable electricity.
- These RPS call for the development of about 12 TWh of renewable energy by 2015, requiring about 2,000 MW of renewable energy capacity.
  - ✓ This capacity estimate assumes that 60% of the capacity has a capacity factor of 34% (assumed to be reflective of wind) and 40% has a capacity factor of 80% (aggregate of all other renewable energy resources).
- While the structure of each of the state's RPS varies for the most part, there are many similar elements. (Rhode Island's and New Hampshire's are closely patterned after Massachusetts'.)
  - ✓ One area where the RPS appear to be very similar which is critical to the effective functioning of an integrated New England market is with respect to the Alternative Compliance Payments (ACPs) that load serving entities incur if they don't hold sufficient RECs to cover their retail load obligation.
    - As the name implies, load serving entities are the parties responsible for serving end-users. In New England this includes local distribution companies (LDCs), who generally have responsibility for supplying power to customers that don't elect a competitive supplier, and retailers. In the New England states that have competitive retail markets, LDCs continue to serve the majority of load, with competitive retailers and marketers having the highest market share serving large customers.
- While Vermont's RPS isn't mandatory unless the state's utilities fail to meet the renewable energy target by 2012, it can be considered to be binding given that if electric utilities fail to meet it then it does become mandatory.

Renewable Energy Certificates (RECs) are used to establish compliance with the RPS in most of the New England states .

- Electricity suppliers must demonstrate compliance with RPS requirements by one of two mechanisms: (1) the purchase of electricity from a renewable facility inclusive of all renewable attributes (sometimes called "bundled renewable electricity"); or (2) use of a Renewable Energy Certificate (REC) system that establishes a tradable right (separate from the electrical energy itself) to claim the environmental and other attributes associated with one MWh of renewable electricity from a specific generation facility. A REC can be viewed as the environmental and renewable attributes of the electricity which are distinct from the value of the electric energy as a source of power. These attributes have value given the state mandates that a portion of electricity supply be provided by renewable energy resources and consumers' preferences for renewable energy.
- A critical design issue is whether the RPS provides for a renewable energy certificate (REC) compliance market which allows for the renewable attributes to be unbundled from the sale of power.
- It is important to understand what is considered "renewable" in each separate RPS. A number of the New England state RPS programs distinguish between Class I, Class II and other resource types.

Wind is considered a Class I renewable energy resource in all the New England states.

- Class I resources are the "highest value" renewable resources and are generally required to be "new" generating resources, i.e., installed after the implementation date of the regulations or the restructuring of the electricity market. Wind is a Class I resource in each state. Therefore, the focus in this report is on Class I resources. The definition of Class I resources in each New England state is shown in the table below.
  - ✓ Class II resources typically include existing facilities and municipal solid waste projects and as such Class II RECs receive considerably lower value. In addition, the definition of Class II resources is much more fragmented.

Definition of Class I Renewable Energy Resources in New England

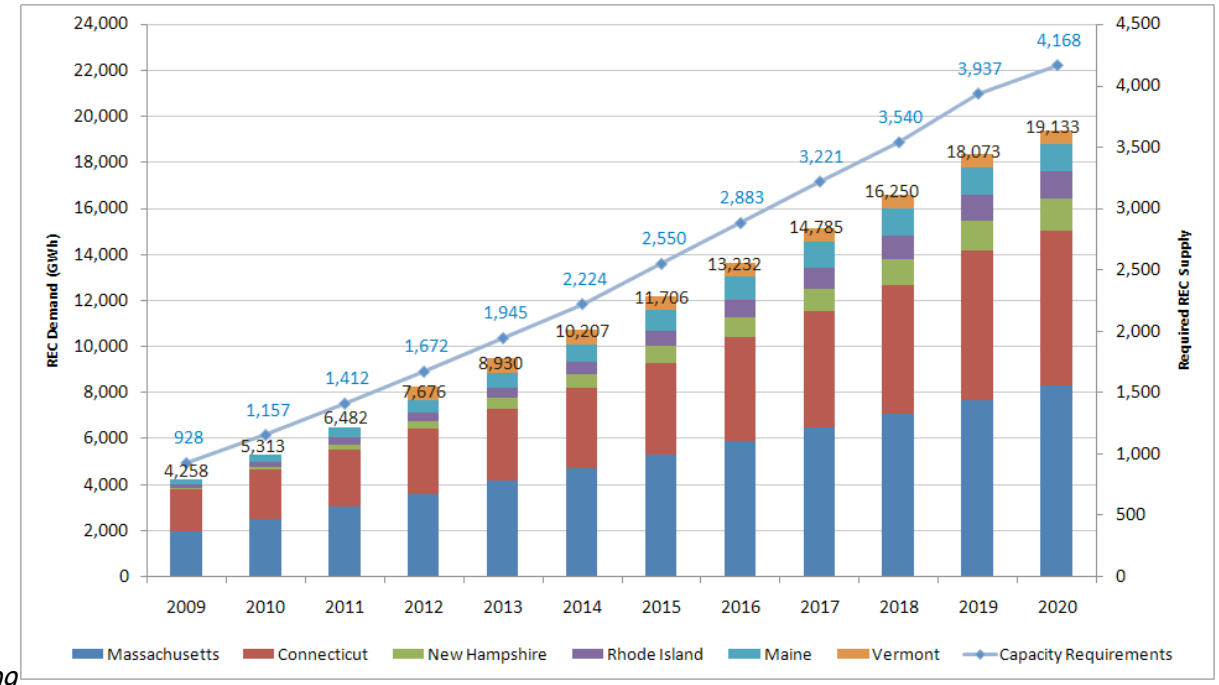
Resource \ State	Connecticut	Maine	Massachusetts	New Hampshire	Rhode Island	Vermont(3)
Wind	X	X	X	X	X	X
Biomass (1)	X	X	X	X	X	X
Fuel Cells (2)	X	X	X		X	X
Geothermal		X		X	X	X
Landfill gas	X	X	X	X	X	X
Small Run-of-river Hydro	X	X	X	X	X	X
Ocean Thermal Power	X		X	X	X	X
Solar PV	X	X	X	X	X	X
Solar Thermal Electric	X	X	X	X	X	X
Wave or Tidal Power	X	X	X	X	X	X

Notes: (1) Biomass requirements vary significantly by state, but generally specify stringent emission limits.
(2) Fuel cells generally must utilize a feedstock that is produced from a renewable resource.
(3) Renewable energy is defined generally as "energy produced using a technology that relies on a resource that is being consumed at a harvest rate below its natural regeneration rate."

REC demand varies by state driven by the REC requirement and load growth.

- Each of the New England states (except Vermont) has a schedule that provides for increased demand for Class I RECs over time. As discussed, REC demand is a typically a proportion of retail sales of investor owned electric utilities. In Massachusetts and Connecticut, the customers of municipal utilities and cooperatives are exempt from REC requirements.
  - ✓ The figure below shows the demand for Class I RECs in GWH for the six New England states. Vermont's demand is based on the goal that incremental growth be meet by renewable energy plus 5% of 2005 retail sales or 10% of 2005 retail sales. Low initial energy growth reduces the demand for RECs.
  - ✓ The blue line shows the capacity requirements assuming that the projects generating RECs have an average capacity factor of 34% (60% of capacity) and 80% (40% of capacity).

Demand for Class I Renewable Energy Resources in New England



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The different New England states have different off-ramps that would allow them to revise the RPS requirements.

- For example, the Rhode Island Public Utilities Commission can open a docket to review the adequacy of renewable energy supplies to meet the increase in the percentage requirements to go into effect in 2011. To the degree that the Commission determines an inadequacy or potential inadequacy of supplies as indicated by costs of satisfying the requirement and other relevant indicators it may delay the increase in the percentage requirement.
- The Maine rules provide that the Commission shall temporarily (for one year) suspend the scheduled percentage increase in the new renewable resource portfolio requirement if reliance on alternative compliance payments is more than 50% of the total statewide obligation in three consecutive years. A suspension of the scheduled percentage increase under this provision shall be for one year or may suspend a scheduled percentage increase in the new renewable portfolio requirement if by March 31st of the years 2010, 2012, 2014, and 2016, the Commission determines that investment in new renewable resources over the preceding two years has not been sufficient and that the resulting use of alternative compliance payments has burdened electricity customers in Maine without providing the benefits of new renewable resources.
- The New Hampshire rules provide that the Commission may accelerate or delay by up to one year any annual increase in Class I RPS acquisition requirements if the acceleration or delay is reasonably expected to increase investment in renewable energy generation in New Hampshire or mitigate cost increases to retail rates for New Hampshire customers without materially hindering the development of renewable resources. (New Hampshire Code of Administrative Rules Chapter 2500, Section 7).
- The Massachusetts RPS rules provide that the minimum standard (15% in 2020) shall increase by 1% per year after 2020 unless modified by law.
- These off-ramps increase the perceived change-in-law risks of the REC market and contribute to the discounts in future REC prices relative to anticipated market value.

Out-of-state suppliers are effectively required to deliver the bundled product to New England so that the environmental benefits are realized.

- Any qualifying renewable project in New England can participate in the Massachusetts, Maine, New Hampshire, Connecticut and Rhode Island REC markets.
- The requirements for Massachusetts, Maine, and New Hampshire, and Rhode Island are similar and require renewable projects from adjacent markets to ensure that the energy is delivered to New England with the appropriate NERC tags and cleared through the ISO-NE markets.
- In addition, the Massachusetts RPS regulations which are the most specific in this regard require that the External Unit Contract be executed between the generation unit owner or operator (conceivably agent) and an electrical energy purchaser located in the ISO-NE control area for delivery of the energy and that the External Unit Contract include associated transmission rights for delivery of the unit's electrical energy over the interties from the adjacent control area.
- The Maine, Massachusetts, Rhode Island and New Hampshire RPS regulations also require that any qualifying renewable generation unit owner provide documentation that the New Renewable Generation Attributes "have not otherwise been, nor will be, sold, retired, claimed or represented as part of electrical energy output or sales, or used to satisfy obligations" in other jurisdictions.
- We note that a number of projects in adjacent regions have been qualified by the Massachusetts Division of Energy Resources to participate in the REC market. The Massachusetts Department of Energy Resources 2007 RPS Compliance Report indicated that 16% of the RECs sold in the Massachusetts market came from Eastern Canada, with Quebec representing 12%, Northern Maine which interconnects to the ISO-NE market through New Brunswick representing 3% and PEI representing the remaining 1%. New York also accounted for 17% of the RECs supplied to Massachusetts in 2007.
- The West Cape Wind project in PEI has been qualified by Massachusetts as a Class 1 renewable energy resource.

Out-of-state suppliers are effectively required to deliver the bundled product to New England so that the environmental benefits are realized.

- The Maine RPS rules require: "The source of GIS certificates used to satisfy the portfolio requirement must be energy that is physically delivered to the ISO-NE control area." (65-407, Chapter 311.6.D)
- In June 2006 the Connecticut rules were amended to provide "an electric supplier or electric distribution company may satisfy the requirements of this section (1) by purchasing certificates issued by the New England Power Pool Generation Information System, provided the certificates are for (A) energy produced by a generating unit using Class I or Class II renewable energy sources and the generating unit is located in the jurisdiction of the regional independent system operator or (B) energy imported into the control area of the regional independent system operator pursuant to New England Power Pool Generation Information System Rule 2.7(c), as in effect on January 1, 2006; or (2) for those renewable energy certificates under contract to serve end-use customers in the state on or before October 1, 2006, by participating in a renewable energy trading program within said jurisdictions as approved by the Department of Public Utility Control."

One of the most critical elements of the RPS rules is the penalty provisions for suppliers that are unable to satisfy the REC requirement.

- RPS rules typically specify an Alternative Compliance Payment (ACP) for those entities that don't purchase a sufficient number of RECs to satisfy their RPS obligation. To the degree that the REC market is in deficit (i.e., that demand is greater than supply) spot REC prices tend to follow ACPs. Furthermore, to the degree that states have different ACPs then the states with the highest ACPs would attract RECs first until the state's REC demand is satisfied.
- The five New England states with formal RPS programs (all New England States except Vermont) have consistent ACPs, except that the Connecticut ACP is fixed at $55/MWh. The Connecticut Department of Public Utility Control can reassess the ACP every two years to evaluate whether it is yielding a sufficient market response.
- Most other New England states set their ACPs at $50/MWh as of 2003 (or at a higher price at a later date, e.g., Maine which provides the same price) and then escalate the ACP at the rate of escalation of the consumer price index. The ACP for 2009 for these states is $60.92/MWh.
- With this consistent ACP, these four New England states can be considered an integrated market at least for wind projects which are eligible to participate as Class I resources in each of these states. Also, given that the Connecticut ACP is just below that of the other states it is reasonable to aggregate its demand with that of the other states.

Another possible market in New England is sales to retailers or LDCs who have a "green power" offering.

- With limited customer switching the penetration rates of "green" retail offerings has been relatively limited. Nonetheless, a number of retailers and LDCs offer a renewable energy supply alternative. These are summarized in the table below.
- Interestingly the Mass Energy Consumers Alliance (a coop-based program) and Community Energy have similar pricing. NSTAR is a local distribution company and as a result its service offering is cost, not value-based. Cape Light Compact is a community aggregation group available to consumers on Cape Cod who elect to be served by Cape Light Compact rather than NSTAR.
- As can be seen, the premiums range from about 1.4 to about 2.4 cents per kWh. For NSTAR customers the total generation supply cost (excluding wires and regulatory charges) for NSTAR Green 100 is 14.103 cents/kWh.
  - ✓ Note that the 14 cents/kWh cannot be viewed as the market price for wind. This is a full requirements price and needs to reflect the costs associated with capacity, energy, ancillary services, load following capability and any required hedging.

Green Pricing Program Premiums

Supplier	Product	Proportion of Supply	Price Premium cents per kWh
Mass Energy Consumers Alliance	New England Green Start	100%	2.4
		50%	2.5
Community Energy	New Wind Energy	100%	2.4
		50%	2.4
Sterling Planet	MA Clean Choice	NA	5
Cape Light Compact	CLC Green	100%	1.6
		50%	1.8
NSTAR	NSTAR Green	100%	1.396
		50%	1.674

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Power Advisory estimates that the market represented by these green energy purchases could ultimately be about 1% to 3% of residential demand.

- Given the limited amount of competitive retail switching and the fact that a number of LDCs don't have a green product offering, the current penetration rate is well below this rate. However, an increasing number of LDCs have a green power offering.
  - ✓ For example, NSTAR has contracted (10-year contract terms) with PPM Energy to receive 30 megawatts from the Maple Ridge Wind Farm in upstate New York and with TransCanada Corporation for 30 megawatts from the Kibby Wind Power Project.
  - ✓ NSTAR reports that about .5% of its eligible customers participate in this program.
- This represents a market of about 475 GWh to 1,420 GWh per year representing about 160 to 480 MW of wind generation at a 34% capacity factor.

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Demand for RECs in New England is high enough to support wind energy development in the Maritime Provinces assuming that it is competitive.

- But not high enough to support the 5,500-7,500 MW suggested in the EA Report.
- The analysis of the REC market suggests that the total REC requirement in New England in 2015 could be met by about 2,500 MW of capacity and by 2020 it would take about 4,200 MW. The calculation assumed that 60 % of that capacity would be wind power with a capacity factor of 34%, giving wind power capacity of about 1,500 MW in 2015 and about 2,500 MW by 2020. This conservatively assumes that renewable energy resources other than wind provide over 50% of the region's requirements for renewable energy. To the degree that this percentage is lower than the requirements for wind will be higher.
- Voluntary green power programs could add another 160 to 480 MW to these wind requirements.
- If the Maritime Provinces provide 40% of these requirements, that would be 660 MW in 2015 and about 1,200 MW in 2020.
- Current transmission capabilities limit wind power exports from New Brunswick to New England to 1,000 MW at times when no other power is being exported.
- So a 40% share of the probable New England market would provide an opportunity for wind power exports from the Maritime Provinces that comes close to the ability of the current systems to integrate in the Maritime Provinces and to export to New England.
- For the Maritime Provinces to export significantly more than the amounts suggested here would require one or more of several changes:
  - ✓ Transmission capacity between New Brunswick and New England would have to increase to accommodate even the 1,000 MW of wind power unless no other electricity is being exported from the Maritime Provinces or from Québec through New Brunswick.
  - ✓ Wind power would have to become cheaper than generation from fossil fired resources through some combination of carbon pricing, fuel cost increases, and reductions in the cost of wind power.
  - ✓ The electricity systems of the Maritime Provinces and New England would have to become better integrated to allow integration of the level of wind power put forward in the EA Report.
  - ✓ The standards set by the RPS programs would have to increase.

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The Regional Greenhouse Gas Initiative (RGGI) will help increase demand for non-emitting sources of electricity in New England

- All of the New England states are participants in the Regional Greenhouse Gas Initiative (RGGI).
- RGGI is a voluntary program aiming at reducing by 10% the CO_2 emissions from the electricity generation sector.
- The commitment is to stabilize emissions at the 2009 level until 2014, then reduce emissions by 2.5% in each of the next four years.
- RGGI is a cap and trade system, so each emitter must own allowances for its emissions.
- The only way to get emissions allowances is to buy them, either at auction from RGGI or from another participant.
- Initial auctions produced prices of just over $3 per ton of CO_2.
- Unlike an RPS, RGGI compliance does not require that the generators use any particular generation technology or fuel source. But by pricing carbon emissions explicitly, it raises the cost of generation sources that use fossil fuels, reducing the relative cost of wind power.
- Generators can reduce carbon emissions in many ways, particularly by switching to less carbon-intensive fuels as for example moving from coal to natural gas.
- No quantitative estimate is made of the impact of RGGI on demand for wind power from the Maritime Provinces, but the impact can only be positive.

Conclusions on demand for renewable energy in New England

- New England requires significant increases in generation from renewable resources. This need is driven by the imposition in all the New England states of a renewable portfolio standard, or RPS, requiring that a certain share of the electricity provided to retail customers must come from renewable resources.
  - ✓ The RPS programs are similar, but not identical, in all the New England states.
  - ✓ The mechanism for meeting the RPS requirement in all states but Vermont is the acquisition of renewable energy certificates, or RECs.
- Wind power from the Maritime Provinces can qualify as Class I renewables, the most desirable class.
- Demand from New England for renewable power from the Maritime Provinces to meet RPS requirements could support development of amounts of wind power that would take up the entire capacity of the current interties.

Market Analysis Outline

- Executive Summary
- Introduction and Purpose of the Project
- Wind Potential in the Maritimes
- Demand for Renewable Energy in New England
- Estimate of the Value of Wind Energy in New England
- Analyze Market for Exports
- Review of Key Market Barriers
- Conclusions

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The value of wind generation in New England depends on market conditions.

- If the market is in deficit (supply of RECs is below RPS requirements) then the market value will be based on ISO-NE energy prices and the value of RECs, assuming that this yields a higher value than the cost of the marginal renewable energy resource needed to clear the market. If the market is in balance (i.e., supply is roughly in balance with demand) then the value will be the cost of the marginal renewable resource that supplies the RECs needed to clear the market.
- From 2003 to 2006, the Massachusetts REC market was in deficit with REC prices trending close to the ACP. This is confirmed by the results of various Class I REC auctions performed on behalf of the Massachusetts Technology Collaborative by Evolution Markets and others. The prices in these auctions were generally just below the ACPs.
- Prices for multi-year forward transactions trend considerably below these ACPs given the perceived market risks which include change-in-law risk and uncertainty regarding the supply and to a lesser degree demand for RECs.
  - ✓ Change in law risks include changes to the RPS laws and regulations which could weaken the RPS requirements and devalue RECs. While there were such changes in these programs initially, Power Advisory believes regulators and administrators are much more aware of these risks and thus more unlikely to make such changes. However, as discussed, the RPS rules allow state commissions to delay increases in REC requirements based on excessive increases in customer costs. Ultimately, change-in-law risks are real and need to be considered when evaluating this market.
  - ✓ Supply uncertainty is also a critical issue which affects REC values and is reviewed in greater detail below.

There is considerable uncertainty regarding the ultimate supply for RECs in New England.

- With New England REC prices tracking ACPs given the deficit in the supply of RECs and attractive wholesale electricity prices, there has been a strong economic incentive to develop renewable energy projects. However, there has been limited renewable energy project development as a result of a difficult permitting environment for all renewable technologies.
  - ✓ With the most attractive wind regimes located on ridge tops and coastlines, New England population densities resulted in land use conflicts for many wind projects.
- There continues to be considerable supply uncertainty. This is driven by a number of factors:
  - ✓ There is limited visibility regarding the development of renewable energy projects given the development lead time for renewable energy resources is relatively short (two to four years for most RPS eligible projects). Furthermore, with renewable energy projects from adjacent regions able to participate in the market, the supply of RECs can change relatively quickly if high REC prices induce additional parties to participate in the New England market. For example out of region (projects not located in the ISO-NE market) RECs provided 33% of the total Massachusetts REC supply in 2007.
  - ✓ Maine, which has a wind resource potential equivalent to all of the other New England states combined, has recently implemented an expedited permitting process for wind projects and targeted the development of 2,000 MW of wind by 2015 and 3,000 MW by 2020.
    - The level of wind project development in Maine is also important because it would compete directly with wind projects in the Maritimes for transmission access to the Southern New England market (given that the output from these projects would flow through Maine) which is the major load centre and market area.
  - ✓ The significant potential offered by off-shore wind. A number of off-shore wind projects (the Cape Wind Project is the most prominent) are proposed and these are large projects which would have a significant impact on REC supply. The successful development of one such project is likely to be followed by others.
    - As demonstrated by the Cape Wind Project, the permitting requirements and resulting development timeframes for these projects are extensive.

The current economic environment increases the uncertainty regarding the supply for RECs in New England.

- The majority of renewable energy projects in New England are developed on a merchant basis, i.e., without the benefit of long-term power purchase contracts that facilitate financing.
  - ✓ As discussed further below, recognizing that this has been a barrier to renewable project development several of the New England states are making it easier for local distribution companies to sign long-term contracts.
- As a result it is more difficult in the current economic environment where capital is highly risk adverse for these projects to attract capital (i.e., both equity and debt). This along with significantly lower energy prices and a fall in REC prices is preventing many renewable energy projects from moving forward.
- The recently signed *American Recovery and Reinvestment Act* (the *Act* or the economic stimulus package) has a major focus on renewable energy which should help renewable energy project developers respond to these challenges. In particular, the *Act* includes a three-year extension through December 31, 2013 of the production tax credit (PTC), the primary US policy support mechanism for wind power. In addition, given the challenges of finding parties that can utilize these tax credits the legislation includes a new program that allows renewable energy developers to forgo the PTC, receive a 30% investment tax credit (ITC) or alternatively secure a grant from the Treasury Department in the amount of the ITC. Under this structure the Treasury is reducing the capital requirements for these facilities by 30%.
  - ✓ The grant is available for projects placed in service in 2009 or 2010, or placed in service before 2013 provided construction begins in 2009 or 2010.
- While the *Act* is not likely to immediately offset conditions in the credit markets, as these markets return to more typical conditions it is likely to reduce renewable project costs and the likelihood of sustained deficits in the New England REC market.

The Massachusetts REC market had a small surplus in 2007.

- In 2007 the Massachusetts REC market actually had a small surplus (i.e., 6%: 88 GWh out of an obligation of 1,529 GWh) as indicated by the Massachusetts DOER's 2007 RPS Annual Compliance Report.
  - ✓ Interestingly, Massachusetts DOER suggests that its experience of a surplus in 2007 is likely to be sustained in future years given the anticipated supply of RECs.
  - ✓ Massachusetts DOER also assumes that energy efficiency programs are likely to cause electricity demand to be flat through 2015. This is consistent with the significant investment in energy efficiency called for by the *Green Communities Act* which was enacted in July, 2008. Power Advisory believes that there is no evidence that the state is taking action which would allow demand to be flat through 2015; as a result this forecast is overly optimistic and understates the likely load growth.
  - ✓ In an October 7, 2008 auction administered for the Massachusetts Renewable Energy Trust prices averaged $30.61/MWh for 2008 Massachusetts RECs and $24.50/MWh for 2008 Connecticut RECs. These lower prices are attributable to an increase in supply, continued regulatory uncertainty as well as adverse financial market conditions. Equally as important the 2009 RECs which were offered didn't sell as prices didn't exceed the reservation price.
  - ✓ The current severe economic slowdown in the United States is affecting prices for all commodities because of uncertainty over when demand will recover. This uncertainty extends to the demand for electricity and therefore to the demand for RECs.
  - ✓ While it is difficult to distinguish between cyclical factors (e.g., adverse financial market conditions) and longer term trends, it is clear that the REC market is subject to considerable uncertainty and that any multi-year longer term transaction in the current environment would require a considerable discount relative to ACPs.
- For our analysis of the value of RECs when the market is in deficit (i.e., when REC supply is less than the RPS requirements), we have assumed that REC prices are 90% of the ACP in Massachusetts, Maine, New Hampshire and Rhode Island given these market conditions.
  - ✓ We are taking a long-term perspective regarding REC market prices.

The value of wind generation in New England is likely to be bracketed by two market conditions.

- The second component of the value of the wind generation will be the ISO-NE energy price. The ISO-NE market has locational marginal pricing (LMP) where prices can vary by transmission interconnection point when there is transmission congestion (i.e., transmission capacity is less than economic transactions) and differences in marginal losses.
- LMPs are typically highest in load centers where there is a generation deficit. Conversely, LMPs are lower where there is a surplus of generation relative to load and transmission congestion is common. Not surprisingly, LMPs at the injection points in New Brunswick are lower than in most other areas so that wind energy produced in the Maritimes is likely to receive lower prices than renewable generators in New England would receive. However, it appears that the jurisdiction with the greatest wind resource potential which is actively pursuing this potential (i.e., Maine) also has relatively low LMPs (i.e., Maine LMPs are at about a 5% discount relative to the Mass Hub which is a major trading point).
  - ✓ With sales from the Maritime Provinces generally flowing through Maine, these LMP differentials are important because they put Maritime Province wind project developers at a competitive disadvantage relative to New England project developers, i.e., wind projects in the Maritimes must cost less or generate more to overcome these disadvantages.
- The LMP differentials between the Mass Hub which is a central pricing point, New Brunswick and Maine are presented on the following page and provide an indication regarding the locational penalty for generation delivered into the ISO-NE system from New Brunswick.

Historical prices between the different pricing points indicate the lower value of energy delivered from New Brunswick.

- The table below presents annual historical prices for the ISO-NE Mass Hub, Maine zone and New Brunswick node between 2003 and 2008.
- The table below also shows historical basis differentials between the ISO-NE Mass Hub, and Maine zones and New Brunswick node between 2003 and 2008.
  - ✓ Summary indicates both Maine zonal and New Brunswick nodal prices have been lower and are expected to be lower than the Mass Hub prices.
  - ✓ The Maine prices are for the Maine Zone which represents the weighted average LMP for the Central Maine Power and Bangor Hydro Service territories. In New England loads pay zonal prices and generators receive nodal prices.
  - ✓ The trend of declining basis differentials most likely reflects reduced exports from New Brunswick as the oil to natural gas price differentials declined and made sales from New Brunswick's largest generating unit (Coleson Cove) to ISO-NE less profitable. Furthermore, a 300 MW increase in the transfer capability from New Brunswick to ISO-NE in late 2007 reduced the likelihood of transmission congestion and marginal losses which would result in lower basis differentials.

Analysis of Pricing Differentials (US$/MWh)

	Annual Average Energy Price ($/MWh)			Basis Differentials	
Year	Mass Hub	New Brunswick	Maine	New Brunswick to Mass Hub	Maine to Mass Hub
2003	$49	$43	$45	-12%	-8%
2004	$54	$47	$49	-12%	-9%
2005	$79	$67	$71	-14%	-9%
2006	$61	$55	$57	-9%	-6%
2007	$68	$63	$64	-7%	-5%
2008	$80	$74	$76	-7%	-5%

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Our electricity market price forecast is presented below.

- The table below presents our annual average energy market price forecast for the ISO-NE Mass Hub, Maine zone, and New Brunswick node for the 16-year period from 2010 to 2025.
  - ✓ All forecast values are in nominal US$. We present our forecast in US$ to avoid embedding a Canadian $ to US $ exchange rate in the analysis. This better allows for changes in exchange rates.
- The forecast indicates that energy prices are not forecast to return to the $80/MWh level until 2017. These lower power prices are driven primarily by lower natural gas prices and the market's expectation that these relatively low natural gas price levels will be sustained. With increases in natural gas prices higher power prices are likely. This is a major forecast uncertainty which is evaluated further on the next several pages.

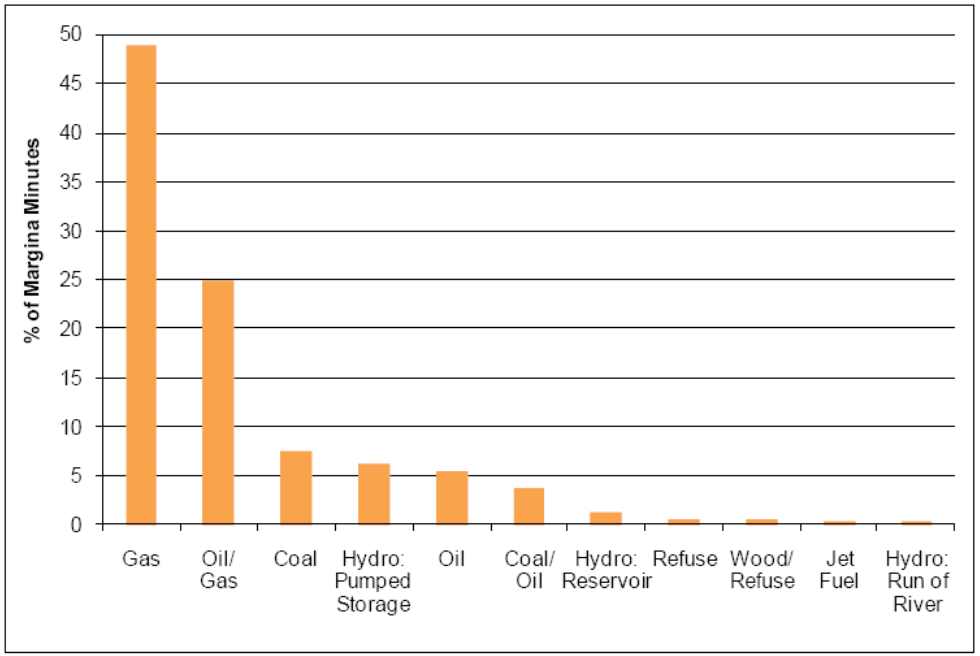
Annual Average Energy Prices ($/MWh)

Year	Mass Hub	New Brunswick	Maine
2010	$63	$58	$60
2011	$68	$63	$64
2012	$71	$66	$67
2013	$73	$67	$69
2014	$74	$69	$71
2015	$76	$70	$72
2016	$78	$72	$74
2017	$80	$74	$76
2018	$81	$76	$77
2019	$83	$77	$79
2020	$84	$78	$80
2021	$86	$80	$82
2022	$87	$81	$83
2023	$89	$82	$84
2024	$90	$84	$86
2025	$92	$86	$88

Natural gas prices are a major determinant of ISO-NE market prices so changes in natural gas prices are likely to result in changes in power prices

- As shown below, gas and oil-fired units set the market clearing prices over 80% of the time in the ISO-NE market, with gas-fired generation being the marginal resource for about 75% of the time.
  - ✓ Given relative oil and natural gas prices oil/gas units typically burn oil.
- This contributes significantly to the volatility of the region's electricity prices and causes ISO-NE energy market prices to closely track natural gas prices.

Marginal Fuel Type in Real Time - 2007



Source: ISO-NE 2007 Annual Markets Report

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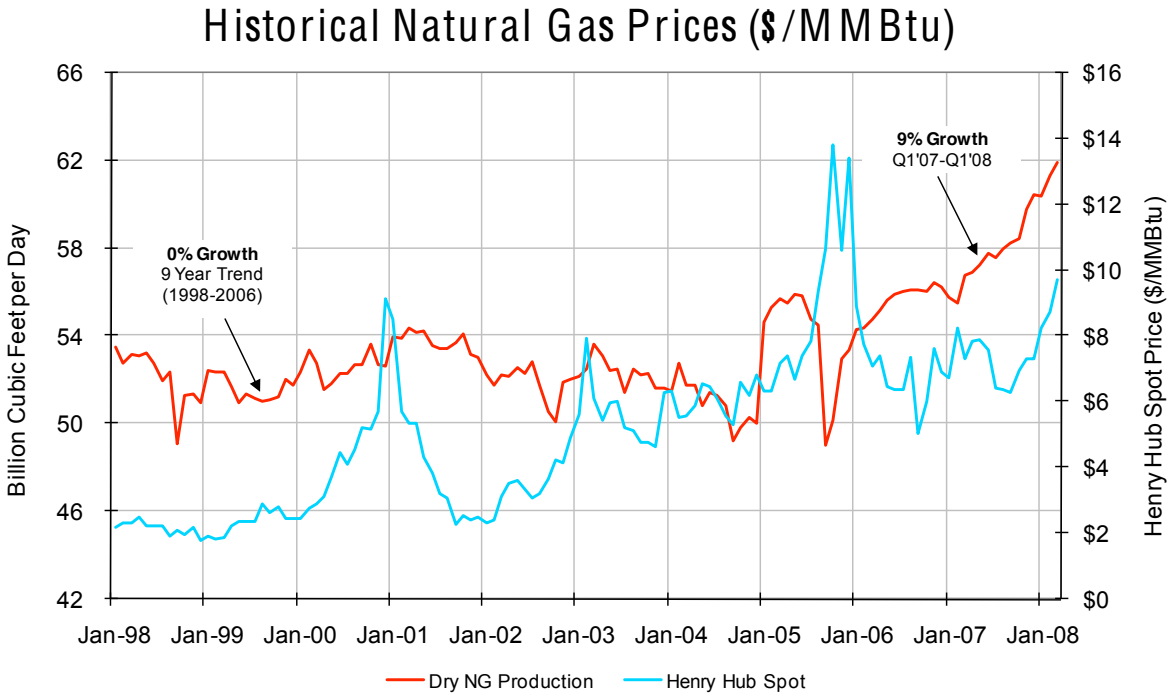
The natural gas prices are subject to considerable price volatility

- The figure below shows Henry Hub natural gas prices from January 1998 to January 2008. As can be seen the natural gas market is subject to dramatic swings in prices.
  - ✓ Henry Hub is a major pricing point in Louisiana where a number of pipelines intersect.
- Current Henry Hub price levels are $4.50/MMBtu. The costs of delivering the natural gas to New England is about an additional $1.20/MMBtu, but varies depending on market conditions.
- The NYMEX futures Henry Hub natural gas price for January 2010 is about $6.00/MMBtu and is reflected in our forecast. Once again, markedly higher natural gas prices are likely to lead to higher energy prices in New England.



Source: EIA 914 Monthly Natural Gas Production Report with Power Advisory Analysis

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The value of wind generation in New Brunswick sold into New England …

- … when the market is in deficit (i.e., when the supply of RECs is less than the demand) is based on the market value of power injected into the ISO-NE grid from New Brunswick as indicated by our electricity market price forecast and the value of REC prices. REC prices are assumed to be 90% of the ACP in Massachusetts.
  - ✓ The cost of transmission in New Brunswick and accessing the New Brunswick market would also need to be considered when establishing the net sales revenue for a wind project. This is reviewed in the next chapter.
- The table below summarizes the value of these two revenue streams and shows the total value under these conditions.
  - ✓ The first row (after the year) is the ACP. The market value of RECs (second row) is assumed to be 90% of the ACP under this scenario. The third row shows our forecast of the ISO-NE LMP at the New Brunswick injection point. The bottom row is the sum of the REC and ISO-NE LMP values and represents the market value of wind generation in New Brunswick when injected into the ISO-NE grid at the New Brunswick interconnection with ISO-NE.

Value of Wind when Market Short of RECs

Pricing Variable \ Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Alternative Compliance Payment	$ 62	$ 64	$ 66	$ 67	$ 69	$ 71	$ 72	$ 74	$ 76	$ 78	$ 80	$ 82	$ 84	$ 86	$ 88	$ 90
Market Value of REC @ 90% ACP	$ 56	$ 58	$ 59	$ 61	$ 62	$ 64	$ 65	$ 67	$ 68	$ 70	$ 72	$ 74	$ 76	$ 77	$ 79	$ 81
ISO-NE NB Price	$ 58	$ 63	$ 66	$ 67	$ 69	$ 70	$ 72	$ 74	$ 76	$ 77	$ 78	$ 80	$ 81	$ 82	$ 84	$ 86
Market Value of Wind ($/MWh)	$114	$121	$125	$128	$131	$134	$137	$141	$144	$147	$150	$154	$157	$159	$163	$167

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Power Advisory estimates that the cost of new wind in New England will represent the lower bound for value

- As CanWEA members are well aware, the cost of wind projects is significantly influenced by project capital costs and capacity factor.
  - ✓ The cost assumptions presented below are all in US$ given that our focus is on the value of wind generation in the New England market.
- Power Advisory assumed project capital costs (all-in overnight costs) of $2,200/kW (2008$) low case and fixed operations and maintenance costs of $30/kW (2008$).
  - ✓ High case capital costs reflect the potential locational cost penalty given that most wind projects in New England are anticipated to be located on ridge lines and the fact that many wind projects in New England are smaller (and less able to realize the full economies of scale) given siting and permitting constraints.
- We assumed that the project would receive 5 year MACRS (Modified Accelerated Cost Recovery System) which is allowed for wind projects. The project was financed with 60/40 debt-equity ratio with 8% cost of debt and 12.5% after tax return on equity.
- The project also benefited from 2.1 cents/kWh production tax credit which applies for the first ten years of commercial operation.
- Based on these assumptions a project with a 34% capacity factor and a 2010 in-service date requires an energy payment of $97.5/MWh for the low case escalating at inflation (assumed to be 2.5%) to provide the target after tax rate of return. The required energy payment for the high case capital costs is $107.50/MWh.
  - ✓ To realize these aggressive RPS targets there will need to be a considerable amount of wind projects developed and these wind projects will have a range of different capacity factors. As such, caution is required when evaluating the results of a cost analysis based on a single point estimate of project capacity factors. Nonetheless, Power Advisory uses such a single point estimate to facilitate a direct comparison between the economics of wind projects in New England versus the Maritimes.
- As discussed, when the market is in equilibrium the value of wind generation is based on project costs for the marginal wind project.

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The projected upper and lower bounds on the market value of wind generation in New Brunswick sold into ISO-NE are shown below.

- Given the potential for swings in the supply of RECs the market value of RECs may swing between the upper and lower bounds.
- Given the significant increases in the requirements for RECs which will absorb new supply (estimated to be about 300 MW per year) we don't expect the value of wind generation to trend below the market equilibrium value for sustained periods.
- This analysis doesn't consider the costs associated with delivering the wind energy to New England (i.e., transmission charges in New Brunswick).

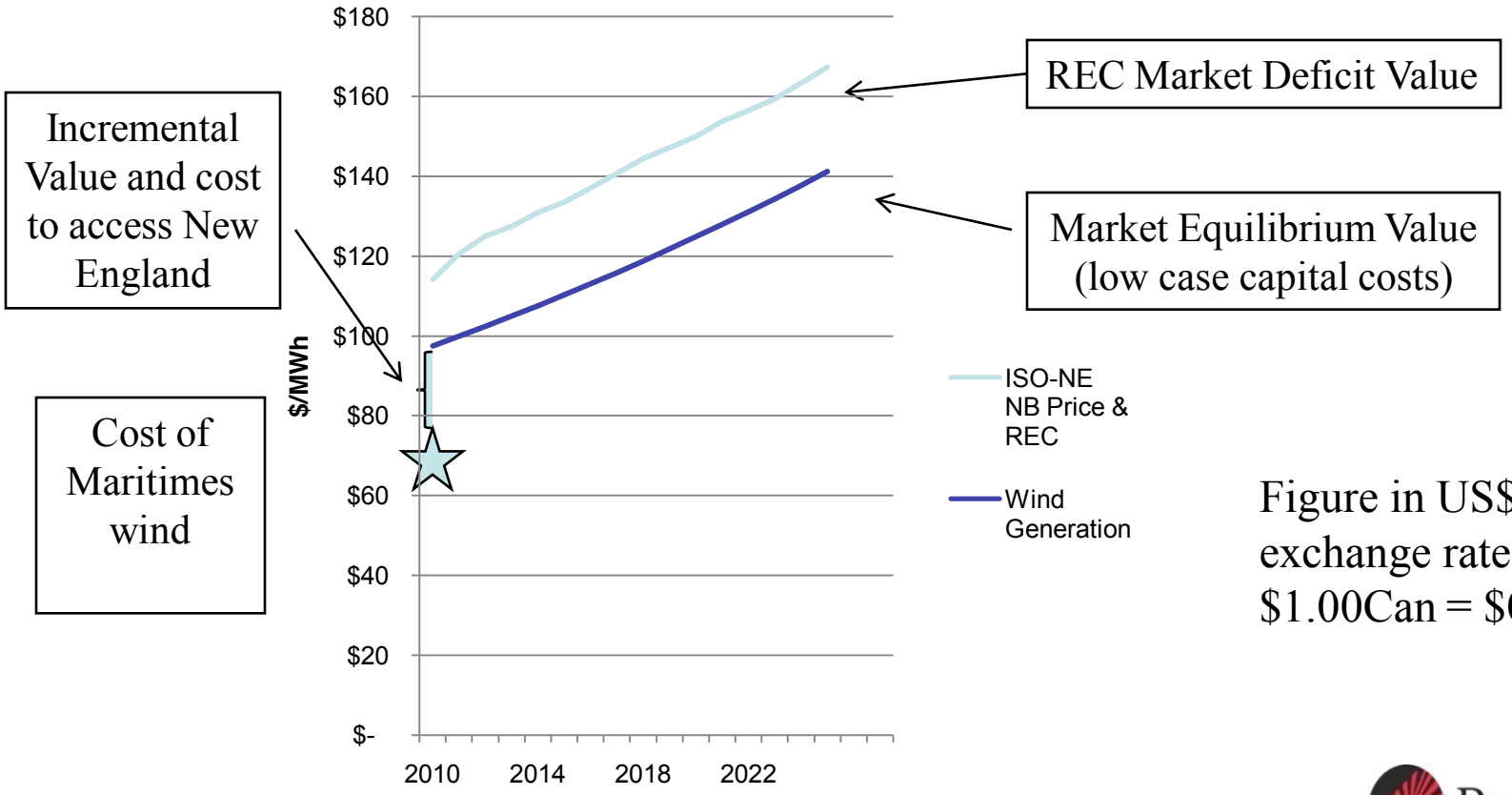

Figure in US$ exchange rate of $1.00Can = $0.84US

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Conclusions on the value of wind power in New England

- The value of wind power in New England is the sum of its energy value and the value of the RECs it creates.
- The value of the RECs is determined by their supply relative to the demand. The demand is created by the RPS requirement, placed on all load-serving entities, to deliver power that includes at least a minimum share of renewable energy.
  - ✓ The maximum value is the Alternative Compliance Payment, which is what load-serving entities have to pay if they don't have enough RECs.
  - ✓ If RECs are in equilibrium (supply equals demand), the REC value is determined by the cost of the marginal unit needed to meet the RPS. The marginal renewable resource in New England is likely to be a wind project.
    - Given the difficulty of siting new energy projects and the significant growth in the demand for RECs, Power Advisory doesn't expect the New England market to have a surplus of RECs for sustained periods of time.
- The rules in New England (except in Vermont) allow sellers from outside New England, including those from the Maritime Provinces, to offer wind power to meet the RPS.
- The rules effectively require sellers of renewable energy from outside New England to offer and deliver a bundled product of energy and RECs.

Market Analysis Outline

- Executive Summary
- Introduction and Purpose of the Project
- Wind Potential in the Maritimes
- Demand for Renewable Energy in New England
- Estimate of the Value of Wind Energy in New England
- Analyze Market for Exports
- Review of Key Market Barriers
- Conclusions

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This section analyzes two aspects of the market for exports of wind power from the Maritime Provinces to New England:

1. The regulatory, cost and physical aspects of transmission access from the Maritime Provinces (in particular, New Brunswick) to New England. This includes discussion of transmission projects that will improve physical access.
2. Conditions for market access and commercial terms that are likely to be available from purchasers of wind generation in New England

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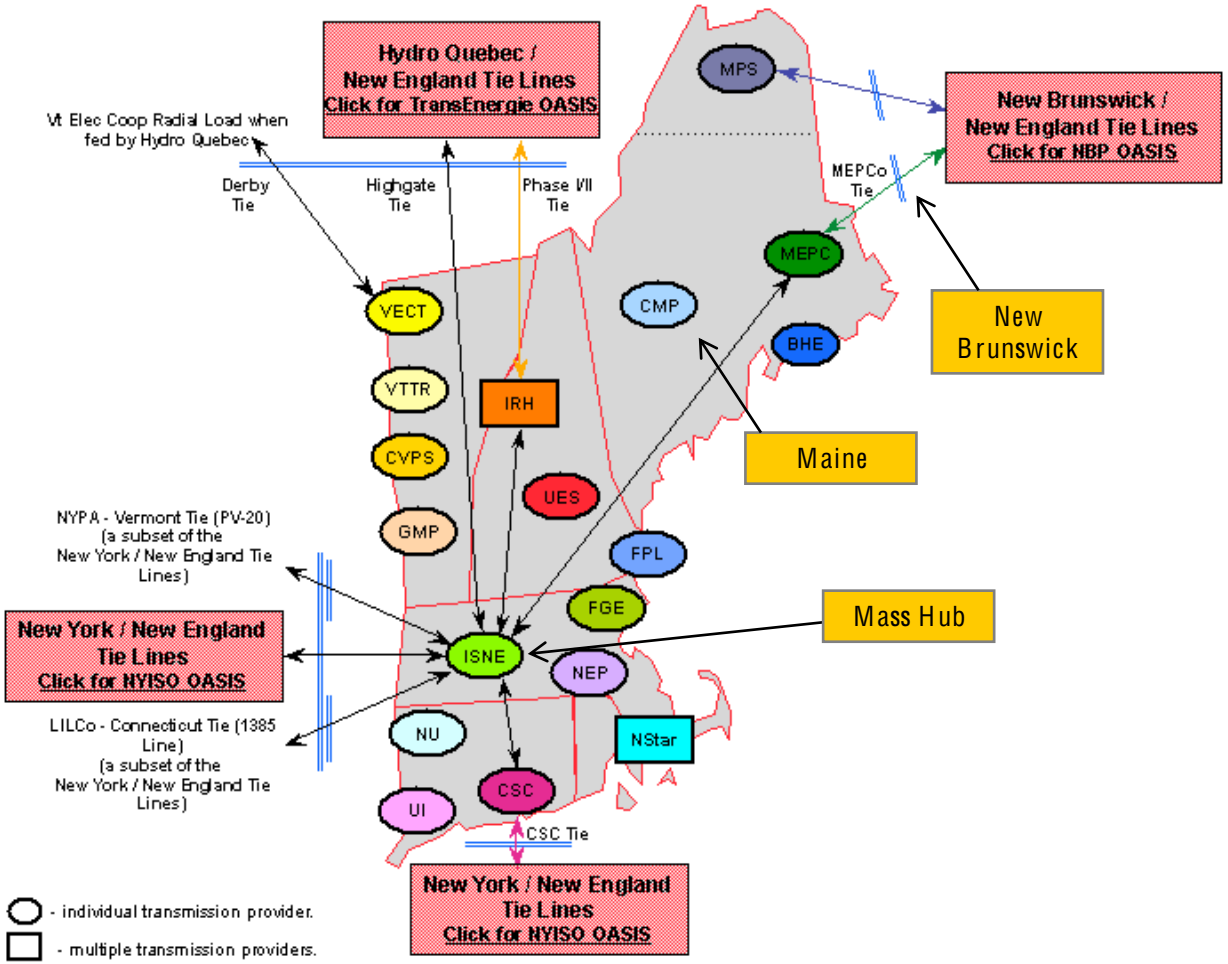
Power Advisory Electricity Market Forecast Overview – Transmission System and Pricing Point Locations Used

- ISO-NE transmission network interconnects the region's major local distribution companies.
  - ✓ Figure below also shows Mass Hub, Maine and NB pricing points along with external interfaces between ISO-NE and its neighbors. As can be seen, Québec is also directly interconnected with New England.



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Selling wind power from the Maritime Provinces into New England takes several steps.

- If not already in New Brunswick, the power must get to New Brunswick, since it is the only Maritime province with transmission connections to New England.
- To get power through or out of New Brunswick requires being a market participant in New Brunswick.
- Getting the power to New England means scheduling across the border at one of the two points of interconnection between New Brunswick and New England.
- All electricity exports from Canada require an export license from the National Energy Board.
- The power can then be injected into the ISO-NE system under its rules.
- To sell associated Renewable Energy Certificates (RECs), the facility must meet the eligibility requirements and establish power delivery, as discussed in the previous chapter.
- The remainder of this section discusses each of these topics.

A generator in New Brunswick must meet the basic requirements of market participation.

- Only a New Brunswick participant in the New Brunswick market administered by the NBSO can inject power into the New Brunswick grid.
  - ✓ The market participant need not be the generator itself. An agent could become the market participant for a generator or other supplier. The market participant (generator or agent) is then responsible for meeting the basic requirements for scheduling in the New Brunswick market.
- The basic requirements for market participation are
  - ✓ License from the New Brunswick regulator (the New Brunswick Energy and Utilities Board – EUB).
  - ✓ Application to the NBSO to become a market participant and execution of a Participation Agreement requiring the market participant to abide by the Market Rules and by dispatch instructions from the NBSO. Under the Market Rules, the market participant must post credit equal to two months of expected billings.
  - ✓ Meeting other requirements including technical requirements, etc .
- Market participants must schedule transactions with the NBSO.
  - ✓ Market participants must file a balanced schedule a day in advance for each hour of the following day, showing amounts and locations of injections and amounts and locations of withdrawals..
  - ✓ The NBSO schedules the transactions and also operates an hourly balancing market to handle deviations or imbalances from the schedule. Imbalances are settled not at a punitive price but at the FHMC (final hourly marginal cost) derived from incremental and decremental bids filed by the generators.
  - ✓ The NBSO now offers an aggregated balancing service to non-dispatchable generators. It will net out the hourly imbalances of all the non-dispatchable generators and settle them on a monthly basis at the FHMC. It will then assign cost responsibility to the non-dispatchable generators according to their contribution to the imbalances.

Electricity exports require a license from the National Energy Board

- Potential exporters must apply giving details of source of the export, amount of export, export path, etc. This information is posted by the NEB and anyone who wishes can intervene and send in Information Requests, etc.
- The NEB can hold an oral hearing, but it never has for an electricity export application, even though some have been contested and an oral hearing has been requested on at least one occasion.
- If there are no interventions or Information Requests, a license can reasonably be expected within 4 months of the completed application.

Accessing New England means obtaining access across the interconnection between New Brunswick and New England.

- There are now two transmission lines between New Brunswick and the node at Orrington, Maine comprising the interface between the Maritimes and the New England system:
  - ✓ One at Keswick and
  - ✓ One from Point Lepreau.
- But virtually all the transfer capacity is held on long-term firm reservations.
  - ✓ New Brunswick Power holds 670 MW of the available capacity on the Keswick tie.
  - ✓ Hydro Quebec holds 300 MW of the capacity on the Salisbury tie, near Point Lepreau.
  - ✓ AVEC holds 28 MW.
- A wind power generator would probably not want firm transmission rights, because the tariff is paid on the full amount of the reservation, no matter how much of it is used. Since wind power capacity factors are 40% or less, paying for firm reservations would mean paying for more than twice as much transmission capacity as is used.
- But there is capacity available on these lines most of the time.
- The next slide shows the total utilization of the tie lines for 2008. In some seasons, very little of the capacity is being used.
  - ✓ The utilization of these lines is affected by the outage at Pt. Lepreau which reduces New Brunswick's supply of low cost energy and ability to export power to New England.
- Unused capacity is made available through the NBSO.
- Sellers can obtain short-term point to point reservations. The cost is set by the New Brunswick transmission tariff which is discussed below.

Power Advisory Electricity Market Analysis – Transmission Utilization

- The tables below summarize transmission line utilization in 2008 between New Brunswick and ISO - New England.

New Brunswick to ISO-NE Flow (GWh)

Year	On-Peak	Off-Peak	Total
Jan	129.4	93.4	222.9
Feb	121.1	92.7	213.8
Mar	79.1	61.0	140.1
Apr	123.0	133.2	256.1
May	81.4	46.4	127.8
Jun	76.1	94.9	171.0
Jul	88.4	54.5	143.0
Aug	100.7	76.6	177.2
Sep	18.7	14.2	32.8
Oct	28.5	19.0	47.5
Nov	14.9	27.9	42.8
Dec	29.5	19.5	49.0
Annual	**890.8**	**733.3**	**1,624.1**

ISO-NE to New Brunswick Flow (GWh)

Year	On-Peak	Off-Peak	Total
Jan	0.4	0.7	1.1
Feb	0.0	0.4	0.5
Mar	3.7	13.0	16.7
Apr	1.7	3.5	5.2
May	4.5	16.9	21.4
Jun	3.2	12.6	15.7
Jul	0.8	7.7	8.5
Aug	2.1	7.3	9.4
Sep	37.4	48.7	86.1
Oct	31.1	35.2	66.4
Nov	23.9	27.3	51.2
Dec	12.5	22.1	34.5
Annual	**121.4**	**195.5**	**316.9**

New Brunswick to ISO-NE Utilization

Year	On-Peak	Off-Peak	Total
Jan	35.2%	24.8%	30.0%
Feb	36.0%	25.7%	30.7%
Mar	23.5%	15.0%	18.9%
Apr	34.9%	36.2%	35.6%
May	23.1%	11.8%	17.2%
Jun	22.6%	24.7%	23.8%
Jul	24.0%	14.5%	19.2%
Aug	30.0%	18.8%	23.8%
Sep	5.3%	3.8%	4.6%
Oct	7.7%	5.1%	6.4%
Nov	4.7%	7.0%	6.0%
Dec	8.0%	5.2%	6.6%
Annual	21.3%	16.0%	18.5%

Maximum reliable transfer capability is assumed to be 1,000 MW which assumes all transmission facilities in Maine and New Brunswick are in-service

ISO-NE to New Brunswick Utilization

Year	On-Peak	Off-Peak	Total
Jan	0.2%	0.4%	0.3%
Feb	0.0%	0.2%	0.1%
Mar	2.0%	5.8%	4.1%
Apr	0.9%	1.7%	1.3%
May	2.3%	7.9%	5.2%
Jun	1.7%	5.9%	4.0%
Jul	0.4%	3.7%	2.1%
Aug	1.1%	3.3%	2.3%
Sep	19.3%	24.1%	21.8%
Oct	15.4%	17.0%	16.2%
Nov	13.6%	12.4%	12.9%
Dec	6.2%	10.7%	8.4%
Annual	5.3%	7.7%	6.6%

Maximum reliable transfer capability is assumed to be 550MW, which assumes all transmission facilities in Maine and New Brunswick are in-service and that sufficient generation resources in the Bangor area are on-line.

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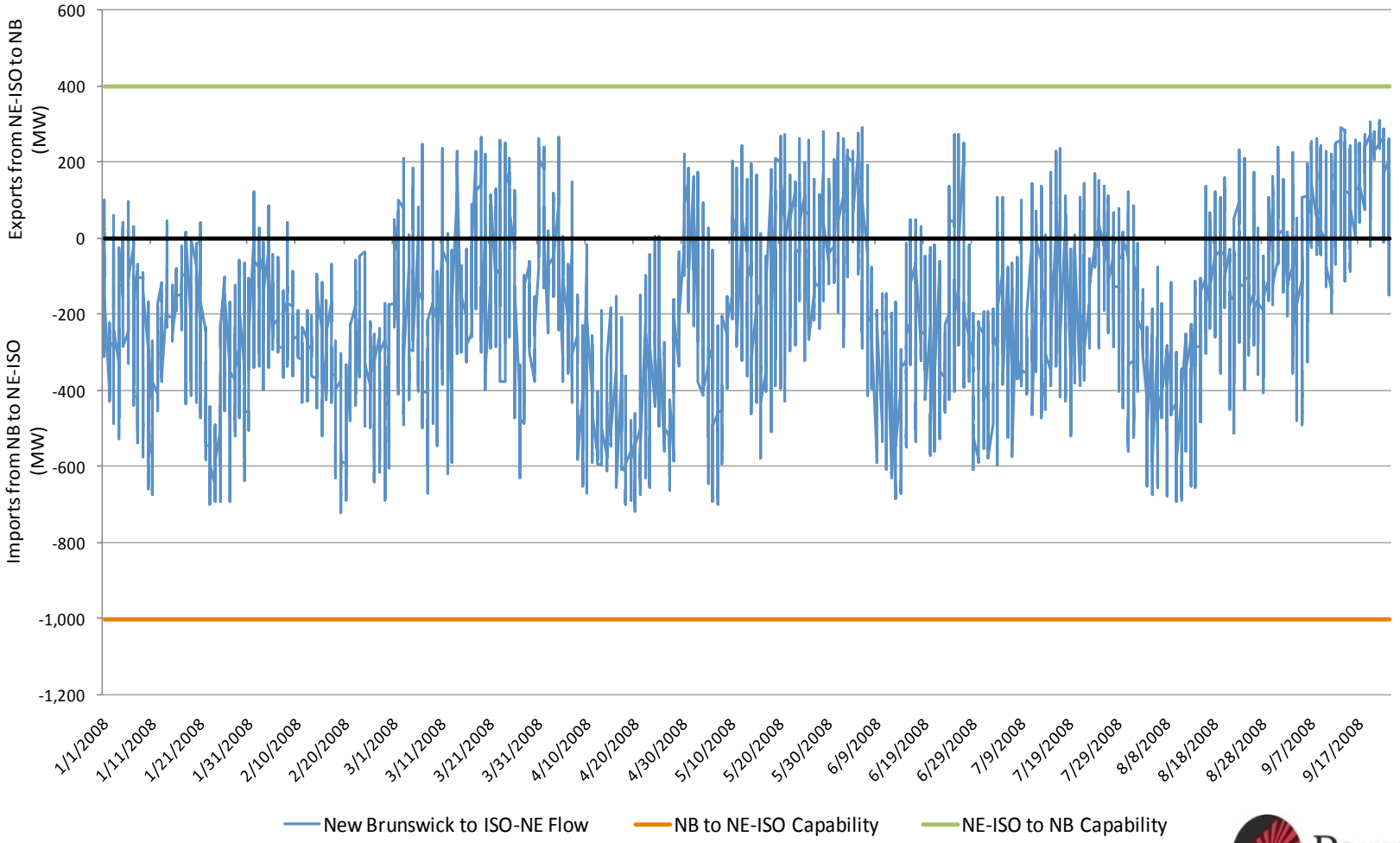
Power Advisory Electricity Market Forecast Analysis – Transmission Utilization between New Brunswick and ISO-NE

- The figures below show hourly transmission line utilization in 2008 between New Brunswick and ISO - NE.
  - ✓ Utilization of the interconnection capacity is also likely influenced by transmission constraints in the US, i.e., beyond the intertie facilities' interconnection at Orrington.



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Exports from the Maritime Provinces would pay transmission tariffs and ancillary services charges in whatever transmission systems they use.

- Any export from the Maritime Provinces must go through New Brunswick and so must at least pay the NB Power Transmission charges.
  - ✓ For a wind generator with a 37.5 % capacity factor, using weekly or daily reservations, the New Brunswick ancillary services charges would be about $4.55 per MWh and the transmission charges about $7.70 per MWh, for a total charge of about $12.25 per MWh.
    - Our analysis of Maritimes wind projects assumes a 37.5% capacity factor there are the same caveats associated with the use of a single point estimate for a Maritimes wind project as for a New England project.
- For Nova Scotia generator with a 37.5% capacity factor, the ancillary services charges are about $5.65 per MWh and transmission charges about $13.10 per MWh for a total charge of about $18.75 per MWh.
- In PEI, the corresponding tariffs are $5.00 per MWh for ancillary services charges and $9.60 per MWh for transmission service, for a total tariff of about $14.60 per MWh.
- It is physically possible to export from the Maritime Provinces through the Hydro Québec TransEnergie system in Québec. The cost, however, is prohibitive. Ancillary services charges are quite low at $0.85 per MWh for a generator at a 37.5% capacity factor. However, transmission service charges are $21.60 per MWh, for a total charge of about $22.45 per MWh. Since the transaction must also use the New Brunswick system, total transmission charges in this case would be almost $35 per MWh.

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Once entered into the ISO-NE control area, the exporter pays no further transmission charges.

- Transmission charges are paid by loads. The buyer of the power will pay no more (and no less) in transmission charges for power bought from the Maritime Provinces than for power bought from generators in New England.
- As in New Brunswick, the seller or its agent must be registered as a market participant in the ISO-NE market and must obey all of its information, scheduling and control rules.

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The attractiveness of the New England market depends on the wind generator's location given the affect of rate pancaking.

- The table to the right provides the analysis of the delivered costs of wind energy for Maritime projects versus the costs of a New England wind project.
- The cost assumptions for the Maritimes wind project are reviewed on the next page.
- New England wind projects were evaluated using a low and high cost estimate.
- As can be seen Maritime wind projects have a considerable busbar cost advantage. This cost advantage is maintained for projects located in New Brunswick, but disappears for Nova Scotia and PEI given rate pancaking.
- Sales to New England continue to be attractive if there is a deficit in the REC market.

	Capacity Factor	Cost US$ ($/MWh)	Cost Can$ ($/MWh)
Maritimes Wind	37.5%	$ 77.53	$ 92.30
New England Wind Low Cost	34.0%	$ 97.50	$ 116.07
New England Wind High Cost	34.0%	$ 107.50	$ 127.98
Busbar Cost Advantage vs. Low		$ 19.97	$ 23.77
Busbar Cost Advantage vs. High		$ 29.97	$ 35.68
New Brunswick Transmission Costs			
Losses	3%		$ 3.48
Transmission Tariff			$ 12.25
Total NB Costs			$ 15.73
LMP Differential	2%		$ 2.32
		Low Cost	High Cost
Value Offered by New Brunswick Wind		$ 5.72	$ 17.62
Premium (%)		6%	19%
Nova Scotia Transmission Costs			
Losses	3%		$ 2.69
Transmission Tariff			$18.75
Total Nova Scotia Costs			$21.44
		Low Cost	High Cost
Value Offered by Nova Scotia Wind		$ (15.72)	$ (3.81)
Premium (%)		-17%	-4%
PEI Transmission Costs			
Losses	2%		$ 1.79
Transmission Tariff			$ 14.60
Total PEI Costs			$ 16.39
		Low Cost	High Cost
Value Offered by PEI Wind		$ (10.67)	$ 1.23

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The cost assumptions for the Maritimes wind projects are generally consistent with those for the low cost New England project.

- The cost analysis assumes about a $1.00 Can to $0.84 US exchange rate. While this exchange rate is higher than the current rate it is believed to be representative of longer term fundamentals.
- The project cost analysis assumes a capital cost of $2,600/kW (Can$) and fixed operations and maintenance costs of $35/kW-year escalating by inflation at 2.5%.
- No credit is take for the ecoENERGY Renewable Power initiative. However, the project is assumed to take advantage of the 50% declining balance Capital Cost Allowance (CCA) for 70% of the project capital cost and 8% declining balance CCA for the remaining 30% of project costs.
- The same project financing assumptions were assumed as for the New England project.
- The key assumptions for the relative cost comparison are the capital costs and the capacity factors. These assumptions are based on PA's professional judgment. Members of CanWEA's Steering Committee, including the developer members, agreed that the assumed capital costs and the assumption of a 37.5% capacity factor for wind power in the Maritime Provinces are reasonable representations of facilities that could be built in the Maritime Provinces.

The Maine Power Reliability Program is expected to increase transfer capability within Maine and between New Brunswick and Maine.

- The Maine Power Reliability Program (MPRP) started in 2006/07 with a study group including representation from ISO-New England, Central Maine Power (CMP), Bangor Hydro Electric Company, Maine Public Service (MPS), Public Service of New Hampshire, and Northern Maine Independent System Administrator.
- The study group focused on the ability of the Maine transmission system to serve Maine load reliably and efficiently.
  - ✓ It investigated multiple transmission expansion alternatives.
  - ✓ It examined hundreds of contingencies and scenarios.
  - ✓ It assessed these against NERC, NPCC and ISO-NE reliability standards.
- From this study, two preferred transmission projects were identified:
  - ✓ A new line from Orrington south to New Hampshire and
  - ✓ A new line for the northern part of Maine.

MPRP is under development and would better connect New Brunswick with New England.

- CMP has filed an application with the Maine PUC for approval of a transmission project it calls the Maine Power Reliability Program (MPRP).
  - ✓ This project would construct a new 345 kV line between Orrington, Maine and Newington, New Hampshire. This would increase the Orrington South limit by 775 MW, relieving the frequent congestion at Orrington. This would reduce the price differentials that occur when there is transmission congestion and losses on the transmission lines are high. (See analysis above of these price differentials which reduce the value of generation delivered from New Brunswick.)
  - ✓ CMP is also evaluating a joint venture with Maine Public Service to construct a direct connection between Northern Maine and the CMP system.
  - ✓ These upgrades could increase New Brunswick export capacity by as much as 400 MW.
  - ✓ The NBSO says that the MPRP facilities are expected to be in place by as soon as 2012.
  - ✓ The project requires over 80 approvals in Maine and other Maine transmission projects have been significantly delayed so and in-service expectation of 2012 may be optimistic.

The Maine Power Connection is another pathway to New England.

- Emera (the parent of Bangor Hydro and NSPI) and National Grid (the parent of New Hampshire Public Service and of distribution utilities in Massachusetts) have announced a joint venture called the Northeast Energy Link. Its first phase would link Northern Maine with Maritime Canada and Southern Maine.
- Maine Public Service and Central Maine Power have proposed the Maine Power Connection, a $625 million project. It assumes that the MPRP is in place, and would directly connect the Maine Public Service service territory in Northern Maine with Southern Maine with a 345 kV transmission line. The project would support a proposed 5-site 800 MW wind power project in Northern Maine. This project might require transmission modifications in New Brunswick.
- The Maine Power Connection project was recently formally dismissed in a hearing before the Maine Public Utilities Commission given that it was found to cause grid instability to the south. The projects sponsors suggested that this was a temporary setback.
  - ✓ The NBSO Discussion Paper said that more study is required to determine the impact of this proposal.

The cost responsibility for these facilities depends on how they are designated.

- Under the ISO's Open Access Transmission Tariff (OATT), the cost of a transmission project is shared throughout the region when the ISO deems that the project provides regional benefits. Each state pays a portion of regional transmission costs on the basis of its share of overall consumption. This cost-allocation methodology was used to fund Reliability Transmission Upgrades: transmission projects that provide regional reliability benefits. However, the OATT also provides for the cost of a transmission project to be shared among states if it is deemed to provide regional economic benefits—that is, to be a Market Efficiency Transmission Upgrade (METU).
- Attachment N of the OATT makes regional cost sharing possible for a METU, or transmission lines that can lower the overall cost of producing electricity by an amount that exceeds the cost of building the line.
- ISO-NE was asked to evaluate whether the Maine Power Connection proposed by Maine Public Service Company and Central Maine Power Company would qualify as a METU given its potential influence on wholesale market costs.
- Without such a designation the cost of these facilities would be borne by the customers of the LDCs that propose them or the generators that request their construction to enable the integration of their project with the New England grid.

ISO-NE identified the conditions under which it believed that transmission facilities would be built to access renewable energy from Canada.

- If the cost of the energy supplied from Canadian resources is sufficiently competitive to cover the cost of the transmission investment;
- As a result of bilateral agreements between parties in Canada and New England; or
- If New England policymakers alter present RPS standards to include Canadian renewable energy; if so, these lines might be paid for regionally.
  - ✓ As discussed below, Canadian renewable energy can participate in these RPS markets so it is not clear what is meant by this last condition.
- However, it is clear that transmission planners and policy makers view the Maritimes as a potential source of cost-effective renewable energy.

Integrating more than about 1,500 MW of wind in the Maritime Provinces requires a commitment by governments, system operators, and developers.

- As the EA study noted, a high degree of coordination between systems is required for economic integration of wind power.
- As the NBSO Discussion Paper noted, amounts of wind power above about 1,500 MW will require transmission reinforcements, probably including additional transmission capacity out of the Maritime Provinces to avoid system problems there.
- In addition to these physical changes, the most efficient and economic balancing of wind power would flow from access to a larger system which can benefit from more capacity and more diversity of resources.
  - ✓ Stronger integration of the electricity systems in the Maritime Provinces is a first step in this process. Such integration has been discussed for some time, and some progress has been made. But further progress would be needed.
  - ✓ The largest system that is currently connected to the Maritime Provinces is that of Québec. It is very well suited to providing balancing services for wind power, because it has so much storage hydroelectric capacity. Storage hydroelectric capacity can balance wind by running when the wind is not blowing and storing water when the wind is blowing.
  - ✓ Hydro Québec Production already provides this service to Hydro Québec Distribution for the wind power it has contracted within Québec.
  - ✓ An arrangement to provide the service to wind power in the Maritime Provinces might be possible. This would be a fully commercial arrangement and Power Advisory expects that the cost of providing this service may be prohibitively expensive given the opportunity cost to Hydro-Québec of foregone exports to New England during some periods.
  - ✓ ISO-NE would presumably also be able to provide this service, but at higher cost given that New England doesn't have the hydroelectric capacity that Québec does.

Marketing access discussion starts with an analysis of the buyers for RECs.

- LDC buyers will need bundled services, which they will get from marketers.
- Probably the largest single market in New England for electricity is the LDCs who continue to serve customers that haven't switched to a competitive retailer. Customer switching levels vary among different customer classes (with the largest customers having the highest switching rates) and among states (depending on the rules, e.g., how standard offer or default service is priced).
- In Connecticut, Maine, Massachusetts and Rhode Island, LDCs' purchasing practices for standard offer service are governed by public utility commission rules which typically require suppliers to these LDCs to provide a fully bundled product that includes the RECs that represent a proportion of customers' retail electricity requirements.
- Consequently, LDCs are not typically a buyer of energy or RECs from renewable energy project developers given these developers aren't able to provide the fully bundled electricity product which includes energy, capacity, various ancillary services and RECs.
- Under this market structure, the most obvious buyers for renewable project developers are marketers who assemble the bundled product and resell it to LDCs and large end-users.
  - ✓ Some large end-users are potential purchasers to the degree that they are willing to purchase some renewable energy to satisfy their RPS obligations. However, given the difficulty of balancing these requirements and demonstrating their compliance with the RPS rules, the majority of large customers purchase a bundled product from retailers or wholesalers.

Wind power generators will likely have to accept their locational risk, given that standard contracts refer to a geographical point.

- With this understanding regarding likely buyers the required form of the contract becomes more apparent.
- Most US marketers and traders rely on the Edison Electric Institute's (EEI) Master Contract which provides standard terms and conditions and contractual boilerplate. http://www.eei.org/ourissues/ElectricityGeneration/Pages/MasterContract.aspx
- In addition to the EEI Master Contract parties will need to agree on pricing provisions and other related contractual issues. These are outlined below.
- Given that these marketers and retailers are focused on serving end-users, they are looking for power supplies to serve these customers. Recall that ISO-NE has locational marginal pricing where prices vary based on transmission constraints and changes in marginal losses. With marketers' and retailers' loads concentrated in the larger metropolitan areas they prefer to have power delivered to these areas or otherwise require the supplier to bear the risk associated with changes in LMPs associated with their point of delivery. The Mass Hub which is located in North Central Massachusetts is a common pricing point and was created to establish a fixed pricing point for such transactions.
- As such, one contract risk which is likely to be allocated to Maritimes wind project developers are the LMP disconnects between their point of injection into the ISO-NE grid and the Mass Hub price.
- Other risks that Maritimes wind project developers will likely have to bear will be market rule and transmission pricing changes which could adversely affect the value of their power. For example, developers would have to bear all transmission cost and access risks from their project busbar to their delivery point into ISO-NE. Furthermore, to the degree that a transmission line is out of service and transmission congestion increases then they will bear this risk as well.

The form of contracts desired by buyers is significantly influenced by the markets that they serve.

- One of the most fundamental issues is whether buyers are likely to be seeking just RECs or the bundled product (renewable energy). With these buyers focused on providing a bundled product that provides full requirements service for end-users, RECs could be viewed as more valuable given the variability of wind output which needs to managed to yield a load shape that follows customer requirements. However, larger traders are better able to manage this variability and wouldn't require a significant discount to manage it. Furthermore, when the market is in equilibrium the market price would be based on the full cost plus a reasonable return of developing a wind project.
- One of the critical issues associated with the contract terms offered is the likely contract duration. The marketers and retailers who are the most likely buyers will seek to "back-to-back" contracts to minimize their risks. Specifically, they will be looking for similar contract terms as required by the LDCs and end-users. The contract durations for the LDCs in the states with competitive retail markets range from about six months to three years. They will be looking for similar contract durations from their suppliers to avoid any residual risk associated with the value of the renewable energy or RECs after the term of the contract with the LDC. Many traders and retailers are unwilling to manage this risk or only willing to accept this risk at a significant discount to the anticipated market price. Some traders view managing this risk as a fundamental part of their business model. However, a critical issue is the underlying uncertainty associated with the value of RECs. This suggests that even the bundled renewable energy product will be discounted significantly for longer contract terms than desired by LDCs.

Changes to market rules to address barriers to renewable energy project development don't necessarily benefit out of region renewable projects.

- With the restructuring of the power market in New England, many LDCs were mandated to purchase power under relatively short durations, i.e., from 6 months to 3-years. As such, the terms available to sellers were of relatively short duration. This required that sellers bear the risks associated with the future price for power when attempting to finance their power projects. This has been recognized as a barrier to the development of new generation projects and caused a number of states to change these rules to allow new project developers to secure long term contracts.
  - ✓ For example, the Maine Public Utilities Commission which administers power procurement RFPs on behalf of the various LDCs in the state recently issued an RFP for long-term power supplies. The RFP is for "capacity and associated energy".
- The enabling legislation established the priorities for different resource types. Renewable resources from out-side of Maine are not favoured.
  - ✓ The RFP indicates that environmental and reliability objectives will be considered in terms of the following Resource Priority Order:

    (1) new interruptible, demand response or energy efficiency capacity resources located in Maine;
    (2) new renewable capacity resources located in Maine;
    (3) new capacity resources with no net emission of greenhouse cases;
    (4) new nonrenewable capacity resources located in Maine, with preference given to resources with no net emission of greenhouse gases;
    (5) capacity resources that enhance the reliability of the Maine's electric grid, with preference given to resources with no net emission of greenhouse gases; and
    (6) other capacity resources.
  - ✓ In sum, it appears that this and subsequent RFPs issued by the Maine Public Utilities Commission aren't likely to be present significant opportunities for wind project developers in the Maritimes unless they offer compelling cost savings.

Massachusetts also recently allowed LDCs to contract with renewable energy facilities.

- Similar to Maine, the Massachusetts legislation is focussed on renewable energy resources that are located in the state. The enabling legislation established the priorities for different resource types. Specifically, the legislation mandates that LDCs issue 2 RFPs over a five year term to contract for renewable energy resources located within Massachusetts and to use 10 to 15 year contracts for these projects. These contracts must be approved by the Massachusetts Department of Public Utilities.
- The legislation also provides that "distribution companies may also voluntarily solicit additional proposals over the 5 year period." Presumably this could be used to contract for renewable energy resources that are generated outside of Massachusetts. However, it is unclear whether LDCs would take advantage of this flexibility. Once again, we expect that they would only attempt to seek approval for such contracts if they represented significant savings relative to in-state resources.

Pricing under the contracts may leave the sellers with some risk that their generation will not occur at high-price times.

- Credit support is likely to be required for developers with credit ratings that are lower than their buyers.
- Buyers are also likely to indicate pricing that they will offer for on and off-peak periods and for contract terms of five years and less or potentially the initial five years of the contract may specify prices on a monthly basis. With such a pricing structure the supplier is at risk for changes in its production profile which result in a greater proportion of power being delivered at lower value periods.

Conclusions on the market for exports of wind power from the Maritime Provinces.

- Conclusions on cost and physical aspects of market access and on enhancements to physical market access.
  - ✓ Wind power from the Maritime Provinces must go through New Brunswick to reach US markets.
  - ✓ Going through New Brunswick requires becoming a market participant in the New Brunswick market.
  - ✓ Wind power has lower costs in the Maritime Provinces than in New England, but transmission tariffs remove any cost advantage unless the wind power is located in New Brunswick.
    - Wind power from other Maritime Provinces must pay a transmission tariff to the province in which the wind power resource is located, as well as tariffs in New Brunswick.
  - ✓ There is limited physical transmission capacity to access New England from New Brunswick, and almost all of it is held on firm contracts by either New Brunswick Power or Hydro Québec.
  - ✓ However, the intertie lines are often not full, allowing wind power to be exported to New England, but with potential transmission interruption.
  - ✓ Several proposed projects in the United States would improve access for wind power from the Maritime Provinces into the US market south of a current bottleneck at Orrington, Maine.
- Conclusions on commercial market access conditions in ISO-NE markets and on contract terms and risk allocation.
  - ✓ Accessing markets in New England will best be done through a marketer who can offer the load-serving entities the bundled product that they need or large customers the bundled product that they desire.
  - ✓ Because of the way that load serving entities prefer (or are required by regulation) to buy power, sellers of wind power will have to bear some of the contract risks:
    - The buyers will want pricing based on the Mass Hub or other relevant hub. The sellers will probably have to bear the risk of changes in the basis differentials between the Maine border injection point and the Mass Hub.
    - The buyers are often prevented by regulation from contracting for periods longer than three years. Sellers will take the risk for prices beyond the contract period.
      - Some states are relaxing this requirement to allow longer-term contracting for renewable supply, but they seem to be allowing the option only for generators within the state.

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- Review of Key Market Barriers
- Conclusions

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Power Advisory explored a number of potential barriers to wind power exports from Maritime Provinces to New England.

- Power Advisory sent a survey to all of the members of the Atlantic Caucus. The survey identified what we believed to be the critical issues with respect to sales to New England.
- We followed up the survey with telephone interviews of members of the Caucus who were believed to have given the most consideration to sales to New England.
- As suggested in the telephone interviews, we also contacted some key market participants and the key market institutions.
- From this information gathering, we obtained good perspectives on the opportunities and barriers for the New England market from a developer viewpoint, good ideas on how to overcome the barriers, and good information on how the institutional players see their emerging roles. We supplemented these perspectives with our market perspective.

There were common themes on barriers and on approaches to eliminating them.

- The most commonly cited barriers were:
  - ✓ Access to transmission (i.e., transmission availability) from the Maritime Provinces to New England.
  - ✓ Cost of transmission from the Maritime Provinces to New England.
  - ✓ Difficulty of using current transmission reservation systems for intermittent generators that are exporting no more than 40% of the time.
  - ✓ Regulatory risks in entering export markets for electricity and for Renewable Energy Certificates.
  - ✓ Price risks in export markets, both for the electricity and for the RECs.
  - ✓ Lack of familiarity with the markets and the market rules and difficulty and complexity of market participation (scheduling, obeying dispatch orders, etc).
  - ✓ Lack of buyers willing to make necessary long-term commitments.
- The most commonly cited remedies for these barriers were:
  - ✓ Use of aggregators or agents (either existing entities or new ones) to schedule output, arrange for export sales, satisfy the criteria for market participation, etc.
  - ✓ Government and regulator commitment to promote new transmission, and promote or ensure regulatory certainty.
  - ✓ Consolidate the regional transmission system by having a single region-wide transmission provider (like a Regional Transmission Organization) or through making an existing system operator (like the NBSO) the operator for the whole region.

Most wind power developers find the New England market attractive.

- They cited several reasons for the expectation that New England represents an opportunity for exporters:
  - ✓ Prices for electricity are generally higher in New England than in the Maritime Provinces.
  - ✓ The value of renewable energy is higher in New England than in the Maritime Provinces.
  - ✓ ISO-NE is a much larger electricity market than that in the Maritime Provinces.
  - ✓ ISO-NE has a competitive market, including that for RECs. Any generator has an open chance to compete in the market. In the Maritime Provinces, the major market for renewables is through RFPs issued by the utilities. RFP processes can be costly and uncertain, and can deter smaller companies from participating.
  - ✓ A market for carbon emissions (or for reductions in carbon emissions), or some other form of restriction on carbon emissions, is imminent. Exporting renewables to New England is an attractive proposition given its expected large requirement for zero or low-emitting resources.
- Some participants said that, though they find the New England market attractive, they are not currently pursuing it for several reasons:
  - ✓ The current prices for electricity and for RECs are currently low.
  - ✓ The market is risky because its price depends so heavily on gas prices, which are volatile and can (as now) be low.
  - ✓ The rules with respect to RECs from outside of New England are viewed as subject to change given the anticipated desire to favour in region renewable resources.
  - ✓ Projects in the Maritime Provinces do not qualify for any government subsidies, while in the United States they get the Production Tax Credit or investment tax credit.

The most commonly identified barrier to increased wind power exports is transmission access.

- Almost all of the survey responses and all of the interviews with potential developers mentioned the difficulty of securing transmission access as one of the major barriers.
- Some recognized that the current conditions do allow for some additional wind power export, but that a significant increase in exports will require an upgrade in the transmission capacity.
  - ✓ The EA study said that such an increase would be cost effective because it would allow more exploitation of the Maritime Provinces wind power resources, which are cheaper than the New England resources.
  - ✓ The NBSO study said that accommodating more than about 1,500 MW of wind power in New Brunswick will require new transmission connections if it is to be economic.
  - ✓ Power Advisory's analysis of the history shows that even the previous export capacity (700 MW from New Brunswick to New England before the opening of the IPL, which raised the capacity to 1000 MW) was not fully utilized most of the time, and would have accommodated 100 MW of wind power at most times.
    - Existing limits on sales to New England can be problematic if the sellers are seeking financing for their projects based on sales to New England.

The most commonly identified barrier to increased wind power exports is transmission access.

- So there is capacity under current conditions to allow some exports from New Brunswick to New England with reasonable certainty of transmission access at most times. Furthermore, the NBSO OATT provides an opportunity for generators to access 188 MW of transmission capacity currently held by NB Power Genco.
  - ✓ At the time the OATT came into effect in New Brunswick in September 2003, firm contracts were in place for all the total transfer capability for the New Brunswick to New England tie (MEPCO tie) with the exception of 188 MW. The NB regulator (Board of Commissioners of Public Utilities of the province of New Brunswick) then allocated the remaining reservation of 188 MW to NB Power Generation (Genco) who was the holder of this initial reservation. Attachment M of the OATT provides options for the transfer of this reservation to non-affiliated parties. The transfer of reservations would need to be negotiated with Genco and include a viable business plan that would provide benefits to New Brunswick.
- As the NBSO report observed, this interface is not capable of accommodating a significant increase in wind power exports to New England.

The most commonly identified remedy to constrained transmission access is more transmission.

- Some said that whether more transmission is built will depend on the determination of governments and regulators.
- One respondent criticized the current model for building and financing transmission, under which an incumbent transmitter builds the line with the approval of the regulators and recovers the cost from all transmission users.
  - ✓ Access to the line is determined by a competitive bidding process, with the reservation going to the proponent offering the highest net present value to the transmission owner. This favors the large companies over the diverse and relatively smaller developers of wind power. Because of its relatively low capacity factor, wind power cannot win in such competitive auctions of the capacity.
- One possibility for improved transmission access is the construction of an undersea line carrying power generated in the Lower Churchill Project in Labrador from the Island of Newfoundland to New England. Wind power exporters from the Maritime Provinces could feed their exports into that line, if it is built.
  - ✓ However, this would require someone in the Maritimes reserving the transmission capacity. As discussed, it is difficult, if not impossible, to make a business case to reserve such transmission capacity for wind generation; a more diverse generation portfolio is required.

The most commonly identified remedy to constrained transmission access is more transmission.

- Several respondents said that aggregation would help with transmission access. By pooling a number of wind power generators, the aggregator would have the benefit of diversity among them. It could then schedule both the injection into the grid in the originating province and the transaction over the intertie. The geographical diversity of the aggregated wind power generators reduces the variability of the total output.
  - ✓ Furthermore, an aggregator would likely have a broader portfolio of resources that it could use to support its exports to New England with wind generation being exported when available and other resources when market economics dictate such sales.
- Some proposed that a government institution or government-owned entity act as the aggregator. The most commonly cited entities were the NBSO or NB Power Generation. The advantage of the NBSO is that it would be neutral, without its own business interests. However, by making the NBSO, in effect, an market participant itself, it would lose its independence as a system operator. As such, it would no longer be an independent system operator.
  - ✓ This independence is generally viewed as essential to ensuring that that the System Operator treats all transactions impartially.
- This could easily be role for a commercially oriented entity such as NB Power Genco.
- The New Brunswick government appeared to be open to having NB Power Genco serve in such a role. This would be a commercial service for which it would be compensated.
  - ✓ NB Power Genco is believed to be serving in this role for a wind project in Northern Maine.

Transmission cost is also seen as a barrier.

- This was especially true for developers contemplating a project in the Maritime Provinces but not in New Brunswick. In that case, they face the possibility of pancaked transmission charges even within the Maritime Provinces.
- But in competition with renewable generators located in New England, those from the Maritime Provinces have higher costs due only to the fact that they have to pay transmission charges at least in New Brunswick, while in New England the transmission tariffs are paid by loads.
- The remedy the respondents cited for pancaking is to move to a system that eliminates separate tariffs in each jurisdiction. One way to do this is to create a single system operator for the whole region, much like the Regional Transmission Organizations in the United States. However, this would require agreement among electric utilities and regulators in the region regarding addressing any transmission tariff revenue losses from such a move.
  - ✓ NBSO is already the reliability coordinator for the entire area; it could become or be the nucleus of a Regional Transmission Organization (or a similar entity) to be the system operator for the whole region.
- However, even with such an RTO eliminating rate pancaking may lead to a reduction in overall transmission revenues which could require an increase in transmission rates and reallocation of transmission costs among system users.
  - ✓ This is an issue that would need to be addressed by the region's utilities and regulators.
  - ✓ Solutions have been found to these cost reallocation issues in other jurisdictions and that this is a critical issue for wind project development in the region.

Some see the complexities of market participation as a barrier.

- An exporter from the Maritime Provinces must become, or be represented by, a market participant in at least the New Brunswick and ISO-NE markets. If located outside New Brunswick, it must also deal with either Nova Scotia Power or Maritime Electric.
  - ✓ In both markets, as a market participant the seller or its agent must obey all of the market's information, settlement, scheduling and control rules.
  - ✓ Intermittent generators have more issues with these rules than do other generators. To file output schedules a day in advance, they must forecast the wind speed. Deviations from schedule due to inaccurate wind speed forecasts create additional costs for the system operator. If the generator is exporting, these risks are negated with dynamic scheduling of the export. These considerations can complicate the relationships between the generator and the system operators.
  - ✓ A market participant needs to monitor its billing and settlement closely. Billing errors are not uncommon, and the rules for challenging settlements are rigid, often with a short window for appeals.
- Again, the use of an aggregator, agent or marketer is seen as the way to ameliorate these problems. Some noted that Emera is currently acting as agent for the sale of the power from the West Cape Wind project (now owned by Suez) in PEI.

The market both for electricity and for RECs is risky.

- The market for RECs depends on several conditions which can change:
  - ✓ The size of the overall New England market, which determines the level of demand for RECs (which are a fraction of the electricity sold);
  - ✓ The amount of generation in New England that is eligible to provide RECs; and
  - ✓ Other regulations and rules, such as those around giving REC credit to electricity generated outside of the ISO-NE control area.
- The electricity exporter also receives the ISO-NE market price. The ISO-NE market price is also subject to uncertainty:
  - ✓ Because New England is highly reliant on natural gas for generation, the price of electricity is often dependent on the price of natural gas. Natural gas prices, in turn, are volatile (as discussed earlier), making electricity prices volatile; and
  - ✓ The level of demand for electricity in New England.
- The preferred way to deal with such risks is to get a long-term contract (some mentioned 10 years, but more said that lenders want 20 year power purchase agreements).
- Some respondents said that they prefer to have at least some of their output sold on a merchant basis. One noted that the tolerance for merchant risk would be greater for larger developers, for whom projects in the Maritime Provinces would be one part of a larger portfolio, and they might take more (or less) risk in the Maritime Provinces to balance the risk in the entire portfolio.

Government and institutions are aware of the opportunities and barriers, and are engaged in looking for answers.

- New Brunswick has identified itself as an energy hub.
- The New Brunswick Department of Energy has commissioned or encouraged several studies addressing these issues:
  - ✓ The EA study on the potential for large-scale wind power generation in the Maritime Provinces;
  - ✓ The NBSO discussion paper on potential transmission and generation developments was completed on behalf of the New Brunswick Ministry of Energy; and
  - ✓ The recommendations of a report on New Brunswick Power and the market structure have been given to the New Brunswick Department of Energy but they are not yet public.
- Discussions with the NBSO and the New Brunswick Ministry of Energy indicate that they see a more active role for a Crown agency (likely NB Power) in facilitating energy development in the province, especially for renewable energy.
  - ✓ For example, they agreed that some government agency could play the role of aggregator for wind power generators, performing the market participant tasks and balancing and scheduling the generation.
  - ✓ The NBSO is considering actions it might take to alleviate potential transmission congestion problems.
  - ✓ The New Brunswick Ministry of Energy said that Ministry staff are in conversations with their counterparts in New England to discuss the possibility and implications of greater market integration.

Conclusions on market barriers.

- Power Advisory surveyed the members of CanWEA's Atlantic Caucus and interviewed some of them as well as key people in other institutions.
- Most respondents said that they think that New England is an attractive market for wind power exports because its RPS creates a need that New England itself is unlikely to be able to fill and because electricity prices are generally higher there than in the Maritime Provinces.
- The process identified a number of barriers to export of wind power from the Maritime Provinces:
  - ✓ The most commonly identified barrier was access to transmission from the Maritime Provinces to New England;
  - ✓ The complexity, difficulty and cost of participation in the markets, arranging sales, and other administrative tasks ;
  - ✓ The cost of transmission access;
  - ✓ Uncertainty caused by the possibility of changes to the market access rules in New England; and
  - ✓ Contracting risks, including price risks and the inability to find buyers willing to offer contracts of at least 10 years.
- In addition to these barriers, some developers noted, as a reason they are not currently pursuing sales to New England, the fact that export sales are not eligible for the ecoEnergy incentives while renewable generation in the United States does get incentives.
  - ✓ However, it appears that this program will not be extended and as such this benefit wouldn't be available to domestic projects either.
- There were several recommendations on how to address these barriers.
  - ✓ Work on increasing the capacity of the transmission interties.
  - ✓ Use an aggregator to handle all of the administrative, scheduling and sales aspects.
  - ✓ Elimination of separate transmission tariffs for going from one Maritime Province to another.
  - ✓ Work with the policy makers in the New England states to allow local distribution companies to increase their reliance on long-term PPAs for the procurement of renewable energy.

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Conclusions: Opportunities

- New England is a significant potential market for wind power exports from the Maritime Provinces.
  - ✓ All New England states have an RPS that requires generation from renewables. Most New England states probably cannot meet these requirements from their own resources.
  - ✓ The Maritime Provinces have the potential to develop large-scale wind power projects which could help New England load serving entities meet their requirements under their state RPSs.
  - ✓ Wind regimes in the Maritime Provinces are generally better than those in New England, giving wind power in the Maritime Provinces a cost advantage.
- There are no institutional or structural barriers to selling both energy and renewable energy certificates (RECs) from the Maritime Provinces to New England.

Conclusions: Transmission barriers

- Physical transmission barriers place an upper limit on the amount of wind power that can be exported from the Maritime Provinces.
- The maximum potential for exports of wind power from the Maritime Provinces is about 1,000 MW, without upgrades to the transmission system. This assumes that wind is using the full transfer capability of these lines.
  - ✓ This limit is created both by the capacity of the transmission interties between New Brunswick and New England and by transmission limits within New England.
  - ✓ This capacity is reserved by others and would only be available for wind generation if the contract holders were not using it or if wind generators contracted for its use on a short-term basis.
- Internally, the Maritime Provinces cannot integrate more than about 2,100 MW of wind power (1,500 MW in New Brunswick or PEI and 600 MW in Nova Scotia) without an increase in internal transmission capacity.
- The Maritime Provinces' cost advantages are reduced, and in some cases eliminated, by the cost of transmission. The advantage is eliminated by rate "pancaking", which occurs when a transaction has to cross a provincial border and must pay a second transmission charge before it crosses the international border.

Recommendations: Transmission barriers

- Proposed transmission investments in the United States would increase capacity for electricity flows south from Orrington. Potential Canadian exporters could support these proposals.
- System operators should pursue further opportunities for integration and coordination of their systems to allow increased electricity interchanges with the existing physical system or with relatively inexpensive upgrades.
  - ✓ This could be an intermediate term priority.
- Additional transmission could be built to enable additional wind generation for export to ISO-NE. This is a longer term objective. The cost/value analysis suggests that ISO-NE market prices need to increase to support this transmission investment unless the costs of these facilities are going to be shared with (borne by) other customers based on the broader societal benefits of wind generation. Potential exporters from the Maritime Provinces should commission or support studies to show that the overall benefits of importing wind power are greater than the cost of associated transmission upgrades.
  - ✓ A long-term perspective is needed when evaluating the benefits of these transmission system investments. In particular, there is a meaningful risk of higher energy prices when the economy rebounds. Furthermore, New England has an increasing demand for renewable and low-carbon generation.
- If wind generation in Nova Scotia or PEI is to cost-effectively access the New England market there is a need to eliminate rate pancaking by adopting uniform transmission tariffs in all the Maritime Provinces or in some other way.
  - ✓ This could be a short-term priority.

Conclusions: Market barriers

- The complexity and cost of becoming market participants, forecasting wind performance, scheduling electricity, and selling output make success difficult for smaller developers.
- There are several uncertainties with respect to the New England market:
  - ✓ Relevant rules might change. These could include rules on eligibility to create and sell RECs, rules on what generation is eligible to sell RECs (relaxing these rules make the RECs from the Maritime Provinces less valuable).
  - ✓ The sale of wind energy to New England carries with it a number of risks for the developer, not all of which are likely to be addressed by the terms of a power purchase agreement (PPA) for the output of a wind generator in the Maritime Provinces.
  - ✓ Obtaining long-term PPAs is very difficult and it is reasonable to expect that the pricing for such a PPA would be at a significant discount off of anticipated market prices.
- Further changes to the New England market structure are needed to further promote the use by LDCs of long-term PPAs for renewable energy supplies. The Eastern Canadian Premiers could advocate such changes in its joint meetings with the New England Governors Conference and as part of the Northeast International Committee on Energy.

Recommendations: Market barriers

- The market would benefit from one or more entities who can be an aggregator which will take on the role(s) of agent or marketer for wind project developers seeking to sell to New England. This entity would, for a fee, be responsible for all the administration of the wind power in the markets. The entity could be private or a government-related entity, such as a Crown corporation.
  - ✓ While there are currently parties that provide this service on a fee for service basis, wind project developers appear to lack information regarding the terms and pricing for such a service. This along with uncertainty and lack of information regarding the New England market represents a barrier to smaller developers considering and ultimately pursuing such sales. As such, one possibility is for an entity such as NB Power Genco to provide this service under a formal tariff or posted rate.
    - CanWEA members should assess the importance of this.
- Work within existing intergovernmental structures, such as the New England Governors/Eastern Canadian Premiers group, to identify uncertainties and barriers that governments can address, such as uncertainty about the rules.
- Promote the importance to both the Maritime Provinces and New England of a stable market and a stable relationship allowing the economic use of Maritime Provinces resources to meet needs in New England.

Appendix: Glossary of Acronyms

- ACP: alternative compliance payment, the amount that load serving entities in New England must pay if they have insufficient RECs to meet their RPS obligations
- CanWEA: Canadian Wind Energy Association, sponsor of this study
- CMP: Central Maine Power, the largest Maine electric distribution company
- DOER: Massachusetts Division of Energy Resources, the state agency responsible for administering Massachusetts' RPS program.
- EA: Energy Analysis, Danish consultancy who did wind potential study for Maritime Provinces
- EEI: Edison Electric Institute, a U.S. electric utility trade association
- FERC: Federal Electric Regulatory Commission, the US federal energy regulator
- ISO-New England: New England Independent System Operator.
- LDC: Local distribution company
- LMP: locational marginal pricing, the pricing framework used in New England where electricity prices can vary across the electricity transmission network based on congestion and marginal losses
- LSE: load serving entity, any entity that serves end user load.

Appendix: Glossary of Acronyms

- MECL: Maritime Electric Company Limited, the electric company in PEI
- METU: market efficiency transmission upgrade, a designation used by ISO-NE for transmission facilities that are anticipated to reduce electricity production costs or congestion costs.
- MPRP: Maine Power Reliability Program, a major transmission system upgrade that has been proposed for Maine.
- MPS: Maine Public Service, a small Maine electric distribution company whose service territory isn't directed interconnected with the ISO-NE market.
- MW: Megawatt, a basic unit of electric power, equal to one thousand kW.
- MWh: Megawatt hour, a basic unit of electrical energy, equal to one thousand kWh.
- NBSO: New Brunswick System Operator
- NERC: North American Electric Reliability Corporation, entity responsible for overseeing the reliability of the bulk power supply system.
- NPCC: Northeast Power Coordinating Council, one of the regional reliability councils that oversees the reliability of the bulk power system.
- NSPI: Nova Scotia Power Incorporated

Appendix: Glossary of Acronyms

- OATT: Open Access Transmission Tariff, the standard open access transmission tariff set by FERC
- PPA: power purchase agreement, contract for the purchase and sale of electric energy
- REC: Renewable energy certificate, the means of satisfying RPS in the New England states
- RES: renewable energy standard, a standard for renewable content set by Nova Scotia
- RFP: request for proposals
- RGGI: Regional Greenhouse Gas Initiative, a program set up by northeastern US states to commit to reductions in carbon emissions from the electricity production industry.
- RPS: Renewable portfolio standard, a state-set standard mandating that all electricity provided to consumers contain a minimum (and increasing) fraction of energy from renewable resources