nationalgrid

Thomas R. Teehan
Senior Counsel

July 10, 2009

VIA HAND DELIVERY & ELECTRONIC MAIL

Luly E. Massaro, Commission Clerk
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02889

RE: Docket 4050 – Commission Review into the Adequacy of Renewable Energy Supplies pursuant to R.I. Gen. Laws § 39-26-6

Dear Ms. Massaro:

On behalf of Narragansett Electric Company d/b/a/ National Grid ("the Company"), I have enclosed ten (10) copies of the Company's pre-filed direct testimony and attachments in the above-referenced matter.

The Commission initiated this docket pursuant to the provisions of R.I.G.L. §39-26-6(d), which requires the Commission to determine on or before January 1, 2010 the adequacy, or potential adequacy, of renewable energy supplies to meet the increase in the percentage requirement of energy from renewable energy resources to go into effect in 2011. In order to assist the Commission, the Company is submitting the pre-filed direct testimony of Madison Milhous and the pre-filed direct testimony and attachments of Ronald Norman of PA Consulting Group.

Thank you for your attention to this transmittal. If you have any questions, please feel free to contact me at (401) 784-7667.

Very truly yours,

Thomas R. Teehan

Enclosure

cc: Docket 4050 Service List
Leo Wold, Esq.
Steve Scialabba, Division

Certificate of Service

I hereby certify that a copy of the cover letter and/or any materials accompanying this certificate were electronically submitted to the individuals listed below.

__________________________________ May 15, 2009

Joanne M. Scanlon Date

National Grid

Docket No. 4050 – Commission's Review Into the Adequacy of Renewable Energy Supplies Pursuant to RIGL 39-26-6(d)
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DIRECT TESTIMONY

OF

MADISON N. MILHOUS

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I. Introduction

Q. Please state your name and business address.

A. My name is Madison N. Milhous, Jr., and my business address is 100 East Old Country Rd. Hicksville, New York 11801.

Q. Please state your position.

A. I am Director of Wholesale Market Relations for the Energy Portfolio Management organization at National Grid. In this capacity, I am responsible for monitoring and engaging in developments in market structure and operations in the New York Independent System Operator ("NYISO") and ISO-New England ("ISONE"), and in other regulatory and policy developments which directly affect electric power procurement. I represent National Grid on the NYISO Business Issues Committee and its working groups. Recently, I served as acting director of Electric Load and Distributed Generation, which is responsible for electric supply procurement for National Grid's four distribution companies. I continue to work with that department on electric power market policy issues.

Q. Will you describe your educational background?

A. I have Bachelor of Engineering and Master of Science degrees in Aerospace Engineering from Georgia Institute of Technology and a Master of Science Degree in Marine Science from New York's Stony Brook University.

Q. What is your professional background?

A. In my prior assignment, I handled the market relations function for KeySpan Energy Supply, which was responsible for fuel supply and electric energy trading for the generating units owned by KeySpan-Ravenswood, LLC ("Ravenswood"). I represented Ravenswood on various committees and working groups of the NYISO, and provided direct technical support to the electric trading operation. In 2006, I served as chair of the NYISO Operating Committee. Previously, I was Director of the Power Engineering Department, which provided engineering services for Ravenswood, and other KeySpan generating units. Prior to that position, I was Director of the Electric Planning and Forecasting Department, which provided resource and T&D system planning services to the Long Island Power Authority. Preceding this assignment, I was the Manager of Environmental Engineering at the Long Island Lighting Company, a predecessor company to KeySpan. I am registered as a Professional Engineer in New York and South Carolina. I am familiar with power generation equipment, environmental regulations and permitting, electric transmission and distribution, load forecasting, and ISO market structures and operations.

Q. Have you previously testified before the Rhode Island Public Utilities Commission ("Commission")?

A. No.

Q. Have you testified before any other state regulatory agencies?

A. Yes. I have testified before the New York Public Service Commission regarding electric system planning and wholesale electric market activities, and before the New York State Department of Environmental Conservation regarding environmental matters.

II. Purpose of Testimony

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to describe National Grid's response to the May 12, 2009 Memorandum issued by the Commission regarding Docket No. 4050 – Commission's Review into the Adequacy of Renewable Energy Supplies pursuant to R.I. Gen. Laws § 39-26-6(d). This section of Chapter 39-26 requires that the Commission determine on or before January 1, 2010, the adequacy or potential adequacy of renewable energy supplies to meet the increase in percentage requirement of energy from renewable energy supplies to go into effect in 2011.

III. Background

Q. Why does National Grid need to participate in this assessment?

A. National Grid is an obligated entity as defined under R.I.G.L. § 39-26-2(16) and the Commission's RES Rules.

Q. Did National Grid prepare an assessment of renewable resource adequacy or direct the preparation of an assessment by an independent consultant?

A. National Grid prepared a scope of work to address the requirements of R.I. Gen. Laws § 39-26-6(d), and engaged PA Consulting Group, located in Cambridge, MA, to prepare an assessment. The resulting report is an exhibit of the filed testimony of Ron Norman of PA Consulting. His testimony describes the methodology and findings of that assessment.

IV. National Grid Outlook on RES Adequacy

Q. Describe National Grid REC procurement experience to date.

A. National Grid has provided, in response to Division Data Request 1-21 in Docket 4041, volume and pricing information on RECs purchased from 2007 forward. This information is competitively sensitive, proprietary information that the Company wishes to keep confidential. The implications of this data with regard to adequacy can be summarized here, however. The data indicated that National Grid has consistently been able to meet its RES obligations by purchasing adequate volumes of RECs at prices consistently below the Alternative Compliance Payment. This conclusion is consistent with National Grid's experience in Massachusetts, with the exception that Alternative Compliance Payments were made on a limited basis in the early years of the Massachusetts RPS program.

Q. In light of the PA Consulting assessment, how would National Grid summarize the current and future outlook for renewable energy supplies.

A. To date, National Grid has found REC supplies adequate to meet its obligations in Rhode Island, and in Massachusetts as well. The PA report clearly signals a tightening of supplies in New England by 2011, as the requirements of the various states increase, and a shortfall of approximately 11% is forecast under the base case assumptions. The base case assumptions with respect to imports from adjacent control areas and with respect to proposed plants expected to be on line in 2011 are conservative, as described in the report. National Grid believes that the assessment performed by PA Consulting is robust. On the other hand, both National Grid and PA Consulting recognize that changes in these two baseline assumptions, in particular, could substantially erase the projected deficit. There is both the potential and incentive for additional supplies flowing from these sources, as identified in the assessment report. Finally, National Grid would point out that laws dealing with long term contracting for renewable energy resources, recently enacted in Massachusetts and Rhode Island, can be expected to have an impact on renewable energy supplies in the years immediately beyond 2011.

X. Conclusion

Q. Does this conclude your testimony?

A. Yes it does.

DIRECT TESTIMONY

OF

RONALD NORMAN

Q. Please provide your name, occupation, and business address.

A. My name is Ron Norman. I am a Partner in PA Consulting Group's Global Energy Consulting practice. My office is located at One Memorial Drive, Cambridge, Massachusetts 02142.

Q. Can you describe PA Consulting Group and the type of work it is involved in?

A. PA is a leading management, systems, and technology consulting firm with over 2,500 employees worldwide and approximately 100 staff members in its global energy practices. Established over 60 years ago, PA operates internationally from over 30 offices in more than 20 countries, including nine offices in the United States. PA has worked extensively on a broad array of renewable energy related projects in the northeast United States, focusing primarily on issues of supply, demand, cost, and valuation.

Q. Please describe your business experience and educational background.

A. I received a Bachelor of Science, Economics from the Massachusetts Institute of Technology. I have over 20 years of energy industry experience and specialize in wholesale electric, gas, renewable energy and emission allowance market analysis and price forecasting, generation and transmission asset and contract valuation, generator fuel pricing and procurement and analysis of environmental regulatory impacts on power and fuel markets. I am a regular advisor to leading power generators, utilities and lenders, and have extensive experience with development of Independent Market Expert reports and Independent Fuel Consultant Expert reports in support of the acquisition and financing of energy assets. My expertise also includes development of fuel and transportation contract analysis and negotiation, and litigation support including expert testimony preparation. I have worked extensively on a broad array of renewable energy related projects in the United States and the Northeast more specifically, focusing primarily on issues of supply, demand, cost, and valuation.

Q. Have you previously testified before the Rhode Island Public Utility Commission ("Commission") or before any other regulatory agencies?

A. I have not previously testified before the Commission, but I have testified or presented testimony in proceedings including testimony before the Federal Energy Regulatory Commission in a matter related to the economic benefits of a proposed new transmission line on behalf of Trans-Elect, Inc. as part of Docket Nos. EC03-30, et al. and testimony in a related technical conference in a matter related to the NYISO's proposed installed capacity demand curve on behalf of KeySpan Ravenswood, LLC as part of Docket No. ER05-428. I also testified before the United States District Court for the southern District of Indiana in 1999 on behalf of Seminole in <u>Seminole Electric Cooperative, Inc. v. Mt. Vernon Coal Transfer Co.</u>, Case No. IP-98-1732-C Y/F (S.D. Indiana).

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide an overview of the scope of the assignment that was given to PA Consulting relative to the adequacy of Renewable Energy Supply available to meet the Renewable Energy Standards obligations in 2011, and to summarize the methodology and conclusions stated in my report titled "Rhode Island Renewable Resource Adequacy Assessment" and dated July 10, 2009.

Q. What was the scope of the assignment that PA undertook?

A. PA was asked to complete an assessment of the adequacy of renewable energy supplies to meet the 2011 requirements of Rhode Island's Renewable Energy Standard (RES), which requires that 5.5% of electric energy supply be met by renewable resources (3.5% must be met by new renewable energy resources while 2% may be generated by either new or existing renewable energy resources).

Q. Please describe the methodology utilized in your assessment.

A. Each state in the New England region competes for the same general resources to meet its own standards, so my assessment necessarily considers the requirements of all states in ISO-NE that have renewable energy requirements, as well as all renewable resources currently operational in ISO-NE, and renewable resources projected to be operational in 2011. Northeast renewable energy markets are highly integrated, making a comprehensive understanding of supply and demand across all of New England essential to any effort to gain a complete understanding of the renewable resource adequacy in Rhode Island, specifically. As such, PA's analysis encompasses the renewable energy supply and demand balance throughout the entire New England region.

PA performed this analysis using public resources and its own database that closely tracks power plant development activities. PA established the demand of all New England RES states (all states except Vermont feature binding standards) and the supply projected to be available to meet that demand in 2011. The existing, projected, and imported supplies include approximately 1,000 renewable energy generation projects, each of which was assigned to one of 29 "bins," which represent the categories of demand that the resource might meet. Ultimately, this comprehensive process was necessary to gain a clear understanding of the adequacy of the renewable resource relative to the region's collective demand for resources of varying technologies and ages.

Q. Please summarize the conclusions of the assessment that you conducted.

A. After analyzing the 2011 supply-demand balances for all New England RES demand segments, PA projects a supply deficit of 11% for regional Class I resources and a large supply surplus across the key Class II-IV segments. It is difficult to predict precisely where the shortfalls will occur – with all states featuring similar penalties for non-compliance, one LSE appears no more likely than the next to acquire the available supply. Thus, the resulting conclusion is that, in the event of a regional shortage of Class I renewable energy, Rhode Island would be expected to be impacted in a manner proportionate to its share of the region's cumulative Class I demand.

This conclusion would not be complete, however, without a clear acknowledgement that, in the absence of perfect foresight, PA has made conservative judgments with regard to the availability of particular renewable resources to meet expected 2011 demand. There are numerous region-wide considerations that could affect Rhode Island's ability to meet its intended renewable energy target. In addition to simple deviations in actual load from projected load or adjustments to specific state standards anywhere in the region, there are several supply-related scenarios that could change the results found in this assessment. For example, PA has assumed no increase in renewable energy imports from outside the ISO-NE control area and has been conservative in identifying new projects likely to come online by 2011. Increased renewable energy imports or faster-than-projected new project construction – both feasible outcomes – would result in the mitigation or complete satisfaction of the projected New England-wide Class I deficit (all else being equal).

Q. Are you providing the details of your assessment along with the overview that you have provided in this testimony?

A. Yes. The complete written assessment, "Rhode Island Resource Adequacy Assessment," is included as Attachment 1 to my pre-filed direct testimony.

Q. Does that conclude your direct testimony?

A. Yes.

PA Consulting Group

Rhode Island Renewable Resource Adequacy Assessment

Methodology and Results

July 10, 2009

Rhode Island Renewable Resource Adequacy Assessment

Methodology and Results

July 10, 2009

Prepared by:
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Version: 4.0

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PA

1. INTRODUCTION AND SUMMARY

1.1 BACKGROUND AND SCOPE

PA has been asked to complete an assessment of the adequacy of renewable energy supplies to meet the 2011 requirements of Rhode Island's Renewable Energy Standard (RES), which requires that 5.5% of electric energy supply be met by renewable resources (3.5% must be met by new renewable energy resources while 2% may be generated by either new or existing renewable energy resources). Each state in the New England region competes for the same general resources to meet its standards, so this assessment must necessarily consider the requirements of all states in ISO-NE which have renewable energy requirements. The assessment spans all of the renewable resources currently operational in ISO-NE, all renewable resources projected to be operational in 2011, and projected imports from adjacent control areas.

1.2 QUALIFICATIONS

PA is a leading management, systems, and technology consulting firm with over 2,500 employees worldwide and approximately 100 staff members in its global energy practices. Established over 60 years ago, PA operates internationally from over 30 offices in more than 20 countries, including nine offices in the United States. PA has worked extensively on a broad array of renewable energy related projects in the Northeast United States, focusing primarily on issues of supply, demand, cost, and valuation.

Additional information about PA Consulting Group is included in Section 2.

1.3 METHODOLOGY

Northeast renewable energy markets are highly integrated, making a comprehensive understanding of supply and demand across all of New England essential to any effort to gain a complete understanding of the renewable resource adequacy in Rhode Island, specifically. As such, PA's analysis encompasses the renewable energy supply and demand balance throughout the entire New England region.

PA performed this analysis using public resources and its own database that closely tracks power plant development activities. PA established the demand of all New England RES states (all states except Vermont feature binding standards) and the supply projected to be available to meet that demand in 2011. The existing, projected, and imported supplies include approximately 1,000 renewable energy generation projects, each of which was assigned to one of 29 "bins," which represent the categories of demand that the resource might meet. Ultimately, this comprehensive process was necessary to gain a clear understanding of the adequacy of the renewable resource relative to the region's collective demand for resources of varying technologies and ages.

1.4 FINDINGS

After analyzing the 2011 supply-demand balances for all New England RES demand segments, PA projects a supply deficit of 11% for regional Class I resources and a large supply surplus across the key Class II-IV segments. It is difficult to predict precisely where the shortfalls will occur – with all states featuring similar penalties for non-compliance, one

LSE appears no more likely than the next to acquire the available supply. Thus, the resulting conclusion is that, in the event of a regional shortage of Class I renewable energy, Rhode Island would be expected to be impacted in a manner proportionate to its share of the region's cumulative Class I demand.

This conclusion would not be complete, however, without a clear acknowledgement that, in the absence of perfect foresight, PA has made conservative judgments with regard to the availability of particular renewable resources to meet expected 2011 demand. Section 4.2 introduces several possible scenarios that could quite feasibly serve to mitigate or even erase the projected Class I regional supply deficit.

1.4.1 Projected Supply-Demand Balance

PA finds that the resources projected to be available in 2011 to meet New England's collective Class I standards – which generally require newer renewable resources including wind, landfill gas, and more sustainable types of biomass – are expected to produce slightly less renewable energy than demanded under current standards. In reaching this conclusion, potential supplies in 2011 were calculated by adding the projected production from existing Class I resources, imports (held constant at 2008 levels), and plants expected to be in operation before the end of 2011. These resources are expected to be able to provide 89% of New England's Class I target for that year. Assuming this deficit gets proportionally applied across the states, Rhode Island would face an 11% supply shortfall relative to its new renewable demand.

By contrast, hydropower, municipal solid waste, and older forms of generation needed to meet each state's unique secondary classes of requirements are projected to be more than sufficient to meet demand in 2011.

1.4.2 Key Considerations

There are numerous region-wide considerations that could affect Rhode Island's ability to meet its intended renewable energy target in 2011. In addition to simple deviations in actual load from projected load, or adjustments to specific state standards anywhere in the region, there are several supply-related scenarios that could alter the result. Supply factors considered include renewable energy imports, the pace of development of proposed plants, the potential for fuel switching at existing plants, and reliance on banking or borrowing of renewable energy credits (RECs) as a means of compliance. All scenarios considered lead to increased supply. PA considered six scenarios incorporating these factors, with four of the six scenarios resulting in elimination of the Class I supply deficits.

PA has also considered the potential impacts of deviations from its principal assumptions, such as treatment of Maine's resources, downside capacity factors, and this assessment's overarching assumption of rational market behavior. These sensitivities are also presented in Section 4.2.3.

2. QUALIFICATIONS

To complete this analysis, PA has drawn on its years of experience in the energy industry and its extensive recent experience with Northeast renewable energy related work.

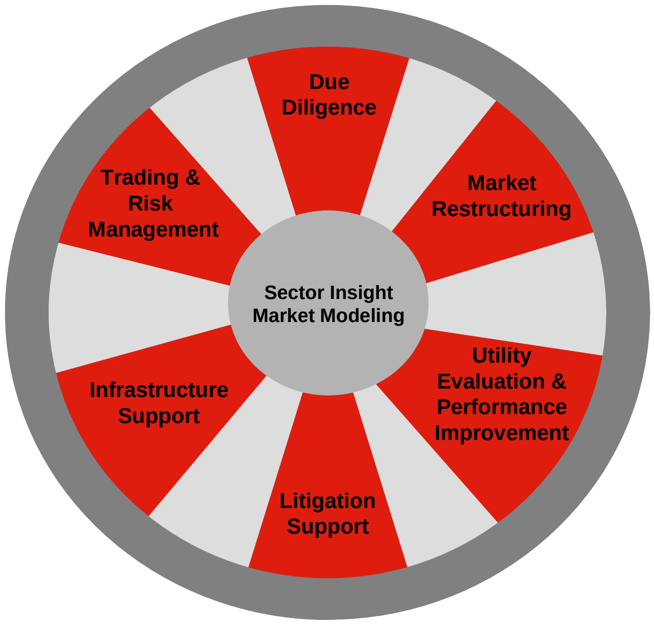
2.1 PA CONSULTING GROUP

PA's Global Energy Practice is an established and broadly recognized consultancy in the U.S. and global energy markets.

PA Consulting Group is a leading management, systems, and technology consulting firm. Established over 60 years ago, PA now operates worldwide from over 30 offices in more than 20 countries (including nine offices in the United States), and has 2,500 staff, whose skills span the initial generation of ideas and insights all the way through to detailed implementation.

PA's global energy practices include over 100 staff members and offers expertise in six key service areas (illustrated in Figure 2-1):

Figure 2-1
PA Global Energy Practice Service Areas



- Trading and Risk Management: PA provides asset management and commodity trading design and advice, including the development of trading strategies, trading floor leadership, and risk management and policy development. This includes the development of infrastructure to support these operations.

- Due Diligence: PA reviews business and asset operations in the natural gas and power industries to issue opinions regarding financial viability and investment alternatives. This includes analysis of strategies to respond to environmental regulations.

- Market Restructuring: PA aids in the design and development of power markets.

- Utility Evaluation and Performance Improvement: PA conducts utility performance benchmarking and helps utilities increase operational efficiency, lower business costs, and strengthen customer loyalty.

- Litigation Support: PA provides expert testimony on a variety of energy industry topics, including regulatory rate cases, damage claims, market power, and trading practices.

- Infrastructure Support: PA performs economic assessments of delivery infrastructure assets, including natural gas assets.

PA

3. METHODOLOGY

Load-serving entities (LSEs) in all New England states except Vermont are subject to binding renewable energy standards (RES), each of which permits the purchase of RECs from any eligible supplier that delivers its energy to the ISO-NE power grid.[1] Because LSEs may meet their obligations with RECs from any eligible New England supplier, to evaluate any New England state's renewable resource adequacy one must consider the supply and demand in all other states in the region. As a result, PA Consulting's (PA) assessment of Rhode Island's renewable energy resource adequacy requires quantification of demand and supply for all New England states, as well as any renewable energy imports from adjacent regions.

This section describes the process used to quantify demand, estimate the production from existing and projected supply, and develop the pursuant analysis.

3.1 DEMAND

Renewable energy demand in a given state is generally a product of the state's total electricity demand that is subject to RES compliance (in GWh) and the state's targets (in percentage terms) with which obligated LSEs must comply. All states feature various slightly different compliance targets and definitions of eligible technologies, and each one typically establishes its various resource goals by arranging compliance obligations under individual classes (i.e. Class I, Class II, etc.).

Table 3-1
RES Demand, by State and Class

	2009	2010	2011
Class I Demand (GWh)			
CT	1,919	2,239	2,579
MA	2,002	2,503	3,027
ME	104	156	210
NH	54	108	217
RI	326	366	451
Total	**4,405**	**5,373**	**6,485**
Class II Demand (GWh)			
CT	960	960	967
MA	1,802	1,802	1,816
MA	1,752	1,752	1,766
ME	3,355	3,355	3,381
NH	4	9	16
Total	**7,872**	**7,877**	**7,946**
Class III Demand (GWh)			
CT	960	1,280	1,290
NH	485	593	707
Total	**1,445**	**1,873**	**1,996**
Class IV Demand (GWh)			
NH	108	108	109
Total	**108**	**108**	**109**

To quantify the expected demand, PA utilized the New England load projections from the *Forecast Report of Capacity, Energy, Load, and Transmission (CELT) 2009-2018*,[2] which provides forecasts for ISO-NE in aggregate. PA disaggregated the regional projection into state-by-state forecasts of demand using the proportions found in actual 2007 historical data from the latest Energy Information Administration (EIA) Form 861 (*Retail Sales of Electricity by State by Sector by Provider, 1990-2007*). To determine the share of load subject to RES compliance in each state, PA consulted the most recently available RES compliance report for each state and applied similar proportions to the 2011 projected state by state load figures. Resulting 2011 demand figures, by state and class, are displayed in Table 3-1. Connecticut's Class III provision was not considered in this analysis because it pertains to cogeneration and efficiency and thus does not affect the Rhode Island renewable energy supply.

[1] In practice, renewable energy standards (RES) and renewable portfolio standards (RPS) are designed to encourage the same general response from the utilities subject to them. For simplicity, we will use the term RES throughout this report to refer to both groups of legislation.

[2] The latest CELT report, issued in April 2009, was accessed through the ISO-NE website.

State targets and program specifics, listed in the Appendix, were generally sourced from state RES legislation accessed via the Database of State Incentives for Renewables & Efficiency (DSIRE) at DSIREUSA.org.

3.2 SUPPLY

PA considered three primary tranches of renewable energy supply: existing New England plants, projects projected to be operating by 2011, and imports.

- Existing renewable energy projects in New England were sourced via Energy Velocity, with primary data largely from EIA-923 and the U.S. Environmental Protection Agency's Continuous Emissions Monitoring System (CEMS).

- PA's plant addition projections are the result of a rigorous ongoing power plant tracking process. Identification of future supplies, or those deemed likely to come online by 2011, requires significant research and external communication. PA routinely reviews public documents, speaks with regulators, and contacts developers and other market participants to remain apprised of plant development activities. To merit inclusion in PA's market modeling base case, a proposed ISO-NE project must first meet one of the following criteria: it must be under construction, have secured financing, or have cleared in the Forward Capacity Market (FCM) auction. For examining expected supplies two to three years in the future, this approach is very comprehensive for technologies that require significant lead time for construction such as biomass. Wind projects, however, can be constructed in shorter time frames. While it would be difficult to identify a more effective way of predicting commercial online dates, it is important to acknowledge that the build time for wind projects, often less than one year, is short enough to allow wind projects to come online by the end of 2011 without having yet met any of the criteria above. To address this reality, PA also tracks proposed plants, though they have not been included in the projected supply quantified in this assessment (see Section 4.2.1(b)).

- New England LSEs may meet their RES obligations through RECs generated outside of ISO-NE, provided the associated energy is delivered to the ISO-NE grid. Data on actual 2008 imports from the New York control area, Quebec, and the Maritimes were obtained from NEPOOL-GIS. While imports increased substantially each year from 2006 through 2008, the 2008 figure has been held constant in this analysis. As discussed further in Section 4.2.1(a), available transmission from all three external regions is heavily utilized and there are no transmission capacity upgrades that are expected to increase the availability of import capacity by 2011. As such, any significant increase in renewable energy imports would necessitate the displacement of non-renewable imports.

PA estimated individual plant production based on actual historic generation figures, where available. When less than one year of actual historic generation data were available – as in the case of new resources or small hydroelectric projects not compelled to file EIA-923 – PA estimated 2011 production according to typical capacity factors by technology (See Appendix for details).

PA

3.3 ANALYSIS

While the same technologies and basic principles often apply from one state's RES to the next, significant variation does exist on a more granular level. States feature multiple resource classes, each including different rules regarding technology eligibility, capacity limits, and plant vintage. Due to the highly nuanced and varied state standards, generation that qualifies in one state may be treated somewhat differently or excluded altogether in another. To meet this challenge, PA pursued a comprehensive project by project, class by class review to gauge supply adequacy.

After identifying 29 exclusive "bins" into which a given unit of supply might fit, PA reviewed all existing and projected renewable energy plants (nearly 1,000) to determine eligibility by state program and class. PA determined eligibility according to the actual programs for which the plants had applied and received eligibility, as identified by NEPOOL-GIS and state specific lists of eligible Class I resources. In cases where a facility is eligible to meet the requirements of a class of renewables for a given state, it was assumed that states with comparable requirements would also grant access to such a plant if the plant were to apply.

After appropriately categorizing and sorting all ISO-NE imported and in-region supply (existing and 2011 projected) into appropriate bins, PA assessed the ability to meet demand, bin by bin. To facilitate consideration of supply across the entire region, PA conducted its analysis with an overarching assumption of regional supply optimization. A project of a given technology and age might meet different classes of demand in different states, but an LSE in one state will comply with its RES obligation using the RECs generated by projects deemed least valuable by other programs. For example, if a Maine LSE can meet its RES using hydro RECs, it will not instead procure wind RECs that might otherwise be used by LSEs in other states that cannot rely on hydro attributes. In other words, all else being equal, an LSE will meet its obligation using the supply of least market value to other participants. While this principle tends to hold in any market that features ample substitutes, it is important to note that suboptimal purchase or sale decisions by market participants could conceivably create an otherwise unwarranted surplus for one requirement and a deficit for another.

PA

4. FINDINGS

In projecting the adequacy of renewable energy supply relative to Rhode Island's expected RES-driven demand in 2011, PA analyzed the supply demand balance as comprehensively as possible. PA employed the best information available, considering any and all pertinent data sources to best project the growth of demand and supply. Using the data available, PA projects a modest supply shortage across the aggregated New England Class I programs, including Rhode Island, and a significant surplus across the Class II+ programs. These results are discussed in greater detail in Section 4.1.

While PA is confident that the resulting assessment is as rigorous as possible under the circumstances, PA acknowledges that this analysis has been conservative in places and that there are any number of scenarios that might impact the supply-demand balance. Section 4.2 identifies and quantifies scenarios which could generally act to mitigate or erase the projected Class I supply deficit, as well as some sensitivities that would act to exacerbate the projected issue of non-compliance.

4.1 PROJECTED SUPPLY-DEMAND BALANCE

PA's assessment found that New England's aggregated Class I demand exceeds projected Class I supply, with projected generation falling 11% short of projected demand. All states' Class I Alternative Compliance Payments are of the same magnitude, suggesting that any supply shortfall would be distributed across all states. With no one state any more likely to meet its RES than any other, it is perhaps appropriate to project that all states, including Rhode Island, will split the 11% shortfall in a proportionate manner.

Rhode Island's projected demand in 2011 equals 451 GWh, consisting of 164 GWh of generation from "existing" resources (2% of demand) and 287 GWh from "new" resources (3.5%). The "existing" standard can be completely met by available older resources, but the "new" standard, assuming proportional compliance rates across New England Class I, would have an 11% shortfall. Thus, Rhode Island's projected shortfall for 2011 is 32 GWh, or approximately the annual generation of 11 MW of wind or 4 MW of biomass.[3]

Across New England, the aggregate lower tiers of supply are projected to significantly exceed demand, buoyed by existing hydro and biomass that are ineligible for Class I compliance.[4]

4.1.1 Demand

Renewable demand, segmented by state, is shown in the following two diagrams. Class I demand increases from 4,400 GWh/yr in 2009 to 6,500 GWh/yr in 2011 – a nearly 50% increase, as shown in Figure 4-1. This growth is driven almost exclusively by escalating renewable penetration targets, with load growth over this period expected to be quite small. Massachusetts and Connecticut dominate the demand, followed by Rhode Island, Maine, and

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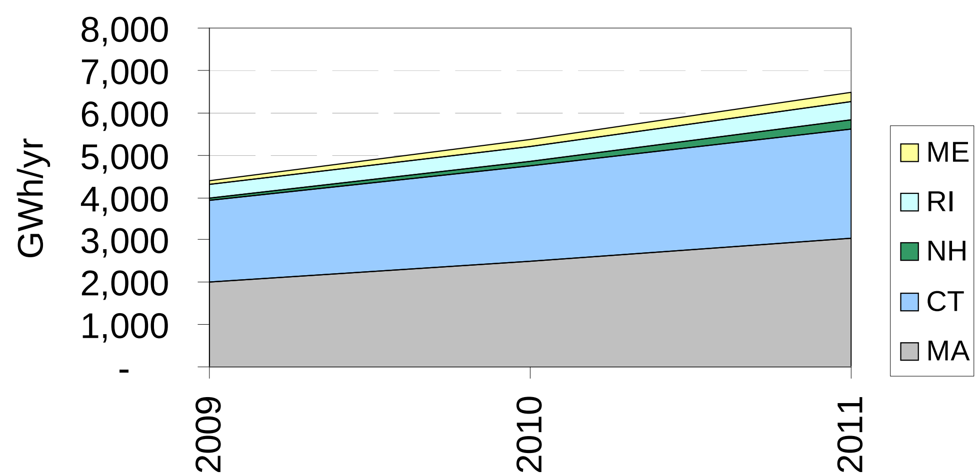
[3] Of course, any supply addition by Rhode Island would be assumed to be divided proportionally among all New England RES states. Class I compliance for all of New England would require the generation equivalent of 250 MW of wind or 100 MW of biomass.

[4] New Hampshire's relatively small Class II solar energy requirement is an exception, as compliance has not been demonstrated in this assessment.

New Hampshire. Vermont's goal is non-binding and is not expected to directly increase the region's demand for renewable energy.

Figure 4-1
2009-2011 RES Demand – Class I



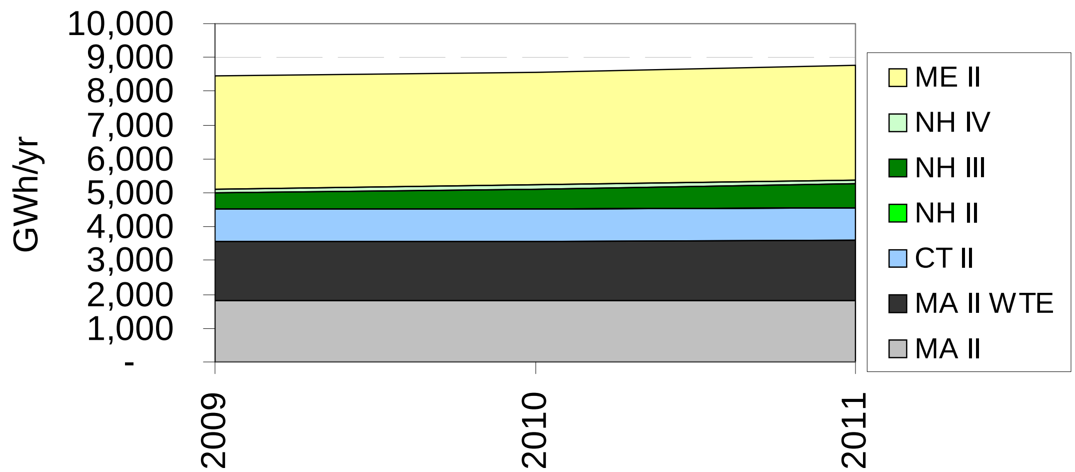
With the exception of Rhode Island, each state also provides requirements for additional classes of resources.[5] These requirements typically allow for older generating units or separate requirements for specific technologies (e.g., waste to energy). Class II, III, and IV demand (Figure 4-2) is largely flat between 2009 and 2011, increasing from 8,500 GWh/yr to 8,800 GWh/yr.[6]

A full description of eligible technologies for each class and state is provided in the Appendix.

[5] Rhode Island does not specifically identify additional classes, though it does differentiate between "existing" (pre-1998) and "new" units. PA's assessment has accounted for this differentiation, but has included all Rhode Island demand in the Class I category (where aggregated across all states).

[6] Excludes Connecticut's Class III provision, which was not considered in this analysis because it pertains to cogeneration and efficiency and thus does not affect the Rhode Island renewable energy supply.

Figure 4-2
2009-2011 RES Demand – Class II, III, IV



4.1.2 Supply

Supply analyzed in this assessment included existing resources, projected supply additions, and imports from outside ISO-NE.

a. EXISTING RESOURCES

Existing resources include only currently operational generating facilities within ISO-NE. Table 4-1 provides a summary of the existing renewable generating capacity as of June 15, 2009 and its expected annual generation (based on historical figures where available). While the largest contributors are hydropower, biomass, and waste-to-energy, respectively, each of those technologies faces strict limitations (or outright prohibitions) from meeting Class I demand. Landfill gas, wind, and solar energy, by contrast, can be consistently applied to the most stringent of categories.

Table 4-1
Existing ISO-NE Renewable Energy Supply

	Capacity (MW)	Production (GWh/yr)
Biomass	948	3,884
Hydro	1,946	8,059
Landfill Gas	135	725
MSW	287	2,161
Solar	1	2
Wind	100	283
Total	**3,417**	**15,114**

Source: Energy Velocity

PA

b. PLANNED RESOURCES

Through 2011, there are 411 MW of planned renewable capacity additions in ISO-NE that meet the criteria necessary to be included as base case resources. These units are projected to generate approximately 1,400 GWh annually (see Table 4-2). Two-thirds of the energy contribution will come from wind additions and over 20% will come from a landfill gas project. The major projects include Kibby Wind (132 MW) and Record Hill Wind (55 MW) in Maine, Granite Reliable Wind in New Hampshire (99 MW), and the Johnston Landfill Gas project in Rhode Island (41 MW). These projects will significantly increase the amount of Class I renewable energy that is generated within ISO-NE. Figure 4-3 shows the location of these plants.

Table 4-2
Base Case Planned ISO-NE Renewable Supply, 2009-2011

Project Name	State	Fuel Type	Capacity (MW)	COD	Estimated Production (GWh/yr)
Milford Fuel Cell Project - NG	CT	Natural Gas	7	Jul-09	55
Milford Fuel Cell Project - Waste Heat	CT	Waste Heat	2	Jul-09	16
PMLD Wind Farm	MA	Wind	3	Sep-09	9
Hancock (Berkshire Wind Power)	MA	Wind	15	Mar-10	43
Coventry Landfill - Expansion	VT	Biomass	2	Mar-10	14
Kibby Wind Power Plant	ME	Wind	132	Jun-10	382
Granite Reliable Power Windpark	NH	Wind	99	Jun-10	286
Record Hill Wind Farm	ME	Wind	55	Dec-10	159
Genco LFG 1 and 2 (Johnston Landfill)	RI	Landfill	41	Dec-10	323
Longfellow Wind Project	ME	Wind	40	Jun-11	58
Concord Steam Power Plant	NH	Biomass	15	Jun-11	53
Total			**411**		**1,397**

Figure 4-3
Base Case Planned Supply, by location – 2009-2011

c. *IMPORTS*

Between 2006 and 2008, imports of renewable energy increased by nearly a factor of eight. In 2008, imports from Quebec exceeded 1,000 GWh, while New York contributed nearly 700 GWh, and the Maritime Provinces contributed over 300 GWh (see Table 4-3). As discussed in Section 4.2.1(a), transmission constraints into ISO-NE are likely to impede the continuation of this growth rate. For the purposes of this study, PA has assumed that the 2008 import level was held constant through 2011.

Table 4-3
Renewable Energy Imports into New England, 2006-2008

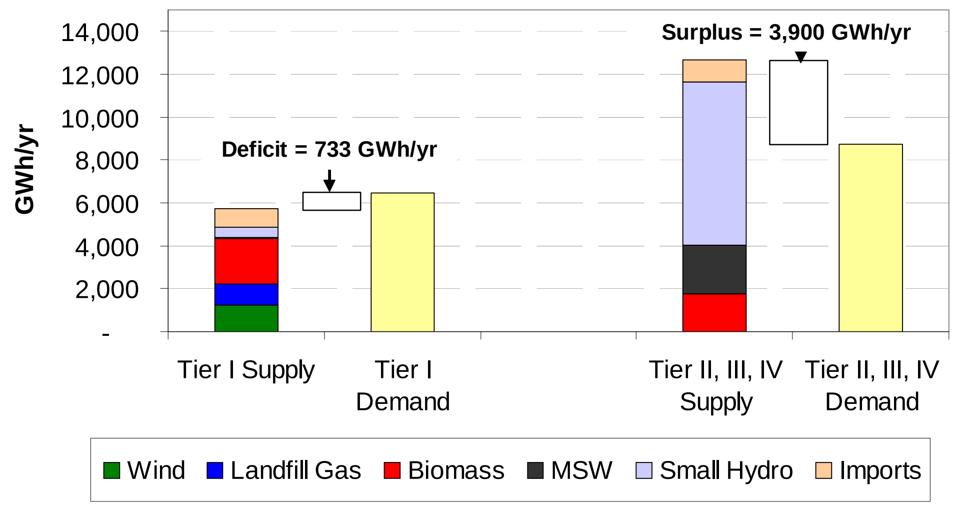
	2006	2007	2008
Historical Imports by Origin (GWh)			
New York	184	371	678
Maritime Provinces	-	118	325
Quebec	55	185	1,077
Total	**240**	**675**	**2,079**

4.1.3 Supply vs. Demand

Figure 4-4 shows the 2011 renewable energy supply and demand across ISO-NE. The demand is representative of the total demand across Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island, while the supply represents the aggregated resources that will be eligible to meet this demand *for any of the state-level standards*.

The expected Class I supply is 5,751 GWh, 733 GWh short of the 6,484 GWh target demand. This 733 GWh shortfall could be eliminated by adding approximately 100 MW of new biomass or 250 MW of new wind capacity.

Figure 4-3
2011 RES Supply and Demand



Class II, III, and IV supply is projected to be approximately 3,900 GWh higher than the aggregated demand for these resources. Approximately 12,700 GWh of Class II is expected to be online in 2011, far exceeding the 8,800 GWh of demand. Much of the surplus cannot be applied to any state's requirement, though. Nearly 25% of this surplus comes from biomass or hydro that could only be used in the oversubscribed ME II Class. Of the remainder, almost all is hydro with limited RES applications.

a. ALTERNATIVE COMPLIANCE PAYMENTS

During compliance periods when renewable demand exceeds available supply, load serving entities must rely on alternative compliance payments (ACP) to meet an unmet demand. The ACP is designed to provide a safety valve or maximum cost for REC prices. It currently stands at approximately $60/MWh for Class I requirements in each of the New England states.

In a well-functioning regional market, the states with the highest ACP would procure available resources while LSEs in states with lower ACP rates would be more likely to meet deficits through the ACP. However, given the similarity of the ACP levels for Class I requirements across the ISO-NE, there is not a state where it would be obviously preferential to utilize the ACP. As such, it is reasonable to assume that any renewable deficit would be essentially spread across all states within the region.

4.2 KEY CONSIDERATIONS

There are any number of factors that could impact the adequacy of New England supply relative to demand, with impacts that could both help or hinder the ability of Rhode Island LSEs to meet their RES requirement. Unanticipated systemic changes could include higher or lower than predicted demand growth. States could also impose regulatory changes that alter the list of eligible technologies, increase or decrease the renewable targets, or create interstate trade barriers. There is precedent for frequent changes to state programs, creating enduring uncertainty for LSEs and developers.

Such changes are difficult to predict. Beyond these regulatory risks, there are other more subtle considerations that help illustrate the potential for variance from the findings stated in Section 4.1. This section expands upon key supply-related considerations, identifying the issues and illustrating the potential impact to the projected supply demand imbalance, and considers sensitivities surrounding the assumptions that PA employs in its assessment.

4.2.1 Supply Considerations

In general, PA has been intentionally conservative in its identification of eligible resources. There are several areas where faster than anticipated progress or uncertain adjustments could create a greater supply of eligible renewable energy if needed to meet 2011 requirements. Examples of potential sources of renewable energy that could cause supply to exceed that estimated in this report include additional imports, faster-than-expected near-term ISO-NE supply additions, fuel switching, and reliance on banking and borrowing.

a. IMPORTS

For the purposes of this assignment, PA has assumed that 2011 imports remain constant at the actual import levels experienced in 2008. While the substantial increase in imports each year from 2006 through 2008 might suggest otherwise, PA sees no developments that call for different treatment. Available transmission from New York, Quebec, and the Maritimes (including Northern Maine) is currently heavily utilized, with no upgrades projected by 2011. Any significant increase in renewable energy imports, therefore, would necessitate the displacement of non-renewable imports. While the favorable revenues stemming from energy plus REC sales make a compelling theoretical case for a changing import mix, PA has not assumed that such displacement of fossil-fired resources will occur.

In the longer term, however, there are several transmission projects planned that, if completed, will increase import capability for renewables. The Maine Power Reliability Program will add capacity from Orrington to New Hampshire, allowing increased imports from the Maritimes. It is expected to be in service in late 2012 or 2013. Additionally, Central Maine Power and Maine Public Service have proposed the Maine Power Connection, an interconnection between northern and central Maine which would substantially increase import capacity from northern Maine and the Maritimes. This project is currently on hold as the parties investigate alternative facilities and funding options. If the project moves ahead, it probably would not be in service before 2014.

Several parties have expressed interest in adding DC transmission from Canada to New England. One advanced proposal from NSTAR, Northeast Utilities, and H.Q. Energy Services would be primarily used for firm sales from large Canadian hydro projects into New England. The participants are investigating the possibility of increasing the capacity of the line to allow for third-party use, which could result in about 200 MW of capacity being made available for more traditional renewables. Another proposal would deliver power from the Maritimes and northern Maine to Boston via an underwater DC cable. None of these projects is likely to be in service before 2015.

No significant increase of transmission capacity from New York to New England is presently planned.

b. PROPOSED PLANTS

There is a significant quantity of potential supply additions that PA has not included in its analysis. The base case view on which PA's analysis is based includes future plants only in the event that they were found to be under construction, to have secured financing, or to have cleared the FCM auction. These plants account for 411 MW of new capacity. But there are numerous other plants which may come online before the end of 2011 that have not yet met those criteria. In total, there is 558 MW of proposed supply with estimated commercial online dates by the end of 2011. The breakdown of these proposed plants, by technology, is illustrated in Table 4-4. A more detailed table is provided in the Appendix.

If all projects were completed, their projected output of 1,870 GWh would account for nearly 14% of New England's 2011 renewable demand across all classes.

Table 4-4
Proposed Supply

Technology	Number of Projects	Capacity (MW)	Estimated Production (GWh/yr)
Estimated COD through 2011			
Biomass	8	296	1,137
Hydro	2	2	8
Landfill Gas	2	6	31
Fuel Cell (Natural Gas)	5	26	120
Wind	9	228	574
Total	**26**	**558**	**1,870**
Estimated COD 2012 and later			
Biomass	15	544	3,812
Hydro	18	1,404	4,059
Landfill Gas	2	50	394
Fuel Cell (Natural Gas)	3	45	315
Solar	3	8	14
Wind (off-shore)	9	1,210	5,157
Wind (on-shore)	19	1,364	3,943
Total	**69**	**4,625**	**17,695**

PA has deemed other possible additions, such as proposed offshore developments in Massachusetts and Rhode Island, unlikely to be completed by 2011. Over 4,600 MW of proposed renewable capacity which may come online after 2011 is currently being tracked by PA. Collectively, if completed, these plants would produce approximately 17,700 GWh of energy each year, providing an abundance of renewable resources for many years into the future.

c. FUEL SWITCHING

After undergoing requisite modifications, coal plants can be converted to use biomass as a feedstock. Assuming emissions requirements and other standards are met, these converted units can serve as major contributors to RES requirements. Fuel switching (or in certain cases blending) in existing fossil fuel plants could allow for the rapid expansion of renewable-certified generation. New England currently has approximately nearly 3 GW of coal-fired generation capacity, providing a significant potential for such fuel switching.

The conversion process often requires updating or adding infrastructure to deal with biomass fuel handling and receiving. One must also anticipate any plant capacity degradation associated with fuel switching due to the lower heat content of forest residue and other woody materials and the possibility that some boilers will require higher operational temperatures to avoid waste material build-up.

The time required to convert a plant is highly dependant on the current state of the boiler, as well as the intended new feedstock and the existing infrastructure capabilities. PA understands plants currently undergoing retrofit will take approximately two years to complete, but often these plants are already in need of major capital investment. Newer plants without such needs could expect reductions in conversion time.

Biomass has and will likely continue to be a major contributor to New England's renewable energy portfolio. Recently, however, market trends show increasing fuel costs of biomass plants in Maine and upstate New Hampshire. Increasing cost trends, if continued, could potentially precipitate postponed development plans, and potentially lead to LSEs opting to pay alternative compliance payments rather than pay escalating REC prices.

d. BANKING AND BORROWING

To provide some flexibility in meeting the renewable energy requirements, some states allow RECs to be banked for use in future years or borrowed from future years. Maine allows for banking and borrowing of up to one-third of the requirement for one year. New Hampshire allows up to 30% of a class requirement to be banked for up to two years or borrowed for up to three months. Massachusetts and Rhode Island each allow up to 30% of the requirement to be banked for two years.

To the extent that RECs are banked from 2009 or 2010, it could impact the supply available in 2011. More likely, though, is the possibility that LSEs might borrow from future years' supply. Borrowing could use future supply to mitigate short-term deficiencies, particularly if major developments like offshore wind come online in 2012 or new imports are facilitated via major new transmission projects.

4.2.2 Supply Scenarios

To better understand the likelihood of PA's projection of supply deficit of 733 GWh in 2011. PA conducted several scenarios to assess the effect of various actions on the New England Class I renewable supply, summarized in Figure 4-4.

- "More Imports": In the base assessment, the renewable imports into New England were held constant at 2008 levels through 2011. This scenario, however, assumes that the annual increases in renewable imports that were achieved between 2006 and 2008 could continue through 2011. This additional 1,200 GWh of supply, which could be obtained by displacing fossil fuel imports with renewable imports, would more than cover the 2011 deficit.

- "Proposed Plants": PA tracks 560 MW of proposed renewable plants in New England that are not included in the base assessment. If all of these plants were to come online, an additional 1,849 GWh of renewable energy would be available in 2011.[7] Just 40 percent of the generation from these plants would eliminate the 2011 supply deficit.

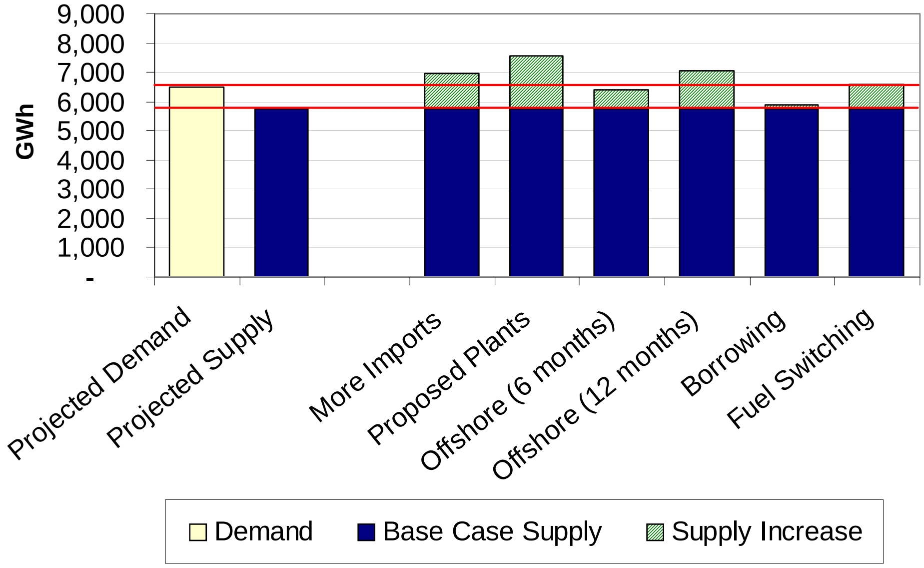
- "Offshore (6 months)" and "Offshore (12 months)": There are several large offshore wind projects currently proposed. None of them meet the requirements for inclusion in PA's base case, but if they were to come online they would serve to significantly increase Class I supply. Deepwater Wind has proposed a 405 MW offshore project with an expected capacity factor of approximately 37%. If the project came online in mid-2011, an additional 650 GWh of supply would be available, nearly eliminating the projected 2011 deficit. If the project were available for the full year, the resulting 1,300 GWh of additional supply would more than eliminate the deficit.

- "Fuel Switching": Coal plants in the region have the ability to switch to biomass fuels and, if the necessary criteria are met, could qualify to meet renewable standards. Fuel switching would likely offer a quicker option than the bottom-up construction of a new biomass plant. In this scenario, a 110 MW coal plant is switched to a biomass feedstock and assumed to operate at an 80% capacity factor. Assuming this plant was operational for all of 2011, an additional 770 GWh of renewable energy would be available, eliminating the deficit.

- "Borrowing": Many of the states' renewable requirements allow RECs to be banked (i.e., saved for future compliance years) and several states also allow for borrowing (i.e., using future generation to meet current compliance needs). PA's database of proposed plants that may come online in 2012 could offer an additional 5,000 GWh of renewable energy over 2011 generation levels. New Hampshire's and Maine's programs have allowance borrowing options, which if fully utilized, could meet up to 135 GWh of 2011 Class I demand with the pending 2012 resources. This would be insufficient to bridge the demand deficit for that year, however.

[7] Plants coming online mid-year in 2011 generate for a partial year.

Figure 4-4
Supply Impact, by Scenario



4.2.3 Sensitivities

Each of the assumptions required to calculate the renewable supply and demand introduces an opportunity for projection error. While this is unavoidable, there are several factors where it is most interesting to test the sensitivity of the assumptions.

- Under Maine's RES, retail electricity sales that are under a supply contract or standard offer service arrangement enacted before September 20, 2007 are exempt from the Class I renewable requirement.[8] While the percentage of sales covered under the RES remains unknown, Maine's most recent compliance report estimated that 45% of sales in 2008 would be required to meet the standard. For the purposes of this study, PA assumed that the 55% exemption would remain in place through 2011. However, if a significant number of contracts were to expire, the coverage could greatly increase. As a sensitivity to the assumption, if one assumes that the exemption dropped to 25% of retail sales by 2011, then the renewable energy deficit increases by 140 GWh.

- Hydropower contributes significantly to Class II supply and more modestly to Class I. Hydro output can vary appreciably from year to year due to rain and weather fluctuation, making planning for supply difficult. If one assumed 2011 hydro output was to drop by 25%, no deficit would emerge for the Class II and higher resources

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[8] Source: http://www.maine.gov/mpuc/legislative/archive/2006legislation/RPSreport.doc

due to the existing surplus, but the supply deficit for Class I resources would increase by 71 GWh (a 10% increase over the originally projected deficit).

- Decreasing the capacity factors of the included plants that are not yet online would also increase the renewable deficit. Dropping the onshore wind capacity factor from 33% to 25%, the biomass capacity factor from 80% to 60%, and the fuel cell capacity factor from 90% to 60% would increase the Class I renewable deficit across New England by 260 GWh in 2011, or 35%.

- Finally, PA assumed rational and optimized behavior by the generators; supply that is eligible for the most programs meets the RES classes that are most prohibitive first. This behavior, however, would require full information and understanding across all market participants, as well as rational market behavior. In practice, some sub-optimal choices will be made which could potentially lead to "stranded supply" and a greater supply deficit. While the magnitude of this effect is difficult to determine, one can envision a system where such inefficiencies lead to increases in the renewable energy deficit.

Appendix

New England State RES Details

State	Target & Timeline	Eligible Technologies
CT	**Class I:** 6% in 2009 escalating 1% thereafter until 2014 and 1.5% until 2020. **Class II:** 3% **Class III:** 3% in 2009, 4% thereafter	**Class I:** solar, wind, fuel cells, methane gas from landfills, ocean thermal power, wave or tidal power, low-emission advanced renewable energy conversion technologies, certain newer run-of-the-river hydropower facilities not exceeding 5 MW in capacity, and sustainable biomass facilities. **Class II:** trash-to-energy facilities, certain biomass facilities not included in Class I, and certain older run-of-the-river hydropower facilities. **Class III:** customer-sited CHP systems, with a minimum operating efficiency of 50%, installed at commercial or industrial facilities in Connecticut on or after January 1, 2006; (2) electricity savings from conservation and load management programs that started on or after January 1, 2006, and (3) systems that recover waste heat or pressure from commercial and industrial processes installed on or after April 1, 2007.
MA	**Class I:** 4% in 2009 escalating 1% annually thereafter **Class II:** 3.6% **Class II Waste to Energy:** 3.5% **APS:** .75% in 2009 escalating .5% to 5% in 2020	**Class I:** photovoltaics (PV); solar thermal-electric; wind; ocean thermal, wave or tidal; fuel cells utilizing renewable fuels; landfill gas; energy generated by certain new hydroelectric facilities, or certain incremental new energy from increased capacity or efficiency improvements at existing hydroelectric facilities; low-emission advanced biomass power conversion technologies using fuels such as wood, by-products or waste from agricultural crops, food or vegetative material, energy crops, algae, biogas, liquid biofuels; marine or hydrokinetic energy; and geothermal energy. **Class II:** Includes systems operating before 12/31/97 that generate electricity using PV; solar thermal-electric energy; wind energy; ocean thermal, wave or tidal energy; fuel cells utilizing renewable fuels; landfill gas; energy generated by certain existing hydroelectric facilities up to five megawatts (MW) in capacity; low-emission advanced biomass power conversion technologies using fuels such as wood, by-products or waste from agricultural crops, food or vegetative waste, energy crops, biogas, liquid biofuels; marine or hydrokinetic energy; or geothermal energy. **Class III:** Waste Energy Minimum Standard **APS:** Effective 1/1/09, requires all retail electricity suppliers to provide a minimum percentage of kWh sales to end-use customers in MA from alternative energy generating sources including: gasification with capture and permanent sequestration of carbon dioxide; combined heat and power (CHP); flywheel energy storage; any facility which substitutes any portion of its fossil fuel source with an equal to or greater portion of an approved alternative, paper-derived fuel source; energy efficient steam technology; and any other alternative energy technology approved by the DOER.
ME	**Class I:** 2% in 2009 escalating 1% annually thereafter **Class II:** 30% non-binding	**Class I:** Eligible new renewables include those placed into service after 9/1/05. Municipal solid waste facilities and CHP systems are not eligible under this class, and hydropower facilities must meet all state and federal fish passage requirements. New wind-power installations may exceed 100 MW in capacity. **Class II:** Electricity generated by a facility no greater than 100 megawatts (MW) in capacity that uses fuel cells, tidal power, solar arrays and installations, wind power, geothermal power, hydropower, biomass power or generators fueled by municipal solid waste in conjunction with recycling. Electricity generated by efficient combined heat and power (CHP) facilities and other systems that qualify as "small power production facilities" under the federal Public Utility Regulatory Policies Act of 1978 (PURPA) also are eligible.
NH	**Class I:** 0.50% in 2007, escalating 1% thereafter to 16% in 2015 **Class II**: 0.04% in 2009, escalating to .30% in 2011 and holding same percentage until 2025 **Class III:** 4.5% in 2009, escalating 1% until 2011 and holding same percentage until 2025 **Class IV:** 1% until 2025	**Class I:** New Renewable Energy (in operation after 1/1/06.) Wind, geothermal, hydrogen-derived from biomass fuels, biogas or landfill gas; ocean thermal, wave, current, or tidal energy; biogas or landfill gas; elegible biomass technologies meeting air emissions requirements; solar electric not used to meet Class II; incremental new production of electricity in any year from an elegible biomass, methane or hydroelectric facility of any capacity, over its historicsl generation baseline; production of electricity from Class II or IV sources that have been upgraded or repowered through significant capital investment **Class II:** New Solar: electricity from solar technologies, provided the source began operation after 1/1/06. **Class III:** Existing Biomass/Methane: electricity from eligible biomass technologies having a gross nameplate capacity of 25 MW or less, and methane gas. In operation prior to 1/1/06. **Class IV:** Existing Small Hydroelectric: electricity from hydroelectric energy, provided the facility began operation prior to 1/1/6, has a total nameplate capacity of 5 MW or less, and meets other environmental protection criteria.
RI	No classes, but a maximum of 2% may be generated from pre-1998 renewable energy resources; 4% in 2009, escalating to 4.5% in 2010 and 1% annually thereafter to reach 16% by 2019.	Direct solar radiation, wind, movement of the latent heat of the ocean, earth's hear, hydro <30MW, biomass sing eligible biomass fuels and maintaining compliance with current air permits; eligible biomass fuels may be co-fired with fossil fuels, provided that only the renewable-energy portion of production from multi-fuel facilities will be considered eligible, fuel ells using renewable resources

Proposed Plants
(not included in the base case assessment)

Online by 2011

Project Name	State	Fuel Type	Capacity (MW)	COD	Estimated Annual Production (GWh/yr)
Estimated COD of Pre-2012					
Woonsocket	RI	Hydro	1	2009	4
Commonwealth Bethlehem Facility	NH	Landfill	1	2009	8
Lightolier Wind Farm	MA	Wind	1	2010	3
Sheffield Wind Farm	VT	Wind	40	2010	116
Barnstead Biomass - Phase 2	NH	Biomass	15	2010	105
Rollins Wind Farm	ME	Wind	60	2010	173
Housatonic Tidal Energy	CT	Hydro	1	2010	4
Fitchville Biomass (Kofkoff Egg Farm)	CT	Biomass	29	2010	203
Watertown Renewable Power	CT	Biomass	30	2010	210
Stetson Mountain Wind Project - Expansion	ME	Wind	26	2010	75
Searsburg Wind Farm Expansion (Deerfield Wind)	VT	Wind	30	2011	87
Bloomfield Fuel Cell Energy Project	CT	Natural Gas	3	2011	24
Bridgeport Fuel Cell Energy Project	CT	Natural Gas	14	2011	110
Danbury Fuel Cell Energy Project	CT	Natural Gas	3	2011	24
Glastonbury Fuel Cell Energy Project	CT	Natural Gas	3	2011	24
Trumbull Fuel Cell Energy Project	CT	Natural Gas	3	2011	24
Plainfield Wood Plant	CT	Wood	38	2011	266
Laidlaw Energy Biomass Plant	NH	Biomass	66	2011	463
Manchester Wind Farm (Equinox)	VT	Wind	9	2011	26
Oakfield Wind Project	ME	Wind	56	2011	162
Fitchburg Landfill Project	MA	Landfill	5	2011	39
Montville Biomass Plant	CT	Biomass	30	2011	210
Turnpike Wind Farm	MA	Wind	1	2011	3
Roland Patenaude Wind Farm	MA	Wind	5	2011	14
Palmer Biomass	MA	Biomass	38	2011	266
Rusell Biomass	MA	Biomass	50	2011	350

PA

Proposed Plants (contd.)

Online After 2011

Project Name	State	Fuel Type	Capacity (MW)	COD	Estimated Production (GWh/yr)
Estimated COD of Post-2012					
Georgia Mountain Community Wind Project	VT	Wind	12	2012	35
Maine 1	ME	Hydro	5	2012	14
Waterbury Waste-Energy Project	CT	Biomass	12	2012	84
Cape Cod Tidal Energy	MA	Hydro	30	2012	87
Western Passage Tidal Project	ME	Hydro	19	2012	55
Barrington Hydro Plant	MA	Hydro	1	2012	3
Nantucket Tidal Energy	MA	Hydro	2	2012	6
Grandpa's Knob Wind Farm	VT	Wind	60	2012	173
Collinsville Lower and Upper	CT	Hydro	2	2012	6
Royal Mills Hydroelectric Project	RI	Hydro	5	2012	14
Jefferson Renewable Energy	RI	Biomass	90	2012	631
Harding Ledge Off Shore Wind Farm	MA	Off-shore Wind	15	2012	49
Redington Wind Farm (Carrabassett Valley)	ME	Wind	90	2012	260
Ludlow Clean Energy Project	VT	Biomass	25	2012	175
Wallingford Fuel Cell - Project 150 (Round 2)	CT	Unknown	1	2012	7
Waterbury Fuel Cell	CT	Biomass	2	2012	14
PPL Energy Fuel Cell	CT	Natural Gas	4	2012	28
Cargill Falls Hydroelectric Project	CT	Hydro	2	2012	6
Versailles Landfill Project	CT	Landfill	20	2012	158
Clean Power Berlin	NH	Biomass	24	2012	168
North Springfield Sustainable Energy Project	VT	Biomass	25	2012	175
South Norwalk Landfill	CT	Landfill	30	2012	237
GenPower Biomass Plant - MA	MA	Biomass	40	2012	280
Ashuelot Park Biomass	MA	Biomass	40	2012	280
Worcester Jail County Wind	MA	Wind	8	2012	23
West Hill Wind	MA	Wind	12	2012	35
Hull Offshore Wind Energy Facility	MA	Off-shore Wind	15	2012	49
Deepwater RI Offshore Wind Farm	RI	Off-shore Wind	405	2012	1300
Douglas Woods Wind Project	MA	Wind	26	2012	75
National Guard Wind Farm	MA	Wind	26	2012	75
Western MA Wind Farm (Hoosac Wind)	MA	Wind	30	2012	87
Bridgeport Fuel Cell - Project 150 (Round 2)	CT	Unknown	13	2012	91
Bridgeport Fuel Cell Energy Center	CT	Natural Gas	20	2012	140
Danbury Fuelcell Project (Triangle)	CT	Natural Gas	21	2012	147
Cape Wind Farm (Off Shore Wind)	MA	Off-shore Wind	420	2013	1361
Black Mountain Wind Project	ME	Wind	40	2013	116
Kingdom Community Wind	VT	Wind	50	2013	145
Windham Wind Project	VT	Wind	50	2013	145
First Wind Maine Project	ME	Wind	80	2013	231
Ball Mountain Hydro	VT	Hydro	4	2013	12
Brattleboro Cogeneration	VT	Biomass	20	2013	140
Hopkinton Energy	NH	Biomass	34	2013	238
Clean Power Merrimack	NH	Wood	40	2013	280
Winchester Biomass	NH	Biomass	50	2013	350
Groveton Renewable Energy Park	NH	Biomass	75	2013	526
Block Island Offshore Wind	RI	Off-shore Wind	20	2013	65
Down East Wind Project	ME	Wind	150	2013	434
Coventry Solar Plant	RI	Solar	8	2013	14
Henniker Biomass Plant	NH	Biomass	20	2013	140
Wiscasset Tidal Resources Project	ME	Hydro	10	2013	29
Murphy Dam Hydroelectric Project	NH	Hydro	2	2013	6
Greenfield Biomass Plant	MA	Biomass	47	2013	329
Exeter Wind Farm	CT	Wind	50	2013	145
Penobscot Indian Nation	ME	Wind	100	2013	289
Aroostook County Wind Farm - Phase 1	ME	Wind	300	2013	867
Aroostook County Wind Farm - Phase 2	ME	Wind	200	2013	578
Rutland County Wind Farm	VT	Wind	80	2013	231
Narragansett Bay Offshore Wind Farm	RI	Off-shore Wind		2014	
Grand Manan Channel Tidal Energy	ME	Hydro	72	2014	208
Cape Island Ocean Energy Project	MA	Hydro	100	2014	289
Half Moon Cove Tidal Energy	ME	Hydro	13	2014	38
Castine Harbor & Bagaduce Narrows	ME	Hydro	13	2014	38
Cobscook Bay OCGen Tidal	ME	Hydro	24	2014	69
South Coast Offshore Wind Project	MA	Off-shore Wind	300	2014	972
Blue H Offshore Wind	MA	Off-shore Wind	420	2014	1361
Aquabank Wiscasset Tidal Energy Plant	ME	Hydro	1000	2015	2891
Rhode Island Ocean Energy Project	RI	Hydro	100	2015	289
National Grid Solar Project - Phase 1	MA	Solar	n/a	n/a	n/a
National Grid Solar Project - Phase 2	MA	Solar	n/a	n/a	n/a
Fox Islands Wind Power Project	ME	Wind	n/a	n/a	n/a

Assumed Capacity Factors

Technology	Capacity Factor
Biomass	80%
Fuel Cells	90%
Hydropower	43%
Landfill Gas	90%
MSW	90%
Solar	20%
Wind (offshore)	37%
Wind (onshore)	33%

Note: Historical capacity factors were applied to all existing plants where data were available. The assumed capacity factors offered in the table above were applied when data were not available, as in the case of newer existing plants, base case projections, and proposed facilities. With the exception of hydropower, all values are based on PA market research. The value for hydropower is based on the average of all <5 MW hydro facilities featuring sufficient publicly available production data.