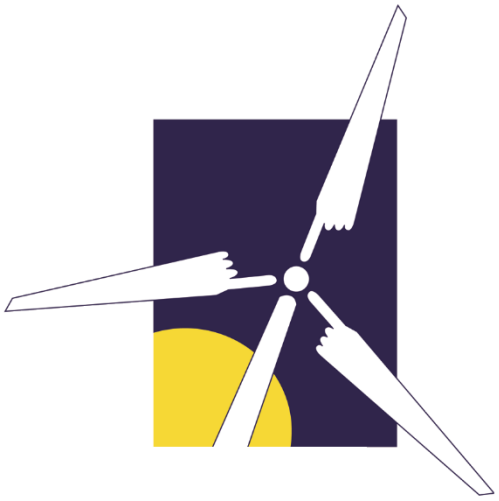
2018 REVIEW OF THE NEW HAMPSHIRE RENEWABLE PORTFOLIO STANDARD

Alternative Scenario Analysis



Sustainable Energy Advantage, LLC
161 Worcester Road, Suite 503
Framingham, MA 01701
508.665.5850
www.seadvantage.com

October, 2018

Table of Contents

1 Background

New Hampshire's Renewable Portfolio Standard (RPS) is comprised of four (4) Classes, plus a carve-out for thermal resources that acts as a subcomponent of Class I. Investor-owned utilities, cooperatives, and competitive load-serving entities are all obligated under the RPS law. Municipal utilities are exempt. Obligated entities demonstrate compliance on a calendar year basis, either through the purchase of Renewable Energy Certificates (RECs) or by making Alternative Compliance Payments (ACPs). The key characteristics of each class are summarized below:

The Class I RPS obligation is intended to spur the development and operation of new renewable energy facilities. Eligible technologies include wind energy, hydrogen derived from biomass fuels or methane gas, eligible biomass, methane gas, ocean energy, solar energy not used to satisfy Class II (see below), and incremental new production of electricity in any year form an eligible biomass, methane or hydroelectric generating facility above its historical baseline. To qualify, a facility must have a commercial operation date (COD) on or after January 1, 2006 and meet specified emissions limits. Beginning in 2014, a portion of the Class I obligation was dedicated to a Thermal Carve-out. Eligible resources include biomass, geothermal, solar thermal, methane gas, combined heat and power (CHP), and "Useful Thermal Energy" all qualify as thermal fuel sources, with biomass thermal required to meet emissions limitations.

Class II became effective commencing in the 2010 compliance year and is dedicated to solar facilities. As with Class I, eligible resources must have entered commercial operation on or after January 1, 2006. Class II sources, to the extent they are not otherwise used to satisfy a Class II obligation, may be used to meet a Class I obligation.

The Class III and Class IV compliance obligations commenced in 2008. Both classes are intended to support the continued operation of existing facilities, those with COD no later than December 31, 2005. Class III-eligible facilities include biomass and landfill gas facilities with a gross nameplate capacity less than or equal to 25 MW and must meet the same emissions limits as Class I. Pursuant to changes implemented during 2017, Class III landfill gas facilities may not locate more than 10 MW on a single landfill site. Class IV-eligible facilities include hydroelectric less than or equal to 5 MW that have installed both upstream and downstream diadromous fish passages and have been approved by FERC. Hydroelectric facilities less than or equal to 1 MW must comply with FERC fish passage restoration requirements and be interconnected to New Hampshire's electric distribution system.

Eligible facilities may be located in ISO-NE, or in an adjacent control area (except Class I Thermal) if the energy is delivered to New England and settled in the market settlement system. New Hampshire does not certify facilities interconnected behind the retail meter in other states.

New Hampshire's 2007 RPS statute requires the Public Utility Commission (PUC) to review the RPS program and report its findings to the General Court by November 1, 2018. The PUC has conducted a stakeholder process, which included public meetings during April, May, and June 2018, and invited written comment through September 7, 2018. The purpose of this analysis and report is to explore the ratepayer, environmental, and economic impacts of alternative scenarios to the current RPS design – namely several options for consolidating the current four-class structure. This analysis is intended to provide guidance and support informed decision-making and the Commission's report to the General Court. If either the PUC or the General Court determines that supplemental analysis of any of the

alternative scenarios, or of additional alternatives, is desirable to support the RPS review process, SEA can leverage the analysis completed to date to accomplish these objectives quickly and cost effectively

2 Methodology

The PUC has commissioned from Sustainable Energy Advantage (SEA) a limited analysis of alternative scenarios being discussed in the context of its 2018 RPS Review, to provide insight on the potential impacts of alternative configurations to the New Hampshire RPS. To provide insight cost effectively, the PUC seeks to leverage the capabilities of SEA's proprietary New England Renewable Energy Market Outlook (REMO) models to probe impacts of the alternative scenarios to renewable energy supply, supply-demand balances, operations of the existing biomass fleet, REC prices and ratepayer costs. The results of New England REMO have been used and scrutinized by a wide and diverse group of regional subscribers since 2005. Proxy metrics will be used for shedding light on important impacts.

Analysis and Models

In this analysis, SEA evaluates the impacts of three alternative scenarios using models developed for SEA's New England REMO. REMO is a suite of MS Excel-based models developed by SEA that forecast scenario-specific renewable energy supply, demand, and Renewable Energy Certificate (REC) price trajectories for New England. The REMO models are designed to project Class I market supply, demand, and price throughout the region. REMO also forecasts the New Hampshire Class III marketplace, which is intimately tied to the Class I market through eligibility overlap with Connecticut Class I. The assumptions and methods deployed herein are consistent with SEA's REMO analysis, and are not intended to reflect the PUC's view on expected outcomes.

Due to the timelines implicit in the development process, near-term renewable energy supply is defined by existing facilities, plus projects under development that are in the advanced stages of permitting and have either identified long-term power purchasers (either through competitive solicitation or bilateral negotiation) or an alternative path to securing financing. Alternative paths include policies providing revenue through tariffs, net metering, or standard offers. These projects are subject to customized, probabilistic adjustments regarding deployment timing and likelihood of achieving commercial operation. Near-term REC prices are forecast as a function of existing, RPS-certified renewable energy supplies, near-term renewable additions, regional RPS demand, alternative compliance payment (ACP) levels in each market, and other dynamic factors including banking, imports, and the deployment of discretional supply including merchant biomass plants and imports from other markets outside of New England.

The long-term REC price forecast, where new market entry is required to fulfill demand, is based on a supply curve analysis that considers developable technical potential, resource cost, and the commodity market value of production over the study period – which for this analysis is 2020 through 2029. These factors are used to identify the marginal, REC price-setting resource for each year in which new renewable energy additions are required to satisfy RPS demand.

The alternative scenarios being analyzed are assumed to take effect in 2020 and apply to all RPS-obligated load beginning on January 1, 2020. No exemptions are offered to otherwise obligated entities. The analysis evaluates potential impacts between 2020 and 2029.

The New England REMO models are proprietary to SEA and are business sensitive. Case-specific results are summarized and explained herein. The underlying MS Excel models cannot be made available without irreparable harm to SEA and will not be distributed.

Assumptions

Assumptions regarding regional renewable portfolio standards, and related or supporting policies, are based on current statutes and policies in place across the six New England states. Forward-looking statutes (for example, which designate authority that has not yet been exercised) have been interpreted by SEA and are held constant across all scenarios. With respect to renewable energy supply currently serving New Hampshire under long-term contracts, SEA has estimated based on its research, and modeled in aggregate, the existing commitments of obligated entities. These quantities are treated as a hedge of the RPS supply obligation in all scenarios. Key assumptions are summarized in both the body and appendices.

Results and Evaluation Metrics

The results of this preliminary analysis focus on direct ratepayer impact (changes in RPS compliance costs to NH ratepayers), environmental impact (incremental renewable energy development); and economic impact (impact on the continued operation of existing biomass and hydro facilities in New Hampshire). The potential impact of each modeled scenario is compared across these three metrics.

Ratepayer impact: Direct ratepayer impact is a function of REC price and unhedged RPS obligation (which itself is a function of load, RPS targets, and existing contractual commitments). The unhedged cost of RPS compliance is the product of scenario-specific spot REC prices and unhedged RPS demand, for each RPS Class, and will be used as a proxy for assessing the relative ratepayer impact across all modeled scenarios. While the proposed changes have the potential to impact wholesale energy and capacity market prices, this potential interaction is not addressed in this analysis. Ratepayer impact will be measured by average (unhedged) REC price and the present value of the cost differential between the Reference Case and each modeled alternative.

Environmental impact: Expected environmental impact is a function of the quantity of incremental renewable capacity, if any, required to satisfy the RPS under each scenario – as compared to the Reference Case. This analysis projects supply quantities required to meet the RPS, including an assessment of whether and when ACPs may be required if qualifying supply is insufficient to meet demand.

Economic Impact: Economic impact is a function of the expected annualized production at existing New Hampshire biomass facilities. Increased operations (relative to the Reference Case) represent incremental economic benefits to New Hampshire. Decreased operations represent the potential for negative economic impacts.

Context

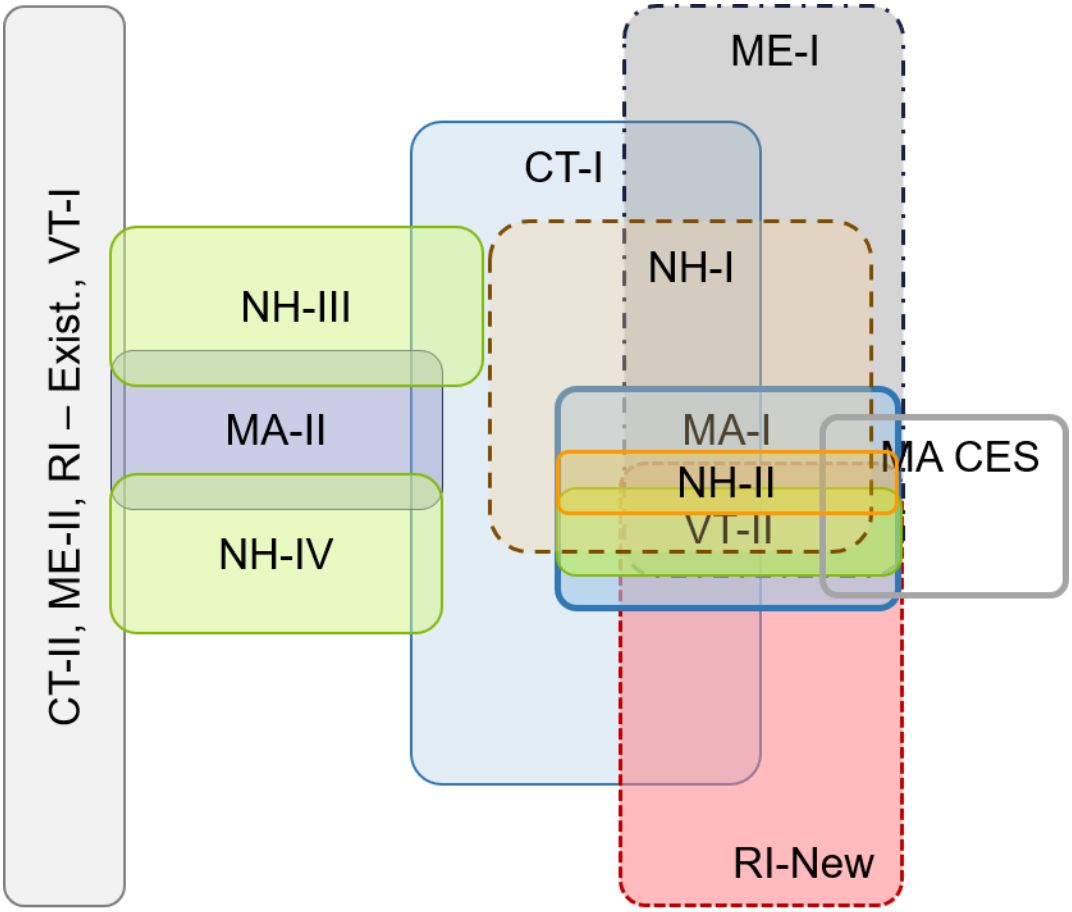
The analysis, and the results described herein, fall within the context of a regional renewables market that is:

(i) complex, involving overlapping eligibility of many state RPS tiers throughout the region (as shown in Figure 1), and

(ii) currently experiencing a surplus of supply over demand, which is the result of recent actions of policymakers throughout the region and is expected to continue throughout most of the study period. These surpluses are expected to continue due in large part to large-scale

renewables procurements and distributed generation tariff programs in Southern New England States that are expected to drive thousands of MW of offshore wind, large hydro, and solar installations into the regional market at a faster rate than regional RPS increases under current statute.

Figure 1: New England RPS 'Eligibility Map'



Through the REMO models, this analysis considers the applicable markets both individually and together. Overlapping eligibility creates opportunities for supply migration. At the same time, however, small differences in eligibility and contracting policies may cause state REC prices to either converge or diverge with changes in supply and demand conditions.

As depicted in the 'eligibility map', changes in some RPS classes may have complex impacts through their connection to other classes – like pulling on a string connecting the markets.

Without increasing demand for new renewables (for instance through an increase in Class I or Class II targets), increases in new renewable capacity should not be expected. Exceptions to this include RPS changes that open up demand for new renewables that was previously limited to the operating renewables fleet, or through impacts that reduce the operation of the existing biomass fleet (which, in large part, is eligible for CT Class 1). Combining new and existing RPS classes can have different expected impacts based on whether the existing tiers (whose *potentially* eligible supply – that which is certifiable –

is a closed system due to vintage requirements) are systemically oversupplied or undersupplied. In the context of supply surpluses in the region, such changes can in some circumstances increase state and regional aggregate demand for new renewables, as discussed further below.

3 Alternative Scenario Definitions

Reference Case Scenario Definition: The Reference Case provides a baseline for evaluating the incremental impact of each alternative scenario. The Reference Case assumes legislation and regulation currently in effect in each state. Neither the Reference Case nor alternative scenario cases endeavor to interpret the potential future legislative or regulatory actions in New Hampshire or other states. The reference case was developed in late September 2018 under SEA's New England REMO service.

RPS Alternative Scenario Definitions:

This analysis includes three (3) RPS alternative scenarios. Each is summarized below. **Please note that the thermal carve-out is assumed to be retained (unchanged) in each case.**

1) The *"Consolidate I & II"* Case
    a. Combines Classes I & II into a single Class, and retains Class III and Class IV as is
    b. Uses current, individual NH-I and NH-II targets through 2019
    c. Combines NH-I (Class I) and NH-II (Class II) targets beginning 2020
    d. Retains individual NH-III (Class III) and NH-IV (Class IV) targets throughout study period
    e. No changes to ACP assumptions, since NH-I and NH-II share the same ACP

2) The *"Consolidate New, Consolidate Existing"* Case
    a. Combines Classes I & II ("New") and Classes III & IV ("Existing")
    b. Uses current, individual targets for all Classes through 2019
    c. Combines NH-I and NH-II targets beginning 2020, **AND**
    d. Combines NH-III and NH-IV targets beginning 2020.
    e. No changes to NH-I and NH-II ACP assumptions
    f. Assumes the combined NH-III and NH-IV Class is subject to the NH-III ACP.

3) The *"Consolidate All"* Case
    a. Uses current, individual targets for all Classes through 2019
    b. Combines NH-I, NH-II, NH-III, and NH-IV targets beginning 2020.
    c. Assumes the new, combined Class has an ACP of $40/MWh

4 Summary of Assumptions

This section summarizes key demand and supply assumptions defined and utilized by SEA in its REMO model. These supply and demand assumptions are held constant across all scenarios. Additional assumption detail is provided in the appendix.

Table 1: Major Demand Assumptions

Key Demand Inputs	Description of Assumption
Load Forecast	ISO-NE 2018 CELT, adjusted for SEA forecast of behind the meter (BTM) generators; Includes SEA Base Case assumption of beneficial electrification.
Load Exemptions	Municipal and Cooperative Utilities (Muni only in NH)
RPS Targets	Per current statute. All states, all classes.
ME Class 1	Assumed to terminate after 12/31/2022

Table 2: Major Supply Assumptions

Key Supply Inputs	Description of Assumption
MA Sec. 83D Procurement	NECEC Approved, 100% Hydro
MA Sec. 83C, OSW[1], Round 1	Initial 800 MW; assume 15% capacity attrition
RI Offshore Wind Procurement	400 MW; assume 15% capacity attrition
CT Offshore Wind Procurement	200 MW; assume 15% capacity attrition
MA Sec. 83C, OSW[2], Round 2	Additional 800 MW; assume 15% capacity attrition
MA Additional OSW Authority	Discretional authority not deployed
CT Zero Carbon Solicitation	Assumed no Class 1 supply is selected (open to nuclear and existing hydro)*
RI 400 MW RFP	Purchase is not mandatory; assume no supply is selected
MA SREC-II	1,780 MW by 2021
MA SMART	1,600 MW by 2024
** This is the Reference Case assumption, and is one of numerous possible outcomes, but is not necessarily the expected outcome. The solicitation is open to nuclear, existing hydroelectric generation, and Class 1 renewables.*	

4.1 Other Key Assumptions

4.1.1 Burgess Biomass

The Burgess BioPower facility in Berlin, NH is currently the region's largest REC producer. As a result, its operation plays an important role in both New Hampshire and regional RPS compliance. The first 400,000 RECs produced from the facility are purchased by Eversource. Eversource also is entitled contractually to purchase 500,000 MWh of energy produced from the facility each year. The contract includes a Cumulative Factor that keeps account of the energy price of the contract compared to the ISO-NE Energy Price. When the Cumulative Factor is negative by more than $100 million, the Excess Cumulative Reduction is deducted from the following year's energy deliveries until the Excess Cumulative Reduction is eliminated. Such a reduction of its energy revenue could impact the facility's ability to continue to operate. This analysis reflects the recent passage of NH SB 577 which delays the operation of the refund provision in the contract for three years from when it would be triggered. The presumed effect of SB 577

[1] Offshore Wind
[2] Offshore Wind

is that the plant continues to operate through 12/31/2022. No output is modeled from Burgess BioPower beginning 1/1/2023. This assumption is consistent with SEA's most recent REMO quarterly regional modeling and is held constant in all scenarios.

4.1.2 Default Service Contracts for Biomass Facilities (SB 365)

This analysis integrates the expected impact of SB 365 – passed into law as a result of a veto-override passed on September 13, 2018. We assume the following:

- Applicable to in-state biomass and waste-to-energy less than or equal to 25 MW;
- Eligible facilities may opt in to an energy-only contract valued at 80% of the residential default service rate (minus RPS compliance costs);
- There is no cumulative policy MW or MWh cap; all eligible facilities may elect to participate;
- Such contracts are available for six default service periods (six months each);
    - The first period is assumed to begin February 1, 2019
- Facilities must opt-in *before* the solicitation for each default service period; and
- Biomass Projects Impacted: Bridgewater, Whitefield, Springfield, Tamworth, Bethlehem

Operational Implications: This analysis estimates eligible plant operations based on their projected economics. Facilities are assumed to operate to the extent that 80% of default service energy, minus RPS compliance costs, plus capacity market revenue plus REC market revenue is greater than each participating facility's estimated short-run marginal cost on a 6-month-average basis.

4.1.3 Interactions between RPS Markets

Because of Connecticut's lack of vintage requirement (no COD year requirement), a significant cross-section of biomass and landfill gas supply is eligible for both CT Class 1 and NH Class III. RECs generated by dual-certified facilities are therefore expected to migrate between CT-1 and NH-III depending on market price. This analysis assumes that RECs flow to the highest value market, and that these two markets will try to equilibrate, subject to supply availability and the relative levels of their ACPs.

4.1.4 Additional Potential NH Class III Supply

Market analysis suggests that approximately 85% of total NH Class III-eligible supply has become certified. Much of the uncertified 15% are landfill gas facilities, many of which are in New York. Historically, CT Class 1 REC prices have exceeded NH Class III prices, and several nominally eligible facilities have therefore never bothered to seek NH Class III certification. With regional Class 1 markets now in surplus, it is possible that such supply will seek to enter the NH Class III REC market. This analysis assumes that such additional supply will become NH Class III certified by the first quarter of 2021.

4.1.5 Additional Assumptions

- *RPS Compliance Banking*: This analysis uses historical banking data (through 2017). Beginning in 2020, bank balances are consolidated in line with scenario definitions. New Hampshire allows banking in all classes for 2 years. The amount of banked compliance deployed in a given year cannot exceed 30% of current year's obligation.
- The *discount rate* for present value analysis in this report is 9.9%, which is intended to represent the utilities' pre-tax weighted average cost of capital.
- CT's *biomass REC eligibility phase-down* is assumed to take effect 1/1/2020 and reduce the quantity of CT-1 eligible RECs to 50% of a facility's qualified output. This limitation begins 15 years from COD for facilities on-line before 2003, and 20 years from COD for facilities on-line in 2003 or later.

5 Modeling Results, Observations, and Implications

5.1 Reference Case

The purpose of the Reference Case is to set a baseline – to create a point of comparison for the three alternative scenarios. The Reference Case is derived from SEA's New England REMO analysis conducted in late September 2018. This report provides a differential analysis in which the results of each scenario measure and summarize the degree of change from the Reference Case.

The Reference Case depicts regional Class 1 RPS markets in surplus, both short- and long-term. The Class 1 surplus also impacts NH Class III due to its overlapping eligibility with CT Class 1. With excess supply available for CT Class 1, all NH Class III-eligible RECs are expected to remain in New Hampshire – producing a modest surplus in the Reference Case. The NH Class IV Reference Case reflects a modest shortage, however, with REC prices approaching the ACP. This is largely the result of overlapping eligibility with MA Class 2, with certified supply insufficient to fulfill both markets. This dynamic is discussed further in the case analysis below.

In general, the regional Class 1 surplus is the result of the fact that regional supply-side policies are out-pacing demand-side policies. In other words, the sum of mandated large-scale procurements, distributed generation programs (including MA SREC-I and SREC-II projects that will create Class 1 RECs after their SREC terms expire), and offshore wind procurements is larger than incremental regional Class 1 RPS demand. Because none of the analyzed alternative scenarios add incremental Class I RPS demand, the long-term surplus identified in the Reference Case means that no incremental new supply (beyond existing commitments) is expected until 2029 – the final year of the study period. If increasing renewable energy supply is desired, then New Hampshire Class I targets should be increased significantly. Due to regional surplus, it is possible for New Hampshire Class I RPS target increases to be fulfilled cost-effectively from sources such as excess RECs from such as MA, CT, and RI procurements.

5.2 Consolidate I & II

In the *Consolidate I & II* alternative scenario, the non-thermal portion of Class I and the Class II solar obligation are combined. Classes III and IV remain unchanged. The following summarizes the market implications of this alternative scenario:

- Ratepayer Impact: While NH Class I benefits from the scale and liquidity associated with the regional Class 1 markets, the NH Class II market is small and relatively illiquid. While there is ample (and increasing) NH-II-eligible supply in the region, NH-II liquidity is low. As a result, the expectation is that market dynamics (with Class I and Class II separated) would produce a long-term (liquidity-driven) REC price differential of roughly $2/MWh. Combining these classes is expected to remove the liquidity premium, reducing ratepayer cost on the Class II compliance quantity, and producing a 10-year net present value (NPV) ratepayer *savings* estimated at $390,000, in 2018 dollars. The addition of Class II demand is not enough to create demand tension and higher REC prices in the Class I market. This case has no impact on Class III and Class IV markets. A comparison of case-specific levelized REC prices is provided in Table 3.

- Environmental Impact: NHII is not currently driving incremental solar. Ample NH Class II-eligible solar is already in the market or will be during the study period. This analysis reflects that there are enough regional solar RECs that are certifiable for NH-II to satisfy the future increases in NH-II targets; eliminating NH Class II by combining it with NH Class I is not expected to reduce the quantity of eligible solar generation during the analysis period, and is not expected to increase other generation; rather it would result in the same generation being retired towards different classes. Therefore, the alternative NH RPS structure modeled herein does not trigger more or less renewable energy compared to the Reference Case.

- Economic Impact: Combining Classes I & II is unlikely to impact annual production at existing New Hampshire biomass facilities.

5.3 Consolidate New, Consolidate Existing

In the *Consolidate New, Consolidate Existing* alternative scenario, Class I is combined with Class II, and Class III is combined with Class IV. The "New" Class uses the current Class I ACP. The "Existing" Class is assumed to use the current Class III ACP. The analysis reflects that a portion of NH-IV-eligible supply is also certified for MA-2 and is historically settled in that market. This dual-certified supply is assumed to continue to settle in the MA-2 compliance market (which is systemically short and always has market prices near the MA-2 ACP, is a situation we expect to continue indefinitely absent policy change). Therefore, RECs from the dual-certified supply are assumed to not be available for retirement towards compliance in New Hampshire, thereby creating a perpetual shortage in the NH Class IV market. The following summarizes the market implications of this alternative scenario:

- Ratepayer Impact: Prior to consolidation, NH Class III has a modest surplus and NH Class IV has a chronic shortfall because of supply retirement for MA Class 2. This analysis assumes that such retirement in MA-2 continues, and that the NH-IV shortage is fulfilled by increased operations from

existing, NH Class III biomass facilities. The increased demand for NH-III biomass increases REC prices modestly, but also provides economic benefit to New Hampshire biomass projects. The effect of combining Classes I & II and, separately, Classes III & IV produces a 10-year present value ratepayer *cost* estimated at $1.8 Million, in 2018 dollars. A comparison of case-specific levelized REC prices is provided in Table 3.

- Environmental Impact: As a result of the assumption that MA Class 2 will be chronically undersupplied, and that dual-eligible NH Class IV supply will migrate to MA Class 2 to fill this shortage, this case creates a slight increase in New Hampshire Class III demand between 2022 and 2029. This will create a small, corresponding increase in Class I demand, since all NH Class III supply will be applied toward compliance with the *Consolidate Existing* class. Given regional surpluses, ample Class 1 supply will remain to fulfill all Class 1 obligations. While the case leads to increased biomass production from existing facilities, the alternative NH RPS structures modeled herein do not, however, trigger additional renewable energy additions compared to the Reference Case within New England due to the expected Class I supply surplus.

- Economic Impact: When Classes III and IV are consolidated, the Class IV shortage creates incremental demand for (is fulfilled by) Class III biomass. This analysis estimated approximately 715 GWh of *additional* production from Class III biomass facilities over the 10-year analysis term. This is approximately equivalent to six years of additional production from a single 15-MW biomass facility.

  While not explicitly modeled, the reduction in revenue available to formerly Class IV hydroelectric plants may not directly impact their production decisions (with near-zero marginal costs); however, reduced revenues might impact spending on operations and maintenance which over time could degrade operating capacity factors (and commensurately, market revenues to owners).

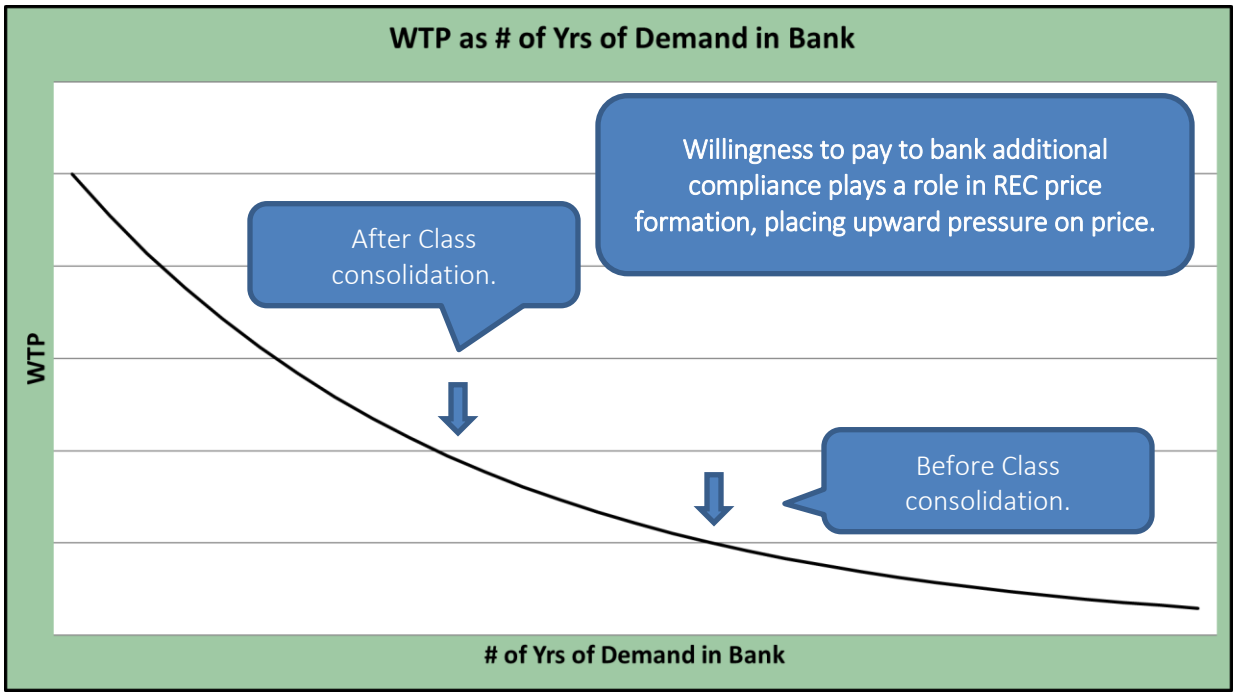
5.4 Consolidate All

In the *Consolidate All* alternative scenario, NH Class I, II, III, and IV are combined into a single Class. Only the Thermal carve-out remains as a separate Class. The combined Class is assumed to adopt an ACP of $40/MWh. The following summarizes the market implications of this alternative scenario:

- Ratepayer Impact: The aggregation of all NH Classes creates a complex interaction with regional supply. Because regional Class I markets are in material surplus during the study period, Class I RECs with multi-state certification are widely available to fulfill *Consolidate All* case demand at a lower cost than current NH Class III and IV supply. As a result, biomass and hydro facilities (which are no longer protected by their separated classes) become price-takers, as Class I facilities become the marginal (REC price-setting) resource for the consolidated class. It is possible that the existing supply formerly protected by Class III and Class IV may find the economics of continued operation difficult to justify. Despite the relative cost-effectiveness of regional Class 1 supply as a source for the new *Consolidate All* class, REC prices in this case are expected to increase (relative to Class I or Class I/II prices in the other cases) as a result of:
  - increased demand tension (modest increased demand for Class I supply to fill the systemic shortages from a no-longer separate NH IV demand); and
  - increasing banking appetite.

With a consolidated class, load-serving entities are expected to exhibit the same decision-making processes as the current Class I, and this is expected to marginally increase RPS-obligated entities' ability and willingness to purchase more RECs in the near-term for contribution toward future compliance because of having somewhat less supply in the bank and having a slightly elevated expectation of future prices. The effect of combining all current NH RPS classes produces a 10-year present value ratepayer *cost* estimated at $3.85 Million.

Figure 2: Willingness to pay (for RECs) as a function of the # of years of RPS demand in the bank



- Environmental Impact: As a result of the cumulative effect of adding demand to Class I targets in excess of added supply from NH-III and IV, this case spurs increased Class I renewable energy demand between 2022 and 2029. However, this demand is met by surplus Class I supply, resulting in a decrease of renewable energy production (due to reduced biomass production from today's Class III facilities). The alternative NH RPS structure modeled herein does not, however, trigger additional renewable energy additions compared to the Reference Case within New England due to the expected Class I supply surplus.

- Economic Impact: When all four NH RPS classes are consolidated, the regional Class I surplus dictates that Class I supply is likely to infringe on biomass as an RPS contributor, to the degree that NH-III is not available as a separate tier with narrower eligibility to protect biomass facilities in the event of Class I supply surplus. This analysis estimates a cumulative reduction of approximately 235 GWh of biomass production over the 10-year study period. This is approximately equivalent to two years of production from a 15-MW biomass facility.

  While not explicitly modeled, the reduction in revenue available to formerly Class IV hydro plants may not directly impact their production decisions (with near-zero marginal costs); however, reduced

revenues might impact spending on operations and maintenance which over time could degrade operating capacity factors (and commensurately, market revenues to owners).

Table 3: Summary of Modeling Results

	Reference Case	Consolidate I & II	Consolidate New, Consolidate Existing	Consolidate All
REC Prices ('20-'29, levelized)	Class I: $14.25 Class II: $16.25 Class III: $14.75 Class IV: $28.25	Class I & II Consolidated: $14.25 Class III: $14.75 Class IV: $28.25	Class I & II Consolidated: $17.25 Class III & IV Consolidated: $16.75	Class I, II, III, & IV Consolidated $19.25
Ratepayer Impact* (Relative to the Reference Case)	Not applicable	$390,000 Savings	$1.8 Million Cost	$3.85 Million Cost
Environmental Impact	Not applicable.	NH RPS restructuring does not alter the course of renewable energy additions between 2020 and 2029.		
Economic Impact	Not applicable.	No change in biomass operation relative to Reference Case.	*Addition* equivalent to 6 years of production at a 15 MW biomass facility.	*Reduction* equivalent to 2 years of production at a 15 MW biomass facility.

** Expressed as a 10-year net present value (NPV), in 2018 dollars.*

A Appendix A: Supporting Assumptions

A.1 Renewable Portfolio Standard (RPS) Targets

Table 4: Summary of New Hampshire RPS Compliance Obligation Targets, by Class

	Class I, Non-Thermal	Class I, Thermal	Class I, TOTAL	Class II	Class III	Class IV
2020	8.9%	1.6%	10.5%	0.7%	8.0%	1.5%
2021	9.6%	1.8%	11.4%	0.7%	8.0%	1.5%
2022	10.3%	2.0%	12.3%	0.7%	8.0%	1.5%
2023	11.0%	2.2%	13.2%	0.7%	8.0%	1.5%
2024	11.9%	2.2%	14.1%	0.7%	8.0%	1.5%
2025	12.8%	2.2%	15.0%	0.7%	8.0%	1.5%
2026	12.8%	2.2%	15.0%	0.7%	8.0%	1.5%
2027	12.8%	2.2%	15.0%	0.7%	8.0%	1.5%
2028	12.8%	2.2%	15.0%	0.7%	8.0%	1.5%
2029	12.8%	2.2%	15.0%	0.7%	8.0%	1.5%

A.2 Load Forecast & Reference Case Compliance Obligations

Table 5: Load Forecast & Reference Case Compliance Obligations (GWh)

	NH Load Forecast	NH-I Obligation	NH-II Obligation	NH-III Obligation	NH-IV Obligation
2020	11,839	913	72	821	154
2021	11,860	986	72	822	154
2022	11,900	1,062	72	825	155
2023	11,949	1,139	72	828	155
2024	11,992	1,236	73	831	156
2025	12,036	1,335	73	834	156
2026	12,089	1,341	73	838	157
2027	12,164	1,349	74	843	158
2028	12,222	1,355	74	847	159
2029	12,286	1,363	75	852	160