CLEAN ENERGY STANDARD
BILL IMPACT ANALYSIS

Prepared for:

EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS

DEPARTMENT OF ENVIRONMENTAL PROTECTION

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December 2019

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Executive Summary

Background

As part of its Massachusetts Clean Energy Standard review, MassDEP directed Sustainable Energy Advantage, LLC (SEA) to conduct quantitative analyses of the estimated market impact of both increasing the CES demand target to 22% in 2020 and establishing a Clean Energy Standard for existing resources, the CES-E, meeting specified eligibility criteria.

Estimated Impact of Increasing the MA CES Target to 22% in 2020

Based on analysis using SEA's New England Renewable Energy Market Outlook models, adjusting the MA CES to 22% in 2020 is expected to increase MA consumer bills by 0.53% (residential), 0.62% (commercial), or 0.73% (industrial) per month in 2020. No material bill impacts are expected in subsequent years. Table RS-1 summarizes expected bill impact by customer class, both in dollars and as a percentage of a typical customer's monthly bill.

RS-1: Estimated Bill Impacts (Nominal $/month, and as a % of monthly bundled bill)

	2019	2020	2021	2022	2023	2024	2025
Residential, $/mo	$0	$0.71	$0	$0	$0	$0	$0
Residential, as %	No Change	0.53%	No Change	No Change	No Change	No Change	No Change
Commercial, $/mo	$0	$2.54	$0	$0	$0	$0	$0
Commercial, as %	No Change	0.62%	No Change	No Change	No Change	No Change	No Change
Industrial, $/mo	$0	$18.69	$0	$0	$0	$0	$0
Industrial, as %	No Change	0.73%	No Change	No Change	No Change	No Change	No Change

Estimated Impact of Establishing a CES-E

As a result of stable demand and static supply, CES-E CEC price and compliance cost dynamics will more closely resemble "maintenance" classes (for existing supply) than "growth" classes like MA Class I. In addition, because CES-E eligible facilities are owned or controlled by a limited number of market participants (high market concentration), CES-E CEC prices may be driven not only by supply and demand, but also by discretional market participation and control of access to the market over interties from neighboring control areas. CES-E compliance costs are modeled herein as a function of the CES-E target percentage, the CES-E Alternative Compliance Payment (ACP) rate, and the projected cost of CES-E certificates (CECs).

In order to estimate the potential impact on ratepayer costs of alternative market design parameters (eligibility, targets, ACPs, caps on CECs from specific resources), SEA performed a detailed analysis of four scenarios evaluating supply, demand, likely market dynamics and CEC price formation, considering potentially available supply from eligible resources, transmission- and cost-related constraints on market access and market concentration. Table RS-2 summarizes the *maximum* expected incremental costs to residential, commercial, and industrial customers under each of these four scenarios. Based on SEA's research and customized analysis, the CES-E is expected to increase MA residential consumer bills by between 0.33% to 0.56% per month in 2020. By comparison, the *total potential cost exposure* – based on

CES-E compliance either exclusively with ACPs or with CECs transacted at the ACP rate – to residential customers ranges from 0.5% under a 15% CES-E with an ACP at 10% of MA-I, to 1.0% under a 20% CES-E with ACP at 15% of MA-I.

RS-2: CES-E Bill Impact Scenario Analysis, Maximum expected cost by scenario and customer class, for 2020

(Nominal $/month)	**Bill Impact Based on Max CES-E CEC Price Case**			
Scenario Name…	**Base Case**	**Low ACP**	**Max S&D, Base ACP**	**Max S&D, Low ACP**
Residential, $/mo	$0.67	$0.44	$0.75	$0.50
Residential, as %	0.50%	0.33%	0.56%	0.37%
Commercial, $/mo	$2.40	$1.57	$2.67	$1.76
Commercial, as %	0.59%	0.38%	0.65%	0.43%
Industrial, $/mo	$17.64	$11.51	$19.63	$12.97
Industrial, as %	0.69%	0.45%	0.76%	0.50%

Table RS-3 summarizes the inputs for each of the four customized policy cases analyzed in this analysis:

RS-3: Scenario Definitions

Case Name	CES-E Target	ACP as % of Class I	Geographic Eligibility
Base	15%	15%	MA, NH, QC
Low ACP	15%	10%	MA, NH, QC
Max S&D, Base ACP	20%	15%	MA, NH, QC, CT, N.L.
Max S&D, Low ACP	20%	10%	MA, NH, QC, CT, N.L.

In all periods and cases, available supply exceeds demand by a substantial margin. In the presence of a competitive market with many eligible suppliers, this would suggest very low CEC prices. In a highly concentrated market, however, CEC prices are likely to be higher for the portion of compliance control by a small number of parties, especially when the cost to access the market varies by party.

The research and analysis performed for this report concludes that supply controlled by parties *other than* Hydro Quebec US (HQUS) is sub-marginal in all analyzed cases. This means that the cumulative supply controlled by parties other than HQUS is always less than CES-E demand. As a result, HQUS is expected to have the ability to set the CEC price near the ACP level for that portion of supply which it alone can fulfill. The remaining supply is subject to competition and is expected to settle at 10% to 50% of the ACP level.

1 Introduction

1.1 Purpose

As part of its Massachusetts Clean Energy Standard (CES) review, the Massachusetts Department of Environmental Protection (MassDEP) directed Sustainable Energy Advantage, LLC (SEA) to conduct quantitative analyses of the estimated market impact of:

(A) increasing the CES demand target to 22% in 2020, and

(B) establishing a Clean Energy Standard for existing resources (CES-E).

On October 4, 2019, MassDEP released draft amendments to 310 CMR 7.75, which are proposed to take effect in calendar/compliance year 2020. This Report is intended to support MassDEP's informed decision-making in advance of final amendments to the CES and CES-E regulations by providing incremental research and analysis regarding the potential market dynamics, compliance costs, and bill impacts associated with an amended CES and the establishment of a CES-E.

1.2 Report Organization

This Report is divided into two (2) distinct sections. Section 2 evaluates the potential Renewable Energy Certificate (REC) price, Clean Energy Certificate (CEC) price, and bill impacts of increasing the CES demand target to 22% in 2020. Section 3 explores the potential market dynamics, cost of compliance, and bill impacts associated with the proposed adoption of a CES-E beginning in 2020.

2 Stringency of Clean Energy Standard (CES) Requirement

2.1 Methodology

To test the sensitivity of REC and CEC prices to MassDEP's proposed change to the CES regulation, SEA used its proprietary New England Renewable Energy Market Outlook (NE-REMO) models to develop Renewable Energy Certificate (REC) and Clean Energy Certificate (CEC) price forecasts based on current regulations and market dynamics throughout the region for the years 2019 to 2025. At MassDEP's request, modeling outputs take the form of (1) Class 1 REC and CEC prices for the years 2019 to 2025, and (2) estimated bill impact for Massachusetts ratepayers. This work relies on a comparison of expected prices from (i) the Reference Case from SEA's NE-REMO Market Briefing 2019#2 (to which MassDEP subscribed) and (ii) a new sensitivity analysis – referred to herein as the Proposed Policy Case – in which the 2020 CES demand target is increased from 20% to 22%. CES demand targets remain unchanged in 2019, and in years 2021 through 2025 in both the Reference Case and Proposed Policy Case.

NE-REMO is comprised of a set of models, developed by SEA, that forecast scenario-dependent renewable energy facility build-outs, REC prices, and CEC prices for both the near- and long-term. The near-term REC/CEC price forecasts are a function of supply, (consisting of operating RPS-certified renewable energy supplies, near-term renewable builds, and additional policy-driven supply (e.g., from state long-term contracting or renewable energy tariffs); regional RPS demand; MA-CES demand; ACP levels in each market; and other dynamic factors. Such factors include REC banking injection and withdrawal, imports, and discretional curtailment of supply eligible to participate in one or more markets. Near-term renewable energy projects are defined as those under development, in the advanced stages of permitting, and have either identified long-term power purchasers or an alternative path to securing financing. These projects are subject to customized, probabilistic adjustments to account for deployment timing and likelihood of achieving commercial operation.

The long-term REC/CEC price forecasts are based on a supply curve analysis considering technical potential, resource cost, and market value of production. These factors are used to identify the marginal, REC price-setting, resource for each year in which new renewable energy builds are called upon. The long-term REC price forecast is estimated to be the marginal cost of entry for each year, meaning the premium requirement for the most expensive renewable generation unit deployed for a given year.

The bill impact methodology supporting this Report focuses on the change in spot market price for *unhedged* RPS and CES supply. The volume of renewable and clean energy supply delivered under long-term contract or tariff ("hedged supply") is held constant between the two cases. The quantity of remaining "unhedged supply" portion is assumed to be transacted at spot market prices, and varies between the two cases in 2020 as a result of the increased CES target. Spot market REC and CEC prices are forecast as a function of this spot market demand and available supply. Bill impacts are estimated based on the product of the expected change in spot market REC prices between the Reference and Proposed Policy cases and the aggregate volume of spot market RECs assumed purchased for Class I RPS and CES compliance in each case. The potential beneficial impact of wholesale electricity price suppression in the Proposed Policy case is not included in this analysis.

2.2 Summary of Key Assumptions

Because this is a sensitivity analysis (varying only the 2020 CES target), the following key assumptions are common to both the *Reference Case* and *Proposed Policy Case*:

Key Demand Assumptions

- Load forecast: Derived from the 2019 ISO-NE CELT Net of Passive Demand Resources, adjusted for SEA's forecast of BTM resources and beneficial electrification.
- State-specific RPS targets based on current statutes, including the RPS expansion adopted by the Maine legislature in 2019 and taking effect in 2020.
- Applicability of both CES and CES-E assumed limited to Investor-Owned Utilities.
- REC/CEC demand supplemented by SEA forecast of voluntary demand, including corporate purchasing and community choice aggregation.

Key Supply Assumptions

- MA 83D (NECEC): Approved, energized 5/1/2024.
- MA 83C Round 1 (Vineyard Wind): 798 MW, energized 1/1/2023 (no attrition).
- MA 83C Round 2: 400 MW online 7/1/2025, another 400 MW online 12/31/2025 (15% attrition).
- MA Additional OSW: 1,600 MW between 2028 and 2031.

- Revolution Wind (CT/RI): 700 MW, 12/31/2023 (No attrition).
- CT Additional OSW, 2019 RFP: 400 MW, 7/1/2026 (15% attrition).
- CT Additional OSW, later RFP(s): 1,600 MW between 2027 and 2031 (10% attrition).
- RI "400 MW" RFP: Assumes 40 MW of solar selected.
- ME Long-Term Procurement: New portion = 10.5% of load, phased in 2022 – 2026.
- SMART program expanded to 2,400 MW.
- CT Biomass/LFG Phasedown (reduction of RECs/MWh) assumed effective 1/1/2020.
- Proposed financial supports for NH biomass projects not adopted; continued operation of regional biomass facilities dependent on forecast economics – many not expected to run.
- New York assumed not to adopt a Tier 2 obligation.
- NYISO assumed to adopt carbon pricing policy effective in 2023.
- Regional DG policies assumed fulfilled, with modest attrition:
  - RI Renewable Energy Growth Program
  - CT LREC/ZREC Program and Low/Zero Emission Tariff Program
  - CT RSIP/SHREC and Residential Solar Tariff
  - Net Metering (all states)

2.3 Results: REC and CEC Price Forecasts

Figure 1 and Table 1 below summarize projected MA Class I REC and MA CES CEC prices for the *Reference Case* and *Proposed Policy Case*. All results are in nominal $/MWh. These estimates of REC and CEC prices are based on a fundamentals analysis of regional RPS supplies and demands for each compliance year. REC and CEC prices vary between the cases in 2020. These forecasts consider market participants' expectations for long-term RPS and CES market surpluses – with REC and CEC prices declining sharply beginning in 2023 for both the Reference and Proposed Policy cases – and the impact of such surpluses on the use of banked compliance to meet a portion of RPS and CES demand in 2020.

Figure 1: Forecasted MA-I REC and CES CEC Prices, Comparison of Reference and Proposed Policy Cases, $/MWh

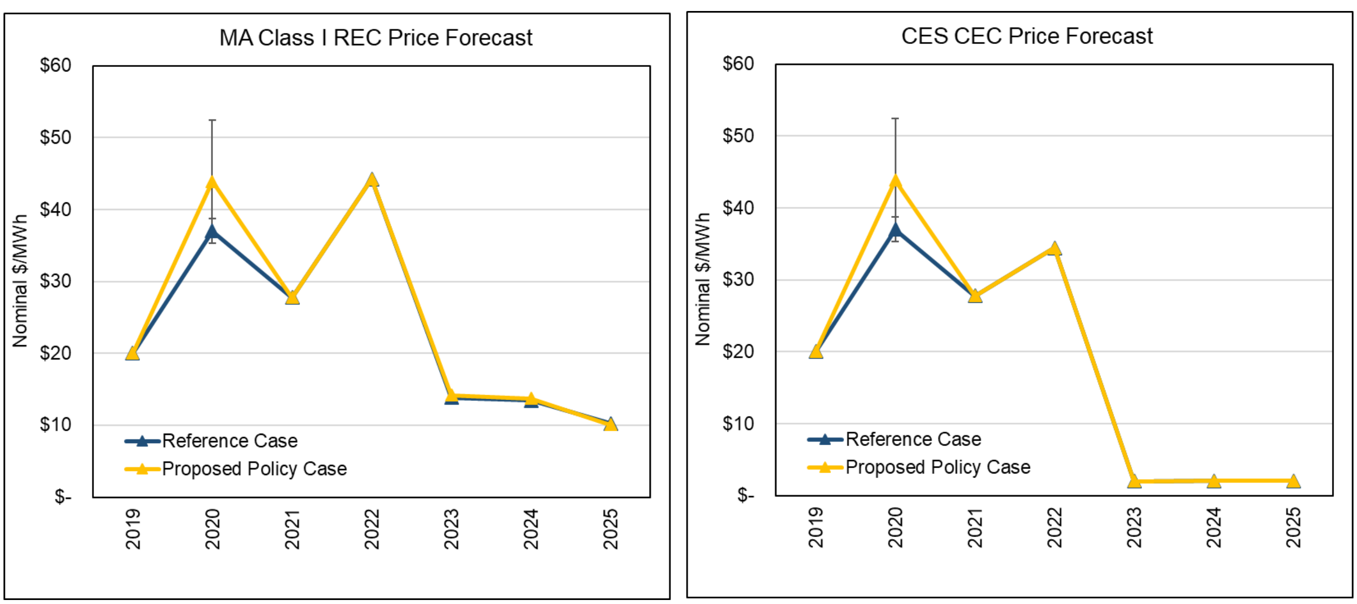


Table 1: Forecasted MA I REC and CES CEC Prices, Comparison of Reference and Proposed Policy Cases, $/MWh

Nominal $/MWh	2019	2020	2021	2022	2023	2024	2025
MA Class I REC Price							
Reference Case	$20.00	$37.00	$27.75	$44.25	$14.00	$13.50	$10.25
Proposed Policy Case	$20.00	$43.89	$27.75	$44.25	$14.00	$13.50	$10.25
MA CES CEC Price							
Reference Case	$20.00	$37.00	$27.75	$34.48	$2.00	$2.00	$2.00
Proposed Policy Case	$20.00	$43.89	$27.75	$34.48	$2.00	$2.00	$2.00

The error bars around the 2020 data points demonstrate the range of possible REC and CEC price outcomes in 2020 as a function of market participant foresight into future market conditions. Currently, regional renewable energy policies prescribe significantly more incremental supply than incremental demand beginning in 2023. As a result, successful policy implementation without further policy changes (such as target increases) will lead to material regional REC surpluses. RECs sold under long-term, fixed price contracts will be unaffected, but short term REC and CEC "spot markets" will show price declines whenever and wherever surpluses are expected. A significant portion of this expected surplus will come from regional distribution utilities selling excess RECs into the spot market (when their long-term commitments exceed their RPS obligations for Basic Service load). The proceeds from these REC resales offset the cost to the utilities' distribution customers, who are responsible for the total cost of long-term renewable energy contracts. At the same time, these REC resales will reduce the cost of RECs for all market participants purchasing from the short term market.

Perfect foresight into expected systemic surpluses would put downward pressure on 2020 REC and CEC prices compared to the expected outcomes shown in Table 1 by recognizing both the likelihood of future regional surpluses and the potential loss in value of excess RPS compliance previously banked by load-serving entities with the Massachusetts DOER and other regional RPS administrators. Conversely, imperfect foresight into future market conditions (the potential that policymakers might increase targets or that contracted supply may fail to reach commercial operation) would put upward pressure on REC and CEC prices (compared to expected outcomes) by discounting the likelihood of prolonged future surpluses if regional procurement policies are successful.

When load-serving entities (LSEs) internalize this point of view, it is expected that they will begin to apply their "bank balances" (or, more precisely, the *excess compliance* that many LSEs have accumulated on a state-by-state basis by retiring more NEPOOL GIS certificates into their state-specific REC disposition accounts than was requires in one or more years) towards 2020 compliance as a result of the expectation that future REC supply will be ample, and available at a lower price than LSEs value their "bank balance." This action will reduce demand – and therefore price – for 2020 RECs. The REC and CEC prices forecast in Figure 1 and Table 1 account for the influence of different market views regarding the likelihood of long-term material surpluses versus policy change and/or supply attrition , as well as the unequal distribution of banked compliance. The solid lines in Figure 1 represent the expected value (a central estimate) of REC and CEC price outcomes in each case.

2.3.1 Additional Observations on REC and CEC Price Forecasts

- For 2019 through 2021, REC and CEC prices move together in both the Reference and Proposed Policy cases.
- Higher REC and CEC prices in 2020 are not indicative of shortage conditions, and most LSEs are not expected to make ACPs in 2020. Due to the unequal distribution of banked compliance, however, it is possible that some LSEs could need to make a small volume of ACPs, even while most are withdrawing and applying past banked surpluses towards 2020 compliance.
- Starting in 2023, REC and CEC prices are expected to diverge in anticipation of the delivery of large hydro over the New England Clean Energy Connect transmission line. While this analysis estimates that the NECEC line will be energized by 2024, the anticipation of surplus CECs is expected to soften spot market CEC prices beginning in 2023 by suppressing LSEs' willingness to pay for "extra" CECs which would otherwise be purchased and converted to banked compliance.

2.4 Results: Estimated Bill Impacts, CES

Bill impacts are calculated as the product of (i) the expected *change in* spot market REC and CEC prices between the Reference and Proposed Policy cases and (ii) the annual volume of spot market RECs purchased for Class I RPS and CES compliance in each case. Renewable and clean energy supply purchased under long-term contract is held constant in both cases. Table 2 summarizes the estimated bill impact for residential, commercial, and industrial customers in both $/month and as a percentage of a typical[1] monthly bill.

Table 2: Estimated Bill Impact (Nominal $/month, and as a % of monthly bundled bill)

	2019	2020	2021	2022	2023	2024	2025
Residential, $/mo	$0	$0.71	$0	$0	$0	$0	$0
Residential, as %	No Change	0.53%	No Change	No Change	No Change	No Change	No Change
Commercial, $/mo	$0	$2.54	$0	$0	$0	$0	$0
Commercial, as %	No Change	0.62%	No Change	No Change	No Change	No Change	No Change
Industrial, $/mo	$0	$18.69	$0	$0	$0	$0	$0
Industrial, as %	No Change	0.73%	No Change	No Change	No Change	No Change	No Change

[1] Based on rates published by the Energy Information Administration for Massachusetts Investor-Owned Utilities.

3 Evaluation of Clean Energy Standard for Existing Resources (CES-E)

3.1 Methodology

As part of its CES review, MassDEP directed SEA to conduct an analysis of the potential cost of compliance with the proposed CES-E regulation. To estimate the potential cost of CES-E compliance, SEA considered three key parameters: (1) the CES-E obligation target, (2) the maximum CES-E Alternative Compliance Payment (ACP), and (3) the expected CES-E CEC price as a percentage of the maximum CES-E ACP. The first two are policy-related assumptions and the third is a function of market dynamics. These parameters enable the calculation of a range of potential compliance costs, and bill impacts, for CES-E.

First, to establish the maximum rate impact at two levels of demand targets and two levels of ACP rates, SEA performed a parametric analysis by assuming the price of all CES-E CECs in each year was at the ACP. Next, SEA evaluated the potential supply and demand dynamics of the proposed CES-E market. This analysis introduced additional market design variables related geographic eligibility and considered the market fundamentals relating to supply and demand; transmission constraints, control and costs; the impact of participation (or partial participation) in the satisfaction of other renewable energy policy objectives; market concentration and competitive dynamics; and other potential factors governing market participation. Section 3.2 summarizes the key assumptions supporting the CES-E analysis.

3.2 Summary of Key Assumptions

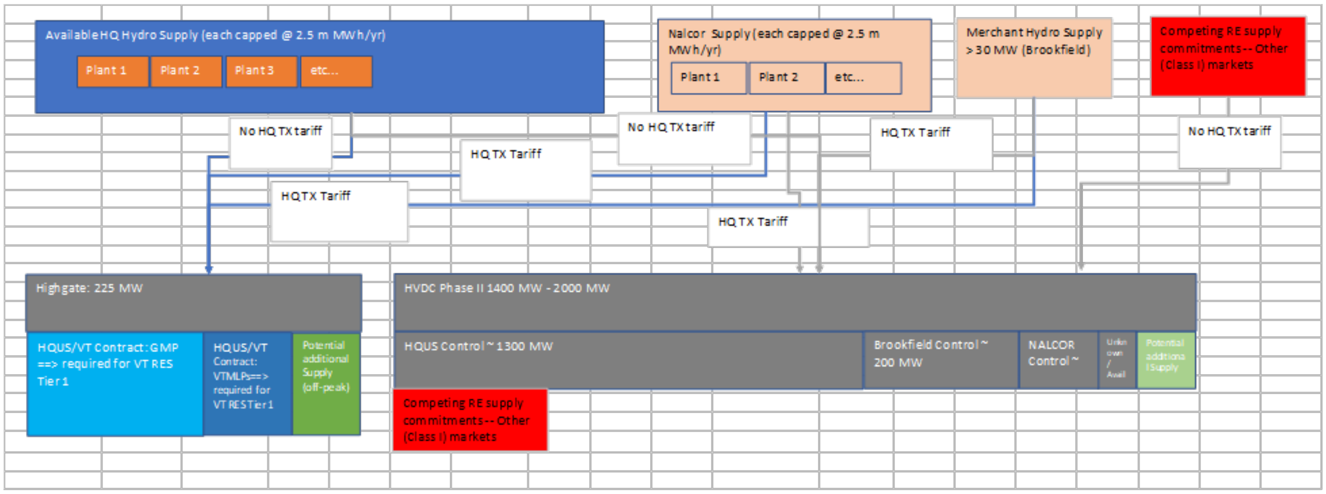
- Demand target options: 15% and 20% of load. In either case, existing retail supply contracts are assumed to be exempt from the CES-E for their remaining durations, assuming a similar pattern to exemptions experienced in the past by DOER in the presence of other RPS rules changes.
- Retail load and targets are modeled as constant from 2020 through 2025. This is intended to be equivalent to the self-adjusting targets proposed by DEP to maintain a constant demand in MWh per year.
- No banking of CES-E CECs is allowed, as proposed by DEP.
- Maximum Alternative Compliance Payment options: 15% of *proposed*[2] MA Class I ACP, and 10% of *proposed* MA Class I ACP.
- Geographic Eligibility (assuming all other eligibility criteria are met):
    - Base: New Hampshire, Quebec
    - Sensitivity: New Hampshire, Quebec, Connecticut, Newfoundland & Labrador
- Maximum generation from any single generator: 2.5 million MWh/yr.
- Potentially eligible generation, subject to geographic and other eligibility limitations, includes a large Hydro Quebec hydroelectric portfolio, three Quebec hydroelectric plants owned by Brookfield, five hydroelectric plants owned by NALCOR, in additional to Seabrook, Millstone 2 and

[2] Proposed amendments to the current MA Class I RPS regulation include fixing the ACP at $70/MWh. It is important to note, however, that whether the maximum ACP is updated or not has very little impact during the analysis term (2019-2025) as a result of modest inflation expectations for this period of time.

Millstone 3 nuclear plants (where nuclear plants have multiple owners, they were treated as if controlled by the majority owner for purposes of this analysis).

- Generation that had previously been used for RPS compliance in New England was considered ineligible (applied to all of one, and part of another Brookfield hydro plant).
- Supply available to fulfill the CES-E was limited by access to the New England market via either the Highgate or HVDC Phase II facilities, each subject to prior/existing delivery commitments deployed in fulfillment of the Vermont Tier 1 RES (over Highgate in all on-peak hours) and various other New England Class I RPS-certified projects (almost 600,000 MWh/year). No additional costs are required to use the Highgate facility (as service is available under ISO-NE network tariffs), while incremental costs to use the Phase II facility apply. Control of rights to use the HVDC Phase II facility via tariff service agreements from the Phase II Interconnection Rights Holders was assumed to be 1,300 MW for Hydro Quebec, 200 MW for Brookfield, and 30 MW for NALCOR, which reflects SEA's understanding of the approximate quantity of current rights held out of a 2,000 MW nominal transfer capacity (which is often limited to 1,400 MW or less transfer capacity for regional reliability purposes). Further, SEA assumed that historical flows over these facilities (using 2018 data as a proxy) would continue to be economic under a CES-E even if the value of CES-E certificates was zero. Hence, there would be no incremental transmission charges for use of the Hydro Quebec transmission system or securing Phase II transfer rights required to maintain the historical levels of imports into New England from Québec.
- The economics of additional flows in the presence of CES-E revenues were considered.
- Incremental supply over these ties was subjected as applicable to additional cost to reserve Phase II (~$3.90/MWh) and (for parties other than HQUS) the Hydro Quebec transmission tariff (~$7.16/MWh). Together, at either ACP examined, they are enough to preclude additional NALCOR supply (if made eligible) above current reservations.
- It is not possible to know whether one or another party might act preemptively to control uncommitted/unreserved transmission access from Quebec to the exclusion of others. For this reason, the analysis considered three alternative scenarios, under which access to available unreserved transmission space was (i) split equally among eligible suppliers, (ii) maximized by HQUS, or (iii) maximized by parties other than HQUS.
- Successful completion of the proposed NECEC transmission line is not expected to materially impact transmission availability or cost over the Phase II or Highgate facilities and is not considered as part of this analysis.
- Figure 2 depicts the characteristics of access, and transmission limitations, constraining access of CES-E eligible generation to delivery into ISO-NE.

Figure 2: Schematic of Access of CES-E-Eligible over Transmission Ties from Quebec



The four custom cases analyzed in this report are defined below:

- **Base**: 15% target, ACP at 15% of Class I, and generation in Massachusetts, New Hampshire and Quebec eligible
- **Low ACP Sensitivity**: 15% target, ACP at 10% of Class I, and generation in Massachusetts, New Hampshire and Quebec eligible
- **Max Expanded Supply and Demand, Base ACP**: 20% target, ACP at 15% of Class I, and generation in Massachusetts, New Hampshire, Quebec, Connecticut, Newfoundland and Labrador eligible
- **Max Expanded Supply and Demand, Low ACP**: 20% target, ACP at 10% of Class I, and generation in Massachusetts, New Hampshire, Quebec, Connecticut, Newfoundland and Labrador eligible

3.3 Results

As a result of stable demand and static supply, CES-E CEC price and compliance cost dynamics will more closely resemble "maintenance" classes like MA-II and MA-II-WTE than "growth" classes like MA-I. Because CES-E eligible facilities are owned by a limited number of market participants, CES-E CEC prices may be driven not only by supply and demand, but also by discretional market participation and/or withholding. CES-E compliance costs are modeled herein as a function of the assumed CES-E % target, the CES-E ACP (which itself is a function of MA-I ACP), and the assumed cost of CES-E CECs.

3.3.1 Maximum Bill Impacts, CES-E

Table 3 below summarizes the maximum potential CES-E compliance costs as a function of the CES-E target (15% or 20%), the CES-E ACP as a percentage (15% or 10%) of the *DOER proposed* MA-I ACP (capped at $70/MWh), at 100% of the designated CES-E ACP.

Table 3: CES-E Bill Impacts, Based on Proposed MA-I ACP & Assuming Compliance at 100% of CES-E ACP

(Nominal $/month)	CES-E Target @ 15%			CES-E Target @ 20%	
% of Proposed ACP…	15% of MA-I ACP	10% of MA-I ACP		15% of MA-I ACP	10% of MA-I ACP
Residential, $/mo	$1.00	$0.67		$1.34	$0.89
Residential, as %	0.75%	0.50%		1.00%	0.66%
Commercial, $/mo	$3.58	$2.38		$4.77	$3.18
Commercial, as %	0.88%	0.58%		1.17%	0.78%
Industrial, $/mo	$26.28	$17.52		$35.04	$23.36
Industrial, as %	1.02%	0.68%		1.36%	0.91%

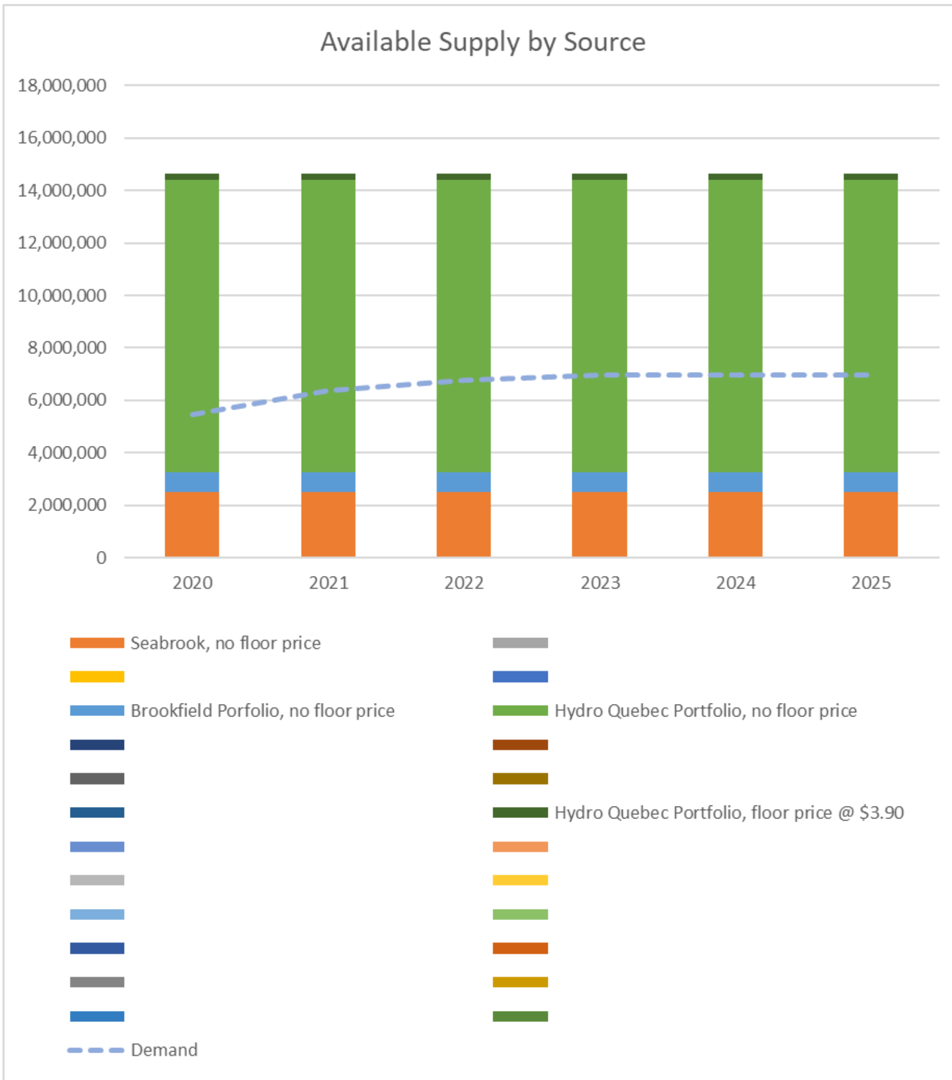
3.4 Estimated Bill Impacts, CES-E

Figure 3, Figure 4, Figure 5 and Figure 6 depict the supply-demand balances for each of the four combinations of targets, ACP and geographic eligibility described in the case definitions above. In each figure, the impact of projected exemptions for existing retail load on the supply-demand balance is evident from 2020 through 2022. In all periods and cases, available supply exceeds demand by a substantial margin, which in the presence of a competitive market with many eligible suppliers, would suggest very low CEC prices (based on experience in similar markets, a market price of $1-2/MWh or less might be expected). The small number of suppliers and high concentration of control is evident in each of the figures. Market concentration for each case is described below each figure.

Supply controlled by parties *other than* Hydro Quebec US (HQUS) is sub-marginal in all analyzed cases – meaning that the cumulative supply controlled by other parties is always less than CES-E demand. As a result, HQUS is expected to have the ability to set the CEC price near the ACP level for that portion of supply which it alone can fulfill. We have assumed, based on observations of pricing in similar markets, that HQUS could charge a price of ACP minus $0.75 per MWh for this portion of supply, which serves as a proxy for the price that LSEs would be willing to pay to cover transaction costs rather than making an Alternative Compliance Payment.

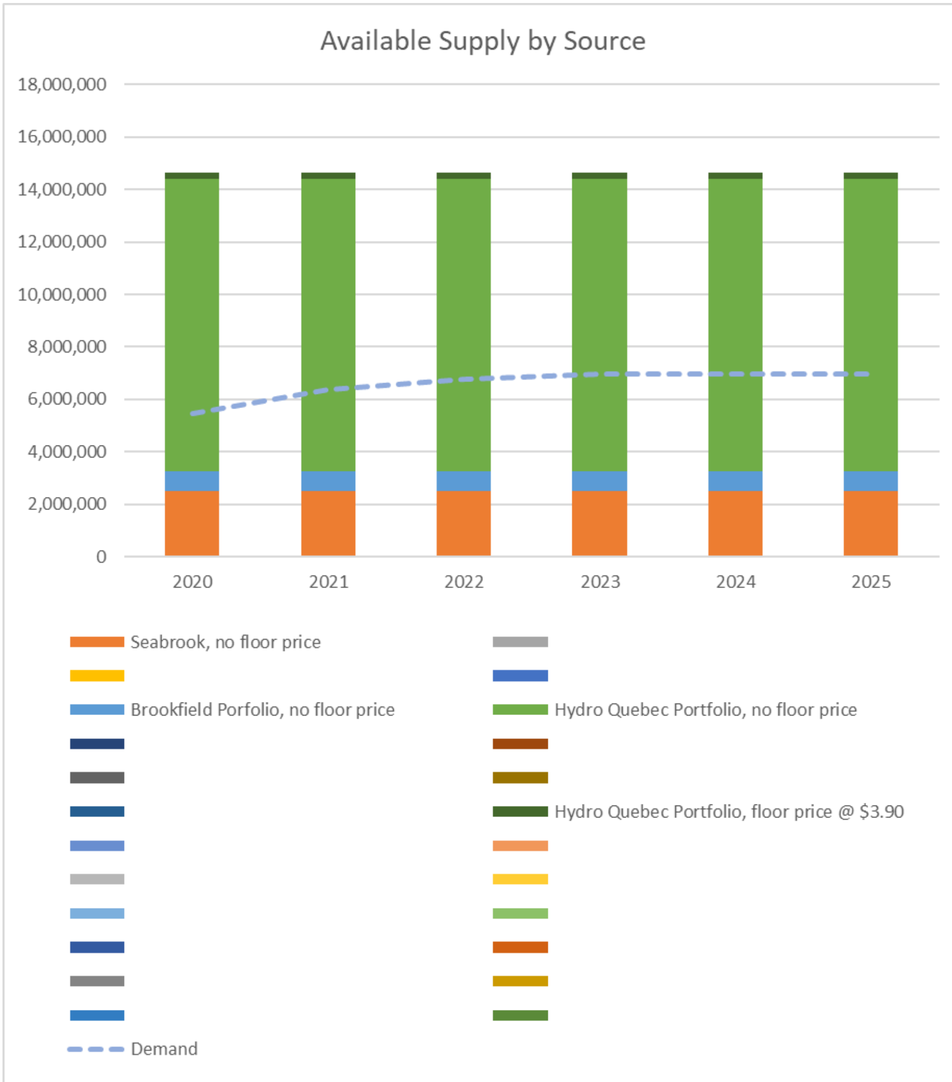
The remaining supply is subject to competition among HQUS and the other eligible suppliers. Supply that would be available subject to additional transmission costs (which could otherwise serve as a price floor) that are above the marginal revenue; due to the magnitude of surplus, such incremental supply is never expected to come into play. While each supplier other than HQUS can offer all of its supply into the market and HQUS could choose to supply the market with less than the full amount to meet compliance (thus increasing the spot CES-E price for all remaining CECs), HQUS will have the incentive to maximize its total revenues by offering more CECs into the market. Suppliers competing with HQUS will be incentivized to reduce the price of their CECs in order to complete and maximize their own revenues. In a highly competitive market, spot price in the presence of such surplus would be bid down to a very low level, likely $1-2/MWH or less. In a market with two competitors, experience in the Massachusetts Class II Waste-to-Energy RPS suggests that prices could be maintained at a high percentage of ACP. With the market concentrations and supply-demand balances indicated in these figures, SEA observes that there is no analytically derived solution to precisely estimate spot prices, as strategic posturing best represented by game theory would likely prevail. SEA estimates that the prevailing price for the competitive portion of the demand would likely fall between 10% and 50% of the ACP. To bound the expected rate impacts, Table 4, Table 5, Table 6 and Table 7 show the projected rate retail rate impacts reflecting the non-competitive portion of demand met by HQUS at ACP less $0.75/MWh, with the remainder met at 10%, 30% and 50% of ACP, respectively.

Figure 3: Base Scenario Supply-Demand Results



In this scenario, three eligible sources or portfolios are controlled by four parties (NextEra Energy Resources and a consortium of municipal light plants control Seabrook entitlements). In the Base Scenario, the assumption of who has access to unreserved transmission space does not impact the rate impact results.

Figure 4: Low ACP Sensitivity Scenario Supply-Demand Results



In this scenario, three eligible sources or portfolios are controlled by four parties (NextEra Energy Resources and a consortium of municipal light plants control Seabrook entitlements). The assumption of who has access to unreserved transmission space does not impact the rate impact results.

Figure 5: Max Expanded S&D, Base ACP Scenario Supply-Demand Results

In this scenario, six eligible sources or portfolios are controlled by nine parties (NextEra Energy Resources and a consortium of municipal light plants control Seabrook entitlements; Dominion, MMWEC and GMP control Millstone 3 entitlements). The assumption of who has access to unreserved transmission space does impact the rate impact results slightly, causing them to vary by approximately plus or minus $0.02 per MWh of CES-E obligated load.

Figure 6: Max Expanded S&D, Low ACP Scenario Supply-Demand Results

In this scenario, six eligible sources or portfolios are controlled by nine parties (NextEra Energy Resources and a consortium of municipal light plants control Seabrook entitlements; Dominion, MMWEC and GMP control Millstone 3 entitlements). The assumption of who has access to unreserved transmission space does impact the rate impact results slightly, causing them to vary by approximately plus or minus $0.01 per MWh of CES-E obligated load.

Table 4: Base Scenario Rate Impact Projections

	Bill Impact: Customized Approach																	
	Min Price Case						Max Price Case						Average Price Case					
	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025
CES-E Obligation (MWh)	5,448,127	6,383,922	6,763,373	6,967,246	6,967,246	6,967,246	5,448,127	6,383,922	6,763,373	6,967,246	6,967,246	6,967,246	5,448,127	6,383,922	6,763,373	6,967,246	6,967,246	6,967,246
CES-E ACP							$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50
CES-E Compliance Price, as % of CES-E ACP																		
CES-E Compliance Cost, Nominal $M	$24.68	$33.81	$37.51	$39.49	$39.49	$39.49	$38.41	$47.53	$51.23	$53.22	$53.22	$53.22	$31.55	$40.67	$44.37	$46.36	$46.36	$46.36
CES-E Obligated Load (MWh)	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304
Cost per MWh of MA CES-E Obligated Load ($/MWh)	**$0.68**	**$0.79**	**$0.83**	**$0.85**	**$0.85**	**$0.85**	**$1.06**	**$1.12**	**$1.14**	**$1.15**	**$1.15**	**$1.15**	**$0.87**	**$0.96**	**$0.98**	**$1.00**	**$1.00**	**$1.00**

Table 5: Low ACP Sensitivity Rate Impact Projections

	Bill Impact: Customized Approach																	
	Min Price Case						Max Price Case						Average Price Case					
	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025
CES-E Obligation (MWh)	5,448,127	6,383,922	6,763,373	6,967,246	6,967,246	6,967,246	5,448,127	6,383,922	6,763,373	6,967,246	6,967,246	6,967,246	5,448,127	6,383,922	6,763,373	6,967,246	6,967,246	6,967,246
CES-E ACP							$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00
CES-E Compliance Price, as % of CES-E ACP																		
CES-E Compliance Cost, Nominal $M	$15.91	$21.76	$24.13	$25.41	$25.41	$25.41	$25.06	$30.91	$33.28	$34.56	$34.56	$34.56	$20.49	$26.34	$28.71	$29.98	$29.98	$29.98
CES-E Obligated Load (MWh)	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304
Cost per MWh of MA CES-E Obligated Load ($/MWh)	**$0.44**	**$0.51**	**$0.54**	**$0.55**	**$0.55**	**$0.55**	**$0.69**	**$0.73**	**$0.74**	**$0.74**	**$0.74**	**$0.74**	**$0.56**	**$0.62**	**$0.64**	**$0.65**	**$0.65**	**$0.65**

Table 6: Max Expanded S&D, Base ACP Scenario Rate Impact Projections

	Bill Impact: Customized Approach																	
	Min Price Case						Max Price Case						Average Price Case					
	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025
CES-E Obligation (MWh)	7,264,170	8,511,896	9,017,830	9,289,661	9,289,661	9,289,661	7,264,170	8,511,896	9,017,830	9,289,661	9,289,661	9,289,661	7,264,170	8,511,896	9,017,830	9,289,661	9,289,661	9,289,661
CES-E ACP							$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50	$10.50
CES-E Compliance Price, as % of CES-E ACP																		
CES-E Compliance Cost, Nominal $M	$16.52	$28.68	$33.62	$36.27	$36.27	$36.27	$42.73	$54.90	$59.83	$62.48	$62.48	$62.48	$29.63	$41.79	$46.72	$49.37	$49.37	$49.37
CES-E Obligated Load (MWh)	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304
Cost per MWh of MA CES-E Obligated Load ($/MWh)	**$0.45**	**$0.67**	**$0.75**	**$0.78**	**$0.78**	**$0.78**	**$1.18**	**$1.29**	**$1.33**	**$1.35**	**$1.35**	**$1.35**	**$0.82**	**$0.98**	**$1.04**	**$1.06**	**$1.06**	**$1.06**

Table 7: Max Expanded S&D, Low ACP Scenario Rate Impact Projections

	Bill Impact: Customized Approach																	
	Min Price Case						Max Price Case						Average Price Case					
	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025	2020	2021	2022	2023	2024	2025
CES-E Obligation (MWh)	7,264,170	8,511,896	9,017,830	9,289,661	9,289,661	9,289,661	7,264,170	8,511,896	9,017,830	9,289,661	9,289,661	9,289,661	7,264,170	8,511,896	9,017,830	9,289,661	9,289,661	9,289,661
CES-E ACP							$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00
CES-E Compliance Price, as % of CES-E ACP																		
CES-E Compliance Cost, Nominal $M	$10.76	$18.55	$21.72	$23.42	$23.42	$23.42	$28.23	$36.03	$39.19	$40.89	$40.89	$40.89	$19.50	$27.29	$30.46	$32.15	$32.15	$32.15
CES-E Obligated Load (MWh)	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304	36,320,850	42,559,482	45,089,151	46,448,304	46,448,304	46,448,304
Cost per MWh of MA CES-E Obligated Load ($/MWh)	**$0.30**	**$0.44**	**$0.48**	**$0.50**	**$0.50**	**$0.50**	**$0.78**	**$0.85**	**$0.87**	**$0.88**	**$0.88**	**$0.88**	**$0.54**	**$0.64**	**$0.68**	**$0.69**	**$0.69**	**$0.69**

3.4.1 Additional Observations on Potential CES-E Bill Impacts

While supply and demand for CES-E will ultimately be static, policy choices that increase the number of CES-E participants and the quantity of CES-E supply have the potential to put downward pressure on CES-E CEC prices and compliance costs. The fewer the market participants and more highly concentrated control over supply, the more likely it is that market participants will be able to place upward pressure on CES-E CEC prices in the presence of surplus supply.

Broadening the geographic eligibility of resources from adjacent control areas (i.e. Canada) is likely to increase price competition among entities vying for space over existing transmission ties. Broadening the types of entities eligible to bring CES-E supply to market (i.e. municipal utilities and other bilateral purchasers of eligible nuclear facilities) may increase price competition by creating new revenue opportunities for entities willing to accept CES-E CEC prices below the ACP.

Taken together, increased diversity in both supply and suppliers is likely to result in greater CES-E CEC price diversity, with some market participants likely to accept prices below the ACP rather than be crowded out by participants controlling large portfolios.