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RAPPORT DU CONSULTANT MERRIMACK ENERGY GROUP INC.

Hydro-Quebec

Benchmark Report Deliverable Two

Comparison of Benchmark Resources to Resources Selected by Hydro-Quebec Via the 480 MW Call for Tenders

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Prepared By:

1 INTRODUCTION

1.1 OVERVIEW

Merrimack Energy Group, Inc. ("Merrimack Energy") was retained by Hydro-Quebec to undertake a benchmark cost assessment of the comparative costs of renewable energy resources in the Northeast United States ("US") and eastern Canadian markets relative to the costs of the proposals submitted to and selected by Hydro-Quebec in its distribution activities under its most recent December 2021 Call for Tenders. Hydro-Quebec issued two Call for Tenders, including one which calls for the purchase of a block of renewable energy with a 480 MW capacity contribution to the winter peak with energy needs of 4.2 TWh on an annual basis and a second which requires a block of wind energy having 300 MW of installed capacity. The new long-term supply contracts expected from the December 2021 Calls for Tenders are required to meet the energy and power needs of Hydro-Quebec.

As part of the contract approval process associated with the projects selected via the 480 MW Call for Tenders, Hydro-Quebec is submitting this report to demonstrate that the contract pricing from its 480 MW Call for Tenders is competitive and represents lowest reasonable cost when compared with market options in neighboring markets.

For this assignment, Merrimack Energy is required to provide two deliverables.

Deliverable 1 includes a benchmark cost assessment of renewable energy resources in the Northeast US and eastern Canadian markets in terms of unit costs per energy source and the expected prices for the future for a specified list of renewable resources. The list of renewable resources required includes:

- Wind power
- Wind power with energy storage
- Hydro
- Solar Power
- Solar power with energy storage
- Biomass power
- Renewable natural gas

Merrimack Energy provided of final version of the Deliverable 1 Report to Hydro-Quebec in early February 2023. The Report is entitled "Benchmarking the Cost of Supplying Electricity from Renewable Energy Sources Relative to Hydro-Quebec's December 2021 Call for Tenders" ("Benchmark Report"). The summary table which provides the estimated Levelized Cost of Energy ("LCOE") and Real

Levelized Cost calculations in $/MWh in both US and Canadian dollars resulting from the Deliverable 1 Benchmark Report is included as Appendix A to this report for reference.

Deliverable 2 requires Merrimack Energy to provide a comparison of the unit costs of winning bids in Hydro-Quebec's Call for Tenders issued in December, 2021 to benchmark resources potentially available in northeast power markets, including the cost of transporting the power to Quebec and factoring in the Quebec business, economic and regulatory context. Hydro-Quebec wishes to obtain an assessment of the anticipated real unit cost (in real levelized $/MWh in Cn$) per originating renewable energy source as the basis for comparison to reflect the same methodology used by Hydro-Quebec for its evaluation and selection of resources.[1]

Under its regulations, the Regie requires that Hydro-Quebec undertake a comparative analysis of the cost of power for similar products from neighboring Northeast power markets. The "similar products" standard is important to define in undertaking the benchmark study and comparison to Call for Tenders bids and can be identified to reflect project technology, size, product specifications, contract term, timing for the Call for Tenders and project in-service date. For example, as described in Merrimack Energy's Benchmark Report, the similar product standard should include size of the resource, timing of the solicitation process for Hydro-Quebec, and commercial operation date of the project, if possible.

This assessment focuses on comparing the cost of power from the bids selected in response to Hydro-Quebec's 480 MW Call for Tenders with the cost of resources for the same technology type in other North American markets as a benchmark cost.[2]

The methodology proposed by Merrimack Energy is designed to assess the competitive cost of long-term power from the winning bids from Hydro-Quebec's recent Call for Tenders with general industry cost data as well as a sample of other similar project types proposed and under development in neighboring North American markets on a real levelized cost basis over consistent contract terms (e.g., 30-year contract terms for wind and biomass resources and 20-year terms for solar and storage resources) based on the expected useful life of such

[1] For the final evaluation, Merrimack Energy has also utilized Hydro-Quebec's discount rate to ensure the evaluation methodology for both resources submitted and evaluated in Hydro-Quebec's Call for Tenders and for evaluating benchmark resources is consistent.

[2] Merrimack Energy has served as Independent Evaluator for several recent high-profile Request for Proposal processes for renewable resources in several regions of the US and has conducted analysis of renewable project costs.

resources. The analysis will also include the cost of transmission from neighboring Northeast markets assuming the power would be purchased in the neighboring market and delivered to Quebec. In cases where multiple data points exist for project proposals, as noted, Merrimack Energy will focus on the cost of projects in the first and second quartiles as the most competitive options relative to the bids selected by Hydro Quebec, which would likely be the most competitive proposals as well. In addition, Merrimack Energy will strive to use publicly available data inputs for each market as a primary source of data if available. If publicly available sources of data are not readily available in neighboring markets, Merrimack Energy will attempt to correlate data in other markets with the data in question for the local markets and apply trends in costs to develop capital cost, operating costs and other cost inputs and assumptions in a consistent manner.

Merrimack Energy has found in preparing such benchmark studies that use of only levelized cost of energy studies can be misleading based on differences in location, capacity factor, project size, contract term, and market cost structure. When capital cost information was available, Merrimack Energy calculated the annualized costs associated with the amortization of the capital costs over the contract term and added estimates of O&M costs and transmission costs for delivering the power from the select market into Quebec, assuming Hydro-Quebec could procure similar resources in other northeast markets and deliver the power to Quebec. Merrimack Energy also relied upon data from other Call for Tenders or Requests for Proposals as a check on the reasonableness of the comparative costs generated.[3] As we did in previous benchmark reports, Merrimack Energy will compare the costs of renewable or other projects bid into Hydro-Quebec's Call for Tenders with similar resources in New York, New England, Ontario, New Brunswick and Nova Scotia, where applicable. Merrimack Energy also addressed other factors in preparing the sample costs including tax credits and incentives in the US and Canada, capacity factor differences, and local conditions for adjusting benchmark costs.[4]

Since the cost of transmission and other related services varies based on project location, the initial focus of this assessment will be on a comparison of the cost of

[3] Section 3 of the Hydro-Quebec Mandate for this assignment includes as Objective 1 identification and analysis of the results of recent North American Calls for Tenders in terms of the unit cost per energy source. However, based on our role as Independent Evaluator for utility solicitations, it is very difficult to gain access to such bid data immediately after completion of a solicitation process given the confidential nature of the data and the market timing associated with Hydro-Quebec's Call for Tenders. Some data may be available from solicitations after contracts are executed and filed for approval with regulatory Commissions but the timing of such solicitations with regards to Hydro-Quebec's Call for Tenders may not correlate, particularly in light of recent price volatility.

[4] In previous Call for Tenders, Hydro-Quebec in its distribution activities generally conducted a procurement process designed to procure a targeted resource (i.e., wind only, or biomass only). As a result, Merrimack Energy's previous benchmark studies prepared for Hydro-Quebec during the period 2005-2015 focused on one specific resource type for comparison purposes. The technologies and resource types are much broader for this assessment.

resource-generated energy. In addition, for the wind resources selected, the focus of the competitive economic analysis will be on recent project costs since the cost of wind turbines and the commodities necessary to produce the turbines and related facilities has increased significantly, similar to cost increases throughout the electricity generation market. As demonstrated in Merrimack Energy's Benchmark Report, several wind power projects under development have recently announced capital cost increases for their projects. The timing of the increase in capital costs for wind turbines, any differences between subsidies for renewable resources in the US and Canada, transmission requirements, and other locational differences that influence the wind regime makes an accurate comparison between the costs of the wind resources selected by Hydro-Quebec Distribution and benchmark resources challenging.

Although it is difficult to conduct a consistent and equivalent evaluation of wind and other renewable energy projects, Merrimack Energy has developed a reasonable approach for conducting the comparative cost assessment required by the Regie. The methodology undertaken by Merrimack Energy assesses the competitive cost of long-term power from the winning bids from the 480 MW Call for Tenders for wind and hydro generated electricity (including an assessment with and without transmission costs) with general industry cost data as well as a sample of other wind and hydro projects proposed and under development in other North American markets on a real levelized cost basis over a 30-year term. The analysis also includes the cost of transmission from neighboring Northeast markets to Quebec.[5]

Regarding Hydroelectric resources, due to the relatively scarce development of projects and with each project having unique characteristics, it is more difficult to find direct local comparisons for costs of newly developed hydroelectric resources. For hydro generated electricity Merrimack Energy is relying largely on publicly available data given the limited amount of actual bid data for comparable hydro resources.

1.2 BACKGROUND

There are a number of factors that influence the cost of wind and hydroelectric resources. These include the capital cost of the equipment, the cost of financing the project, operation, maintenance, and other administrative costs (e.g., property taxes and insurance costs), site-specific conditions, the size of the

[5] The cost of transmission from each relevant market is based on the transmission tariff rate associated with neighboring markets. However, it is quite common that to deliver wind energy to the market hubs, additional transmission capacity may be required due to the general remote nature of these projects relative to the location of the best wind sites.

project, project configuration, and government incentives such as production tax credits, accelerated depreciation and local subsidy programs. Based on recent dramatic changes in electric power project costs resulting from such factors as: (1) supply chain constraints affecting the availability and cost of generating equipment; (2) project input commodity costs for a wide range of raw materials required in the production process such as steel, copper, cement, etc.; (3) inflationary trends affecting labor and other project development costs; (4) increases in interest rates in the US and other markets which affects the cost of borrowing to construct such projects; (5) worldwide competition for renewable resources; (6) exchange rate impacts; and (7) legislative and regulatory initiatives to increase subsidies for renewable projects, it is important that the cost of benchmark resources should be assessed in conjunction with Hydro-Quebec's timing for its Call for Tenders in which bids were due in July 2022 and projects are expected to come on-line in 2026.

The strength of the wind resource (i.e., wind regime), including wind speed and wind speed distribution over the course of the year, and the matching of the wind resource to the wind turbine power curve, is also a major determinant of project cost. These factors determine project output and the associated capacity factor of the wind system. Since most of the costs associated with a wind generation facility are fixed costs, the higher the capacity factor, the lower the per-unit cost.

However, since the cost of wind generation is highly site specific, it is very difficult to consistently and equitably compare the economics of various projects since each project has a unique set of local conditions. Unlike other generation technologies, such as combined cycle or combustion turbine facilities that generally have a standard design and fairly consistent cost characteristics, the economics of wind generation can vary considerably in a number of areas.

The capital costs of new hydroelectric projects can also vary widely depending on a number of factors, including the size of the project, the location, and the specific technology used. In general, however, capital costs for new hydroelectric projects have been increasing since 2010. This is due in part to the rising cost of materials and labor, as well as increased regulatory requirements. Additionally, new hydroelectric projects are being built in remote or difficult-to-access locations, which can drive up costs. The cost of hydroelectric projects also vary greatly depending on the location, complexity of the project, and project type as will be discussed in this report.

1.3 COST FACTORS

1.3.1 Capital Cost and Operating Costs of Wind Projects

The capital cost of wind projects has been rising rapidly over the past year. An article on wind project costs increases by IHS Markit, a part of S&P Global, issued on January 31, 2022[6] identified the major drivers of cost increases for wind projects based on discussions with Original Equipment Manufacturers ("OEM"). The article notes that the cost of onshore wind fell 40% in the latter half of the 2010's; however, prices are now on the rise, and that trajectory is set to continue, as cost increases and COVID induced bottlenecks snarl supply chains. For example, Vestas indicated it expected costs to continue to rise through 2022 and beyond because the company expected an increased impact from cost inflation related to raw materials, wind turbine components and energy prices.

The article also noted that the cost increases behind the price hike span materials, freight, labor needs coming out of the pandemic, and geopolitical risk. Rising material costs for aluminum, copper, fiber glass resins, and more have played a prominent role. Higher raw material prices are resulting in higher costs for all critical components including towers, blades, power electronics, and foundations. The top of the material cost list is the increase in steel prices, which accounts for a significant portion of wind project costs. In addition, increasing transportation and logistics costs are expected to continue to affect the wind power industry throughout 2022.

Based on recent increases in capital costs (which include the cost of turbines plus balance of plant costs plus development costs plus interconnection and network upgrade costs) for wind projects, capital costs now consistently exceed $2,000/kW installed (in nominal US dollars) in markets throughout the US. Since the cost of wind power is generally higher in the Northeast than other prominent wind regions in the US such as the PacifiCorp northwest and Midwest markets, Merrimack Energy has estimated the LCOE for wind based on a range of capital costs of $2,000/kW (US$) to $2,500/kW (US$). Actually, within the past two months we have witnessed proposals for mid-sized wind projects with capital costs (including network upgrade costs) of over $2,500/kW (US$).[7]

In addition to the recovery of capital-related costs, project developers also incur annual operation, maintenance and administrative costs and other operating expenses. The largest operating expense, by far, are scheduled maintenance, turbine repair costs and warranties. Other annual operating expenses include

[6] IHS Markit, "North America Wind Capital Cost and LCOE Outlook", January 2022.

[7] Merrimack Energy is also seeing increases in network upgrade costs required to construct the facilities necessary to connect the projects to the utility system due to the increasing number of renewable energy projects in utility interconnection queues throughout the US.

infrastructure and balance of plant maintenance, administrative and general costs (A&G), land royalties, property taxes, project insurance, electrical usage, and contingency.

The US Department of Energy (DOE) (Land Based Wind Market Report 2022) estimated O&M costs for wind projects to average about $21/kW-year (US$) for projects that have entered service since 2010. According to DOE, O&M costs represent about 50% of all total operating costs, which according to DOE is estimated to be about $44/kW-year (US$). There are a number of other costs that should also be included in operating costs such as insurance, property taxes, capital expenditures, etc. We have seen estimates of total operating costs to range from about $35/kW-year (US$) to over $50/kW-year (US$). The NREL ATB calculates a Fixed O&M rate of $42.19/kW-year (US$) for wind projects.

Merrimack Energy is therefore using an operating cost consistent with the NREL value of $42.19/kW-year (US$) starting in 2026 and escalating annually by inflation, utilizing Hydro-Quebec's internal forecasted annual inflation rates.

1.3.2 Capital and Operating Costs of Hydropower Projects

There are several factors that can impact the capital cost of a hydroelectric power plant including:

- The size of the project.
- Location – projects built in remote or difficult-to-access locations can have higher costs due to the need for additional infrastructure such as roads and transmission lines.
- Type of dam – costs can vary greatly depending on the type of dam used. For example, a concrete dam may be more expensive than an earth fill dam.
- Type of technology – there type of technology will impact costs, such as run-of-the-river or pumped storage.
- Design and engineering – the complexity of the design and engineering will impact costs.
- Environmental and social impact – the cost of mitigation measures and compensation to the local population will impact project costs.
- Financing costs – the cost of financing the project, including interest rates and terms of the loan, will impact the total project costs.

For Hydropower resources, due to the very limited amount of new construction projects, Merrimack Energy is relying on publicly available data. The National Renewable Energy Laboratory's ("NREL") 2022 Annual Technology Baseline study provides cost data for several different categories of Hydropower resources within

the two broader categories of non-powered dams ("NPD") and new stream development ("NSD"). NPDs are existing dams that do not include hydraulic turbine (hydropower) equipment. Such dams were constructed for one or more non-energy benefits, including flood control, water supply, inland navigation, or recreation[8]. NPDs are further divided into lock and lake design categories, each with four cost groups (low cost, medium cost, high cost, and very high cost). NSDs are then split into four categories based on the two resource characteristics of 10 MW or fewer, greater than 10 mw, 3-30ft head, and head greater than 30 ft.

The NREL ATB has published Capital and Operating costs by resource category are provided in Table 1 below.

Table 1: Hydropower Project Costs by Resource Category

Resource Category	Resource Detail 1	Resource Detail 2	CapEx ($/kW US$ 2021)	Capacity Factor	Fixed O&M ($/kW-yr US$)
NPD 1	Lake	Low Cost	$2,574.06	34%	$64
NPD 2	Lake	Medium Cost	$5,514.42	41%	$77
NPD 3	Lake	High Cost	$5,470.63	33%	$91
NPD 4	Lake	Very High Cost	$12,372.29	38%	$154
NPD 5	Lock	Low Cost	$4,215.72	44%	$30
NPD 6	Lock	Medium Cost	$6,873.83	44%	$34
NPD 7	Lock	High Cost	$11,888.44	61%	$54
NPD 8	Lock	Very High Cost	$16,282.95	31%	$119
NSD 1	3-30ft head	1-10 MW	$7,965.47	66%	$137
NSD 2	3-30ft head	10+ MW	$7,110.97	66%	$45
NSD 3	30+ ft head	1-10 MW	$6,964.79	62%	$129
NSD 4	30+ ft head	10+ MW	$6,269.89	66%	$32

The *"EIA Annual Energy Outlook 2022"* published costs for Hydropower projects of $2,025/kW (US$) in New England and $4,144/kW (US$) in Upstate NY. The large variance in Capital costs for these two regions are likely due to the limited number of projects and specific resource characteristics in each sample set. Unfortunately, there is not enough information available to verify the costs or technology options. Merrimack Energy questions the low capital cost for hydro

[8] The United States Department of Energy has a program designed to assess the energy potential at non-powered dams (NPDs) throughout the United States. According to the US Department of Energy report entitled "An Assessment of Energy Potential at Non-Powered Dams in the United States (April 2012), the priority placed on this NPD assessment effort (relative to an assessment of energy potential from new impoundments, for example) is based on the hypothesis that many of the costs and environmental impacts of dam construction have already been incurred at NPDs and may not be significantly increased by the incorporation of new energy production facilities. Thus, the development of some NPDs for energy purposes is assumed to be achievable with lower installed cost, lower levelized cost of energy, fewer barriers to development, less technological and business risk, and in shorter timeframe than development requiring new dam construction. The largest facilities are navigation locks on major US rivers as well as their major tributaries.

based on the New England values above and speculates these costs may represent upgrades to an existing facility rather than a new incremental project.

The NREL ATB estimated Fixed O&M costs for 2022 Hydropower projects are based on the resource category as provided in Table 1 above.

NREL estimates the O&M costs to be roughly 2.5% of the Capital costs. The EIA estimated the fixed O&M for conventional Hydropower costs to be $43.78/kW-year (US$) in 2021 dollars.

2 METHODOLOGY, APPROACH, RESULTS AND CONCLUSIONS

Given the recent dramatic increase in the capital cost of wind projects and other generation options, a valid comparison of the market price of generation resources with the projects selected in the 480 MW Call for Tenders requires an assessment of only the most recent projects proposed or contracted. For wind, only the prices of projects contracted within the last eight months to a year will be comparable with the projects bid into the 480 MW Call for Tenders given the timing of the bids submitted to the December 2021 Call for Tenders.

To assess the pricing of bids submitted and selected from Hydro-Quebec's 480 MW Renewable Energy Call for Tenders (A/O 2021-01), Merrimack Energy has developed real levelized costs for market benchmark resources in neighboring power markets to compare to the real levelized cost of the bids selected by Hydro-Quebec from the 2021 480 MW Call for Tenders. Table 2 below provides a summary of the bids selected by Hydro-Quebec from its 2021 480 MW Call for Tenders, including the real levelized cost with and without transmission and integration costs. Merrimack Energy has prepared real levelized benchmark costs for wind and hydro resources in neighboring Northeast power markets to match the portfolio of bids selected by Hydro-Quebec. Real levelized costs have been prepared under two cases: (1) Case 1 which does not include applicable transmission related costs for either the bids selected by Hydro-Quebec or the benchmark resources; and (2) Case 2 which includes applicable transmission related costs for both the bids selected and benchmark resources required to deliver the power to the Quebec market. The comparative results for each case are described in this memo.

Table 2: Summary of Bids Selected for 2021 480 MW Call for Tenders

Bid No.	Type	Capacity (MW)	Energy (MWh)	Term (Yrs)	Trans Cost - $2022 per MWh (Cn)	Losses – integration service (firming and balancing and curtailment cost - $2022 per MWh (Cn)	Real Levelized Cost of Energy - $2022 per MWh (Cn)	Final Project Cost – energy, losses, integration service, transmission costs and curtailment - $2022 per MWh – (Cn)
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9
1	Hydro	159	1,392,840	20	$0.00	-$4.39	$69.99	$65.60
5	Wind	102.2	350,679	30	$8.48	$6.04	$46.22	$60.74
6	Wind	120	412,162	30	$10.12	$3.20	$69.16	$82.48
12	Wind	270	832,364	30	$9.49	$3.69	$65.00	$78.18
14	Wind	349.8	1,076,215	30	$9.19	$4.26	$55.54	$69.99
Total			4,064,260		$6.69			$70.83

Merrimack Energy has developed estimates of the real levelized costs of comparable benchmark projects for the Northeast US and eastern Canada (New England, New York and Ontario) as a comparison to the real levelized costs of bids selected by Hydro-Quebec from Hydro Quebec's 2021 480 MW Call for Tenders. Merrimack Energy initially prepared a benchmark report[9] which provides estimates of comparable costs for renewable resources in New England and New York ("bus bar costs") without any transmission costs included to deliver the power to the Quebec market. The benchmark cost analysis was developed using two methodologies: (1) calculate the real levelized cost based on the sum of the Net Present Value ("NPV") of capital cost for wind and hydro projects (including network upgrade costs and Operations and Maintenance ("O&M") costs divided by the NPV of the generation from the projects for those markets from which the project emanate[10]; and (2) calculate the levelized cost of wind projects based on levelized project costs for wind projects in New England and New York based on bid data adjusted for cost increases experienced for wind projects to Q3 2022 to match the date of receipt of bids for the 2021 Hydro-Quebec Call for Tenders. Since there was little information regarding benchmark costs for eastern Canadian Provinces, Merrimack Energy has utilized the benchmark costs for New England and New York as samples. Those initial costs for wind and hydro (without

[9] See Final Report of Merrimack Energy Group, Inc., "Benchmarking the Cost of Supplying Electricity From Renewable Energy Sources Relative to Hydro-Quebec's December 2021 Call For Tenders", January 31, 2023.
[10] Data associated with capital costs of benchmark wind generation resources includes network upgrade costs since a sample of the projects utilized are based on bid data which includes network upgrade costs for the resources.

transmission costs added) are provided in Table 3 below[11]. For example, data in the first three rows of columns 2 reflects the projected levelized cost for wind for each capital cost level identified in US$. Column 3 includes the same costs but calculated in Canadian dollars based on Hydro-Quebec's projected exchange rate for US and Canadian dollars. Columns 4-5 calculate the costs in real levelized dollars to match Hydro-Quebec's methodology for evaluating bid resources. Column 6 presents the real levelized cost based on Hydro-Quebec's discount rate to reflect a consistent comparison of costs for the benchmarks and bids selected from the 480 MW Call for Tenders.

Table 3: Summary of Northeast US LCOE Calculations

Resource Cost Assessment	Levelized Cost of Energy ($/MWh US$)	Levelized Cost of Energy ($/MWh Cn$)	Real Levelized Cost of Energy (2022 $/MWh US$)	Real Levelized Cost of Energy (2022 $/MWh Cn$)	Real Levelized Cost of Energy (2022 $/MWh Cn$) Based on Hydro-Quebec Discount Rate of 2.87%
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Wind					
Capital Cost - $2,000/kW (US$)	$66.36	$86.27	$47.77	$62.11	$59.85
Capital Cost - $2,250/kW (US$)	$72.48	$94.22	$52.18	$67.82	$65.29
Capital Cost - $2,500/kW (US$)	$78.59	102.17	$56.57	$73.56	$70.73
New England LCOE (US$)	$73.92	$96.10	$52.23	$69.17	
New York LCOE (US$)	$73.92	$96.10	$52.23	$69.17	
Hydropower[12]					
Capital Cost - $2,025/kW (US$)	$36.89	$47.95	$26.23	$34.08	$33.19

[11] The data in this table is taken from Table 23: Summary of Northeast US LCOE Calculations contained in Merrimack Energy's Report entitled "Benchmarking the Cost of Supplying Electricity from Energy Sources Relative to Hydro-Quebec's December 2021 Call for Tenders."

[12] The first two hydro cases evaluated are based on US Department of Energy, "Energy Information Administration Annual Energy Outlook 2022" estimated capital and O&M costs for hydropower projects in New England and New York respectively. The third case (NSD4) reflects the estimated cost for a new hydro project with greater than 10 MW with a 30+ foot head. The fourth project is defined as a lake-based project and the fifth project a lock-based project. The lake-based option includes non-lock dams while the lock-based option is based on navigation dams with locks.

Capital Cost - $4,244/kW (US$)	$65.60	$85.27	$46.62	$60.62	$58.73
Capital Cost – NSD4 10+ MW - $6,269/kW (US$)	$80.85	$105.10	$57.47	$74.71	$72.18
Capital Cost – NPD2 – Medium - $5,514/kW (US$)	$131.91	$171.49	$93.78	$121.92	$118.32
Capital Cost – NPD6 – Medium - $6,873/kW (US$)	$132.59	$172.37	$94.26	$122.54	$118.36

The initial assessment involves a comparison of wind project costs for both the benchmark resource and Hydro-Quebec's selected bids without transmission costs included in the evaluation. Based upon Merrimack Energy's estimate of the benchmark resource real levelized cost for wind of $70.73/MWh (Cn$) based on capital costs at $2,500/kW (US$) and using Hydro-Quebec's discount rate of 2.87% (last column in Table 2), all wind projects selected by Hydro-Quebec (See Column 8 of Table 2 without transmission and other costs) have real levelized costs below the estimated benchmark costs. At a capital cost of $2,250/kW, all wind projects selected by Hydro-Quebec, with the exception of one wind project are below the benchmark cost[13]. At a capital cost of $2,000/kW, two wind projects are below the benchmark and two are above. As previously noted, since completing the final draft of the Benchmark Report for Deliverable 1, Merrimack Energy has seen wind projects bid into an RFP in the western US with proposed capital costs of over $2,500/kW (US$), including Network Upgrade Costs, in a region of the US that we would expect would have lower overall capital and operating costs for wind projects than the Northeast US and eastern Canada.

For hydropower projects, it is very difficult to get reasonable data on recent and comparable projects. Merrimack Energy is skeptical of the estimates provided by the Energy Information Administration for New England. The Energy Information Administration also does not identify the type of hydro projects to which the cost estimates are related. In Merrimack Energy's view, the NSD4 resource is probably most applicable to the hydropower bid selected by Hydro-Quebec. In this case, the cost of the hydropower bid selected by Hydro-Quebec is lower than the benchmark cost for NSD4 of $72.18/MWh (Cn$). For perspective, the Canadian Energy Regulator report entitled Canada's Renewable Power: Recent and Near-Term Developments, March 2021, identified one hydro project recently

[13] Note that the levelized costs for wind for New England and New York (rows 4-5) would correspond to a capital cost that is between $2,250/kW (US$) and $2,500/kW (US$).

constructed in Ontario, called the Peter Sutherland Hydro Project, a 28 MW project completed in 2017 at a cost of $10,000/kW.

Merrimack Energy has also provided benchmark costs for comparison to the total real levelized cost of the bids selected by Hydro-Quebec (Col 9 of Table 2) that include transmission costs to deliver the power to Quebec from New England and New York, as well as from Ontario. Tables 4, 5 and 6 below include the transmission costs assumed for delivery of power for wind and hydro projects from New England to Quebec, from New York to Quebec, and from Ontario to Quebec to compare against the real levelized cost of power including energy losses, integration service, transmission costs and curtailment costs evaluated by Hydro-Quebec and included in the selection of the final portfolio of five bids selected (last column of Table 1), including one hydro project and four wind projects.

Table 4: ISO-NE Services and Tariffs to Deliver Power to Hydro-Quebec System

Transmission Service	Rate	Comments
Through or Out Service – Schedule 8	$1.60895/MWh	
Schedule 1 – Scheduling, System Control and Dispatch Services	$1.751180/kW-year should equal about $.57/MWh	
Schedule A – US portion of Phase I/II HVDC facilities	Previous rate used for other benchmark studies was $2.50/MWh	A transmission customer shall pay the Schedule 20A Service Provider's Phase I/II HVDC – TF Services charge to the Schedule 20A Service Provider.

Table 5: NYISO Services and Tariffs to Deliver Power to Hydro-Quebec System

Transmission Service	Rate	Comments
NYISO Transmission Service Charge	$2.19/MWh	Rate to Hydro-Quebec from NYPA to Chateauguay
NYPA Transmission Service Charge	$4.62/MWh	TSC rates differ on each utility system. The Consolidated Edison rate is $7.19/MWh and the Niagara Mohawk rate is $9.9684. Merrimack is using the NYPA rate.

Table 6: Ontario Services and Tariffs Deliver Power to Hydro-Quebec System

Transmission Service	Rate	Comments
Ontario Export Transmission Service ("ETS") Charge (Cn $)	$1.78/MWh	Rate to Hydro-Quebec from Ontario

Table 7 provides the real levelized costs for the three wind benchmark capital cost options with transmission cost adders for ISO-NE, NYISO and Ontario to compare against the total real levelized cost determined by Hydro-Quebec for the 480 MW Call for Tenders.

Table 7: Real Levelized Delivered Cost Comparison for Wind Resources

Resource Cost Assessment	Real Levelized Cost of Energy (2022 $/MWh Cn$) HQ Discount Rate (2.87%)	Real Levelized Cost of Energy (2022 $/MWh Cn$) with Tx NYISO HQ Discount Rate (2.87%)	Real Levelized Cost of Energy (2022 $/MWh Cn$) with Tx ISO-NE HQ Discount Rate (2.87%)	Real Levelized Cost of Energy (2022 $/MWh Cn$) with Tx Ontario HQ Discount Rate (2.87%)
Wind				
Capital Cost - $2,000/kW	$59.85	$65.91	$64.01	$61.10
Capital Cost - $2,250/kW	$65.29	$71.36	$69.45	$66.55
Capital Cost - $2,500/kW	$70.73	$76.78	$74.89	$71.99

As the data in Table 7 above relative to Table 2 (col 9) illustrates, at a capital cost of wind of $2,500/kW (US$), two wind bids are above the benchmarks and two are below. At a capital cost of $2,250/kW (US$), two are below New York benchmark costs and two are competitive with New England wind project costs. At a capital cost of $2,000/kW (US$), one wind project is below market benchmark costs. Finally, from an overall portfolio basis, the average real levelized cost for Hydro-Quebec's portfolio of resources selected of $70.83/MWh (Cn$) is below the benchmark cost for wind in all markets at a capital cost of $2,500/kW (US$), while at a capital cost of $2,250/kW (US$), the benchmark cost for wind in New York is higher than the average real levelized portfolio cost, while the real levelized cost for New England, due to the lower estimated transmission rates, is 2% lower. Merrimack Energy would expect the real levelized cost of Hydro-Quebec's portfolio to be very similar to New England's benchmark costs if real levelized cost of wind are compared based on adjusted bid data as described in this report.

Table 8 provides the real levelized costs for the hydropower benchmark resource categories with the transmission cost adders for ISO-NE, NYISO, and Ontario included.

Table 8: Real Levelized Delivered Cost Comparison for Hydropower Resources

Resource Category	Real Levelized Cost (2.87% Discount Rate)	Real Levelized Cost of Energy (2022 $/MWh Cn$) with Tx NYISO (2.87% Discount Rate)	Real Levelized Cost of Energy (2022 $/MWh Cn$) with Tx ISO-NE (2.87% Discount Rate)	Real Levelized Cost of Energy (2022 $/MWh Cn$) with Tx Ontario HQ Discount Rate (2.87%)
NPD 2	$118.32	$124.37	$122.4	$119.57
NPD 6	$118.36	$124.41	$122.42	$119.62
NSD 4	$72.18	$78.22	$76.10	$73.44
EIA - New England	$33.19	$39.24	$37.15	$34.36
EIA - Upstate NY	$58.73	$64.80	$62.68	$60.00

As the data above in Table 8 shows, the real levelized cost of the hydro project selected is below the NSD 4 benchmark as illustrated above, and is similar to the New York market benchmark for the EIA hydro project identified.

Merrimack Energy's overall conclusion based on this analysis is that the real levelized costs for the majority of resources selected by Hydro-Quebec and the overall portfolio costs for the selected resources by Hydro-Quebec are generally lower than benchmark costs in the high capital cost case of $2,500/kW (US$), which is consistent with recent wind project cost data we have witnessed through RFP proposals, as well as in the mid-case. Two of the wind projects selected by Hydro-Quebec are above the market benchmarks in all cases. It also appears that Hydro-Quebec's transmission costs (network upgrades) and costs associated with losses, integration service and curtailment costs associated with bid evaluation are having a reasonable influence on the competitiveness of these bids relative to market benchmarks.

Merrimack Energy also reviewed the option of utilizing renewable natural gas in a combined cycle unit as an alternative but found, based on review of contracts for renewable natural gas, that the renewable natural gas had a price premium over natural gas of $15 to $20/MMBtu or nearly three times the price. Furthermore, based on our experience, the supply of renewable natural gas is currently limited which would create challenges for sourcing enough renewable natural gas to

operate a combined cycle unit operating in high intermediate or baseload mode. As a result, Merrimack Energy does not view the use of renewable natural gas in a combined cycle unit as cost effective or practical at this time.

Appendix A: Summary of Northeast US LCOE Calculations

Resource Cost Assessment	Levelized Cost of Energy ($/MWh US$)	Levelized Cost of Energy ($/MWh Cn$)	Real Levelized Cost of Energy (2022 $/MWh US$)	Real Levelized Cost of Energy (2022 $/MWh Cn$)
Wind				
Capital Cost - $2,000/kW	$66.36	$86.27	$47.77	$62.11
Capital Cost - $2,250/kW	$72.48	$94.22	$52.18	$67.82
Capital Cost - $2,500/kW	$78.59	102.17	$56.57	$73.56
New England LCOE	$73.92	$96.10	$52.23	$69.17
New York LCOE	$73.92	$96.10	$52.23	$69.17
Solar 17% CF				
Capital Cost - $1,800/kW	$112.85	$146.70	$87.52	$113.77
Capital Cost - $2,000/kW	$123.32	$160.31	$95.62	$124.29
Capital Cost - $2,200/kW	$133.79	$173.92	$103.72	$134.84
Solar 22% CF				
Capital Cost - $1,800/kW	$87.20	$113.36	$67.62	$87.91
Capital Cost - $2,000/kW	$95.29	$123.88	$73.88	$96.05
Capital Cost - $2,200/kW	$103.38	$134.39	$80.15	$104.19
New England LCOE	$77.90	$101.27	$60.43	$78.54
New York LCOE	$70.85	$92.11	$54.96	$71.43
Standalone Storage				
Capital Cost - $1,600/kW	$119.36	$155.17	$99.94	$129.76
Capital Cost - $1,900/kW	$135.56	$176.23	$113.51	$147.55
Capital Cost - $1,600/kW – LCOE ($/kW-month)	$12.34	$16.05	$10.33	$13.43
Capital Cost - $1,900/kW – LCOE ($/kW-month)	$14.02	$18.22	$11.74	$15.27
Solar + Storage				
4-hr duration BESS at 10% ($4/MWh Adder)	$99.29	$129.08	$75.83	$98.59

4-hr duration BESS at 100% ($25/MWh Adder)	$120.29	$156.38	$91.87	$119.44
Biomass				
Capital Cost - $2,500/kW	$65.99	$85.79	$47.18	$61.35
Capital Cost - $5,000/kW	$97.65	$126.95	$69.81	$90.76
Capital Cost – NREL - $4,360/kW	$89.55	$116.41	$64.02	$83.23
Capital Cost -NE - $5,372/kW	$102.58	$133.35	$73.34	$95.33
Capital Cost -NY - $5,389/kW	$102.36	$133.07	$73.19	$95.15
Hydropower				
Capital Cost - $2,025/kW	$36.89	$47.95	$26.23	$34.08
Capital Cost - $4,244/kW	$65.60	$85.27	$46.62	$60.62
Capital Cost – NSD4 10+ MW - $6,269/kW	$80.85	$105.10	$57.47	$74.71
Capital Cost – NPD2 – Medium - $5,514/kW	$131.91	$171.49	$93.78	$121.92
Capital Cost – NPD6 – Medium - $6,873/kW	$132.59	$172.37	$94.26	$122.54