UNDERSTANDING THE TRUE IMPACTS OF CHAMPLAIN HUDSON POWER EXPRESS

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EXECUTIVE SUMMARY

UNDERSTANDING THE TRUE IMPACTS OF CHAMPLAIN HUDSON POWER EXPRESS

Champlain Hudson Power Express ("CHPE") is a 1,000 MW 330-mile transmission line, proposed by Transmission Developers Inc. ("TDI"), to deliver energy into New York City, plus an additional 250 MW bi-directional line to deliver energy into and out of New York to Canada. Energy flows across the 1,000 MW line into New York City could total up to 8.3 TWh (i.e., million MWh) of energy, which would be purchased under one or more long-term contracts.

Potential purchasers of energy through CHPE include New York City and New York City building owners; the generation attributes or credits required to claim that the energy is hydroelectricity could be purchased by the energy off-taker or a third party. TDI is actively marketing CHPE as a conduit to deliver hydroelectricity from Hydro-Québec to give building owners an additional option they might use to comply with New York City Local Law 97, which established stringent emissions requirements for buildings. Local Law 97 provides owners with an option to purchase renewable energy, carbon offsets, or hydroelectricity delivered directly into New York City, as an alternative to making investments in building efficiency improvements.

The results of our analysis show that CHPE will *not* result in reduced global emissions of carbon dioxide (referred to as "carbon" in this report) – and may even *increase* overall carbon emissions. Any long-term contracts associated with CHPE would, therefore, fail to meet the spirit and underlying goals of Local Law 97, that is, greenhouse gas emission reductions. Assessment of available data shows that Hydro-Québec has enough transmission capacity to be able to sell all of the energy from its existing hydroelectric facilities across existing lines and is not planning on building any additional hydro facilities in the foreseeable future in order to meet CHPE obligations if the project were to proceed. Without new power generation, the purchase of electricity over CHPE would result in no measurable reduction in carbon emissions.

The only way Hydro-Québec could export 8.3 TWh to New York City via CHPE would be to redirect energy sales from other parts of New York, divert energy sales from existing export markets, and/or increase imports into Quebec from other markets, which would then be sold at above-market prices via CHPE. Importantly, the New York system in place to track electricity attributes cannot be used to measure the impact CHPE would have on emissions and would not, in and of itself, confirm that the energy is not, in effect, being

sourced from other markets. In fact, New York City Local Law 97 does not require the use of any tracking system. In order to supply CHPE, it is likely that Hydro-Québec would reduce its export volumes into New York in order to provide that same energy to New York City at a higher price.

Additionally, contracts with CHPE would delay and decrease investments for in-state renewables and building efficiency improvements and make it more difficult and more expensive to achieve New York's Climate Leadership and Community Protection Act ("CLCPA") goals, which require that 70 percent of energy consumed in New York State by 2030 be produced by renewable resources and that the power sector be emissions free by 2040. Carbon emissions reduction credits to New York City would be offset by reduced imports into upstate and western New York and increased carbon emissions in other markets.

New York City does not benefit from, and is adversely impacted by, CHPE.

New York City would pay billions of dollars for energy that otherwise would flow into upstate New York and other markets. And what does New York City get in return?

- **No Net Carbon Emissions Reduction:** Purchasing Hydro-Québec energy through CHPE does not reduce carbon emissions regionally on a net basis, and, by squeezing out investments in energy efficiency and in-state renewables that do reduce carbon, results in higher emissions than otherwise would occur. Redirection of energy from one part of New York to another would have negligible impacts on state dispatch, simply shuffling energy around and failing to reduce carbon emissions within the state.

- **Higher Ratepayer Costs:** A large portion of the energy from Hydro-Québec does not help New Yorkers meet the renewable energy requirements set by the State because Hydro-Québec energy imports that would be diverted from other parts of New York already are included in the base used by state agencies to estimate how much incremental renewable energy is required to meet state targets. Hydro-Québec energy is not eligible by the State of New York to generate Tier 1 RECs under the Clean Energy Standard ("CES") (see CES Appendix A). New York City consumers, along with the rest of New Yorkers, would be burdened with even greater costs because they would have to make up the energy that is redirected into CHPE to achieve New York's renewable energy goals by 2030 and 2040.

- **Expensive Energy:** The price for energy delivered over CHPE is likely to be above

market. Although Hydro-Québec has some flexibility with respect to its supply price, the Canadian government-owned company is unlikely to bid a long-term contracted price below what it receives by selling to provincial load or is projected to earn through sales into non-firm energy markets. Transmission costs also would be higher than a comparable contract for delivery into New England – via the New England Clean Energy Connect ("NECEC") transmission line -- given the more expensive transmission distance and design of CHPE. Even if Hydro-Québec were to bid a lower price to offset the higher transmission costs of CHPE, the minimum price of a contract with Hydro-Québec is likely to be higher than the levelized cost of on-shore wind in New York.

- **Wasteful Investment in Congestion Relief:** To the extent the purpose of CHPE is to relieve transmission congestion, there are less expensive ways to achieve that outcome, including transmission system investments that increase reliability, resiliency, and enables transportation of in-state renewables to load centers, which CHPE does not do.

CHPE allows Hydro-Québec to sell energy that otherwise would be sold into New York at higher prices.

The CHPE transmission line is not necessary to export additional energy from Quebec into external markets as Hydro-Québec already is, and will be, exporting all of the energy it can. Hydro-Québec has a financial incentive to sell as much energy as it can produce and deliver, at the highest price it can obtain, subject to water, generation and delivery. With nearly 8,000 MW of existing transmission interconnections into other markets, and more than 50 TWh of delivery capability, Hydro-Québec exports over US$1.0 billion of energy each year, at prices well above its cost of production. Hydro-Québec claims that it will have 40 TWh to sell per year in the coming years. However, Hydro-Québec's own assumptions and forecasts imply that it will have less than 30 TWh of energy available to export into other markets per year under expected conditions going forward without relying on its reservoir reserves. Hydro-Québec itself issued a study in 2018 that assumed a baseline of 22.4 TWh into northeast U.S. markets. Third-party studies indicate that transmission constraints are not the limitation. Therefore, there is plenty of existing transmission capacity for Hydro-Québec to export its projected surpluses.

With the combination of extensive interconnections, available transmission capacity, and an incentive to maximize its profits, energy flowing into CHPE would simply be a diversion of sales that Hydro-Québec otherwise would sell into already interconnected export markets such as New York. A new intertie merely allows Hydro-Québec to access a

higher-priced, long-term contract with New York City instead of selling into competitive spot markets at lower, more uncertain prices.

CHPE allows Hydro-Québec to redirect energy from upstate New York into New York City.

If CHPE were built, Hydro-Québec would divert energy from the lowest-priced markets first, much of which would come from New York. In 2018, Quebec flowed 10.5 TWh of energy into upstate New York, most of which was sold by Hydro-Québec. Using 2018 power flows and pricing as an example, more than 50 percent of the energy sold through CHPE to New York City would be energy that would otherwise flow into upstate or western New York. This redirection simply shuffles around energy that New York already would receive, increases carbon emissions elsewhere in New York, and would have little to no benefit to the environment.

Energy flows across CHPE also shuffle energy and carbon emissions from different locations, offsetting any supposed environmental benefits in those markets.

Any reduction in carbon emissions in New York City would be offset by increased emissions elsewhere. Under average or highwater conditions, much of the energy flowing into New York City through CHPE would be a redirection of energy that otherwise would flow from Quebec into New York through existing interties. Some of it would come from energy exports that otherwise would displace oil or coal plants in New Brunswick or natural gas plants in New England. The economic analyses submitted by TDI in support of its Article VII application to the New York Public Service Commission in 2010 are incorrect, stale and unreliable given system changes and the failure to properly model the source of energy that would be delivered by CHPE. Similarly, the more recent report by PA Consulting appears to make a similar assumption that all of the energy flowing through CHPE would be incremental, overstating the impact of CHPE on carbon emissions in New York and the surrounding region.

Investing in CHPE squanders an opportunity to reduce carbon emissions.

Under Hydro-Québec's own assumptions, Hydro-Québec would have more than enough transmission intertie capacity to export its excess energy without CHPE. With CHPE, Hydro-Québec would not be able to maintain exports at historical levels across existing lines into New York unless it diverted sales from other markets. Hydro-Québec has engaged in the described "arbitrage" behavior in the past and has every incentive to engage in this behavior to optimize its profits going forward. CHPE is simply a means for

Hydro-Québec to earn a higher price in New York City by selling the same energy it otherwise would sell to upstate New York and other markets under a different, higher-priced, long-term contractual arrangement. In exchange, New York City pays above-market prices and squanders the opportunity to make an effective investment in reducing carbon emissions with investments that are guaranteed to offset carbon emissions.

CHPE would increase total carbon injections into the atmosphere.

A long-term contract to deliver energy via CHPE from Hydro-Québec would hinder development of incremental investments in energy efficiency and in-state renewable generation that actually would guarantee reduction in carbon emissions and create local jobs and economic opportunities. By squeezing out 8.3 TWh of investment in energy efficiency and in-state renewable energy – alternative ways to comply with Local Law 97 -- CHPE would increase carbon emissions.

Hydro-Québec can and does buy energy from other markets, potentially increasing carbon emissions into the atmosphere as if Hydro-Québec were generating power from fossil fuels directly.

There is no guarantee that impact of energy flowing through CHPE would be greater levels of renewable energy, would be higher than historical levels sold into New York, would be hydroelectric, or even would be sourced from Quebec. If Quebec experiences dry or drought conditions, Hydro-Québec would retain water in its reservoirs and have to make up shortfalls in energy production by purchasing energy from other markets with no contractual guarantees that the energy purchased would be renewable. Then, during higher priced periods, Hydro-Québec would sell back to those markets the water retained in its reservoir (less losses). This strategy was described publicly by the government of Quebec back in 2004 and continues to be applied today. Adding a new transmission line and contractual obligation simply increases the potential need for Hydro-Québec to arbitrage between markets.

Purchasing energy from Hydro-Québec through CHPE, instead of renewables or energy efficiency directly, is a misguided policy that does not benefit the environment and adversely impacts New Yorkers.

UNDERSTANDING THE TRUE IMPACT OF CHPE

1. OVERVIEW OF CHPE

This report examines the impact of energy sold by Hydro-Québec through CHPE to New York City on regional carbon emissions. The CHPE project consists of the following:

- **Uni-directional High Voltage Direct Current ("HVDC") Transmission Line in New York:** 330-mile 1,000 MW HVDC transmission line from Quebec through New York to New York City (i.e., New York Independent System Operator ("NYISO") Zone J).

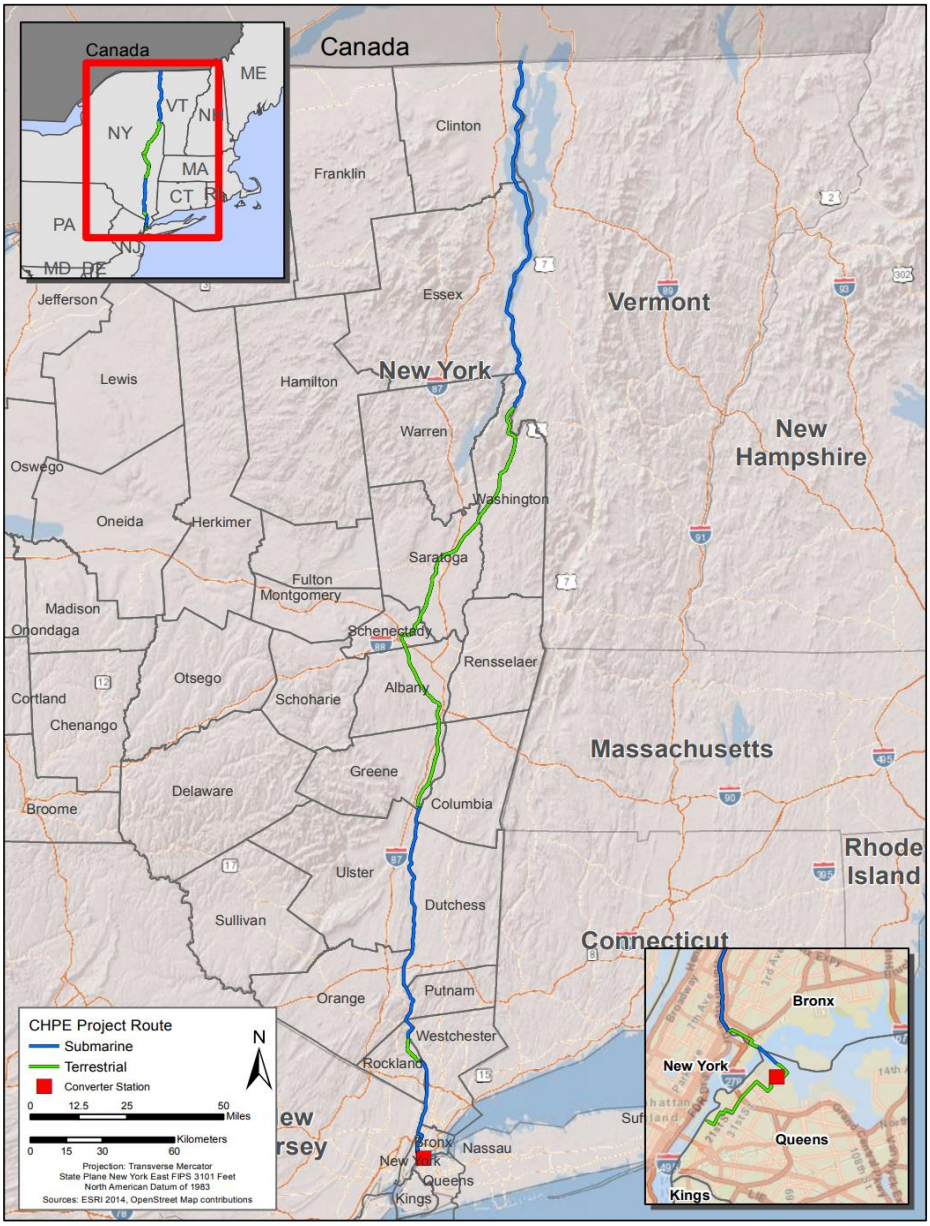
- **Bi-directional HVDC Transmission Line into and out of New York City:** 250 MW HVDC transmission line along the same route purported to flow energy from offshore wind off the coast of Long Island into Quebec, store it in Quebec's reservoirs, and then transmit back to New York City when needed.

- **Transmission Interconnection in Quebec:** HVDC transmission cables extending from the New York border to interconnect with the Quebec system at or near the Hertel High Voltage Alternating Current substation located near the city of Montreal.

- **Energy Supply from Hydro-Québec's Power Portfolio:** 8.3 TWh of energy that would flow annually across the 1,000 MW HVDC line under a long-term agreement. Contractual arrangements for the bi-directional line have yet to be disclosed.

Figure 1 illustrates the proposed path of the CHPE project between Quebec and New York City. CHPE would not have any on-ramps or exits along the entire route and essentially would be a long extension cord from Hydro-Québec's system into New York City, with no access for upstate renewable resources.

Figure 1: Proposed CHPE Project[1]



[1] CHPE website, http://www.chpexpress.com/about.php,

1.1. Evolution of CHPE

CHPE has been under development for more than a decade and is a permitted project. Since 2010, there have been many reports, applications, permits and relevant policy decisions. The following two events are among the most recent and the most pertinent for the purposes of this report:

- **2017 – CHPE Benefits Analysis Assesses Potential Carbon Reductions:** A benefits study performed on behalf of TDI by PA Consulting includes an assessment of reductions in carbon emissions created by CHPE and delivery of 8.3 TWh of energy into New York City. The study estimates that CHPE would reduce carbon emissions by 3.4 million metric tons per year.[2]

- **2019 – Climate Mobilization Act:** New York City Mayor Bill DeBlasio announced an intention to enter into a long-term contract with Hydro-Québec to deliver hydroelectricity through CHPE under the OneNYC 2050 strategy.[3] New York City Council passes the Climate Mobilization Act, including Local Law 97 which establishes stringent emissions requirements for buildings but offers building owners an option to purchase renewable energy or hydroelectricity from Quebec as an alternative to making investments in building efficiency improvements.[4]

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[2] PA Consulting Group (August 2017). CHPE Analysis of Economic, Environmental, and Reliability Impacts to the State of New York. Available at: http://www.chpexpress.com/docs/PA_Analysis_Report_on_Champlain_Hudson_Power_Express_Benefits.pdf.

[3] OneNYC 2050, "A Livable Climate," Volume 7 of 9, p. 14, https://onenyc.cityofnewyork.us/strategies/a-livable-climate/ (stating, "As one key initial step, the City, in coordination with New York State, will pursue an investment in new transmission to access large-scale Canadian hydropower at a competitive price, resulting in a 100 percent carbon-free electricity supply for City government operations.")

[4] New York City Local Law, Chapter 97 of the Laws of 2019, Intr. 1253-C - A Local Law to amend the New York City Charter and the Administrative Code of the City of New York, in relation to the commitment to achieve certain reductions in greenhouse gas emissions by 2050; enacted on May 19, 2019. Available at https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=3761078&GUID=B938F26C-E9B9-4B9F-B981-1BB2BB52A486

1.2. 2017 Assessment of Carbon Reductions – Grossly Overstates Benefits

PA Consulting estimates that CHPE would reduce carbon emissions by 3.4 million metric tons per year and contribute to 5 percent of the State's renewable energy goals. However, this analysis grossly overstates the true impact. In fact, CHPE energy from Hydro-Québec hydroelectric plants does not qualify as a Tier 1 REC under the CES.[5] Although Hydro-Québec energy imported into New York is included in the baseline estimate as renewable, CHPE energy would redirect that energy that otherwise would flow into upstate New York and other markets, and the contribution to the State's renewable energy goals would have to be reduced by the loss of Hydro-Québec exports into New York that are redirected into CHPE. This redirection, along with the shuffling of energy from New York and other markets into CHPE, would offset the carbon emissions impact of CHPE so that there would be little net impact region-wide.

PA Consulting starts the analysis by assuming business-as-usual and that New York does not meet its CES (Tier 1) targets without Hydro-Québec imports through CHPE. PA Consulting then assumes that Hydro-Québec energy does qualify as a Tier 1 renewable resource, which it does not – any hydroelectric facilities with impoundments are excluded.[6] In addition to assuming that New York would not achieve its carbon emissions reduction goals without CHPE,[7] the analysis appears to assume that all of CHPE energy is incremental and only measures the beneficial impact on emissions but ignores offsetting effects elsewhere.[8]

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[5] Clean Energy Standard, 8/1/2016, Appendix A, https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard

[6] Ibid.

[7] PA Consulting explains, "In order to evaluate the contribution that the Project would make to New York meeting its CO2 emission reduction and CES Tier 1 targets, the Reference Case assumed New York is not compliant with its CES Tier 1 targets during the study period . . . More specifically, the Reference Case assumes the availability of Tier I RECs is insufficient to meet New York's CES Tier 1 targets" (PA Consulting, p. 43)

[8] In addition, PA Consulting completely ignores emissions associated with large reservoir hydroelectricity, including methane release from newly submerged vegetation (PA Consulting, p. 16, no discussion on carbon emissions from hydroelectricity or offsetting impacts from diverting energy to supply CHPE, pp. 14-15, 45). This oversight is not addressed here, but it is the basis for concerns about hydroelectricity previously raised by environmental organizations such as the Sierra Club (see Sierra Club, Peggy Kurtz, Laura Burkhardt and Gale Pisha, "Canadian Hydropower – Wrong Direction for the Future").

The PA Consulting analysis does not appear to measure or account for carbon emissions increases that would be generated by energy flows diverted into CHPE from other areas for three reasons:

1) **Consumption-based Standard:** The report attributes carbon reductions to New York City (and New York) based on a "consumption-based standard" that attributes the reduction in carbon system-wide emissions associated with CHPE to New York City, even if the plants are not displaced in Zone J.[9] This approach precludes the need to report on the location of emissions reductions in New York and elsewhere.

2) **No Mention of Adjustments to Hydro-Québec's System:** If PA Consulting had made an adjustment to Hydro-Québec's system to reflect the source of 8.3 TWh of energy, it would be a big enough assumption, and reference as to how that adjustment was made should be described in Appendix B with the other modeling assumptions and methodological approaches. Neither the report by PA Consulting nor Appendix B makes any mention of such an adjustment, implying that none was made.

3) **Carbon Emissions Reductions Indicate a Simple Injection:** Although the analysis by PA Consulting uses a regional model that includes Quebec, the results imply that the analysis does not actually supply CHPE energy flows from Hydro-Québec plants. As an HVDC line, one way to model CHPE is simply to build it into Zone J as a new generator producing energy from a 1,000 MW plant 95 percent of the time. The annual reduction of 3.4 million metric tons per year of carbon emissions using a "consumption-based standard" is similar to the estimated New England displacement impacts of a new transmission line into New England (which has a similar generation mix to New York) of 3.1 to 3.6 million metric tons per year.[10] It appears that PA Consulting used the same modeling approach as experts

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[9] Ibid., p. 14. PA Consulting did not project that the addition of CHPE would have any impact on congestion in Zone J. Ibid., p. 2.

[10] In the Maine PUC case regarding siting approval for NECEC (Docket 2017-00232), Daymark Energy Advisors estimated that NECEC would reduce emissions in New England by 3.1 metric ton per year (Exhibit NECEC-5, p. 4 of 98 or p. iii in the document); The Maine PUC consultant, London Economics, calculated New England generation carbon reductions of 3.6 metric ton per year, "Independent Analysis of Electricity Market and Macroeconomic Benefits of the New England Clean Energy Connect Project," May 21, 2018, p. 30. The difference can be attributed to different gas price projections.

supporting the transmission line proposed to deliver Hydro-Québec sales into New England did. That is, PA Consulting simply modeled the injections at the point of delivery with no adjustment to the source of supply. In effect, new energy magically appears in New York City with no associated new hydroelectric plant in Quebec and no changes in hydroelectric generation without CHPE.

PA Consulting also performed its analysis before Hydro-Québec obtained a potential long-term power purchase agreement via NECEC under Massachusetts utility contracts. To the extent there is any excess energy lost through spillage, which has not been supported either by Hydro-Québec or by the analysis in this report using Hydro-Québec's assumptions, CHPE would have even less potentially positive impact during heavy water conditions when spillage can occur because NECEC would already relieve Quebec system spillage.[11]

As a result, impacts on carbon emissions in other parts of New York and across other markets appears to be grossly understated if not completely ignored. Studies that have properly modeled where Hydro-Québec's energy supply would come from (i.e., as a redirect of exports that otherwise would occur) indicate that there would be offsetting effects across other markets, negating any carbon emissions benefit.

Insight

Any analysis of CHPE's impacts on carbon emissions should be treated with caution until fully understood. The estimated impact reported by PA Consulting implies that energy from CHPE was simply modeled as a straight injection of energy into New York with no recognition or modeling of how Hydro-Québec would supply that energy. This grossly overstates the environmental benefits of CHPE.

1.3. 2019 Climate Mobilization Act – CHPE does not help New York State goals.

Local Law 97 of the Climate Mobilization Act limits the amount of carbon emissions that buildings can emit as measured by carbon dioxide per square foot across ten building categories based on building code occupancy groups.

[11] Hydro-Québec's claims that new transmission into the United States would relieve spillage have not been supported with any analysis. The amount of Hydro-Québec spillage each year is not publicly-reported and therefore cannot be independently verified. Lastly, a certain amount of spillage occurs on any hydro-electric system that has reservoirs and variable water conditions, including Hydro-Québec's system.

Reducing energy consumption or increasing efficiency can help to meet the requirements. The law also provides some flexible alternatives to achieve compliance, including:[12]

- **Renewable Energy and Hydroelectricity:** Purchasing credits for clean energy generating in[13] or directly injecting into New York City;[14]

- **Carbon Offsets:** Purchasing greenhouse gas offsets (details to be determined by rule);[15]

- **Carbon Trading with Other Buildings:** Acquiring carbon credits from other buildings which fall below their limit through a system to be implemented by 2021;[16] and

- **Discretionary Waivers:** The NYC Department of Buildings also will be able to grant waivers for reasons such as financial hardship and practical constraints outside of the control of the building owner.

The first alternative, by definition, allows purchase of energy delivered through CHPE to be used as an offset. Although rules will be promulgated by the Buildings Department in

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[12] Article 320, § 28-320.3.6, https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=3761078&GUID=B938F26C-E9B9-4B9F-B981-1BB2BB52A486

> **§ 28-320.3.6 Deductions from reported annual building emissions.** The department may authorize a deduction from the annual building emissions required to be reported by an owner pursuant to section 28-320.3 where the owner demonstrates the purchase of greenhouse gas offsets or renewable energy credits, or the use of clean distributed energy resources, in accordance with this section.

[13] "Article 320, § 28-320.3.6.3 Deductions from reported annual building emissions for clean distributed energy resources."

[14] "Article 320, § 28-320.6.1 Deductions from reported annual building emissions for renewable energy credits."

[15] "Article 320, § 28-320.3.6.2 Deductions from reported annual building emissions for purchased greenhouse gas offsets."

[16] "Article 320, § 28-320.11 Carbon trading study."

consultation with the Mayor's office, the definition of RECs in Article 320 explicitly includes hydroelectricity from Quebec that would be injected into Zone J via CHPE:[17]

> **RENEWABLE ENERGY CREDIT**. The term "renewable energy credit" means a certificate representing the environmental, social and other non-power attributes of one megawatt-hour of electricity generated from a renewable energy resource, which certificate is recognized and tradable or transferable within national renewable energy markets or the New York generation attribute tracking system. This term also means the environmental, social, and other non-power attributes of one megawatt-hour of electricity generated from **a hydropower resource that does not trade or transfer renewable energy certificates for those hydropower resources in any renewable energy market or via the New York generation attribute tracking system,** provided that the hydropower resource owner certifies the amount of energy produced in each reporting year and that it has not sold the non-power attributes equal to its energy production more than once.

(emphasis added).

Insight

Energy from Quebec to New York City delivered via CHPE can be purchased to comply with Local Law 97 building emissions standards instead of investing in building efficiency improvements to reduce carbon emissions.

New York City Local Law 97 explicitly precludes any requirement that energy sold via CHPE be tracked through a renewable energy market tracking system or the New York generation attribution tracking system (NY GATS). This creates challenges with ensuring that the energy flowing through CHPE actually comes from Hydro-Québec's hydroelectric portfolio versus another market.

Allowing hydroelectricity to be considered renewable for New York City also runs counter to the CES, which does not recognize most forms of hydroelectricity as renewable for purposes of generating Tier 1 RECs. The order establishing the CES states: "Resources eligible to produce RECs will be resources that came into operation after January 1, 2015,

[17] Article 320, Definition of Renewable Energy Credit.

and that meet the eligibility criteria set forth in Appendix A."[18] Per Appendix A, only hydroelectric upgrades and low impact run-of-river hydroelectric facilities in operation after January 1, 2015 are eligible to produce RECs. Impoundments (i.e., reservoirs) of any kind are excluded.[19]

Clarity on this issue is further provided in the PSC order:

> Several parties argued that there should be no restrictions at all on the eligibility of large scale hydro facilities. This issue was extensively debated in the creation of the RPS, with many parties opposing the environmental impacts of large impoundments, including methane emissions. **The resolution in that proceeding, that no new storage impoundment will be permitted for any eligible hydroelectric facility, remains reasonable and is not changed.** To the extent any factor has changed since the RPS Order, it is an increasing awareness of the climate change impacts of methane and concern over methane releases from large hydro impoundments, particularly new ones in which flooded vegetation would be decomposing and releasing methane.[20]

(emphasis added).

As a result, New York State does not consider Hydro-Québec hydroelectricity a Tier 1 renewable resource for purposes of generating Tier 1 RECs. Hydro-Québec's run-of-river facilities were built well before 2015 and would not be eligible to produce those RECs under New York State's clean energy requirements. The Romaine Units, some of which are coming online post-2015, have significant impoundments and would be precluded from designation under the CES requirements. Therefore, any energy delivered from Hydro-Québec's existing portfolio of hydroelectric resources would not be eligible to produce Tier 1 RECs under New York State's clean energy requirements.

Unlike energy efficiency improvements and investment in new in-state renewable resources, Hydro-Québec energy cannot reduce carbon emissions. If the energy flowing through CHPE is from new impoundments, carbon emissions are increased, especially in

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[18] State of New York Public Service Commission, CASES 15-E-0302 & 16-E-0270, p. 16, https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard

[19] Ibid., Appendix A, p. 3.

[20] State of New York Public Service Commission, CASES 15-E-0302 & 16-E-0270, pp. 105-106.

the first ten years of rotting associated with submerged vegetation. If new impoundments are not used, it is simply a repackaging of energy that Hydro-Québec already would produce and export with no net impact on carbon emissions.

Insight

Hydro-Québec hydroelectric energy is not considered a renewable resource for purposes of generating Tier 1 RECs under the CES.

CHPE is not an effective solution for achieving New York's carbon reduction goals for the following reasons:

- **CHPE does not reduce greenhouse gas emissions:** CHPE would not have any net impact on carbon emissions, and could even increase them beyond what otherwise would occur. Given that most of the energy that would flow through CHPE is simply a redirect of energy Hydro-Québec otherwise would sell into New York or other markets, there would not be a one-for-one impact on New York in-State emissions for CHPE energy. CHPE would be much less effective in reducing greenhouse gases by 2030 compared to development of in-State renewables where every MWh of energy generated is incremental. By using a consumption-based standard and failing to model the true source of CHPE energy (i.e., a diversion or redirection from other New York and other markets), PA Consulting's analysis fails to highlight the real emissions impact of CHPE. Much of the energy sold through CHPE would be redirected from New York and other markets where it otherwise would displace carbon-emitting generation on the margin.

- **New York City squanders an opportunity to reduce carbon emissions if it were to contract for Hydro-Québec energy:** None of the 8.3 TWh of energy that would be procured via CHPE would count toward meeting New York State Tier 1 renewable energy goals. By spending $2 to $3 billion on an environmentally ineffective transmission line, and even more for above-market energy that does not generate Tier 1 RECs, New York City squanders an opportunity to realize its environmental objectives and fails to help the State to effectively achieve its clean energy goals. By assuming CHPE energy is eligible to generate Tier 1 RECs on the state level (when it is not), PA Consulting overstates the estimated contribution of CHPE to New York State's renewable requirements.

Insight

CHPE energy from Quebec would not be entirely incremental and does not meet the State's definition of Tier 1 renewable energy.

2. SOURCE OF CHPE ENERGY SUPPLY

Hydro-Québec owns and operates a large system of hydroelectric generation and other power generating capabilities along with an extensive transmission network. In order to understand how Hydro-Québec is likely to supply energy via CHPE, it is important to understand the current and anticipated state of its system, the amount of excess energy it could produce with or without CHPE and what Hydro-Québec otherwise would do with that energy in the absence of CHPE. This section provides a high-level summary of the Hydro-Québec system and how Quebec allows for energy exports.

2.1 Quebec is short capacity and long on energy.

Hydro-Québec has around 37,000 MW of installed capacity providing power to the grid, made up of 63 hydroelectric plants (36,767 MW)[21] and 24 thermal stations (542 MW).[22] In addition to 24 diesel units used to supply remote areas, Hydro-Québec owns and operates the Bécancour Gas Turbine, located between Montreal and Quebec. Bécancour is a 411 MW gas turbine with 4 units connected to the Quebec grid and is used by Hydro-Québec to meet peak loads.[23] Additionally, independent power producers in Quebec provide 10,314 MW of power supply from gas, wind, biomass and other hydro plants.[24]

In understanding Hydro-Québec's ability to export electricity products, it is important to distinguish between energy and capacity. Capacity is provided by existing or planned generating plants that are available to generate electrical energy when needed. Energy is the electricity that flows when those generating plants are operating. The distinction is particularly important for hydroelectric plants when availability of energy may vary over

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[21] Hydro-Québec 2018 Annual Report, p. 35.

[22] Hydro-Québec 2017 Annual Report, Appendix A.

[23] Hydro-Québec website, http://www.hydroquebec.com/generation/centrale-thermique.html

[24] Hydro-Québec website, http://www.hydroquebec.com/generation/

the course of the year due to seasonal waterflows or across multiple years creating periods when output at the nameplate capacity may not be achievable.

Quebec's system is a winter-peaking system, and, as such, Hydro-Québec is required to maintain generation capability above its peak demand in the winter. However, water flow is at its lowest during the winter months, requiring Quebec to rely on stored water in its reservoirs to produce energy. Therefore, Hydro-Québec's energy production capacity is limited by its already-built generation capacity and reservoir levels.[25] Hydro-Québec manages its hydroelectric system to manage these limitations and store energy at sufficient levels to be able to call upon it over the course of the winter until snow melt can replenish the reservoirs again.

In 2017, the North American Electric Reliability Corporation ("NERC") projected that Quebec could be short of its required reserve margins by 2024 unless another 1,100 MW of prospective resources were obtained.

> Under the Prospective Scenario, a total of 1,100 MW of expected capacity imports are planned by the Québec area. These purchases have not yet been backed by firm long-term contracts. However, on a yearly basis, the Québec area proceeds with short-term capacity purchases (UCAP) in order to meet its capacity requirements if needed.[26]

In other words, Quebec is projected to require nearly the equivalent of CHPE's potential capacity by 2023 according to NERC. If Hydro-Québec must purchase capacity to meet its own provincial needs, it would not be able to sell capacity into another market such as New York unless Hydro-Québec purchased sufficient capacity from New York or other markets. In fact, Hydro-Québec already appears to be engaging in capacity arbitrage – purchasing short-term capacity from New York's Unforced Capacity ("UCAP") market in

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[25] As with any large hydroelectric system operator, Hydro-Québec manages its reservoir levels to be able to meet its energy needs over the course of the year and under adverse run-off conditions over multiple years as well as during peak periods.

[26] NERC, 2017 Long-term Reliability Assessment, pp. 55-56, Under the prospective scenario, a total of 1,100 MW of expected capacity imports are planned by the Quebec area, although these purchases have not yet been backed by firm long-term contracts.
https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_12132017_Final.pdf

the winter months and through a commitment from Ontario for 500 MW while selling capacity supply obligations to New England's Forward Capacity Market ("FCM").[27]

Insight

Hydro-Québec is short capacity and purchases winter capacity from Ontario and New York to make up its shortfalls.

The shortfall in capacity does not correspond to a shortfall in energy because Quebec has reservoirs and can store water to generate excess energy across the year whereas capacity requirements are an instantaneous need at the point of peak demand on the system. Given the natural flows of precipitation and snow melt in Quebec, the province is flush with water in the late spring and early summer months. That water is used to produce energy as well as to replenish the reservoirs for the winter. Similar to capacity, if Hydro-Québec falls short of water to produce energy given reservoir constraints, it also can purchase from one market to meet its load and use the stored reservoir energy at a later time to generate energy for load or exports.

That said, Hydro-Québec's hydroelectric plants cannot produce energy at maximum capacity year-round. Actual output depends on precipitation and snow melt, reservoir storage, and transmission line limits. Run-of-river hydro plants produce energy corresponding to the timing of water flows, and they are built to meet maximum flow, languishing during the dry season. Even reservoir hydro cannot operate at high capacity levels because the reservoirs do not provide unlimited storage and need to be managed to meet seasonal and annual fluctuations.

As a result of these constraints, the average capacity factor of Hydro-Québec's hydroelectric plants is around 60 percent.[28] Producing 8.3 TWh to fill CHPE requires around 1,580 MW of hydroelectric capacity plus extensive reservoir capacity to manage seasonal and annual water flow variations.

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[27] Ibid., pp. 53-54. Ontario may not be in a position to renew the current sale of 500 MW of capacity to Quebec when the current contract expires.

[28] In other words, a 1,000 MW hydroelectric facility would only produce 5.25 TWh versus the total potential of 1,000 MW at 8.76 TWh. The assumed capacity factor of 60 percent comes from an analysis performed by Central Maine Power in consultation with Hydro-Québec submitted as part of the NECEC docket No. 2017-00232, excel spreadsheet NRCM-002-021_Attachment_1_(2017-232). This capacity factor also is supported by historical production levels.

The distinction between capacity and energy also is important because Hydro-Québec historically has sold its energy under long-term contracts into other markets as energy only sales – not capacity.[29] Although the contracts may be for firm energy, those contracts generally are backed by Hydro-Québec's portfolio versus specific generating plants. Hydro-Québec's system and the ability to optimize energy purchases and sales across its four system interties also provides firming opportunities without the need to dedicate specific hydroelectric units to the contract.

Insight

A contract with Hydro-Québec for power to be delivered through CHPE is likely to be energy only.

2.2 Hydro-Québec's excess energy available for exports is limited.

Although Hydro-Québec tends to have excess energy to sell into export markets, such energy is limited by operating capacity, hydrological conditions, load, line losses and contractual obligations. Of these, hydrology and load are the most variable.

Water conditions can be variable, causing periods of flush water conditions as well as drought.

[29] Although the proposed contracts for energy through NECEC require Hydro-Québec to attempt to qualify to provide capacity into the ISO-NE market, there is no penalty if such capacity is not available or does not clear the market, "For the avoidance of doubt, but without limiting the condition set forth in Section 3.4(b)(ii), **Seller shall have no obligation during the Services Term** to pay for such Network Upgrades or **to complete the Forward Capacity Auction qualification process**" (emphasis added).

Figure 2: Variability in Water Flows at the City of Québec[30]

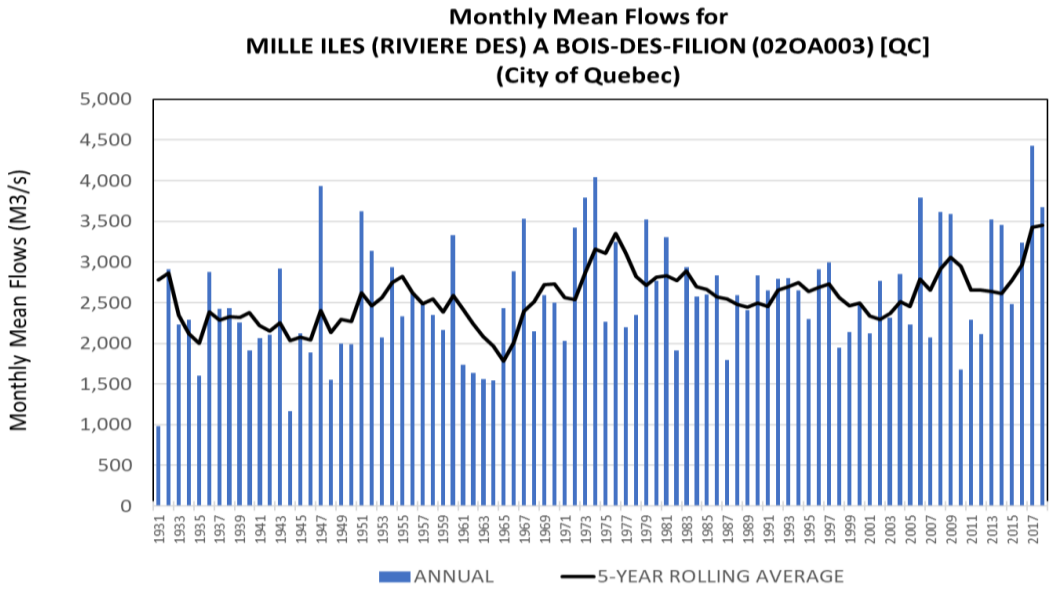

Figure 2 illustrates the annual variability in monthly mean flows for the Rivière-des-Mille-Îles, a channel of the Ottawa river in Southwestern Quebec. Although five of the past six years have been above average, 2010-2012 experienced very low water flows. Recent levels of exports reflect these flush water conditions and should not be expected to continue going forward. In fact, export levels for 2019 have been running at below 2018 levels, reflecting a reversion to average water flow levels.

Insight

Variability in water conditions can constrain the amount of energy that Hydro-Québec can produce and therefore export.

Demand for electricity depends on a number of factors, including temperature and economic growth. A very cold winter allows for less energy available for export; a mild winter deceases internal demand for energy and allows greater levels of excess energy available for export than what otherwise would have occurred. Projections of energy use

[30] Government of Canada, Hydrometric Information, https://wateroffice.ec.gc.ca/report/statistics_e.html?stn=02OA003&mode=Table&type=stat&results_type=statistics&dataType=Monthly&parameterType=Flow&y1Max=1&y1Min=1

by commercial and industrial end-users also impact the amount of energy that is available for export. For example, a recent influx of cyber currency operators responding to Quebec's offer of low-cost energy[31] increased load projections issued in 2018 and 2019.[32]

Combining all of these factors indicates that Hydro-Québec is expected to have less than 30 TWh of energy available to export going forward (**Figure 3**). In order to export 40 TWh in the near-term, as Hydro-Québec claims it can,[33] Hydro-Québec would have to draw on its reservoir levels. The amount of excess energy available in reservoirs by the time CHPE becomes operational will depend on Hydro-Québec's exports and future precipitation.

Figure 3: Hydro-Québec Excess Energy Projected to be Available for Export[34]

	Projected Energy Available for Export Through 2029 (TWh)							
Line Item	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Available Production	**232.08**	**232.08**	**232.08**	**234.72**	**234.72**	**234.72**	**234.72**	**234.72**
Less Line Losses due to Transmission (6.1% per NECEC)	(14.16)	(14.16)	(14.16)	(14.32)	(14.32)	(14.32)	(14.32)	(14.32)
Total Net Generation / Available Production less Line Losses	**217.92**	**217.92**	**217.92**	**220.40**	**220.40**	**220.40**	**220.40**	**220.40**
Less Hydro-Quebec Internal Load	(195.70)	(196.50)	(199.00)	(198.00)	(196.00)	(194.00)	(196.00)	(196.00)
Net Energy that Can be Sold to Other Markets	**22.22**	**21.42**	**18.92**	**22.40**	**24.40**	**26.40**	**24.40**	**24.40**
Less Vermont Maxium Contracted Exports	(1.30)	(1.30)	(1.30)	(1.30)	(1.30)	(1.30)	(1.30)	(1.30)
Less Ontario Maximum Contracted Exports	(2.00)	(2.00)						
Less New Brunswick Average Annual Contracted Delivery	(2.35)	(2.35)	(2.35)	(2.35)	(2.35)	(2.35)	(2.35)	(2.35)
Less Proposed MA Utilities Contract (NECEC)		(9.45)	(9.45)	(9.45)	(9.45)	(9.45)	(9.45)	(9.45)
Net Non-firm Energy Available for Sale to CHPE	**16.57**	**6.32**	**5.82**	**9.30**	**11.30**	**13.30**	**11.30**	**11.30**
Less Proposed NYISO Potential Energy (CHPE)			(8.30)	(8.30)	(8.30)	(8.30)	(8.30)	(8.30)
Net Non-firm Energy Available for Sale Across Existing Lines	**16.57**	**6.32**	**(2.48)**	**1.00**	**3.00**	**5.00**	**3.00**	**3.00**

Projected levels of available net energy that could be sold into other markets are consistent with a study Hydro-Québec sponsored that assumes exports to wholesale

[31] Congressional Research Service, "Bitcoin, Blockchain and the Energy Sector," August 2019, pp. 14-15 https://crsreports.congress.gov/product/pdf/R/R45863

[32] As a result, these projections indicate less available export energy than what prior estimates indicated.

[33] Hydro-Québec, "Portrait des ressources énergétiques d'Hydro-Québec," November 2019, pp. 12-13, http://www.hydroquebec.com/data/achats-electricite-quebec/pdf/portrait-ressources-energetiques.pdf

[34] Table compiled using Hydro-Québec reported values reported in its Distribution System Plan and an analysis submitted by Central Maine Power in the NECEC case before the Maine PUC, Docket 2017-00232.

energy markets in the U.S. northeast would remain constant at 22.4 TWh without a build-out of new hydroelectric facilities.[35]

Hydro-Québec's own assumptions organized in this manner show that it is close to overselling its available energy under normal water conditions. By 2024, Hydro-Québec would have to purchase energy to meet its CHPE contractual obligations and invest in the planned 500 MW upgrades by 2025 to cover its expanded delivery obligations over CHPE if NECEC is built. If both NECEC and CHPE proceed, even with the upgrades, Hydro-Québec would have less than 5 TWh available each year to sell across existing lines that historically have transmitted up to 36.5 TWh per year. Hydro-Québec would have difficulty meeting its CHPE contractual obligations during a dry spell or in periods with less than average water conditions; Hydro-Québec would have to purchase energy from other markets.

Even under normal water conditions, Hydro-Québec could find itself unable to meet CHPE obligations. Load from 2026 through 2029 could be even higher than what Hydro-Québec projects. At the end of 2019, Quebec has announced an initiative to achieve 100 percent electric vehicles by 2050, with interim goals for 2026 and 2030. Based on those goals, Quebec's load could increase by 0.7 TWh in 2026 and 2.2 TWh by 2030.[36]

Quebec's projected load growth constrains the amount of energy that Hydro-Québec can export and indicates that it would not have much excess energy to export across its existing tie lines if both NECEC and CHPE are built. Any decrease to below average water flows would require purchases from other markets to meet contractual obligations. Even if NECEC is not built, however, existing transmission export capability of more than 50 TWh per year is more than adequate to export all of Hydro-Québec's excess energy.

[35] Deep Decarbonization in the Northeastern United States and Expanded Coordination with Hydro-Québec, April 2018, p. 30.

[36] This estimate is based on the New York Gold Book and estimated additions to electricity load from electric vehicles,

Hydro-Québec Distribution ("HQD") already has acknowledged anticipated shortfalls in energy that will require purchases from other markets.[37]

- Starting in 2020, HQD starts "Achats sur les marchés de court terme" or "short-term market purchases."
- Starting in year 2026, HQD projects: "Approvisionnements additionnels requis" or "Additional supplies required."
- Additional supplies can come from new wind, new hydro or purchases from other markets.
- Due to the seasonal characteristics of supplies and needs, there are periods when some of the heritage electricity is not used and others, especially in the winter, where additional purchases are required from short-term markets.

Insight

Hydro-Québec is projected to have less energy available for export going forward due to load growth. Under average water conditions, potential contracts such as CHPE and NECEC could force Hydro-Québec to purchase energy from other markets to meet its obligations.

2.3 Hydro-Québec firm energy is very expensive.

The marginal cost of hydroelectric energy tends to be very low. In addition, Hydro-Québec's internal transmission costs are effectively zero because it owns and operates the transmission system.[38] As a result, it is economically rationale for Hydro-Québec to bid low prices into competitive energy markets and deliver energy, so long as it can receive a positive price. The same cannot be said for firm energy sold under long-term contracts.

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[37] Hydro-Québec, "Portrait des ressources énergétiques d'Hydro-Québec," November 2019, pp. 12-13, http://www.hydroquebec.com/data/achats-electricite-quebec/pdf/portrait-ressources-energetiques.pdf

[38] Quebec abides by FERC open access requirements (in order to access U.S. markets, it must provide reciprocity under FERC Order 888). As a result, Hydro-Québec Power, the generation and marketing arm of Hydro-Québec, is required to pay the same transmission rate as other power shippers. However, payment goes to Hydro-Québec TransEnergíe, the transmission arm of Hydro-Québec. Therefore, from a corporate perspective, profits are maximized if the marginal cost of transmission is assumed to be zero.

The cost for delivered energy from Quebec into New York City over CHPE would not be known until bids are received. The experience in New England, however, provides an indication that delivered prices into New York City would exceed $63/MWh. Delivered energy costs over CHPE are likely to be higher than NECEC into New England for the following reasons:

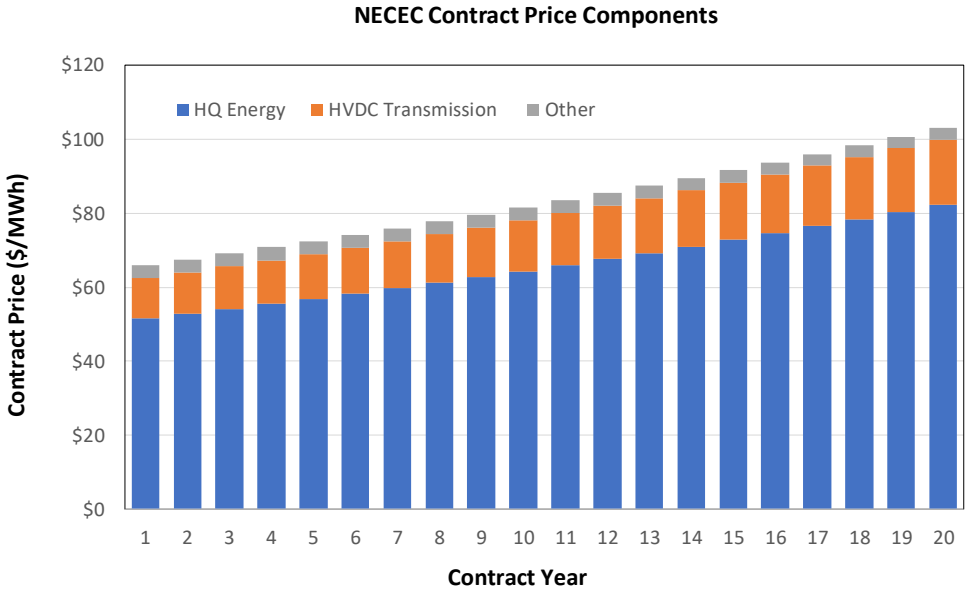
- **Delivery:** The transmission cost for NECEC came in at a starting price of $11/MWh. This reflects the $1.1 billion cost of a 145-mile line which, for the most part, was expected to be above-ground. One could expect that the 330-mile underground and submarine cable of CHPE would be roughly twice to three-times the cost. Indeed, cost estimates for CHPE have placed it at around $2.2 billion to $3 billion.[39]

- **Energy Price:** The Hydro-Québec hydroelectric energy component for NECEC came in at a starting price of $51.50/MWh rising to over $100/MWh by the end of the 20-year contract (**Figure 4**). This price is similar to the starting price of delivered energy to a residential consumer in Montreal of US$53.50/MWh.[40]

[39] Champlain Hudson Power Express, http://www.chpexpress.com/

[40] Converted from CAN$71.3/MWh at an exchange rate of CAN$1 to US$0.75. Canadian electricity prices come from an annual report published by Hydro-Québec, "2018 Comparison of Electricity Prices in Major North American Cities Rates in effect April 1, 2019," p. 6, http://www.hydroquebec.com/data/documents-donnees/pdf/comparison-electricity-prices.pdf

Figure 4: Hydro-Québec Firm Energy Contract Price in Massachusetts[41]



- **Effective Price Due to Redirection:** Although the total contractual price may be $70 - $80 / MWh for delivered energy over CHPE, New York would be purchasing a net amount of energy that is less than the contracted amount. Because an estimated portion of energy delivered through CHPE may be redirected from other parts of New York, and the baseline measure produced by NYSERDA would only reflect the net amount, the effective price for CHPE energy into New York would be above $100/MWh.

Unless Hydro-Québec reduces its energy supply price to below what it charged in New England, delivered energy sold via CHPE can be expected to cost New Yorkers more than twice[42] the current wholesale market price for energy.

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[41] Power Purchase Agreement for Firm Qualified Clean Energy from Hydroelectric Generation between NSTAR Electric Company D/B/A Eversource Energy and H.Q. Energy Services (U.S.) Inc. as of June 13, 2018; Power Purchase Agreement for Firm Qualified Clean Energy from Hydroelectric Generation Between Massachusetts Electric Company and Nantucket Electric Company D/B/A National Grid and H.Q. Energy Services (U.S.) Inc. as of June 13, 2018; Power Purchase Agreement for Firm Qualified Clean Energy from Hydroelectric Generation between Fitchburg Gas And Electric Light Company D/B/A Unitil and H.Q. Energy Services (U.S.) Inc. as of June 13, 2018.

[42] NYISO, State of the Market Report, p. 8.

Insight

Energy sold through CHPE is likely to be well above current market prices.

The PA Consulting report estimated that CHPE would create a price suppression impact for Zone J of $7.7 billion in savings over the first 30 years, or roughly $250 million per year.[43] For reasons discussed in the next section regarding how CHPE was modeled, this estimated savings is an overstatement.[44] Without the underlying price projections generated in support of the report, we cannot compare the anticipated cost of the contract to projected market prices. However, assuming the first year's price is still at twice the wholesale market price for energy, the incremental cost of 8.3 TWh to Zone J customers would exceed the estimated price suppression benefit.

Insight

The premium for energy from Quebec via CHPE could be higher than the calculated price suppression benefits to New York City residents, offsetting the calculated macroeconomic benefits associated with CHPE.

The next section discusses why there may not be any price suppression impacts as well as negligible, if any, carbon emissions reductions.

Insight

Lack of any net price suppression benefits and carbon reduction benefits raises the question of why New Yorkers would pay a significant premium over market prices.

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https://www.nyiso.com/documents/20142/2223763/2018-State-of-the-Market-Report.pdf/b5bd2213-9fe2-b0e7-a422-d4071b3d014b

NYISO Zone J 2018 Prices averaged $40.91 per NYISO data, https://www.nyiso.com/custom-reports

[43] PA Consulting Report, p. 6.

[44] If energy supplying CHPE is simply a diversion from upstate and western New York, the only price suppression impacts would be due to congestion and losses, a much smaller impact than an incremental injection of 8.3 TWh into the NYISO system.

3. HYDRO-QUÉBEC WOULD DIVERT ENERGY TO SUPPLY CHPE.

Hydro-Québec would not produce any new energy to supply CHPE. Any energy flowing through CHPE would be energy that otherwise would be exported. Given New York's relative prices compared to other markets,[45] most of that energy is likely to be a diversion from upstate and western New York into Zone J. As a result, there would be limited price suppression impacts and negligible, if any, net carbon reductions. This section describes the basis for the conclusion that most of the energy supplied through CHPE would simply be a redirect of energy that Hydro-Québec otherwise would sell into New York.

There are four factors that determine whether Hydro-Québec would simply divert energy or purchase from other markets to meet CHPE obligations:

1) **Existing Interties:** Quebec already has multiple interconnections with multiple markets, including New York.

2) **Transmission Availability:** Transmission capacity from Quebec into other markets is not fully utilized and would have even lower capacity factors with contracted transmission lines into New England.

3) **Profit Motive:** Hydro-Québec is motivated to maximize profitable sales, including arbitrage activities across markets, while meeting its own load obligations.

4) **Energy Supply:** Hydro-Québec's export activities depend on the amount of precipitation and water in its reservoirs. Despite significant reservoir capacity, Hydro-Québec's excess energy available for export is highly dependent on water conditions. As a result, Hydro-Québec has been in positions when it has had to purchase energy from other markets to meet its internal load. Hydro-Québec's purchases and sales are therefore very dependent on the weather.

    - Periods of excess water: Hydro-Québec maximizes exports into other markets during high water flow conditions, subject to maintaining reservoir storage to cover dry conditions.

[45] New York tends to have lower wholesale energy prices than surrounding markets. With more aggressive renewable energy goals, New York's prices would continue to remain lower than New England in the near term unless a carbon price is implemented

- Periods of low water flows: Hydro-Québec purchases energy from other markets to meet its contractual obligations and arbitrage.

If all four conditions are true, energy sold by Hydro-Québec through CHPE would not have any impact on carbon emissions and could even increase them if Hydro-Québec had to operate its natural gas-fired power plant or purchase fossil fuel energy from other markets to maintain energy export levels and maximize profitability.

The diversion or purchase of energy to supply CHPE creates an offsetting impact on carbon emissions reduced by an injection of energy across CHPE into New York City. If the energy is redirected from upstate or western New York when there is little or no congestion, there would be no net impact on carbon emissions. This section further explains these conditions and the implications of CHPE which would be supplied by diverted or purchased energy.

3.1. Quebec is interconnected with multiple markets.

Quebec is physically located to the north of the northeastern United States, east of the Province of Ontario and west of the Maritimes. Unlike the rest of the eastern interconnect, which includes those Canadian provinces, Quebec operates an asynchronous grid, meaning that any imports or exports with interconnected markets needs to be synchronized through a DC tie line. Hydro-Québec has a total of 15 external interties between New Brunswick, Ontario, New York and New England with a total export capacity of around 8,000 MW (**Figure 5**).

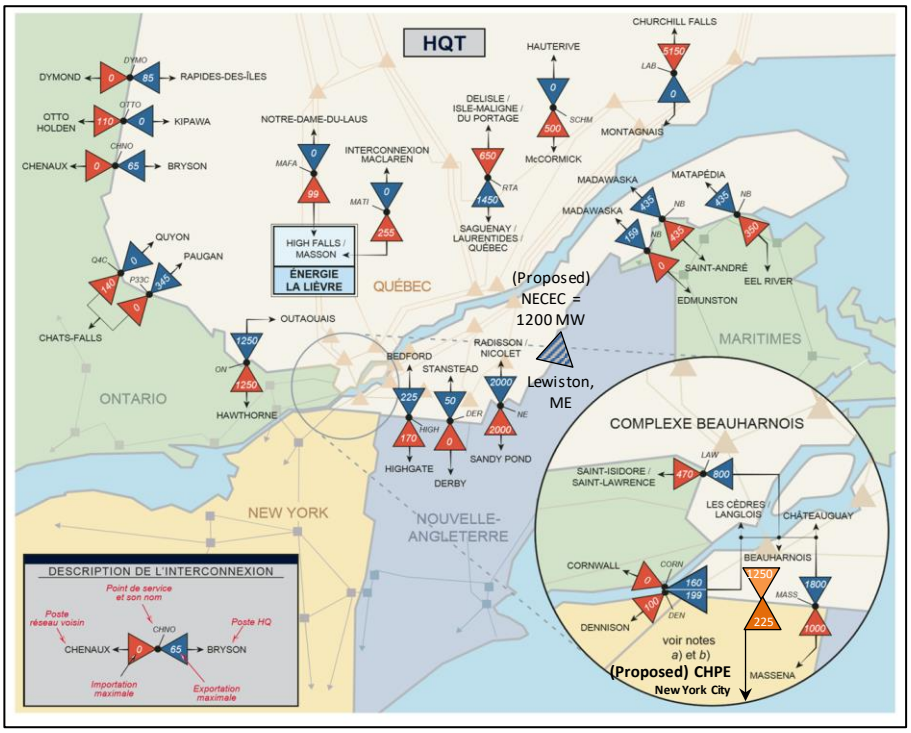
Figure 5: Transfer Capacity of Quebec Interties[46]

Interconnected Region	Number of Interconnections	Imports (MW)	Exports (MW)
New York	2	1,100	1,999
Ontario	8	1,970	2,705
New England	3	2,170	2,275
New Brunswick	3	785	1,029
Total	**15**	**6,025**	**7,974**

[46] Hydro-Québec TransÉnergie, Plan Directeur, 2020, ND, p. 5, titles translated from French, http://www.hydroquebec.com/transenergie/fr/ Note: Cornwall (Ontario) and Dennison (New York) are connected and can only transmit 325 MW simultaneously.

Figure 6 graphically depicts the geographical location of Quebec's interties, including two new proposed interties to support CHPE and NECEC:

Figure 6: Map of Quebec and Interties[47]



If both transmission projects were to proceed, both CHPE and NECEC would add transmission capacity to an already extensive set of interties and increase total export capacity from Quebec by more than 25 percent. CHPE alone would increase total capacity from Quebec into other markets by more than 10 percent.

Figure 7 illustrates the relative size of Quebec's interties and how Quebec is physically interconnected to additional markets via DC and AC tie lines. Quebec has direct interties with New England, Ontario, New York and New Brunswick. It is interconnected to these markets plus PJM and MISO via the AC transmission network connecting the broader Eastern Interconnect to the west of the Mississippi River ("Eastern Interconnect AC Transmission System").

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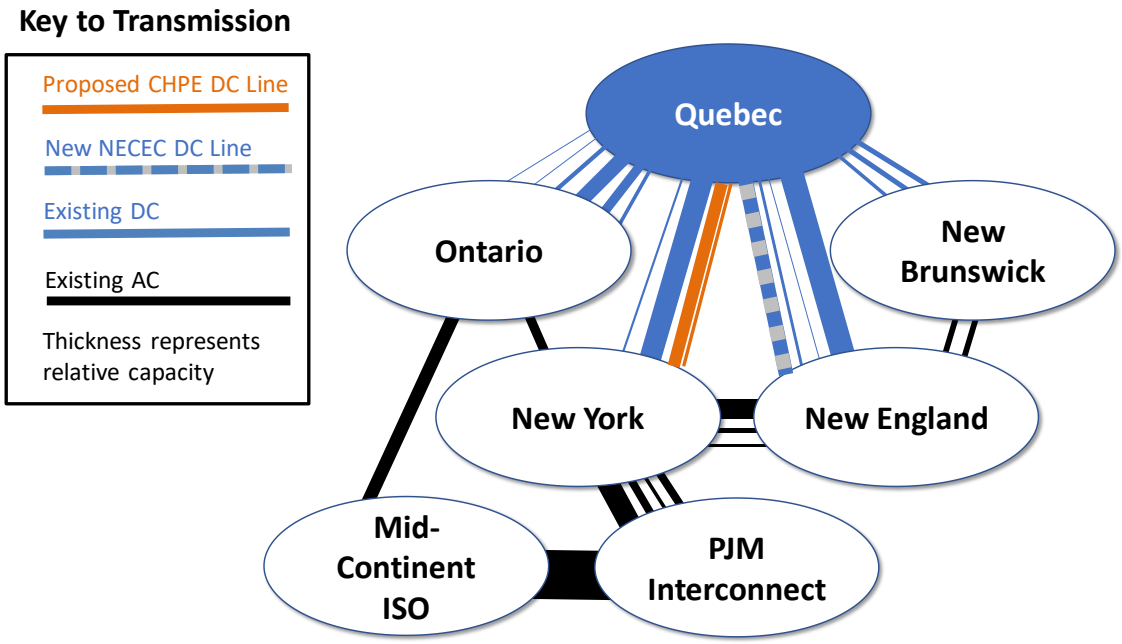
[47] Hydro-Québec TransEnergíe, Plan Directuer 2020, http://www.hydroquebec.com/data/transenergie/pdf/hqt-plan-directeur-2020.pdf

Figure 7: Graphical Representation of Relative Export Transmission Capacity



Hydro-Québec sells energy into New York directly or through other markets. Quebec is directly connected with New York via the Massena intertie and can receive flows via the Dennison intertie (subject to Cornwall constraints). In addition, Hydro-Québec wheels through Ontario and New England into New York via those direct interties and the Eastern Interconnect AC transmission network. Hydro-Québec also can and does sell into PJM and the Mid-Continent ISO[48] -- two markets that are explicitly listed in Hydro-Québec's application for a blanket export license via Ontario and New York;[49] both markets often have coal plants that operate on the margin. Hydro-Québec can also purchase energy from other markets when needed (see section 3.4).

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[48] National Energy Board, Analysis of Commodity Tracking System Data,

https://apps.neb-one.gc.ca/CommodityStatistics/Statistics.aspx?language=english

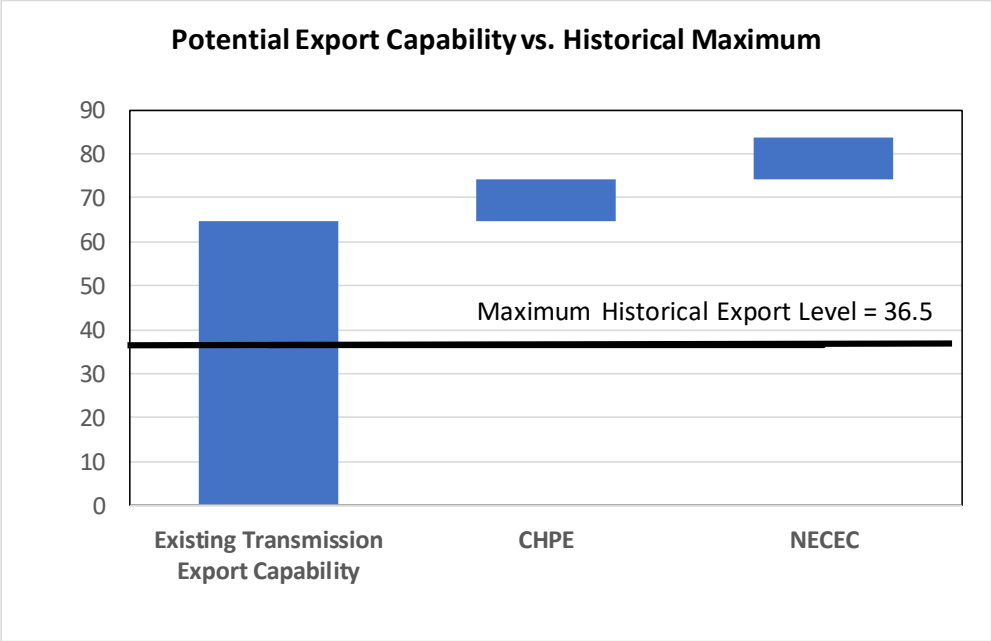
[49] National Energy Board, Application by Hydro-Québec, "Application for a Blanket Electricity Export Permit Pursuant to s.119.03 of the National Energy Board Act and s.9 of the National Energy Board Electricity Regulations," Application Submission Date 02/19/2010, p. 4.

"(3) Provide a brief description of the export markets (e.g. geographic area, NERC region, etc.) to be served. Les marchés visés sont les marchés nord-américains desservis par le New York Independent System Operator, Inc., l'ISO New England Inc., le Midwest Independent Transmission System Operator, Inc. et la PJM Interconnection, LLC."

3.2. Hydro-Québec has enough transmission capacity to sell its excess energy.

Hydro-Québec has enough transmission intertie capacity to sell its excess energy. **Figure 8** illustrates the available transmission capacity that Hydro-Québec currently has compared to the historical maximum export level of 36.5 TWh.

Figure 8: Comparison of Transmission Capacity to Maximum Export Levels (TWh)



Compared to projected excess energy available for export below 30 TWh under normal conditions (refer to **Figure 3**), lack of transmission export capacity is not an issue. If NECEC is built, there would be even greater availability for delivery across existing lines, eliminating any potential claims that CHPE would relieve spillage.

Insight

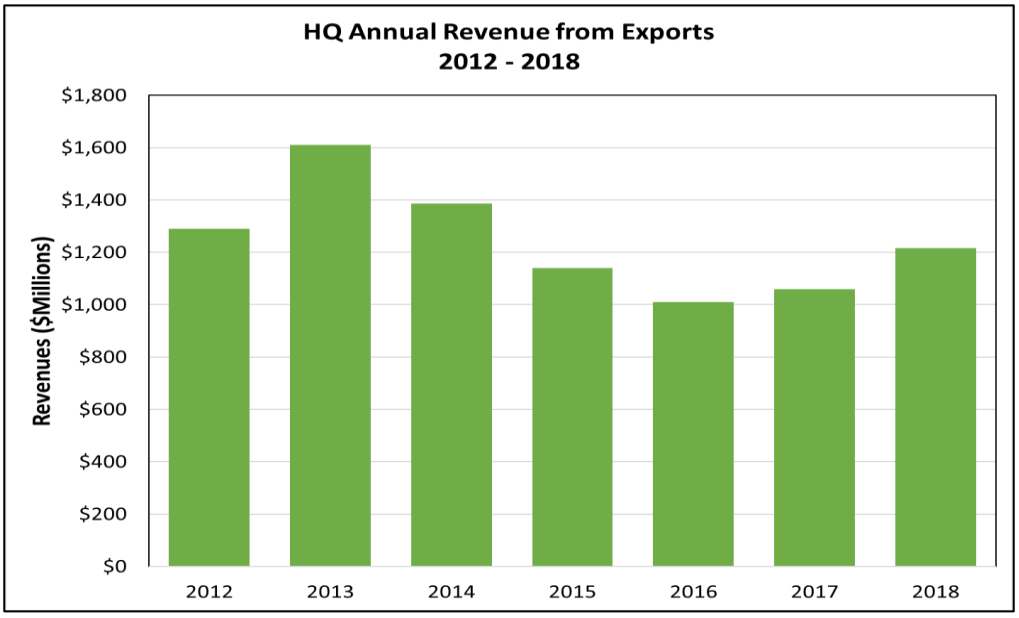
Building CHPE would simply create even more unused transmission capacity.

3.3. Hydro-Québec is motivated to maximize profits.

Historically, Hydro-Québec has generated excess energy over the course of the year that it can sell into other markets at a profit. Revenue from sales to external markets has

exceeded US$1 billion over the past few years (**Figure 9**).[50] In 2017, Hydro-Québec issued more than US$1.5 billion back to the Quebec government as a dividend for the fifth consecutive year.[51]

Figure 9: Hydro-Québec Export Revenues (US Dollars)[52]



Selling exports has become a necessity for Hydro-Québec, as indicated by Hydro-Québec CEO Éric Martel's recent comment, "Without exports, our profits are in trouble."[53]

Contracts with New York City and New Yorkers to sell energy through CHPE simply represent a higher value opportunity for Hydro-Québec than its existing exports strategy

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[50] Hydro-Québec Annual Reports. Annual reports generally are issued in late February.

[51] Reported as CAN$2 billion in 2017 Hydro-Québec Annual Report, p. 3, http://www.hydroquebec.com/data/documents-donnees/pdf/annual-report-2017.pdf

[52] Compiled using Hydro-Québec Annual Reports 2012 – 2018. Assumes an exchange rate consistent with what was reported by Hydro-Québec to the Internal Revenue Service for each year. www.hydroquebec.com/about/financial-results/annual-report.html

[53] Financial Post, "Without exports our profits are in trouble: Hydro-Québec plugs into U.S. markets for growth," April 20, 2018, https://business.financialpost.com/commodities/energy/without-exports-our-profits-are-in-trouble-hydro-quebec-plugs-into-u-s-markets-for-growth

because sales through CHPE would be made through an above-market, fixed price contract. Sales through CHPE are an example of an arbitrage opportunity across markets that Hydro-Québec publicly describes as an activity in which it engages.

This motive was identified in New England with respect to the NECEC project. As the Maine Public Utility Commission Technical Expert London Economics noted,[54]

> With a new outlet for its energy, such as NECEC, HQP [Hydro-Québec Production] will have an increased ability to capture higher energy prices in ISO-NE's energy markets, forfeiting sales to other lower-priced markets . . . This arbitrage opportunity is the core of HQP's exporting strategy and the key motivator for HQP in contracting with NECEC.

Higher-priced, long-term contracts are another example of the way Hydro-Québec can arbitrage between markets – buying low in one market and then reselling that energy at a higher price elsewhere. The above-market price of the contracts with Massachusetts through NECEC illustrates how Hydro-Québec would use CHPE to maximize profits through optimization of its imports and exports while selling under a lucrative long-term contract.

3.4. Hydro-Québec would supply CHPE energy by redirecting or diverting it.

In theory, there are multiple ways that Hydro-Québec could meet its firm energy commitment to CHPE:

1) **Build:** Invest in new impoundments and associated hydroelectric facilities to increase system output, already underway for its own capacity needs as motivation for the Romaine units.

2) **Upgrade:** Invest in existing hydroelectric facilities to obtain higher maximum output levels, already planned for 2025.

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[54] *Central Maine Power Co.*, Request for approval of CPCN for the New England Clean Energy Connect, Maine P.U.C. No. 2017-000232, Technical Conference Transcript (Sep. 19, 2018), pp. 21-25.

3) **Purchase:** Buy energy directly from other markets.

4) **Redirect/divert:** Reduce energy sales into other markets to meet CHPE needs.[55]

Under average water conditions, the most likely scenario is that Hydro-Québec would simply divert energy from other exports into CHPE. Under dry conditions, Hydro-Québec would have to purchase energy from other markets to meet its contractual obligations. Each of these alternatives and their implications for CHPE are described in more detail below.

3.4.1. Build

Although Hydro-Québec could build new hydroelectric facilities to service CHPE, this is unlikely to occur. According to Hydro-Québec's own study, a new hydroelectric facility with impoundments would have a levelized cost of electricity of between $70/MWh and $130/MWh.[56] Combined with the costs of CHPE, this would put the starting electricity price at above a minimum level of $90/MWh, extremely uncompetitive even for a sole-sourced contract with New York City. Building a new facility solely for purposes of export also would require extensive review; a new license with the National Energy Board would have to use existing facilities or be subject to an extensive environmental impact review. Furthermore, a new hydroelectric facility in Quebec would take at least 10 years to build, postponing operations to 2030. Hydro-Québec does not intend to supply CHPE by building a new hydroelectric facility.

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[55] Rob Ferguson, The Star, "Ontario signs deal for electricity from Quebec in bid to defuse anger over hydro bills," October 21, 2016, https://www.thestar.com/news/queenspark/2016/10/21/ontario-signs-deal-for-electricity-from-quebec-in-bid-to-defuse-anger-over-hydro-bills.html

[56] Ibid., p. 28. All dollar values are reported in US Dollars per Energyzt conversation with Evolved Energy Research, one of the authors of the report.

3.4.2. Upgrade

Hydro-Québec has announced that it may invest in 500 MW of upgrades to existing units by 2025. Although upgrades could cost less than building a new facility, those reported upgrades already are required to maintain exports at historical levels while meeting Quebec's domestic load growth. Those upgrades only offer 13 TWh of additional energy, all of which is required to meet Hydro-Québec's growing demand.[57] Hydro-Québec does not intend to supply CHPE through upgrades.

3.4.3. Purchase

As already mentioned, Hydro-Québec is positioned to purchase energy from markets with low or even negative prices to meet its energy commitments. The ability to purchase imports in order to conserve water in its reservoirs for use during higher-priced periods creates a profit-maximizing opportunity that Hydro-Québec is uniquely positioned to pursue. The impact on the environment could be the same as if Hydro-Québec were generating incremental energy in those markets directly.

Although Hydro-Québec's extensive reservoir system is very sensitive to hydrological conditions and load requirements, the interconnected transmission system allows Hydro-Québec to arbitrage across wholesale electricity markets. It is a simple matter to purchase low-cost energy from one market, retain water in its reservoirs, and then sell that water at a different time when energy prices in neighboring markets are higher. Hydro-Québec already engages in this strategy and is projected to do so to meet its energy needs going forward.

Hydro-Québec has engaged in purchases and sales across markets, and to meet its own needs, as early as 2004, as indicated by the Government of Quebec:

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[57] Hydro Québec, Deep Decarbonization in the Northeastern United States and Expanded Coordination with Hydro-Québec, April 2018, pp. 27-28. Per Footnote 5, which indicates 144 TWh already is available, there would be only 13 TWh of additional energy available through upgrades.

"Load in Québec was assumed in all scenarios to grow by 0.42% per year for a total increase of 28.7 TWh between 2015 and 2050."

> Hydro-Québec is able to purchase electrical energy from neighbouring markets at lower prices during certain periods, and then resell it later to neighbouring networks at higher prices. If rainfall conditions permit, and once Québec's own energy security has been guaranteed, Hydro-Québec Production's unused supplies can be exported (net export sales) to neighbouring markets.[58]

These activities, known as "arbitrage transactions," are described in Hydro-Québec's 2016 Annual Report:

> Hydro-Québec supplies the Québec market with electricity and also sells power on wholesale markets in Canada and the United States. In addition, it is active in **arbitrage transactions**. Revenue from electricity sales and arbitrage transactions is recognized on delivery. **Arbitrage transactions are recognized net of related electricity purchases.**[59]

(emphasis added).

Although such references were removed from the 2018 Annual Report, they continue to appear in Hydro-Québec's SEC Form 18-k filing.[60]

The ability to purchase from other markets and store an equivalent amount of energy by reducing flow through its turbines provides valuable flexibility to Hydro-Québec. This flexibility is particularly profitable during low water conditions when Hydro-Québec would have less energy to sell into external markets or high-priced years when the difference between peak and off-peak energy prices is greater.

For example, during the past few years, Quebec has experienced heavy water conditions and record energy exports; Hydro-Québec imported relatively little energy. In 2010,

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[58] Minestere des Ressource natuelles, dela Faune et des parcs, Gouvernement du Quebec. 2004. The Energy Sector in Québec, Context, Issues and Questions. p. 41.

[59] Hydro-Québec 2016 Annual Report, p 50.

[60] Hydro-Québec 2018 SEC Form 18-k filing,

"Generation: Hydro-Québec Production operates and develops our generating facilities in Québec . . . It also sells electricity in markets outside Québec and engages in energy-related **arbitrage transaction**" (p. 8, see also p. 80).

however, conditions were much different; Hydro-Québec exported 23.4 TWh, nearly half of that was offset by 10.7 TWh of imports (**Figure 10**).

Figure 10: Hydro-Québec Historical Exports and Imports[61]

Year	Exports (TWh)	Imports (TWh)	Net Exports (TWh)
2008	21.3	6.1	15.2
2009	23.4	4.9	18.5
2010	23.3	10.7	12.6
2011	26.8	6.0	20.8
2012	31.8	1.7	30.1
2013	32.2	1.4	30.8
2014	26.6	1.2	25.4
2015	29.9	0.6	29.3
2016	32.7	0.1	32.6
2017	34.9	0.5	34.4
2018	36.5	0.4	36.1

NOTES:
[1] See "Hydro-Québec at a Glance," p. 2 across the Annual Reports for a consistent set of data on electricity sales outside of Quebec. For 2012 and earlier, there is conflicting information in other areas of the report, which is ignored for purposes of developing this table.
[2] Derived as the difference between reported Exports and Net Exports.
[3] Net Electricity Exports, p. 12 (2016 Annual Report), p. 12 (2014 Annual Report).

The extensive set of transmission interties across multiple markets allows Hydro-Québec to engage in arbitrage. While this type of arrangement can help Hydro-Québec to maximize its profits, it also creates a situation where Hydro-Québec can create the perception that its energy is clean and renewable when it is not. When Hydro-Québec has to purchase energy to meet its incremental contractual obligations, that contract effectively generates any carbon emissions associated with Hydro-Québec's purchases.

Specifically, Hydro-Québec's interconnectedness would allow CHPE energy to appear to

[61] Compiled using Hydro-Québec Annual Reports 2012 – 2018.
www.hydroquebec.com/about/financial-results/annual-report.html

come from Hydro-Québec's hydroelectric plants when, in reality, such excess energy only would be enabled through purchases from fossil fuel plants.

There is no reason to assume that Hydro-Québec would not engage in the same strategy, which it described in 2004, clearly executed upon from 2008 through 2012, and referenced in its annual reports as recently as 2017. As a result, anyone contracting for energy to be delivered through CHPE, such as the City of New York, would be paying multiples on the market price for something that is already being produced and sold into New York or elsewhere. CHPE would simply be a conduit for energy that Hydro-Québec purchases or shifts from other markets.

Insight

Hydro-Québec has every incentive to arbitrage between markets, and it already does so. The lucrative arrangements under the CHPE contract would create an even greater incentive for Hydro-Québec to buy from other markets, when it does not have enough excess energy to export or if such purchases are profitable.

3.4.4. Redirect/Divert

The most likely source of supply for CHPE is diversion. As already discussed, the four conditions hold and are met. In fact, diversion was conceded in the context of CHPE's New England equivalent during testimony by London Economics, Inc.,[62] who has served as a consultant to both CHPE[63] and Hydro-Québec.[64]

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[62] *Central Maine Power Co.*, Request for approval of CPCN for the New England Clean Energy Connect, Maine P.U.C. No. 2017-000232, Technical Conference Transcript (Sep. 19, 2018), p. 28:3-7, p. 58:23 – 60:11.

[63] Direct Testimony of Julia Frayer, Case 10-T-0139, June 7, 2012. The London Economics analysis for CHPE used a New York model with scheduled imports and exports based on historical levels. For Quebec, Ms. Frayer modeled imports into New York as increasing over time due to anticipated capacity additions and does not appear to have made any adjustment for diversion of flows out of upstate New York to supply CHPE. As a result, her estimate of price impacts and economic benefits associated with CHPE do not reflect the current proposal to supply CHPE from existing Quebec production and are overstated.

[64] London Economics International, Carbon Pricing in the NYISO Wholesale Energy Market: Addressing Leakage, April 2018

https://www.nyiso.com/documents/20142/1394934/LEI%20IPPTF%20Apr%209%202018-03-28.pdf/95243771-3a63-9d17-40eb-fe06ea7fc08d

> MR. SHOPE: …As I understand your report, you state that in order to serve the Massachusetts contract, Hydro Quebec will divert power that it otherwise would have exported to other markets like Ontario or New York. Am I right so far?
> MS. FRAYER: Yes.

The Massachusetts Department of Environmental Protection ("DEP") explicitly identified a concern that "resource shuffling" of Canadian hydro (i.e., the contractual or transactional reassignment of clean energy without increasing the total amount of clean energy overall) could result in the Massachusetts Clean Energy Standard delivering no additional clean energy to the Commonwealth:

> Excluding existing resources from the CES would not be sufficient to prevent resource shuffling with respect to transmission of electricity from Canada. Currently, electricity imported from Canada is an important source of clean electricity for Massachusetts, but the ability to import additional electricity from Canada is limited by the amount of transmission capacity. Resource shuffling could occur if new hydroelectric generation resources were to displace existing hydroelectric resources as the source of the electricity traveling through existing transmission lines. In this case, CES compliance could occur without any change in the amount of clean energy available for use in Massachusetts.[65]

As a result of Hydro-Québec diverting energy from New York or other markets into a new transmission line such as CHPE, there would be negligible impacts on carbon emissions. The Massachusetts Attorney General's expert discussed the offsetting carbon emissions impact in the context of NECEC in New England as part of the hearings before the Massachusetts DPU:

> Diverting clean energy from other regions to New England would enable a reduction in fossil generation and emissions within New England, but the reduced deliveries to other regions may need to be replaced by additional fossil generation in those regions. This would effectively substitute fossil generation in other regions for fossil generation in New England, shifting

[65] Massachusetts Department of Environmental Protection, Background Document on Proposed New and Amended Regulations, December 16, 2016, p. 30.

> emissions from one region to another, without causing a material decrease (the actual impact would depend on the relative emissions intensities of each region).[66]

As concluded by London Economics, the Brattle Group, and the Massachusetts DEP, any transmission line from Quebec would simply shift energy and have negligible impact on carbon emissions. Therefore, any energy supplied through CHPE would fail to decrease carbon emissions regionally.

Insight

Hydro-Québec would not provide any new energy through CHPE. A proper calculation of impacts needs to consider the offsetting impact associated with changes in energy flows to and from other interties.

3.5. Analysis confirms that CHPE energy would come from New York.

Having established that Hydro-Québec has the incentive and expected level of exports compared to transmission capacity to support diversion, the next question is from which markets would Hydro-Québec divert its exports? Such diversion is most likely to come from the hours in the markets representing the lowest prices to Hydro-Québec. As upstate and western New York tends to have some of the lowest-priced energy compared to other markets, most of the diversion would simply be redirected from energy that otherwise would be wheeled through other markets into New York or sold directly into upstate New York.

Energyzt developed a model based on test year 2018 to illustrate how 30 TWh of energy flows from Quebec into other markets would change based on CHPE.[67] The details of this analysis are described in Appendix B.

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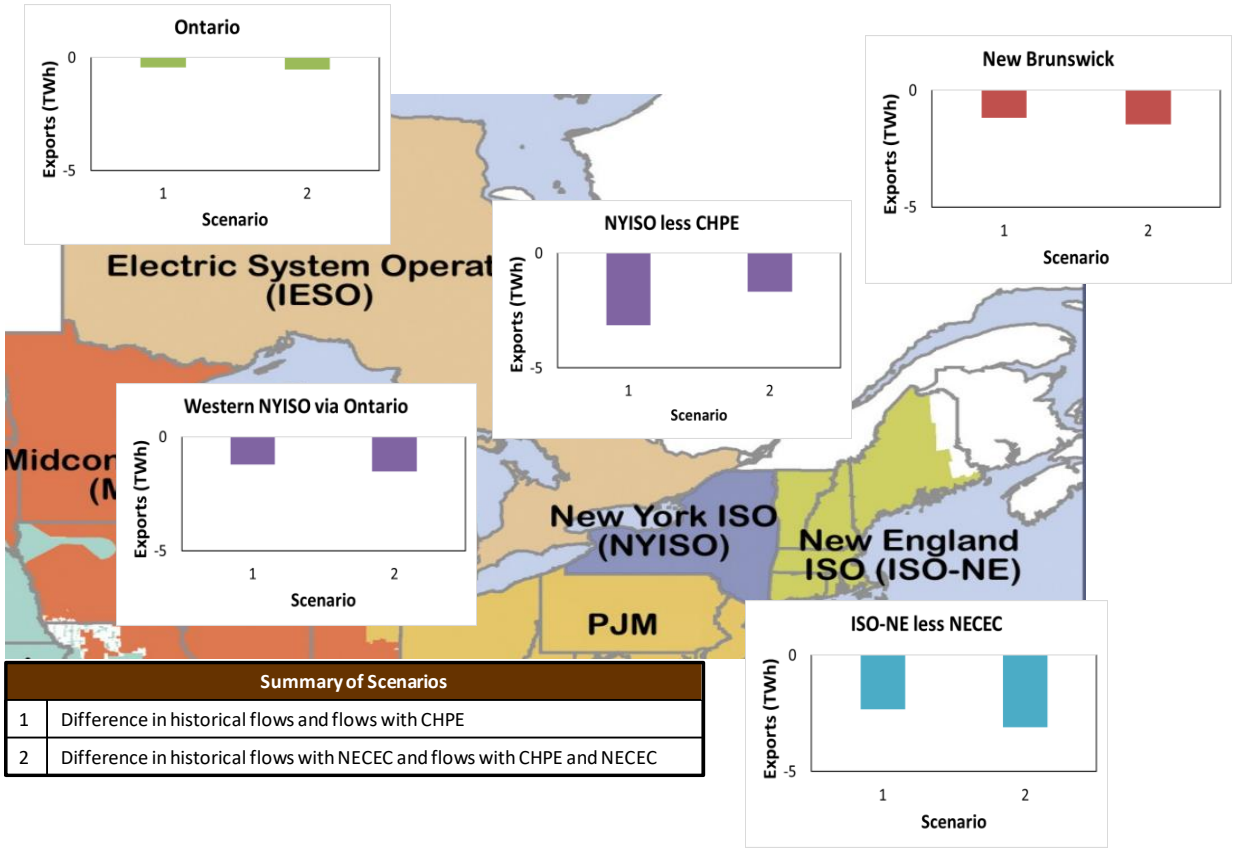
[66] Testimony of Dean W. Murphy (Brattle Group), Witness for the Massachusetts Attorney General. Petition for approval by the Department of Public Utilities of a long- term contract for procurement of Clean Energy Generation, pursuant to Section 83D of An Act Relative to Green Communities, St. 2008, c.169, as amended by St. 2016, c. 188, § 12, December 21, 2018, p. 15, https://www.nrcm.org/wp-content/uploads/2019/03/2018MAAGMurphyTestimony.pdf

[67] Recall that the projection using Hydro-Québec assumptions and forecasts in **Figure 3** indicated that Hydro-Québec would have less than 30 TWh to export by 2025 under normal water conditions. The exported flows in 2018 of 36.5 TWh are reduced to 30 TWh as an illustration of future conditions that can use existing reservoir storage to increase exports to a slightly higher level in order to maintain historical export levels.

Figure 11 illustrates the conclusions. Regardless of whether or not NECEC is built into New England (differentiated as Scenarios 1 and 2), a significant amount of the energy Hydro-Québec supplies through CHPE would otherwise flow into New York.

Figure 11: Change in Intertie Flows due to CHPE (with and without NECEC)



Scenario 1: CHPE is Added.

If CHPE were added to Quebec's existing intertie configuration, most of the energy (i.e., 4.4 TWh) would be diverted from other parts of New York (upstate and into western New York via Ontario). Another 2.3 TWh would be diverted from New England.[68] 1.2 TWh would be diverted from flows into New Brunswick, of which some flows into Maine. As fossil fuel is on the margin in most of the hours when Hydro-Québec is selling into these other markets (i.e., Hydro-Québec does not have any incentive to sell during negatively priced hours), this diversion from New York and other markets would have an offsetting

[68] Historically, around two-thirds of Hydro-Québec's flows into Ontario are wheeled through and sold into New York according to the Canadian Government database on provincial electricity exports and Ontario flow data.

impact on any carbon emissions displaced in New York City by intended hydro imports over CHPE. Except possibly during hours of extreme congestion (in which case Hydro-Québec is unlikely to be exporting energy into upstate New York), there would be no net impact on carbon emissions or New York prices because CHPE simply diverts energy from one part of the state into another.

Under Scenario 1, roughly half of the energy flowing into CHPE would be diverted from other parts of New York.

Scenario 2: CHPE is Added After NECEC.
Energyzt also examined what the impact of CHPE would be on flows using 2018 as a test year, if NECEC were built. To this end, 9.5 TWh of energy flows were first diverted from the lowest priced hours and markets into New England to supply NECEC. Then, exports were diverted from the remaining non-firm energy flows during the lowest priced hours and markets back into CHPE. In this Scenario 2, more energy is diverted from New Brunswick (1.5 TWh) and ISO-NE (3.1 TWh), both of which have significant fossil fuel generation mixes. New Brunswick is 50 percent coal and oil-fired generation; New England is predominantly natural gas but moving to renewables. If NECEC is built, CHPE could have an adverse impact on the environment with carbon emissions from ISO-NE and New Brunswick offsetting any displacement in New York and potentially increasing total emissions.

Under Scenario 2, 3.2 TWh would be diverted from other parts of New York, roughly 38.5 percent of total deliveries.

Going forward, CHPE's impact on total carbon emissions would depend on the amount of energy available for export, relative prices in each market, implementation of a carbon price, and fuel source generating electricity on the margin. With New York implementing more aggressive policies than surrounding markets, wholesale energy prices in New York are likely to remain lower, making the energy that is diverted to supply CHPE most likely to come from upstate or western New York.

As New York and other markets proceed with their carbon reduction goals, relative carbon intensity is likely to change. The analysis using 2018 conditions indicates that, at least for the next ten years as states move towards their 2030 carbon goals, a large portion of the energy flowing into CHPE would be a shuffling of energy that otherwise would flow into New York. Reduction in carbon emissions in New York would be replaced by carbon emissions elsewhere.

Insight

A large part of the energy that Hydro-Québec supplies through CHPE would be a redirect from other interties into New York. If NECEC, CHPE's New England equivalent, is built in Maine, nearly 40 percent would come from other parts of New York, with the rest coming from fossil-fuel markets of New Brunswick and New England, negating any impact on and potentially increasing total carbon emissions.

3.6. There is no guarantee that energy through CHPE would be incremental.

Although contracts with Hydro-Québec have yet to be signed, the terms of those contracts are unlikely to be able to ensure that energy sold through CHPE would be incremental to what Hydro-Québec historically has sold into New York or would sell into New York.

The experience from New England is a warning. Despite an initial requirement that energy delivered via NECEC be incremental to historical levels, Hydro-Québec negotiated those provisions away. As a result, Massachusetts contracts do not guarantee that energy flowing through NECEC would be incremental to historical levels or to what otherwise would occur.[69]

The Massachusetts request for proposal originally required hydroelectric imports to be "incremental to New England" and required a showing of what Quebec's imports into New England have been over the prior three years. The template for the contract, included as part of the RFP, also included a definition for incremental energy to be delivered:

> "Incremental Hydroelectric Generation" means Firm Service Hydroelectric Generation that represents a net increase in MWh per year of hydroelectric generation from the bidder and/or affiliate as compared to the 3-year historical average and/or otherwise expected delivery of hydroelectric generation from the bidder and/or affiliate within or into the New England Control Area.[70]

However, the final contracts excluded the entire definition of "Incremental Hydroelectric Generation." Although the contract does include penalties for Hydro-Québec's failure to

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[69] Testimony of Dean W. Murphy, p. 16.

[70] NECEC Section 83D Application Form, p. B (redacted).

deliver adequate amounts of "clean energy" under the Attachment H to the contract, the penalties are limited, allowing Hydro-Québec to make an economic decision as to how to manage its system to optimize profits taking into account the opportunity costs of sales into other markets versus NECEC.

Insight

Hydro-Québec's negotiations with Massachusetts illustrate a potential problem with CHPE energy. There is no guarantee that the energy would be incremental. There is no guarantee that it would come from Quebec. There is no guarantee that it would be "clean," and there is no guarantee that total carbon emissions, which are global in nature, would be reduced.

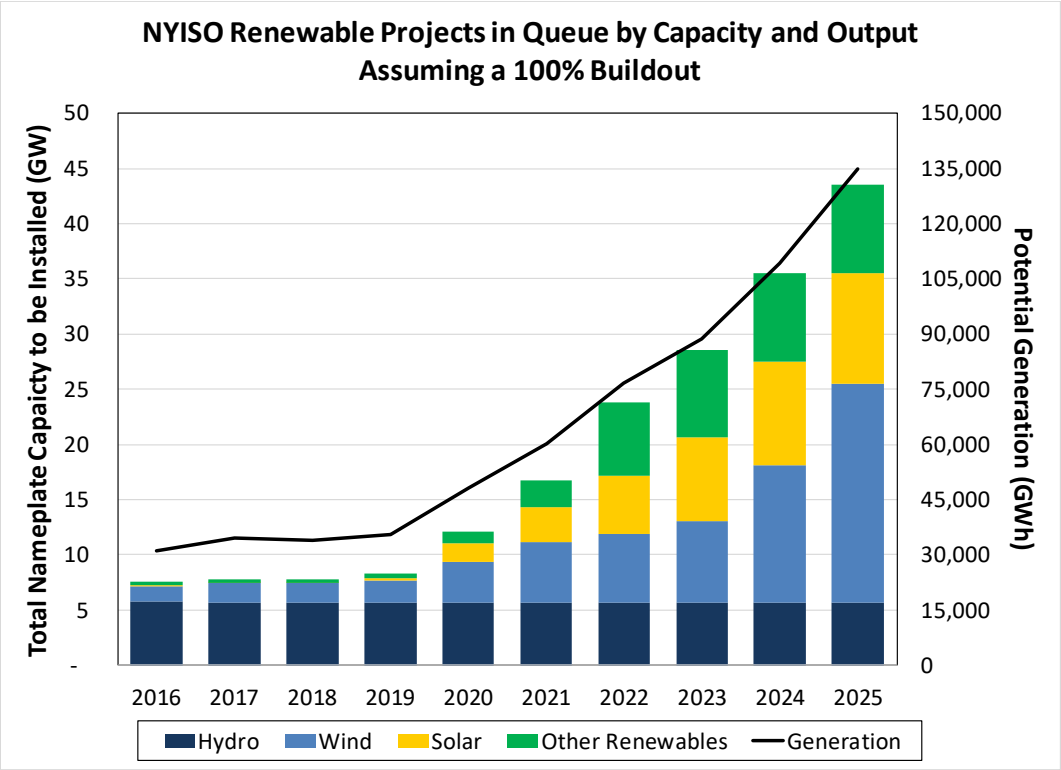
4. ADVERSE IMPACT ON NEW YORK IN-STATE RENEWABLES

Under the Climate Mobilization Act, purchases of hydroelectricity from Quebec can substitute for energy efficiency. Purchases of Quebec's hydroelectric energy via CHPE also would squeeze out development of in-State renewables, which is another option in the buildings' emissions act and source of State-sanctioned RECs.

CHPE is not needed to meet New York's renewable goals. The NYISO has a significant quantity of renewables in its interconnection queue (**Figure 12**). The energy equivalent of projects in the queue approaches almost 90 percent of the projected baseline load projected by NYISO in the 2019 Gold Book.[71]

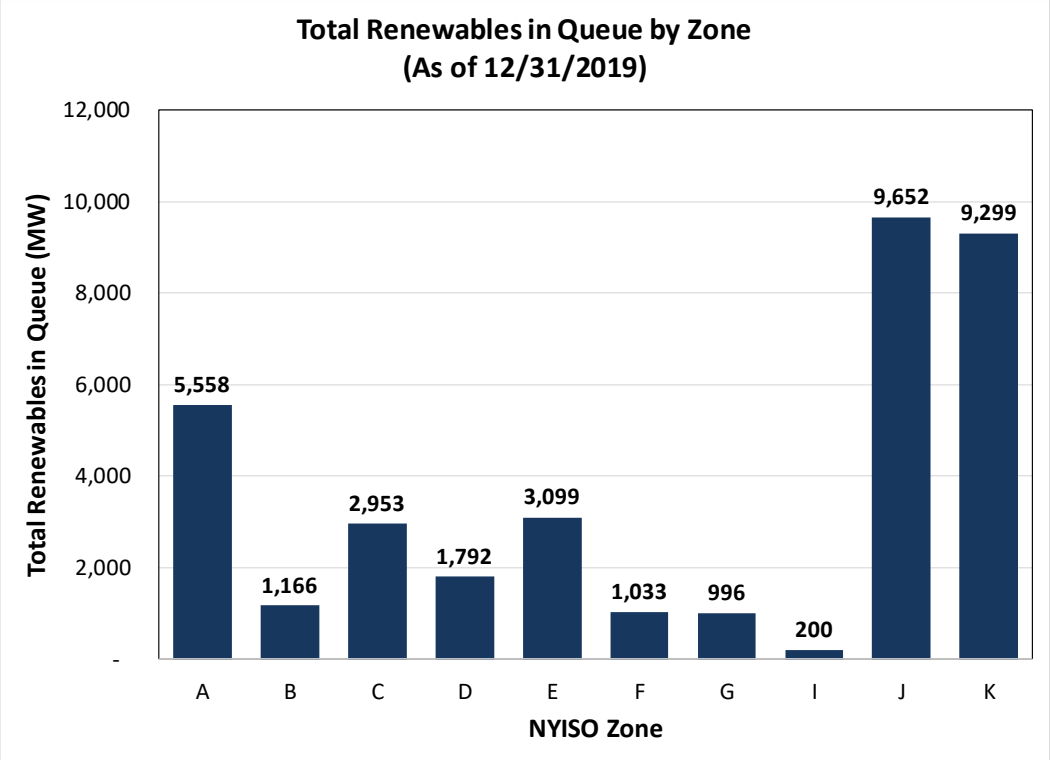
[71] The 2019 Gold Book issued by NYISO projects 149,023 GWh in end-use consumption and 153,449 GWh in baseline consumption (end use plus electric vehicles and net electricity consumption from storage), NYISO, "2019 Load and Capacity Data," also known as "The Gold Book," https://www.nyiso.com/documents/20142/2226333/2019-Gold-Book-Final-Public.pdf/a3e8d99f-7164-2b24-e81d-b2c245f67904?t=1556215322968

Figure 12: In-state Renewables in the NYISO Queue by Operation Date



Most of the renewables in the queue would connect into Zones J and K (**Figure 13**). These are predominantly off-shore wind projects offered by different developers for different off-shore lease locations. CHPE is a direct competitor to 9.7 GW of in-state renewables that could inject into Zone J.

Figure 13: In-state Renewables in the NYISO Queue by Zone



Like CHPE, some of the proposed renewables require a contract priced above current market prices in order to be financed and built. Given limited resources, CHPE would crowd out 8.3 million MWh of contracted energy from the market.

In addition, CHPE would make it more expensive for the State to achieve its renewable goals. Even though large hydroelectric plants are not Tier 1 renewable resources per New York rules, imports from Quebec currently count as part of New York's baseline renewables and are included in the 2018 baseline calculation.[72] The baseline establishes the amount of renewable generation currently serving the State's load to measure progress against previous baseline levels and future goals.

CHPE would not generate a one-for-one addition of renewables to the baseline. Under CHPE, the purchase of 1 MWh of energy delivered through CHPE would include

[72] NYSERDA, "Clean Energy Standard Annual Progress Report: 2018 Compliance Year Final Report," December 2019, p. 15, http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={B8CE2B80-3EB5-4553-842A-C164E3B2C121}

redirection of energy from one part of New York to New York City. As a result, CHPE is an ineffective means of increasing clean energy goals.

CHPE also would increase carbon emissions in other parts of New York and surrounding jurisdictions. Although CHPE apparently would be considered a zero-carbon emissions resource for achieving New York City goals by 2040,[73] there would be negligible net carbon emissions reductions in total.

Insight

CHPE is a direct competitor to incremental renewable resources that actually would create carbon reductions and help New York to achieve its environmental goals.

5. IMPLICATIONS FOR CARBON EMISSIONS

CHPE would result in negligible and possibly higher carbon emissions.

Energy flows redirected from New York into CHPE are likely to offset each other and have little to no net impact on carbon emissions. Energy flows diverted from New England to supply CHPE would generate similar carbon emissions to what would be displaced in New York, and could even produce greater emissions than what is displaced going forward. Diversion from New Brunswick will tend to be more carbon intensive than New York due to the high percentage of coal and oil. The net impact is likely to be little, to no, impact on carbon emissions.

A separate study performed by ESAI for Northern Pass in New England similarly determined a new transmission line from Quebec would have no net impact on carbon emissions.[74] This study makes four significant conclusions:

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[73] Based on conversations with New York officials, energy delivered through CHPE could be considered renewable and zero carbon emissions energy, although not a Tier 1 renewable eligible for a Tier 1 renewable energy credit.

[74] ESAI, "Analysis of Greenhouse Gas Emissions Impacts: New Class I Resources vs. Existing Large Hydro," Prepared for GridAmerica Holdings, Inc., September 2017, focused on the impact of Northern Pass Transmission.

1) **Excess energy is the same with, or without, a new intertie (e.g., NECEC or Northern Pass):** Hydro-Québec exports into other markets are limited by water availability, not transmission delivery capability. Therefore, the total amount of excess energy that Hydro-Québec has available to sell into external markets will remain the same with, or without, a new transmission line into the U.S.

2) **Hydro-Québec would divert external sales to meet new energy delivery requirements:** In order to meet new firm energy requirements associated with a long-term power purchase agreement to be delivered over a new tie line, Hydro-Québec would reduce energy sales into other markets.[75]

3) **Higher carbon emissions elsewhere offset the impact in New England:** As a result of Hydro-Québec's diversion of energy sales from other markets via a new transmission line from Quebec, carbon emissions would be higher in other markets from which energy sales are diverted.

4) **The offset in other markets could result in higher total emissions in some years:** The amount by which carbon emissions would exceed the savings at the injection point depends on where Hydro-Québec sources its energy. However, displacing a less carbon-intensive market by activating a more carbon-intensive market could result in higher total carbon emissions than otherwise would occur if the transmission line were not to proceed.

Given that Hydro-Québec's circumstances are no different with respect to sales of energy into New York, a study of CHPE that properly models the source of CHPE energy would not show a different result.

More adverse environmental consequences tie to displacement of energy efficiency and in-state renewables, as discussed in section 4. If New York City were to purchase energy through CHPE for billions of dollars, that money cannot be invested in energy efficiency or in-state renewable to meet the Climate Mobilization Act, New York State's CES, and the CLCPA. As a result, ratepayers would have to pay more than they otherwise would to achieve State goals defined through the REC program.

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[75] The Maine PUC Technical Expert, London Economics Incorporated, makes the same assumption for purposes of its analysis of the NECEC Minimum Offer Price Rule. *Central Maine Power Co.*, Request for approval of CPCN for the New England Clean Energy Connect, Maine P.U.C. No. 2017-000232, Transcript (September 19, 2018).

In summary, CHPE would have a negligible impact on total carbon emissions and could even increase them when effects on other markets and in-state renewables are considered. Hydro-Québec's redirect of energy into New York generally is a wash, and diversion of energy exports from other power markets to service CHPE results in incremental carbon emissions as power plants in those markets fire-up generators to make up the missing energy flows. In effect, there is no net impact to carbon emissions, and, instead, possible adverse environmental consequences, because Hydro-Québec would divert its surplus energy resources that it otherwise would export into CHPE.

Insight

CHPE is not likely to reduce carbon emissions and may even increase emissions by displacing in-state renewables.

6. CONCLUSION

CHPE is a means for Hydro-Québec to lock in higher energy prices under a long-term contract. CHPE is not likely to reduce carbon emissions and could even increase them above what would otherwise occur by consuming resources that otherwise could support energy efficiency investments and in-state renewables.

New York City would pay billions of dollars for energy that otherwise would flow into New York or other markets. And, what does New York City get?

- Negligible, if any, carbon emissions reductions and possibly carbon increases.
- No Tier 1 RECs.
- An offsetting impact from in-state diversions that could offset more than 50 percent of CHPE energy deliveries from in-state diversions.
- Expensive energy that does not provide the same environmental value as in-state renewables and energy efficiency investments.
- Wasteful investment in congestion relief and price suppression which can be achieved in less costly ways.

The State of New York also is adversely impacted by CHPE:

- Higher ratepayer costs would be required to purchase additional Tier 1 RECs for

the State that are in addition to the purchases of Hydro-Québec energy through CHPE as a result of redirection of imports from Quebec into New York.

- Minimal, if any, carbon emissions reductions would occur due to the redirection of energy from one part of New York to another.

- Less price suppression would occur than estimated in previous studies as New York City's purchase of energy that otherwise would be sold into New York would fail to generate the price suppression impacts originally contemplated when the project was sited.

Hydro-Québec's sales via CHPE would not be incremental to Quebec's historical hydroelectric generation sales into New York. The energy does not have to be incremental to what Hydro-Québec otherwise would sell into other markets. There is no guarantee that Hydro-Québec would flow 100% "clean energy" with CHPE given diversion and purchases from other markets. There is no guarantee that the environment would receive a net reduction in carbon emissions.

If CHPE were allowed to proceed, the only guarantee is that Hydro-Québec would receive billions of dollars in future dividends and New York's in-state renewables and energy efficiency goals would be adversely impacted.

APPENDIX A:
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APPENDIX B:
Technical Description of Modeled Flows

Energyzt conducted an analysis on their historical export patterns through the external interties. In doing so, hourly and sub-hourly flow data was pulled from each ISO where Hydro-Québec maintains an export intertie, along with the nearest possible real-time intertie price for that energy.[1] These external markets include:

- New England - ISO-NE[2]
- New York – NYISO[3]
- New Brunswick – Énergie NB Power[4][5]
- Ontario - IESO[6]

The flow data was then organized from highest priced hours to lowest and analyzed across each hour for the year 2018, including both hourly flows as well as a comparison of hourly flows versus line limits in order to calculate the surplus capacity on each line. Furthermore, the flow data was eventually used to estimate the impact of possible contracted supply via the NECEC and CHPE lines and which markets those flows would be diverted from.

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[1] NYISO data is reported in 5-minute intervals. Data was then converted to hourly flows by taking the average for any given hour.

[2] Hourly export flows, line limits and pricing were sourced from https://www.iso-ne.com/

[3] Hourly export flows, line limits and pricing were sourced from https://www.nyiso.com/

[4] Hourly export flows and pricing were sourced from https://www.nbpower.com/Welcome.aspx

[5] NB Power does not provide hourly line limits. Because the majority of flows from HQ to New Brunswick are passed through to ISO-NE, the lower of the HQ to New Brunswick max line limit versus the New Brunswick to ISO-NE line limit was used as a proxy for any surplus calculations.

[6] Hourly export flows, line limits and pricing were sourced from http://www.ieso.ca/

Because a large portion of HQ to Ontario exports are passed through to NYISO, for accuracy of the analysis the larger of the Ontario Hourly Energy Price (OHEP) versus the Western NYISO zone less the Ontario transmission cost was used as a proxy for HQ to Ontario exports.

QUANTITY

Hydro-Québec is not the only entity exporting over the Quebec external interties. Total flows exceeded Hydro-Québec's reported 36.5 TWh's for 2018 and therefore needed to be prorated to match this total.[7] To do so, the total hourly flows and line limits across all Quebec external interties were reduced by 8.1 percent.[8]

Once the exports matched Hydro-Québec's 2018 reported export total, any existing firm contracted supply between Hydro-Québec and other markets were removed from the list of flows so that they were not available to be included in the diverted flows analysis. This included contracts with the IESO for up to 2.6 TWh as well as up to 3.4 TWh of supply from the ISO-NE Highgate intertie.[9][10]

Additionally, because HQ relies on large reservoirs that are dependent on rainfall and potential spillage, the total available quantity of exports, including all contracted supply, were revised to a total of 30 TWh to reflect a maximum anticipated generation output projected by Hydro-Québec of 26.4 TWh in 2027 plus another 3.6 TWh of available water in reservoir storage per year.[11] To reach the new total, the lowest priced hours in 2018 were removed from the bottom of the stack so that the total historical flows for the year represented 30 TWh.

One other adjustment was made to estimate the amount of energy Hydro-Québec exported into Ontario versus western New York across the Ontario interties. For each hour Quebec interties exported into Ontario, the energy was assumed to flow into Ontario or western New York based on the relative price in each market. If the locational marginal price at the

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[7] Hydro-Québec 2018 Annual Report, p. 47.

[8] Total flows across Hydro-Québec external interties in 2018 equaled 39.7 TWh. In order to prorate flows to 36.5 TWh the following calculation was used: Prorated Flows (8.1%) = (39.7 – 36.5) / 39.7

[9] Because some of the flows did not total the max contracted amount for those lines, the entire line was assumed to be contracted as firm supply (i.e. IESO Cornwall line and the ISO-NE HQ Highgate line).

[10] See Hydro-Québec 2018 18-K for contracted energy, p. 13. http://www.hydroquebec.com/relations-investisseurs/pdf/18K-2018.pdf

[11] The incremental reservoir level reflects the difference between Hydro-Québec's claims that it has 40 TWh to sell each year for some years going forward versus the maximum export of 36.5 TWh in 2018.

Ontario intertie to New York, less wheeling charge, was higher than the Ontario price, the energy was assumed to flow to New York. If the Ontario price were higher, Hydro-Québec's exported energy was assumed to be sold to Ontario.

MARKET PRICES

Market prices used in the analysis generally based on the locational marginal price at the Quebec Intertie. There are two exceptions:

1) **New Brunswick:** Prices are not available. A proxy was used based on the hourly locational marginal price of the New Brunswick intertie into Maine. Total remaining energy after CHPE and NECEC is confirmed to be adequate to meet the announced energy sale from Hydro-Québec to New Brunswick

2) **Western New York:** In order to export to western New York, Quebec would have to wheel through Ontario. Prices in western New York were adjusted to reflect the published Ontario transmission charge that Hydro-Québec would have to pay to wheel energy through Ontario into New York.

Adjusted prices were then ranked from highest to lowest across all markets to determine which flows would be diverted or redirected based on economic reasons.[12]

RESULTS

Once the actual flows were prorated and contracted exports were removed, the remaining flow data was then analyzed under four scenarios:

1. 2018 Historical Flows
2. 2018 Historical Flows with NECEC (9.45 TWh)
3. 2018 Historical Flows with CHPE (8.3 TWh)
4. 2018 Historical Flows with NECEC (9.45 TWh) and CHPE (8.3 TWh)

[12] Hydro-Québec sales also may reflect system requirements tied to reservoir management. Such sales could not be identified. Given that all of the projected available energy would be exported, however, an economic-based assumption of diversion reflects the system requirements as they were managed in the base case.

To estimate how the remaining exports would be diverted under each scenario, the historical scenario looked at flows to each market totaling 30 TWh. The potentially contracted capacity from CHPE and NECEC were then taken from the bottom of the stack, leaving the remaining flows available for export. By removing the assumed CHPE and NECEC (8.3 TWh and 9.45 TWh) capacity from the lowest priced hours, the remaining exports could then be analyzed to show where the energy would have been taken from to fulfill this contracted supply.

Figure B-1 displays the results of each scenario. Negative values (in brackets) indicate the amount of energy that the model redirected or diverted to meet CHPE contractual obligations.

Figure B-1: Results of Redirecting / Diverting Flows to Meet Contractual Obligations

	Existing Transmission Interties					New Lines		
Estimated Exports (TWh)	NYISO	Western NYISO via Ontario	ISO-NE	New Brunswick	Ontario	NECEC	CHPE	Total
30 TWh as exported (historical)	6.11	4.53	12.46	5.38	1.51	-	-	30.0
30 TWh Exports with CHPE	2.96	3.31	10.14	4.21	1.07	-	8.30	30.0
30 TWh Exports with NECEC	2.62	3.18	9.76	4.00	0.99	9.45	-	30.0
30 TWh Exports with CHPE & NECEC	0.94	1.67	6.65	2.53	0.46	9.45	8.30	30.0
Different in historical flows vs. with CHPE	**(3.15)**	**(1.22)**	**(2.32)**	**(1.17)**	**(0.44)**	**-**	**8.30**	**-**
Difference in historical flows with NECEC vs. with CHPE & NECEC	**(1.68)**	**(1.51)**	**(3.11)**	**(1.47)**	**(0.53)**	**-**	**8.30**	**-**

The table above provides an example of how historical exports would have changed if the CHPE and NECEC lines were added to the system. Compared to historical levels, much of the energy in the case of CHPE would have been diverted from the NYISO (52.6%) and ISO-NE interties (28.0%).

Had both the CHPE and NECEC lines been added to the system, more of the energy flowing through CHPE would have been pulled from New Brunswick and ISO-New England, with 38.5% being redirected from New York into CHPE.

Modeling Hydro-Québec's 2018 exports by market and accounting for both contracted flows and the potential new CHPE and NECEC lines indicates where energy would have been diverted from under relative price and market conditions similar to 2018. The

analysis makes it clear that the energy used to meet these contracts would simply just be diverted energy from existing New York lines and other New England markets, and would result in virtually no overall benefits on carbon reduction goals.