SS-DG-2

Assessment of the Economics, Need, Energy Planning, and Regional Grid Effects of the Proposed Shaftsbury Solar Project

An Assessment of a Proposed 20 MW_{AC} Solar Project in Vermont

Prepared for VT Real Estate Holdings 1 LLC (dba Shaftsbury Solar)

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EXECUTIVE SUMMARY

As part of VT Real Estate Holdings I's (dba Shaftsbury Solar) plan to develop a 20-megawatt ("MW") solar electric generation facility to be located in Shaftsbury, Vermont, Shaftsbury Solar commissioned Synapse Energy Economics, Inc. (Synapse) to evaluate several aspects of the project's impacts within the state of Vermont and regionally. This report presents the results of an assessment of the Project as it relates to the following criteria under 30 V.S.A. § 248(b):

- Need for the Project (§ 248(b)(2))
- Economic Benefit (§ 248(b)(4))
- Vermont's Comprehensive Energy Plan (§ 248(b)(7))
- Greenhouse Gas Effects (§ 248(b)(5))

The Vermont Public Utility Commission ("PUC") will apply these criteria in its review of Shaftsbury Solar's request for a Certificate of Public Good ("CPG"). With retirement of fossil and nuclear generating capacity across New England, the region's independent system operator— ISO New England, transmission operators, and local distribution utilities face challenges in maintaining the reliability of the bulk power system and local distribution grids, while addressing capacity constraints and balancing energy supply and demand. Intensifying these challenges, New England states have adopted ambitious targets and corresponding policies encouraging a regional shift to renewable energy sources to decrease greenhouse gas emissions.

In Vermont, megawatt-scale projects such as the proposed Project can help address these energy and environmental needs. Synapse's analysis of the Project, within the context of the PUC's Section 248 criteria, found the following:

- **The Project would provide substantial direct and indirect economic benefits to Vermont over its 40-year operating life.** These include an estimated 248 job-years, more than $9.8 million in new income, and more than $29.9 million in gross domestic product ("GDP") for the state.

- **The Project would help meet clearly demonstrated electricity needs both in the New England region and Vermont.** Most notably, it would alleviate the well-documented gap between needed and available capacity—primarily during the summertime peak—that the region will continue to face in the coming years.

- **The Project would be part of a diversified solution to the region's clean energy challenges as New England seeks to reduce its dependence on natural gas and other fossil fuel resources over time.** In particular, it would qualify as both a Tier 1 resource within Vermont and a Class I Renewable Energy Credit resource throughout New England, thus addressing an ever-increasing demand for renewable energy resources to meet legislated targets.

- **The Project would be directly connected to the Green Mountain Power ("GMP") transmission grid and not contribute to local distribution system congestion.** As a larger 20 MW utility-scale solar PV facility, the Project would be directly observable by ISO New England (the overall grid operator), VELCO (Vermont's transmission system operator), and GMP (the interconnecting utility); it will directly interconnect to an existing GMP 46 kV transmission line via a substation at the Project site to be installed by Shaftsbury Solar and that will be owned and operated by GMP.

- **The Project would add a source of zero-emissions electric generation to the New England generation mix**, by generating approximately 1.24 million megawatt hours ("MWh") over its 40-year operating life. It should be noted that the avoided carbon dioxide ("CO_2") emissions from the Project's generation will approximately compensate for all the sequestered carbon dioxide equivalent ("CO_{2e}") released due to tree clearing during the construction phase of the Project. This generation would displace an average of between 7,932 and 16,159 short tons of ("CO_2") emissions annually, and between 317,279 and 646,345 short tons of CO_2 emissions over the life of the Project, net of all CO_2. These avoided CO_2 emissions result in a net estimated social benefit (when including consideration of forest clearing impacts) of between $75.5 and $262.5 million ($2024) over the life of the Project, while generating approximately 1,240,585 megawatt-hours over its 40-year operating life.

In the overall New England energy landscape, the Project is a large, 20 MW utility-scale photovoltaic ("PV") facility with a direct transmission interconnection that provides needed size and geographic diversity to a regional renewable resource mix presently dominated by smaller distributed scale solar PV generators. Due to its scale, design and location, the Project will play a significant role in transitioning the region to a clean energy economy. Moreover, the Project can contribute to Vermont's economy in ways that fossil-fuel-based resources cannot, such as providing employment, tax revenue, avoided carbon emissions and solar energy and capacity that will provide reliable generation serving increasing demand for clean electricity to serve transportation electrification other loads to help Vermont achieve its decarbonization goals.

1. INTRODUCTION

The proposed Shaftsbury Solar Project is described in the pre-filed testimony of Mr. Reed Wills. In general summary, it is a 20 MW AC solar electric generation facility to be located within an approximately 83-acre fenced footprint within the Project parcels. The parcels are located off Holy Smoke Road and U.S. Route 7 ("US-7") in Shaftsbury, Vermont (Refer to Exhibit SS-RW-2).

The Project consists of ground-mounted, fixed-tilt solar modules mounted on metal racks arranged in rows running east to west in three distinct areas, or "sub-arrays." The entire Project will be enclosed by perimeter fencing. Shaftsbury Solar has received conceptual approval from the Vermont Agency of Transportation ("VTrans") to utilize a temporary access from US-7 for heavy duty vehicles during construction, and an existing access from Holy Smoke Road to service light duty vehicles during construction and permanent operations.

In addition to the solar arrays, Shaftsbury Solar will install a Project substation and an adjacent substation (to be owned and operated by Green Mountain Power ("GMP"), in order to interconnect with GMP's existing 46 kV transmission line operated that is located on the Project property. The results of Synapse's analysis, described in detail throughout this report, show that the output and environmental attributes of the Project benefit Vermont and the New England region and will result in an economic benefit to the state. Section 2 addresses the need for the Project, both regionally and in Vermont. Section 3 summarizes the results of Synapse's analysis of the Project's economic impacts in Vermont. Section 4 addresses the effect of the Project on regional transmission grids. And finally, Section 5 discusses the role that the Project would play in Vermont's and New England's efforts to meet clean energy goals and the Project's consistency with Vermont's Comprehensive Energy Plan.

Vermont and every other New England state have set challenging targets for procuring renewable energy. The resulting policies ensure strong and annually increasing demand for renewable energy generation for the foreseeable future. To address the Project's relation to these policies and the relevant 30 V.S.A. § 248(b) criteria, Synapse analyzed the following:

- The need for Vermont utilities to obtain more energy and capacity
- The need for Vermont utilities and the utilities in the region to obtain more renewable energy
- The extent to which the Project meets these needs, including the proposed Project's effect on Vermont and other New England states in their efforts to meet Renewable Energy Standards ("RES") or Renewable Portfolio Standards ("RPS")
- The extent to which the Project would contribute directly and indirectly to economic activity within Vermont
- The Project's likely impacts on the regional wholesale energy and capacity market
- The Project's likely impact on Vermont's greenhouse gas emissions
- The relationship of the Project to Vermont's Comprehensive Energy Plan

While the Project is only a small part of a much bigger equation, it can perform a useful role in achieving the state's recognized goal of creating a cleaner energy system in a way that is beneficial to ratepayers and local communities. Moreover, the region's existing policies and goals point to a long-term and continuously increasing demand for a range of renewable energy projects such as this one.

2. NEED FOR THE PROJECT'S OUTPUT

There is a need for capacity, energy, and renewable generation, both in Vermont and New England-wide. These energy needs, however, manifest in different ways in Vermont and regionally. In both instances, the need for energy *per se* is reflected in the seasonal peak capacity needs (the ability to meet peak loads in winter and summer); but the New England regional demand is increasing at a faster rate than in Vermont. The reliance of the New England bulk power system on natural gas-fired capacity makes the regional energy market administered by ISO New England particularly susceptible to natural gas fuel supply chain volatility. According to ISO New England, natural gas is the predominant fuel used to generate electricity in the region. Therefore, the commodity price of natural gas delivered into New England sets the price most often in the regional wholesale electricity market. Diversifying the regional generating mix with megawatt-scale solar PV generation such as the Project provides a hedge against natural gas fuel supply chain volatility influence on wholesale electricity market prices.

Vermont electricity consumers would benefit from the wholesale market price benefits associated with additional resources, such as the Project, that provide energy and capacity with little to no marginal cost. And should the Project's output, all or some, be sold to a Vermont utility, the Project would also directly contribute to Vermont's energy supply needs and its renewable energy goals.[1]

2.1. Capacity

The New England region (including Vermont) has a continuing demand for additional electric generating capacity to serve both summer and winter peak demand and overall electricity demand. ISO New England forecasts that net electricity demand will on average increase 1.7 percent in Vermont and 1.4 percent in New England annually between 2022 and 2031.[2] Between 2022 and 2031, ISO New England anticipates retirement of 1,878 MW of existing capacity, and addition of 1,445 MW in new capacity.[3] An additional 5,000 MW of coal- and oil-fired capacity in the New England control area is considered by ISO New England to be at risk to retire between 2023 and 2031.

Meanwhile, the annual demand and daily summer peaks for electricity in Vermont and New England are both expected to increase. Between 2022 and 2031, summer peak demand across New England is

[1] Synapse understands from Shaftsbury Solar that it intends to seek buyers for the output once the Project is further along in the development process.

[2] ISO New England. 2022. "CELT Report: 2022-2031 Forecast Report of Capacity, Energy, Loads and Transmission." (Revised August 10, 2022), https://www.iso-ne.com/static-assets/documents/2022/04/2022_celt_report.xlsx, Tab 1.5.2 Energy, Row 30.

[3] Id., Tab 1.1, Rows 28, 29.

forecasted to increase from 24,686 MW to 25,322 MW, a net increase of 636 MW. During that same period transportation electrification across New England is projected to increase the annual summer peak 43 MW in 2023 to 1,096 MW in 2031, while in Vermont transportation electrification will increase the annual summer peak by 4 MW in 2023 and 142 MW in 2031.[4]

The Project adds summer capacity and contributes to reliability within the control areas serving Vermont and the entire New England region. Assuming an average firm capacity (or expected output at peak) of 42 percent, based on the qualified capacity assigned by ISO New England of similar sized, fixed tilt solar PV projects already on the power grid, the proposed Project's 20 MW nameplate capacity would result in an additional 8.4 MW of summer capacity in New England.[5]

2.2. Energy

Gross energy demand in Vermont is forecasted to increase from 6,453 gigawatt-hours ("GWh") in 2022 to 7,759 GWh in 2031, while gross energy demand across New England will increase from 140,536 GWh in 2022 to 164,965 GWh in 2031.[6] ISO New England forecasts solar PV generation in Vermont will increase from 551 GWh in 2022 to 815 GWh in 2031. These long-term regional energy projections include existing and planned solar generation and energy efficiency investments in the region which are shown broken down for the region and Vermont in Table 1 below, but do not include the Project.

Table 1. Forecasted energy demand between 2022 and 2031 for New England and Vermont

	New England				Vermont			
	Annual Energy (GWh)				Annual Energy (GWh)			
	Gross Energy	PV Generation	Energy Efficiency	Net Energy	Gross Energy	PV Generation	Energy Efficiency	Net Energy
2022	140,536	3,747	12,771	124,019	6,453	551	635	5,267
2023	143,042	4,216	13,590	125,236	6,533	583	676	5,274
2024	145,929	4,671	14,411	126,847	6,637	614	717	5,306
2025	148,167	5,155	15,232	127,781	6,734	643	758	5,334
2026	150,695	5,676	15,796	129,224	6,869	672	786	5,411
2027	153,159	6,165	16,252	130,742	7,019	701	809	5,509
2028	156,172	6,584	16,461	133,127	7,198	730	821	5,646
2029	158,727	6,963	16,565	135,199	7,364	758	827	5,779
2030	161,748	7,335	16,565	137,847	7,559	786	828	5,944
2031	164,965	7,692	16,468	140,805	7,759	815	825	6,119

Source: ISO New England. 2022. "CELT Report: 2022-2031 Forecast Report of Capacity, Energy, Loads and Transmission Forecast Data File (Revised June 7, 2022). https://www.iso-ne.com/static-assets/documents/2022/04/forecast_data_2022.xlsx, Tab 2C, Annual Energy New England States.

[4] ISO New England. 2022. "CELT Report: 2022-2031 Forecast Report of Capacity, Energy, Loads and Transmission." (Revised August 10, 2022), https://www.iso-ne.com/static-assets/documents/2022/04/2022_celt_report.xlsx, Tab 16 Electrification, Column C, Summer Peak Transportation (MW).

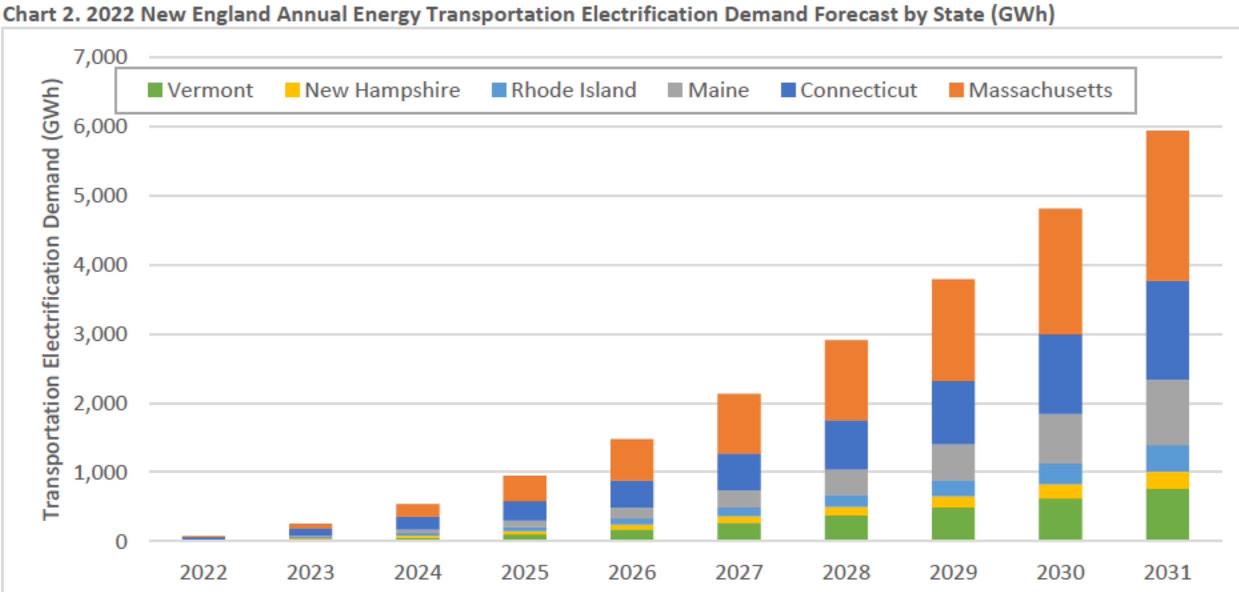
[5] Id., Tab 2.1, column R.

[6] ISO New England. 2022. "2022 Forecast Data File." Table 2C Energy (GWh), Rows 5-6, 84-95. https://www.iso-ne.com/static-assets/documents/2022/04/lf2022_itemized.xlsx.

The Project would make an appreciable contribution to both New England's and Vermont's future energy needs by generating approximately 33,500 megawatt-hours ("MWh"), annually for the New England electric grid, based upon Shaftsbury Solar's estimate. Assuming a 0.4 percent degradation factor for solar generating capacity, over a 40-year operating life, the Project could generate 1.24 million MWh.[7]

The increase in forecasted energy demand between 2022 and 2031 is driven in large part by dramatic growth in projected annual demand for electric vehicle charging across New England. For example, in 2025, Vermont forecasts electric vehicle adoption could reach over 41,000 new electric vehicles with an annual electric vehicle ("EV") charging demand of 101 GWh, growing to over 190,000 vehicles and 624 GWh in EV charging demand by 2030. In 2025 alone, the Project could meet the equivalent of approximately one third of projected annual electric vehicle charging demand in Vermont.

Chart 2. 2022 New England Annual Energy Transportation Electrification Demand Forecast by State (GWh)



Source: ISO New England. 2022. "CELT Report: 2022-2031 Forecast Report of Capacity, Energy, Loads and Transmission Forecast Data File (Revised June 7, 2022). https://www.iso-ne.com/static-assets/documents/2022/04/forecast_data_2022.xlsx, Tab 1.7, Electrification Forecast.

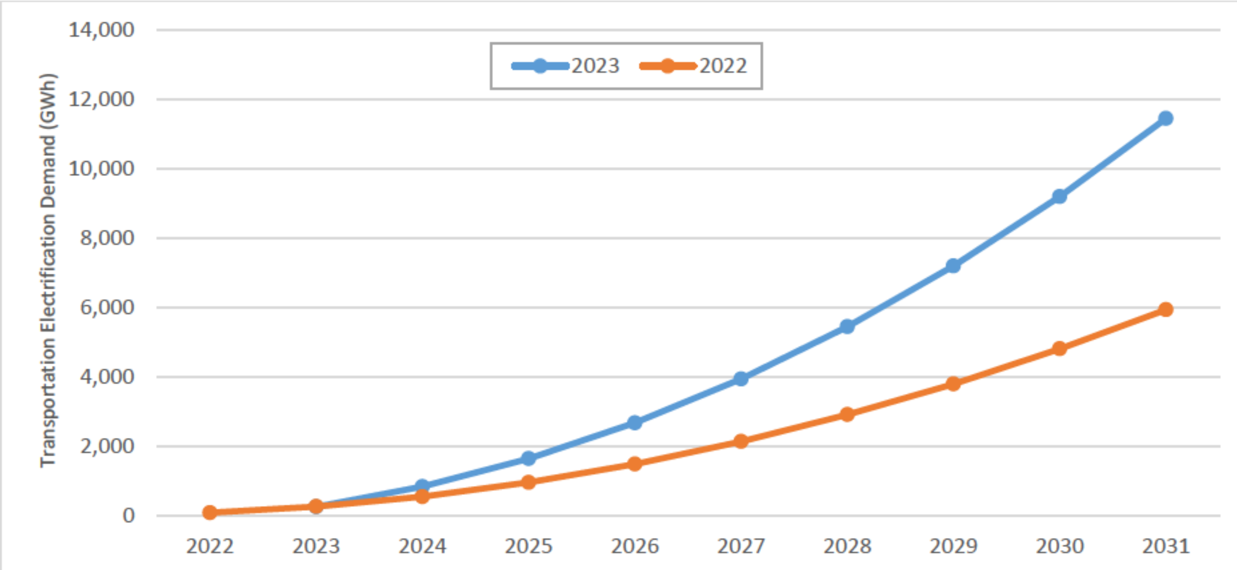
The need for the Project becomes evident when considering recent federal incentives for clean energy and transportation electrification. The transportation electrification incentives in the Inflation Reduction Act (Pub. L. 117-169) and Infrastructure Investment and Jobs Act (Pub. L. 117-58) could benefit the State of Vermont with over $1.4 billion in direct tax incentives for clean energy, new electric vehicles and financing for electric vehicle charging infrastructure and transmission grid enhancements.[8] After reviewing the combined impact of these federal laws with input from State regulators and taking into consideration related state actions, ISO New England revised its transportation electrification assumptions for the 2023 transportation electrification forecast, nearly doubling its estimate of the

[7] A degradation rate of 0.4% implies that production from a solar panel will decrease at a rate of 0.4% per year. This means that in Year 40, the module is producing approximately 85% of the electricity it produced in Year 1.

[8] RMI, "The Economic Tides Just Turned for States" (February 6, 2023), https://rmi.org/economic-tides-just-turned-for-states/.

cumulative EV charging demand between 2022 and 2031 from 22,875 GWh to 42,612 GWh compared it its transportation electrification forecast from the prior year.[9]

Chart 3. New England Annual Energy Transportation Electrification Demand Forecast, 2022 vs. 2023 (GWh)



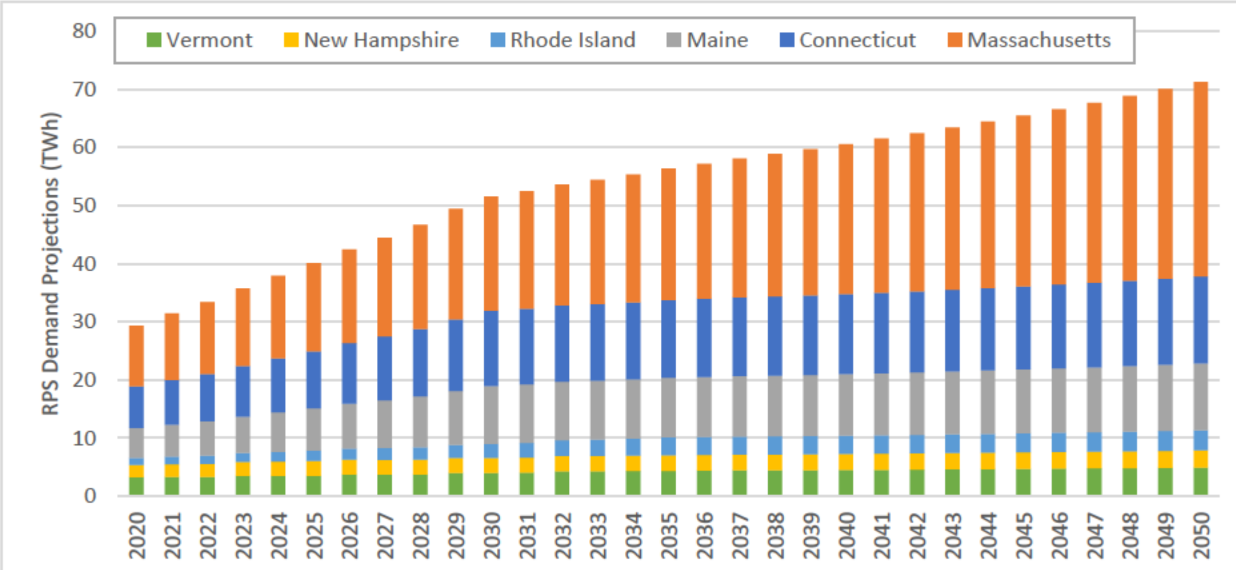
Source: ISO New England. 2023. "2023 Final Draft Energy and Seasonal Peak Forecasts" (April 14, 2023). https://www.iso-ne.com/static-assets/documents/2023/04/lf2023_finaldraft.pdf,Slide 18, 2023 Gross and Net New England Annual Forecast, New England Summary.

2.3. Renewable Energy Goals and Progress

Vermont and the other New England States have established ambitious goals to curb emissions from the generation of electricity (and other sectors utilizing fossil fuels, including transportation), and to prioritize increased reliance on renewable electric generating resources. Figure 1 shows that the projected demand for eligible renewable generation to meet all RPS targets is expected to outstrip the currently anticipated supply, with Vermont renewable generation targets in 2020 representing 11 percent of total regional renewable energy production (~3.3 Terawatt hours ("TWh")) in 2020 declining to 7 percent by 2050 (~4.9 TWh).

[9] ISO New England. 2023. "2023 Final Draft Energy and Seasonal Peak Forecasts" (April 14, 2023). https://www.iso-ne.com/static-assets/documents/2023/04/lf2023_finaldraft.pdf, Slide 18, 2023 Gross and Net New England Annual Forecast, New England Summary.

Figure 1. **Projected Renewable Portfolio Standard Generation Demand by New England State (TWh)**



Source: Lawrence Berkley National Laboratory, "Renewable Portfolio Standard Demand Projections" (February 2021) https://eta-publications.lbl.gov/sites/default/files/rps_demand_projections_feb_2021.xlsx.

2.4. Vermont Renewable Energy Standard[10]

In the Renewable Energy Standard and Energy Transformation Act enacted in 2015, Vermont defines renewable technologies as those that use "a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate."[11] Under the RES, Vermont utilities are required to retire bundled renewable energy and/or Renewable Energy Credits equivalent to 55 percent of retail sales in 2017, escalating steadily by 4 percent each third year until reaching 75 percent on or after 2032.[12] The RES specifies three distinct categories of required resources to meet the requirements of RES" including: (1) total renewable energy ("Tier 1"), (2) distributed renewable energy ("Tier 2"), and energy transformation ("Tier 3").[13] Tier 1 requires that 55 percent of retail electric sales be obtained from renewable energy sources (broadly defined, including both existing and new renewables) in 2017. This requirement increases to 75 percent renewable in 2032. Tier 2 requires that 1 percent of retail electric sales in 2017 be obtained from new distributed renewable generation sources, increasing to 10 percent in 2032. This distributed generation requirement represents a subset of the Tier 1 total renewable requirement. New distributed renewable projects must have a capacity of less than 5 MW and achieve commercial operation on or after July 1, 2015.

The Project will qualify as a Tier 1 resource in Vermont or for compliance with the Renewable Portfolio Standards in other New England states. Demand for solar, offshore wind and other first tier REC classes

[10] In June 2024, the Vermont Legislature enacted H.B. 289 to update the state's Renewable Energy Standard (originally enacted in 2015). The update will take effect July 1, 2024 and puts Vermont on track to achieve 100 percent renewable energy from the state's utilities by 2035. The analysis in this report has not been updated to reflect the updated RES.

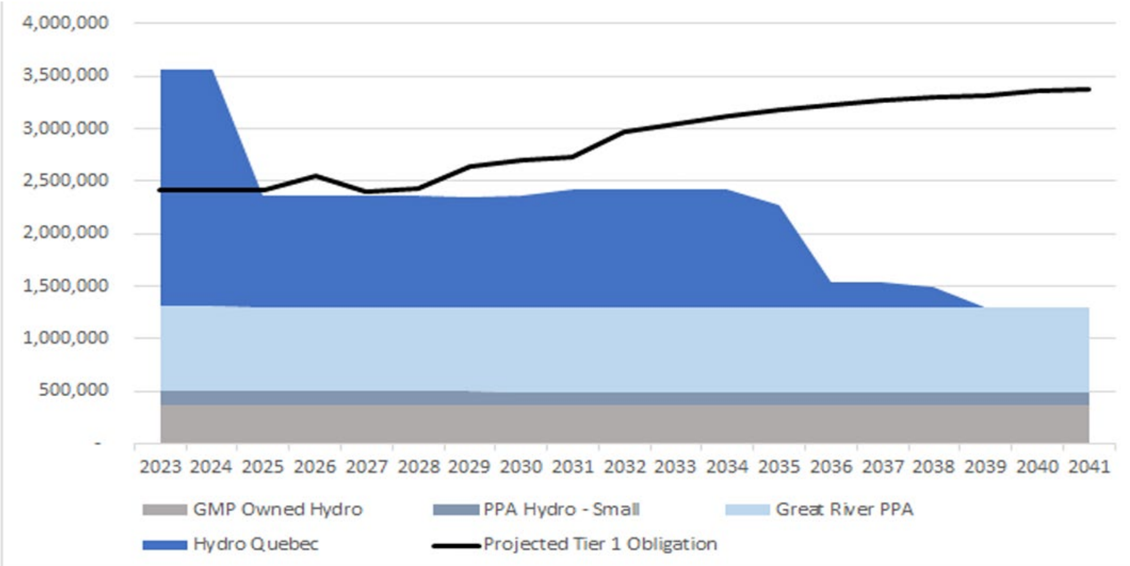
[11] 30 V.S.A. § 8002(21).

[12] 30 V.S.A. § 8005(d)(4)(A).

[13] 30 V.S.A. § 8005(a).

in the New England region are expected to increase from 2023 through 2030 and sustain the current price range ($38 - $45/MWh).[14]

Figure 2: Green Mountain Power projected RES Tier 1 Requirements vs. Existing Supply (MWh)



Source: Green Mountain Power 2021 Integrated Resource Plan, https://greenmountainpower.com/regulatory/integrated-resource-and-climate-plans/, Figure 7-6 Projected Tier I Requirement and Supply, page 7-15.

In its 2021 Integrated Resource Plan, Green Mountain Power forecasts a sufficient supply of Tier 1 renewable energy credits ("RECs") in the near term (Figure 2). After 2028, GMP anticipates a shortfall in needed quantity of Tier 1 RECs (black line in Figure 2) compared to the quantities of Tier 1 RECs it has procured through 2041. The Project's Tier 1 RECs could be used to help meet this anticipated shortfall.

2.5. Decarbonization Goals

Regional decarbonization goals are similarly ambitious. Massachusetts, Connecticut, Maine, Rhode Island and Vermont have mandates for economy-wide greenhouse gas reduction targets of 80 percent or greater by 2050 (mostly using a 1990 baseline) with several additional individual decarbonization targets:

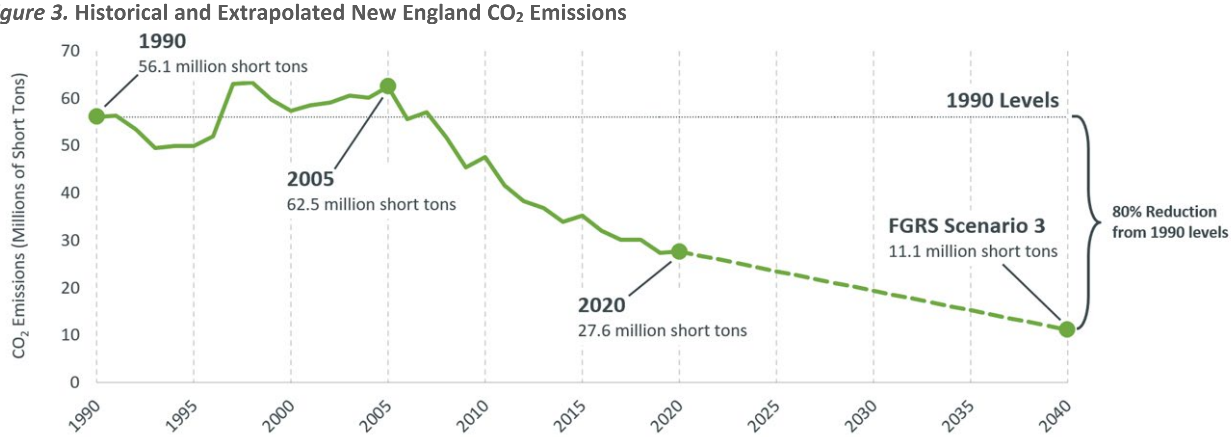
- Connecticut adopted a zero-carbon electricity requirement of 100 percent by 2040
- Massachusetts adopted a net-zero by 2050 emissions reduction requirements along with a clean energy standard of 80 percent by 2050

[14] S&P Global Market Intelligence, US renewable energy credit market size to double to $26 billion by 2030 (December 16, 2022), https://www.spglobal.com/marketintelligence/en/news-insights/research/us-renewable-energy-credit-market-size-to-double-to-26-billion-by-2030. S&P Global Commodity Insights estimates in 2021, 32 million RECs were retired to meet New England state-level renewable portfolio standards (RPSs) and solar carve-out requirements at a total cost of $1.46 billion. By 2030, New England is projected to retire 79 million RECs at a total cost of $2.48 billion.

- Maine adopted a renewable energy goal of 100 percent by 2050 and a carbon emissions neutral requirement by 2045
- Rhode Island adopted a renewable energy requirement of 100 percent by 2030, and
- Vermont adopted an updated renewable energy requirement of 100 percent by 2035.

If fully realized, the aggregate New England regional decarbonization targets would require reducing economy-wide CO_2 emissions from 56.1 million short tons in 1990 to 11.1 million short tons in 2040. In 2020, regional CO_2 emissions were estimated at 27.6 million short tons.

Figure 3. **Historical and Extrapolated New England CO_2 Emissions**



Source: ISO New England. 2023. "2021 Economic Study: Future Grid Reliability Study Phase 1" (July 29, 2022). https://www.iso-ne.com/static-assets/documents/2022/07/2021_economic_study_future_grid_reliability_study_phase_1_report.pdf, page 6.

Vermont has several interrelated clean energy and decarbonization mandates that place a premium on clean energy generation from larger, utility-scale solar PV resources such as the Project. In 2022, the Department of Public Services ("DPS") issued the latest *Comprehensive Energy Plan* ("CEP"), setting out a goal for the electric sector to meet 100 percent of energy needs from carbon-free resources by 2032. The 2022 CEP is structured to meet the greenhouse gas requirements of the *Global Warming Solutions Act*, and to be consistent with the *Climate Action Plan* required by 10 V.S.A. §592.[15]

The 2022 CEP recommends developing a pathway to a carbon-free power supply, designed to equitably reduce greenhouse gas emissions in the electricity sector. A decarbonized electric sector will in turn deepen greenhouse gas emission reductions in the transportation and thermal sectors through electrification measures. Recognizing that "[p]ower supply choices are long-lived," the 2022 CEP urges:

> The development of a carbon-free power supply requirement should consider and include transparent information on the costs and benefits of different design considerations, including, at a minimum, (1) the addition of new resources, (2) time and locational considerations, and (3) resource size and diversity.[16]

[15] Vermont Department of Public Service. 2022. "Comprehensive Energy Plan 2022." page 26 (quoting 30 V.S.A. § 202a).

[16] Id. at 18.

As a larger, 20 MW utility-scale solar PV facility with a direct interconnection to a higher voltage GMP transmission line, the Project is responding to the need recognized in the 2022 CEP for greater size and geographic diversity in the deployment of additional regional renewable resources into a renewable capacity mix presently dominated by smaller distributed scale solar PV generators.

3. ECONOMIC BENEFITS TO VERMONT

3.1. Overview

Synapse evaluated the anticipated macroeconomic impacts of the Project by projecting net changes in employment, income, and GDP in Vermont that are expected to result from construction and operation of the Project. Our analysis principally relied on the IMPLAN model.[17,18] We conclude that the Project will lead to substantial macroeconomic benefits for the state.

3.2. Methods

The analysis of macroeconomic impacts begins with mapping out each of the distinct spending changes (or spending streams) associated with the Project. We identified six potentially relevant spending streams:

- New spending on solar construction
- New spending on solar O&M
- New spending on distribution grid construction
- New spending on distribution grid O&M
- Avoided spending on construction of gas-powered generation units
- Avoided spending on gas-power generation unit O&M

While the Project is also expected to result in an increase in tax revenues (e.g., property sales, income) that could spur still further macroeconomic benefits, we opted to maintain IMPLAN's default approach and treat these revenues as a leakage. In other words, we did not assume any economic stimulus benefits from the projected increase in tax revenues. In Synapse's view, this approach to tax revenues is both conservative and prudent, since assuming any direct change in government fiscal policy as a result of new tax revenues would be speculative. Similarly, we do not assume that the new tax revenues from the Project result in any changes in tax policy.

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[17] IMPLAN is an industry standard input-output model used to estimate macroeconomic impacts. For more information, see: https://support.implan.com/hc/en-us/articles/360038285254-How-IMPLAN-Works#:~:text=IMPLAN%20is%20an%20I%2DO%20modeling,past%20or%20existing%20economic%20activity.

[18] In conjunction with the IMPLAN model, Synapse used a set of complementary inputs to characterize direct wage impacts and associated direct macroeconomic impacts.

The totals for new spending on solar construction and O&M and new spending on distribution grid construction and O&M were sourced from the Shaftsbury Solar. Meanwhile, we used the U.S. Environmental Protection Agency's Avoided Emissions and Generation Tool ("AVERT") and the 2024 study of Avoided Energy Supply Cost in New England (AESC 2024)[19] to determine the potential range of any *reductions* in gas-powered generation activity resulting from the Project to estimate the value of avoided spending on construction or O&M for gas-powered generation units.[20] We assumed that the Project would displace some natural gas-fired generating capacity because these units are typically on the margin in New England currently, and are expected to remain marginal resources during at least some hours of the year moving forward.[21] Based on our AVERT and AESC 2024 analysis, we determined that the extent of any gas-powered generation displacement (and associated downside macroeconomic impacts) in Vermont would be negligible, since Vermont imports the great majority of its generation from out of state and is not home to any appreciable amount of natural gas-fired generation.

Macroeconomic Outputs

As noted above, our analysis reported impacts to employment, income, and gross domestic product.[22,23]

Macroeconomic impacts were evaluated at three levels:

- ***Direct impacts*** are those closest to the change in spending—for a new solar facility, these direct impacts would include the new on-site construction jobs, the wages that these onsite workers receive, and value added GDP through construction of the Project.

- ***Indirect impacts*** reflect supply-chain effects that proceed from the direct impacts—for a new solar facility, these impacts would encompass the jobs, income, and GDP gains associated with the manufacture of solar facility hardware.

[19] The Avoided Energy Supply Costs in New England (AESC) study. Synapse Energy Economics. 2024. Available at https://www.synapse-energy.com/sites/default/files/inline-images/AESC%202024%20May%202024.pdf. The AESC study developed projections of electricity and natural gas costs that would be avoided due to reduction in electricity and natural gas use resulting from improvements in Energy Efficiency.

[20] EPA Avoided Emissions and Generation Tool (AVERT). AVERT is available at: https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert. AVERT evaluates how adding renewable energy changes emissions of particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon dioxide (CO_2), volatile organic compounds (VOCs), and ammonia (NH_3) from electric power plants at state, or regional power system level.

[21] ISO New England Internal Market Monitor, "2021 Annual Markets Report" (May 26, 2022), https://www.iso-ne.com/static-assets/documents/2022/05/2021-annual-markets-report.pdf, noting "[n]atural gas-fired generators continued to be the dominant price-setting resources in 2021 at 52% in the day-ahead market and 83% in the real-time market." At page 20.

[22] Employment changes are provided in *job-years*. One job-year is equivalent to full-time employment for one person for one year.

[23] Gross Domestic Product (GDP) changes reflect the total value added within Vermont across all goods and services.

- ***Induced impacts*** occur from the re-spending of wage earnings associated with direct and indirect impacts—for a new solar facility, induced impacts would capture the effects of the re-spending of direct and indirect labor wages in the wider economy.

Leakages

Our analysis determined that some of the macroeconomic impacts resulting from this project would occur outside of Vermont. We excluded these impacts from our results.[24]

3.3. Results

In Table 2, our analysis predicts that the Project will result in macroeconomic benefits totaling 248 new job-years, $9.8 million in new income, and nearly $29.9 million in new GDP within Vermont. These results reflect both the initial capital investments totaling about $40 million and ongoing O&M totaling $618,000 annually over a 30-year modeled lifespan.[25]

Table 4. Total Macroeconomic Impacts

Shaftsbury Results	Total Jobs	Total Income	Total GDP
Utility PV Construction	64	$ 3,663,977	$ 8,017,303
Distribution Grid Construction	59	$ 2,167,373	$ 5,384,712
Utility PV O&M	93	$ 2,858,547	$ 12,153,064
Distribution Grid O&M	32	$ 1,158,559	$ 4,399,637
Total	**248**	**$ 9,848,457**	**$ 29,954,717**

From a temporal standpoint, the macroeconomic benefits of the Project are largely realized during the early years. The benefits from capital expenditures are anticipated to occur in 2023 and 2024[26], while the O&M benefits are expected to occur over 30 years. We anticipate that about half of the benefits will occur as a result of capital expenditures in the Project, while the remaining half will be realized over the 30-year lifetimes of the Project. This amounts to about 123 short-term job-years from capital expenditures and 125 O&M job-years over the 30-year lifespan (or an average of 4 jobs annually). This represents the direct, indirect, and induced job impacts (excluding tax impacts) from the investment in the Project.

[24] Synapse assumed that 20 percent of the new solar construction jobs associated with this project would be filled by Vermont residents and 100 percent of the new solar O&M jobs associated with this project would be filled by Vermont residents, consistent with the guidance received from the project developer. We further assumed that 100 percent of distribution grid construction and O&M jobs would be filled by Vermont residents.

[25] IMPLAN uses historical economic data to construct its model of the economy. As such, IMPLAN is most appropriate for use in formulating macroeconomic projections for the near- and moderate-term future. IMPLAN is generally not utilized for making truly long-term economic impact forecasts, since the IMPLAN software does not account for changes in the structure of the economy that inevitably occur over time. For this project, we utilized IMPLAN to estimate effects over a 30-year time horizon. While the Project is expected to be in service for at least 40 years, we opted not to estimate macroeconomic impacts for the final ten years of operations in the interest of conservativism and in deference to the limitations of the IMPLAN model.

[26] 2023 and 2024 were originally assumed to be the first two years the Project was online. These dates will shift as the online date is delayed and do not materially impact the results.

Additional Property Taxes

As noted above, we opted not to include any stimulus impacts from increased tax revenues. However, we do report these tax revenues below in Table 3 as a separate but related macroeconomic benefit of the Shaftsbury project. Our tax assumptions were based on values provided by the project developer. The subsections below explain how tax revenue estimates for each category were derived, the timelines involved (due to limitations with modeling tools available), and the assumptions made. In each category we applied discount values and assumptions that were conservative and therefore tend to underestimate potential tax revenues.

Table 5, Shaftsbury Taxes, Annually and Over Cumulative Project Life

	Vermont Uniform Solar Capacity Tax	Municipal Tax on Solar Project	Municipal Tax on Land	Total
First year	$80,000	$123,689	$11,183	$214,872
Lifetime cumulative (undiscounted)	$3,200,000	$1,615,171	$447,302	$5,262,473
Lifetime cumulative (discounted)	$1,608,459	$1,314,595	$224,833	$3,147,888

To estimate lifetime cumulative tax values, we assumed a 40-year revenue stream for each tax type except for the municipal tax on the Project, which was calculated over 30 years as a result of modeling limitations in the "PV Value" tool that was used to calculate the fair market value ("FMV") on which the municipal tax is assessed.[27] For consistency, each of the discounted cumulative values was determined using a discount rate of 6.38%, which is the low-end discount rate utilized in the "PV Value" modeling, and an assumed 2.32% escalation rate, which is the default assumption utilized by the "PV Value" tool.[28] Additional details on the specific calculations underlying each of the component tax results are presented below.

Vermont Uniform Solar Capacity Tax

To calculate the uniform capacity tax revenue for the first year, we multiplied the uniform capacity tax rate of $4,000 per-megawatt by the expected 20 MW nameplate capacity of the Project. To determine the total lifetime cumulative capacity tax, we constructed and then summed a 40-year value stream based upon the first-year estimated revenue and subject to a 6.38% discount rate and a 2.32% escalation rate. The escalation rate as applied to this calculation should be conceptualized as reflecting the projected increase in the rate of tax over time.

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[27] See PVvalue.com

[28] The assumed discount rate of 6.38% may be on the high (conservative) side when applied to tax revenues. The PV Value tool constructs discount rates to resemble the utility Weighted Average Cost of Capital (WACC), which may be more appropriate for private financial analysis than for public fiscal calculations.

Municipal Tax on Solar Project

To calculate the municipal tax the Project, we first used the "PV Value" tool to estimate for the FMV for the Project in its first year of service. This model determines the FMV based upon a projection of future annual revenues from energy generation for the project over a 30-year horizon. (As noted above, the model is limited to this 30-year period and cannot forecast revenues further into the future). To determine the first-year tax liability, this FMV value was multiplied by 70% to determine an estimate of the assessed value, and then the applicable tax rate of 0.4775% was applied to this result.

To estimate the lifetime cumulative revenue from the municipal tax on the project, we estimated each subsequent year's FMV by simply subtracting out from the 30-year revenue stream total (returned by the model in estimating the first-year FMV) all projected energy revenues associated with years preceding the given year. We then summed the individual estimated FMVs for each of the 30 years, applied the 70% assessment factor, and finally, multiplied by the applicable tax rate of 0.4775%.

Municipal Tax on Land

To calculate the first-year municipal tax on land, we multiplied the listed value for the Shaftsbury project parcels, $554,800, by the municipal tax rate of 0.4775% and added the education non-residential land tax rate of $1.5381 per $100 in property value. To calculate the total lifetime cumulative municipal tax on land, we constructed and then summed a 40-year value stream based upon the first-year estimated revenue and subject to a 6.38% discount rate and a 2.32% escalation rate. The escalation rate as applied to this calculation should be conceptualized as reflecting the increase in the value of land over time.

4. Effects on the Region's Transmission and Distribution Networks

Vermont's transmission electricity grids are integrated into the broader New England bulk power system, operated by the region's independent system operator, ISO New England. As such, analysis of the demand for and the impacts of the Project includes assessment of the regional transmission grid (bulk power system) serving the distribution grids across all six New England states.[29]

ISO New England, VELCO, GMP, and the State of Vermont have all noted the challenges presented by managing the impacts of increasing quantities of distributed solar PV on load forecasting, dispatch and operation of the regional bulk power system, the state transmission grid and local distribution grids.[30] As a larger 20 MW utility-scale solar PV facility directly interconnected via a substation operated by

[29] The New England transmission grid, or bulk power system, refers to the 9,000 miles of high voltage transmission lines (defined by ISO New England as rated at 115 kV and above) that form the transmission network serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. In New England, distribution grids are generally defined as those networks delivering electricity to end users via low-voltage electric power lines (typically less than 69 kV), however in Vermont, a 46 kV line is considered transmission level. See PUC Rule 4.600.

[30] Distributed or behind-the-meter (BTM) solar refers to distributed generation resources located behind a customer load billing meter.

GMP, the Project is directly observable by ISO New England, VELCO and GMP, unlike distributed solar PV capacity in the region that are "behind-the-meter" and only controllable by the interconnecting utility. The integration of increasing quantities of distributed solar resources has reduced the hosting capacity of many distribution circuits on local distribution grids in several New England States, requiring additional local grid investments before more distributed solar may be added.[31] The Project, by interconnecting to a higher voltage GMP transmission line, avoids further eroding hosting capacity in Bennington County Regional Commission (BCRC) area where it will be located.

ISO New England tracks PV installation trends for both utility-scale and behind-the-meter solar PV and, working in consultation with the six New England States, integrates that data into its annual load forecasts and daily operations. Since 2019, ISO New England has developed an annual solar PV forecast for the New England control area, tracking New England state public policies, state and federal tax and financing incentives, and technology costs. At the end of 2021, ISO New England found 243,301 solar PV installations across the six New England States, totaling 4,767 MW_{AC} as of December 31, 2021.[32] By the end of 2022, as shown in Table 4, solar PV installed capacity reached 5,743 MW_{AC}, an increase of 16 percent. Solar PV installed capacity is forecasted to increase from 4,767 MW in 2021 to 11,520 MW by 2030.

Table 4: New England Cumulative Solar PV installed Capacity Totals by State

State	**Installed Capacity (MW_{AC})**		**Number of Installations**	
	2021	**2022**	**2021**	**2022**
Massachusetts	2,953	3,289	130,040	150,020
Connecticut	809	912	63,735	73,553
Vermont	434	468	17,296	19,348
Rhode Island	288	326	12,641	17,034
New Hampshire	156	183	12,186	14,427
Maine	125	295	7,403	8,583
New England	4,767	5,473	243,301	282,965

Source: ISO-NE 2022 PV Forecast, slide 14, ISO-NE December 2022 Distributed Generation Survey Results (February 17, 2023) https://www.iso-ne.com/static-assets/documents/2023/02/2_survey_results.pdf . Reflects statewide aggregated solar PV installation data provided to ISO New England by regional distribution utilities. The values represent installed nameplate as of December 31, 2022.

In 2022, across Vermont, solar PV installed capacity increased from 434 to 468 MW_{AC}, an increase of 8 percent while solar PV installations increased from 17,296 in 2021 to 19,348 in 2022.[33] In 2022, across New England, 34.7 percent of installed solar PV capacity were at sites with less than 25 kW capacity, 3.9 percent at sites with greater than 25 kW, but less than 100 kW, 21.1 percent at sites with 100 kW to 1 MW, and 40.3 percent at sites with greater than 1 MW.[34] Utility-scale solar projects, such as the Project,

[31] National Renewable Energy Laboratory, Advanced Hosting Capacity Analysis, https://www.nrel.gov/solar/market-research-analysis/. In this analysis we use the National Renewable Energy Laboratory definition of hosting capacity: the amount of distributed solar PV that can be added to the distribution system before control changes or system upgrades are required to safely and reliability integrate additional distributed solar PV.

[32] These include behind-the-meter, energy only resource, and forward capacity market participating solar PV facilities.

[33] That 34 MW in 2021-2 is close to what the Vermont Department of Public Service forecasts for average annual solar PV capacity installations through 2030.

[34] ISO-NE 2022 PV Forecast, slide 14, ISO-NE December 2022 Distributed Generation Survey Results (February 17, 2023) https://www.iso-ne.com/static-assets/documents/2023/02/2_survey_results.pdf

in New England typically have an installed capacity greater than 5 MW_{AC}, and at the end of calendar year 2022, 239 MW were concentrated in 24 such utility-scale projects interconnecting with higher voltage transmission lines via nearby substations.[35] The 2022 CEP notes that:

> "Vermont has one of the highest penetrations of solar PV in the nation (as a percentage of total generation but especially as a percentage of total load, at about 40%), and thus faces the challenge and opportunity to lead the way on solutions to integrate additional solar without making the grid unreliable."[36]

Examining hosting capacity saturation by distributed solar, the 2022 CEP noted (based on data provide by GMP and VELCO), "[m]ost of the available transmission-hosting capacity is in southern Vermont," and in these Regional Planning Commission (RPC) areas, "distribution headroom is the only limiting factor to consider when siting additional solar PV capacity."[37] Table 5 shows, based on the hosting capacity data provided, the regional commission areas where hosting capacity remains and indicates whether additional transmission or distribution headroom remains. As a larger 20 MW utility-scale solar PV facility directly interconnected via a substation operated by GMP, the Project is proposed within the Bennington County Regional Commission (BCRC) area which shows it has 66.4 MW of transmission headroom available for additional interconnections.

Table 5: Vermont Transmission vs. Distribution Hosting Capacity

RPC	Additional Transmission Headroom (MW)	Additional Distribution Headroom (MW)	Headroom Limited by Lower of Transmission or Distribution
Addison (ACRPC)	30.1	14.2	14.2
Bennington (BCRC)	66.4	304	66.4
Central Vermont (CVRPC)	44	101.3	44
Chittenden (CCRPC)	41.5	512.3	41.5
Lamoille (LCPC)	25.5	22.6	22.6
Mt. Ascutney (MARC)	56.7	101.8	56.7
Northeastern (NVDA)	28	45	28
Northwest (NRPC)	8.6	57.3	8.6
Rutland (RRPC)	126.6	64.7	64.7
Two Rivers (TRORC)	59.3	209.3	59.3
Windham (WRC)	148.2	142.4	142.4
Totals	636	1,574.9	548.4

Source: 2022 Comprehensive Energy Plan, page 87, Exhibit 4-13. Transmission vs. Distribution Hosting Capacity by Regional Planning Commission area. Red text denotes the limiting factor in an RPC area, whether transmission or distribution headroom, green denotes most remaining transmission hosting capacity (concentrated in southern Vermont).

In the 2021 Vermont Long Range Transmission Report ("LRTP"), VELCO considered various demand scenarios including heating and transportation electrification, coupled to higher energy efficiency and distributed generation and concluded the Vermont transmission system is capable of serving expected

[35] ISO-NE Draft 2023 Photovoltaic Forecast (February 17, 2023), slide 11.

[36] Vermont 2022 Comprehensive Energy Plan, page 82. "In Vermont, given the high solar penetration (~44% of 2020 peak loads statewide; over 80% of substation transformer rated capacity in at least 41 substations, and over 100% of substation capacity in at least 17 substations), additional interconnections are increasingly limited by substation transformer thermal overloads." Page 85.

[37] 2022 Comprehensive Energy Plan, page 87.

load conditions through 2030.[38] Distributed solar PV installations (i.e., not this transmission-level project), are presenting challenges and the risk of increased operating and capital costs, potentially requiring upgrades of transformers and protection equipment at substations due to dwindling hosting capacity. As a larger 20 MW utility-scale solar PV facility directly interconnected to a higher voltage transmission via a substation installed by the developer, and operated by GMP, the Project helps achieve 2022 CEP goals for adding clean energy resources without further stressing distribution grid infrastructure. The 2022 CEP noted that this outcome could be avoided according to the 2021 VELCO LRTP if the transmission system added certain components:

- Load management mechanisms, particularly of electric vehicles, to keep winter loads below 1,470 MW and summer loads below 1,210 MW; and
- Coordinated planning of where and how distributed generation is deployed, as well as how it's interconnected.[39]

The Project would not further erode distribution-level hosting capacity in the BCRC area. As a larger 20 MW utility-scale solar PV facility, the Project would interconnect to an existing 46 kV GMP transmission line intersecting the project site. Interconnecting to the existing GMP transmission line would not decrease the integrity or reliability of the immediate circuit. Region-wide, geographically dispersed megawatt-scale solar projects that are interconnected at the transmission level and not connected to existing distribution circuits, can help avoid some of the challenges presented by distributed solar PV saturation as noted by VELCO and GMP.

5. ROLE IN ACHIEVING ENVIRONMENTAL TARGETS

The Project will result in important environmental benefits. The solar energy produced by the Project will reduce the electricity needed in the New England region from fossil fuel-fired generating capacity. The Project will emit no air pollutants or greenhouse gases in its day-to-day operation generating electricity, and thus will help in a measurable way to address climate change and achieve regional decarbonization goals.

5.1. Vermont and Regional Emissions Reductions

To understand the emissions reduction potential for the Project, we modeled two possible futures for the energy grid during the Project's 40-year life. In the first scenario, we assumed the power grid remains much the same as it is today over this period and relied on the outputs of the AVERT model. In the second, we assumed grid decarbonization consistent with the AESC 2024 study.

[38] VELCO, 2021 Vermont Long-Range Transmission Plan, https://www.velco.com/assets/documents/2021%20VLRTP%20to%20PUC_FINAL.pdf.

[39] 2022 Comprehensive Energy Plan, page 65.

Avoided emissions assuming no change to the New England power grid

First, we evaluated avoided emissions assuming that the power grid in New England continues to look much the same as it does today for the Project life. Under this assumption, we find that the Project would likely displace emissions on an annual basis from fossil-fuel fired electric generating capacity, predominantly outside of Vermont, based on the AVERT analysis shown in Table 6.

Table 6: Annual State Emission Changes from Electric Generation in New England due to Changes in Vermont

State	Sulfur Dioxide (lbs)	Nitrogen Oxides (lbs)	Carbon Dioxide (Short Tons)	Fine Particulates (lbs)	Volatile Organic Compounds (lbs)	Ammonia (lbs)
Connecticut	-1,510	-1,740	-3,740	-270	-100	-210
Maine	-1,740	-880	-2,020	-100	-50	-50
Massachusetts	-2,030	-2,570	-6,670	-420	-250	-340
New Hampshire	-1,630	-2,350	-2,310	-170	-50	-110
Rhode Island	-50	-710	-2,530	-460	-230	-330
Vermont	0	-130	-190	0	-20	-10

Note: Negative numbers indicate displaced generation and emissions. All results are rounded to the nearest ten in pounds (lbs) or short tons.
Source: U.S. Environmental Protection Agency, Avoided Emissions and Generation Tool (AVERT), https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert, avoided emissions from adding 20 MW utility-scale solar PV project in Vermont generating 33,500 MWh per year.

In the New England control area, generation from the proposed Project would most often displace generation from natural gas fired combined cycle units, the most common marginal generating unit on a load-weighted basis in the region.[40] Most of the shift in emissions shown in Table 7 for the New England bulk power system would occur outside of Vermont as shown in Table 6 above.

Table 7: Annual State Emission Changes from Electric Generation in New England due to Changes in Vermont

	Original Regional Generation & Emissions	After Project Addition in Vermont	Change in Regional Generation & Emissions
Generation (MWh)	49,806,940	49,773,380	-33,500
Sulfur Dioxide (lbs)	4,272,680	4,265,710	-3,350-6,960
Nitrogen Oxides (lbs)	8,742,410	8,734,030	-8,380
Carbon Dioxide (Short Tons)	25,898,760	25,881,310	-17,450
Fine Particulates (lbs)	1,748,910	1,747,490	-1,420

Note: Negative numbers indicate displaced generation and emissions. All results are rounded to the nearest ten in pounds (lbs) or short tons.
Source: U.S. Environmental Protection Agency, Avoided Emissions and Generation Tool (AVERT), https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert, avoided emissions from adding 20 MW utility-scale solar PV project in Vermont generating 33,500 MWh per year.

As of 2021, the New England power system had an average carbon intensity of between 539 and 658 pounds per megawatt hour (lbs CO_2/MWh) and a marginal carbon intensity of between 758 and 900 lbs

[40] ISO New England, "2021 ISO-NE Electric Generator Air Emissions Analysis: Draft Report", (February 16, 2023) https://www.iso-ne.com/static-assets/documents/2023/02/draft_2021_emissions_report_presentation.pdf. Slide 27, showing in 2021 a natural gas-fired combined cycle unit was the marginal unit each month greater than 70 percent of the time on a load-weighted basis.

CO_2/MWh as estimated by ISO New England and EPA.[41] Based on the AVERT results, the Project would displace 1,042 pounds CO_2 per megawatt hour of generation, calculated by dividing the first year projected avoided annual CO_2 emissions of -17,454 short tons by the projected generation of approximately 33,500 MWh.

$$\frac{(-17{,}454\ short\ tons\ CO_2\ \times 2{,}000\ lbs)}{33{,}500\ MWh} = -1{,}042\ lbs\ avoided\ CO_2/MWh$$

Assuming a 0.4 percent degradation factor for solar generating capacity, over a 40-year operating life, the proposed Shaftsbury Solar project could generate 1,240,585 MWh.[42] Applying the avoided CO_2 emissions rate of -1,042 lbs avoided CO_2/MWh to the total project generation over 40 years:

$$\frac{1{,}240{,}585\ \text{MWh} \times\ -1{,}042\ lbs\ avoided\ CO_2/MWh}{2{,}000\ lbs} =\ -646{,}345\ short\ tons\ avoided\ CO_2$$

The Project will avoid approximately 646,345 short tons of CO_2 emissions on the New England Power system, primarily outside of Vermont, since few emitting generating resources are located in Vermont. This estimate of avoided CO_2 emissions is prior to consideration of tree clearing at the Project site, which is addressed below.

Avoided emissions assuming transformation of the New England power grid

Next, we evaluated avoided emissions assuming that the New England power grid decarbonizes based on the modeling assumptions used in the 2024 Avoided Energy Supply Cost of New England (AESC) study. Under this assumption, we find that the Project would still displace emissions on an annual basis from fossil-fuel fired electric generating capacity, predominantly outside of Vermont. The total displaced emissions level would be lower in the future than they are today based on the increased deployment of non-emitting resources. In the AESC modeling, like in the AVERT modeling, the shift in generation will still occur predominantly outside of Vermont.

Using the AESC model results, we found the marginal carbon intensity of the New England power grid each year of the project life, which ranged from 775 lbs/MWh in the near term down to 357 lbs/MWh out beyond 25 years. We calculated that the project would displace, on average, 7,932 short tons CO_{2e} per year, for a total of 317,279 short tons of avoided CO_2 over the project operating life (also assuming a 0.4 percent annual degradation factor, a 40-year operating life, and 33,500 MWh first year generation).

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[41] EPA, " Emissions & Generation Resource Integrated Database (eGRID)", https://www.epa.gov/system/files/documents/2023-01/eGRID2021_data.xlsx, Tab SRL21, Row 13 NPCC New England, Columns V, DB; ISO New England, "2021 ISO-NE Electric Generator Air Emissions Analysis: Draft Report", (February 16, 2023) https://www.iso-ne.com/static-assets/documents/2023/02/draft_2021_emissions_report_presentation.pdf., slide 18, noting average CO_2 emission rate for the adjacent control areas were estimated at 698 lbs/MWh for New Brunswick, 428 lbs/MWh for New York, and 3.7 lbs/MWh for Quebec.

[42] Assumes Year 1 annual generation of 33,500 megawatt-hours (MWh). A degradation rate of 0.4% implies that production from a solar panel will decrease at a rate of 0.4% per year. This means that in Year 40, the module is producing approximately 85% of the electricity it produced in Year 1.

Value of avoided emissions

The value of avoided CO_2 emissions from the generation by the Project can be estimated by making the assumptions described below. The primary assumption is selecting the valuation for avoided CO_2 emissions. The 2024 AESC study, provides several non-embedded costs using a 15 year levelized average and varying discount rates. The New England marginal abatement cost is used by several New England states, and therefore is provided here for context. Vermont (and the federal government) rely on the social cost of carbon (SCC) for all cost benefit analysis, therefore that is the value we use for our calculations in this report.

- A New England-based marginal abatement cost for the electric sector of $173 per short ton CO_2 ($2024),
- A New England-based marginal abatement cost derived from multiple sectors of $581 per short ton CO_2 ($2024).
- The 2024 AESC SCC values, which are based on the U.S. EPA's social cost of carbon calculations. These range from $249 to $415 per short ton CO_2 ($2024).

All referenced 2024 AESC carbon values are shown in Table 8 as CO_2. All carbon values have been converted to short tons and adjusted to $2024 to allow direct comparison.

Table 8: Estimated Value of Avoided CO_2 Emissions from Project Generation

	Value in dollars per short ton ($2024)	Project Life-Time Avoided CO_2 Emissions (Short Tons)		Value of Avoided CO_2 Emissions ($2024 Millions)	
		AVERT	AESC 2024	AVERT	AESC 2024
New England Marginal Abatement cost - Electric Sector (2024)	$173	646,345	317,279	$111.8	$54.8
New England Marginal Abatement cost - Multiple Sectors (2024)	$581			$375.5	$184.3
2023 EPA SCC (2023)	$249 - $415			$160.9 - $268.2	$79.0 - $131.7

Notes: All values shown are levelized over 15 years. All AESC 2024 values except the SCC are levelized using a 1.74 percent discount rate (the 2.0 percent SCC is levelized using a 2.0 percent discount rate, while the 1.5 percent SCC is levelized using a 1.5 percent discount rate). All AESC 2021 values are levelized using a 0.81 percent discount rate, except SCC which uses a 2 percent discount rate, then converted into 2024 dollars. Values shown above remove energy prices, but not embedded costs. Values shown above do not include transmission and distribution losses. Values shown above remove embedded costs (e.g., RGGI, MA 310 7.74, MA 310 7.75). All values quoted use a summer on-peak seasonal marginal emission rate and include a 9 percent energy loss factor. All values shown are only inclusive of point-of-consumption CO2 GHGs and do not include upstream GHGs or GHG cost impacts related to CH4 or N2O.

Using the 2023 EPA social cost of carbon of $249 - $415 per short ton CO_2 ($2024) and applying it to the avoided emissions from the AVERT model, we find that the Project provides between $160.1 and $268.2 million ($2024) in social benefit from avoided CO_2 emissions before consideration of forest clearing at the Project site.[43] Using the same social cost of carbon and applying it to the avoided emissions assuming transformation of the New England Power grid, we find that the Project provides between an estimated $79.0 and $131.7 million ($2024) in social benefits from avoided CO_2 emissions before consideration of forest clearing at the Project site.[44]

Taking into account that approximately 43 acres[45] of forest and other vegetated areas will be cleared for the Project, approximately 12,599 metric tons (or 13,889 short tons) of sequestered CO_{2e} would be released, based on the Vermont Department of Forests – Parks and Recreation estimate that each acre of Vermont forestland sequesters approximately 293 metric tons of (CO_{2e}) (or 323 short tons of CO_{2e}).[46] This is a conservative assumption, as it assumes that all cleared acreage is the same uniform forest type and density.[47]

It is noteworthy that the avoided emissions from the Project's generation will compensate for the release of 13,889 short tons of sequestered CO_{2e} in approximately one year, since the estimated avoided emission in the Project's first year of operation range from 12,261 short tons CO_{2e} (under the AESC model) to 17,454 short tons CO_2 (under the AVERT model).

Assuming no change to the New England power grid and subtracting the released 13,889 short tons of emitted CO_{2e} from the avoided CO_2 emissions of 646,345 short tons over the 40-year operating life of the proposed Project, the net avoided CO_2 emissions of the Project would be approximately 632,457 short tons. The net estimated social benefit from avoided CO_2 emissions using the SCC would be between $157.5 million and $262.5 million ($2024) over a 40-year operating life.

Assuming transformation of the New England power grid and subtracting released 13,889 short tons of emitted CO_{2e} from the avoided CO_2 emissions of 317,279 short tons over the 40-year operating life of the proposed Project, the net avoided CO_2 emissions of the Project would be approximately 303,391

[43] Avoided Energy Supply Components in New England: 2021 Report (March 15, 2021), https://www.synapse-energy.com/sites/default/files/AESC%202021.pdf, Table 76. Comparison of GHG costs under different approaches to in Counterfactual #1, p. 170.

[44] Avoided Energy Supply Components in New England: 2024 Report (May 24, 2024) https://www.synapse-energy.com/sites/default/files/inline-images/AESC%202024%20May%202024.pdf, p. 15.

[45] The revised site plan assumes 42.2 acres of forestland will be cleared. Our estimate for carbon emissions from tree clearing is conservative because we did not update our calculations to account for the marginal change from the original 43 acres assumption.

[46] Vermont Department of Forests – Parks and Recreation (2016), "Forest Carbon" https://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Forest%20Carbon-Nov2016.pdf, Vermont forests on average store about 80 MtC per acre (293 metric tons CO_2 equivalent (MtCO2e) or 322.97 short tons of CO_2 equivalent). Fiona V. Jevon, Anthony W. D'Amato, Christopher W. Woodall, Kevin Evans, Matthew P. Ayres, Jaclyn Hatala Matthes, "Tree basal area and conifer abundance predict soil carbon stocks and concentrations in an actively managed forest of northern New Hampshire, USA," Forest Ecology and Management (2019), https://doi.org/10.1016/j.foreco.2019.117534, calculated carbon density of a New Hampshire mixed forest at 292 metric tons per acre.

[47] The Vermont values are also conservative relative to carbon sequestration values used by the national Forest Service and the State of New Hampshire. National Forest Service. "Baseline Estimates of the Carbon Stocks in Forests and Harvested Wood Products for National Forest System Units – Eastern Region" (March 2015) https://www.fs.usda.gov/sites/default/files/eastern-region-carbon-assessment.pdf, estimating White Mountain National Forest carbon density at approximately 80 metric tons per acre.

short tons CO_2. The net estimated social benefit from avoided CO_2 emissions using the SCC would be between $75.5 million and $125.9 million ($2024) over a 40-year operating life.