SS-PS-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 1'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 1.27 million megawatt hours ("MWh") over its 40-year operating life. It should be noted that within the Project's first full year of operation, the avoided carbon dioxide ("CO_2") emissions from the Project's generation will more than 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 approximately 17,450 short tons of carbon dioxide ("CO_2") emissions annually, and approximately 647,324 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 of roughly $82.8 million over the life of the Project, while generating approximately 1,269,123 megawatt-hours ("MWh") over its 40-year operating life.

In the overall New England energy landscape, the Project is a larger, 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 and 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 GMP), in order to interconnect with GMP's existing 46 kV transmission line 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 ("CEP")

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. 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 increase 1.7 percent in Vermont and 1.4 percent in New England 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 forecasted to increase from 24,686 MW to 25,322 MW, a net increase of 636 MW. During that same

[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.

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 capacity factor of 42 percent, based on the qualified capacity assigned by ISO New England of similar sized, fixed tilt solar PV projects, 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).

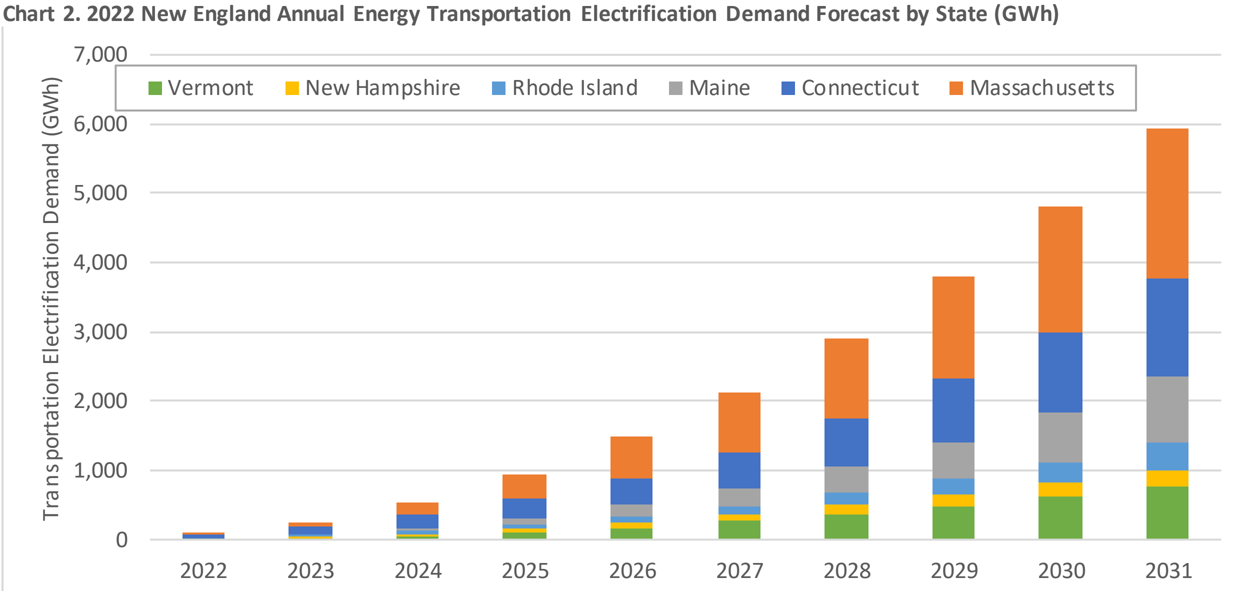
5 Id., Tab 2.1, column R. See also Lawrence Berkley National Laboratory, "Utility-Scale Solar: Project Level Performance Cumulative Capacity Factor through 2021." (September 2022), https://emp.lbl.gov/pv-capacity-factors. Examining reported operating data from all solar PV projects over 5 MW_{AC} in capacity (205.3 MW_{AC}) built through 2020 in New England, LNBL estimated a weighted average capacity factor of 17.2 percent for utility-scale, fixed-tilt, solar PV projects in New England.

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 1.27 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 a third of projected annual electric vehicle charging demand and help reduce CO_2 emissions by -146,980[8] tons in Vermont.[9]

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

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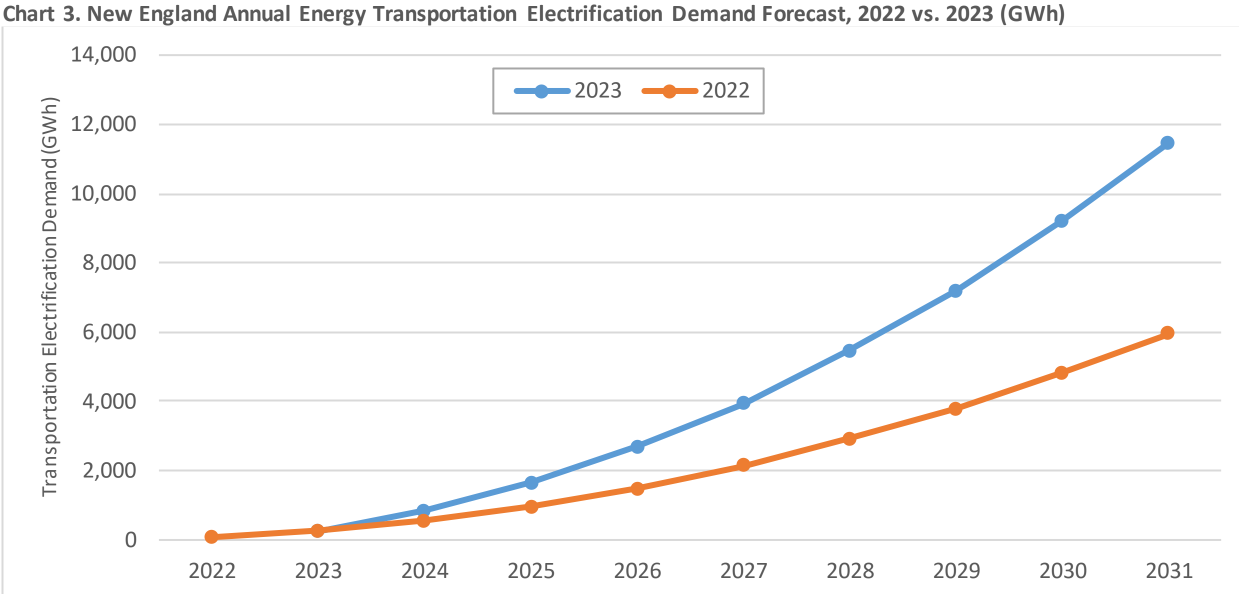
[7] A degradation rate of 0.4% implies that production from a solar panel will decrease at a rate of 0.4% per year. This means that in Year 40, the module is producing approximately 85% of the electricity it produced in Year 1.

[8] Negative numbers throughout this report indicate displaced generation and emissions, as the case may be.

[9] U.S. Environmental Protection Agency, "Avoided Emissions and Generation Tool" (AVERT), https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert, assuming 41,969 light duty electric vehicles (2025 model year) deployed in Vermont in 2025 along with 33,500 MWh of generation from the 20 MW utility-scale solar PV Project in Shaftsbury, Vermont, would be equivalent to reducing CO_2 emissions by 147,520 short tons from light duty internal combustion engine vehicles across New England. According to the AVERT model, most of the CO_2 emissions reduction benefits accrue in Vermont, -146,980 of the -147,520 short tons in calendar year 2025.

financing for electric vehicle charging infrastructure and transmission grid enhancements.[10] 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 cumulative EV charging demand between 2022 and 2031 from 22,875 GWh to 42,612 GWh compared with its transportation electrification forecast from the prior year.[11]

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.

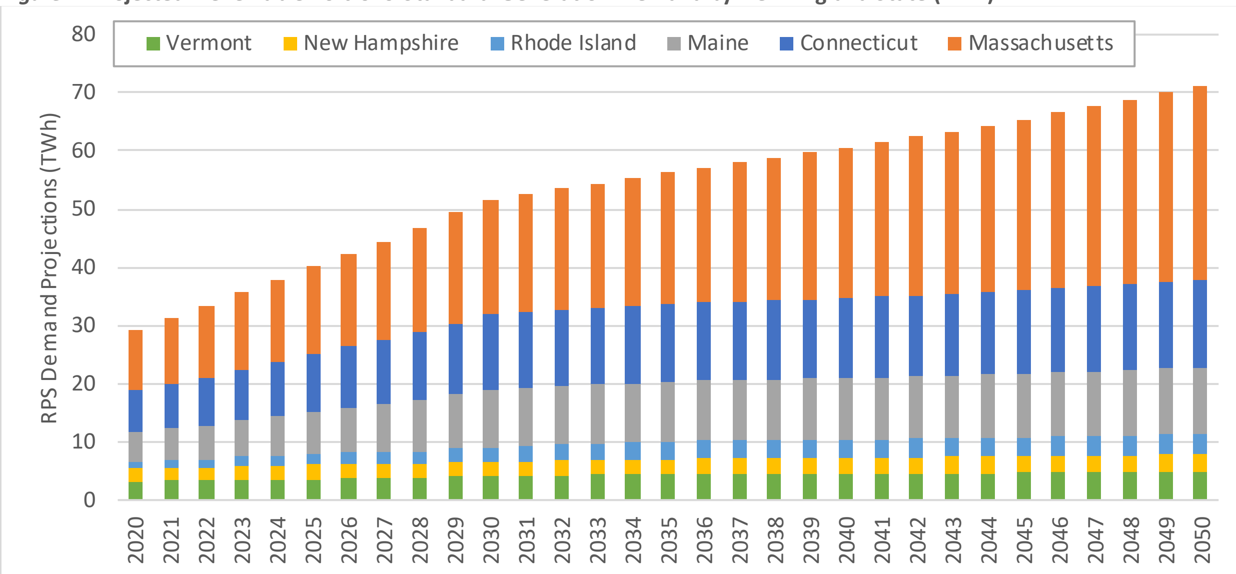
2.3. Renewable Energy Goals and Progress

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).

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

[11] 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

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."[12] 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.[13] 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 (3) energy transformation ("Tier 3").[14] 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

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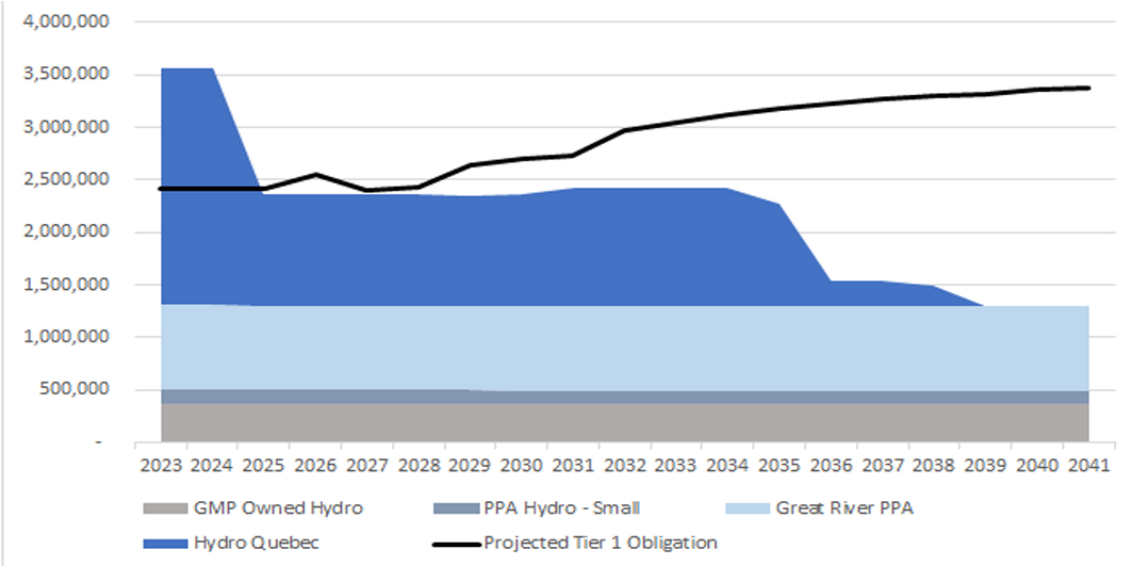
[12] 30 V.S.A. § 8002(21).

[13] 30 V.S.A. § 8005(d)(4)(A)

[14] 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).[15]

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:

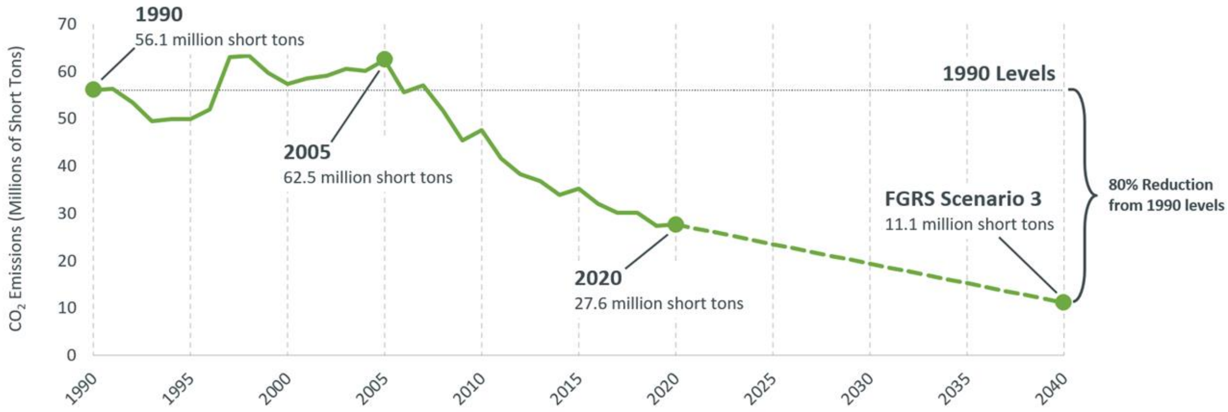
- Connecticut adopted a zero-carbon electricity requirement of 100 percent by 2040
- Massachusetts adopted a net-zero by 2050 emissions reduction requirements along with a clean energy standard of 80 percent by 2050
- Maine adopted a renewable energy goal of 100 percent by 2050 and a carbon emissions neutral requirement by 2045

[15] 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.

- Rhode Island adopted a renewable energy requirement of 100 percent by 2030, and
- Vermont adopted a renewable energy requirement of 100 percent by 2030.

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 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.[16]

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.[17]

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

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

[17] Id. at 18.

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.[18,19] 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.

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") to

[18] 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.

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

determine the extent 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 natural gas-fired generating capacity because these units are typically on the margin in New England.[21] Based on our AVERT 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.

- ***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]

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[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.

[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.

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, 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.

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

[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.

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.[26] 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.[27] 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.

Municipal Tax on Solar Project

To calculate the municipal tax for 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 2022 municipal tax rate of $0.4775 per $100 of assessed value 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,

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[26] See PVvalue.com

[27] 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.

applied the 70% assessment factor, and finally, multiplied by the 2022 tax rate of $0.4775 per $100 of assessed value.

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 2022 municipal tax rate of $0.4775/$100 of assessed value and added the 2022 education non-residential tax rate of $1.5381 per $100 of assessed 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.[28]

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.[29] As a larger 20 MW utility-scale solar PV facility directly interconnected via a substation operated by 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.[30] The Project, by

[28] 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.

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

[30] 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.

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.[31] 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.[32] 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.[33] Utility-scale solar projects, such as the Project, 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.[34] 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

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

[32] 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.

[33] 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

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

challenge and opportunity to lead the way on solutions to integrate additional solar without making the grid unreliable."[35]

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."[36] 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 load conditions through 2030.[37] 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

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[35] 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.

[36] 2022 Comprehensive Energy Plan, page 87.

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

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.[38]

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

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.

[38] 2022 Comprehensive Energy Plan, page 65.

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.[39] 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.
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 -38,090 MWh.*

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 CO_2/MWh as estimated by ISO New England and EPA.[40] Based on the AVERT results, the Project would displace 1,009 pounds per megawatt hour of generation, calculated by dividing the projected avoided annual CO_2 emissions of -17,670 short tons by the projected generation of approximately 33,500 MWh.

$$\frac{(-17{,}450\ short\ tons\ CO_2\ \times 2{,}000\ lbs)}{33{,}500\ MWh} = -1{,}042\ lbs\ avoided\ CO_2/MWh$$

Assuming a 0.4 percent degradation factor for solar generating capacity, over a 40-year operating life, the proposed Shaftsbury Solar project could generate 1,269,123 MWh.[41] Applying the avoided CO_2 emissions rate of -1,042/MWh to the total project generation over 40 years:

[39] 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.

[40] 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.

[41] 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.

$$\frac{1{,}269{,}123 \text{ MWh} \times -1{,}042 \; lbs \; avoided \; CO_2/MWh}{2{,}000 \; lbs} = -661{,}213 \; short \; tons \; avoided \; CO_2$$

The Project will avoid approximately 661,213 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.

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 that generation from the Project will most often displace generation from a natural gas-fired combined cycle unit, which in 2022 was the marginal fuel type unit 80 percent of the time in the New England control area.[42] If the marginal unit is another renewable resource, such as offshore wind, then generation from the Project will not be realizing any greenhouse gas reduction benefits during those periods. The other primary assumption is selecting the valuation for avoided CO_2 emissions. The 2021 Avoided Energy Supply Component (AESC) in New England study, provides several non-embedded costs using a 15 year levelized average and 2 percent discount rate estimates:

- A New England-based marginal abatement cost for the electric sector of $128 per short ton $CO_{2equivalent}$ ("CO_{2e}") ($2021 dollars),
- A New England-based marginal abatement cost derived from multiple sectors of $493 per short ton CO_{2e} ($2021 dollars).

The 2021 AESC also recommends as an option the 2020 State of New York social cost of carbon. If we substitute the updated 2022 State of New York figure using the same 15 year levelized average and 2 percent discount rate, it yields a social cost of carbon of $154. All referenced 2021 AESC carbon values are shown in Table 8 as CO_{2e} along with the 2022 proposed EPA social cost of carbon as a point of comparison. All carbon values have been converted to short tons and adjusted to $2021 dollars to allow direct comparison.

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

	Value ($2021)	Project Life-Time Avoided CO_2 Emissions (Short Tons)	Value of Avoided CO_2 Emissions ($2021 Millions)
New York State SCC (2022)	$154	661,213	$102.0
New England Marginal Abatement cost - Electric Sector (2021)	$128		$84.6
New England Marginal Abatement cost - Multiple Sectors (2021)	$493		$326.0
Proposed 2022 EPA SCC (2022)	$254		$168.0

Note: all carbon values in 15-year levelized average with a 2 percent discount rate and converted into short tons.

[42] ISO New England Internal Market Monitor, "Fall 2022 Quarterly Markets Report" (January 31, 2023), https://www.iso-ne.com/static-assets/documents/2023/01/2022-fall-quarterly-markets-report.pdf, Figure 3-3: Real-Time Marginal Units by Fuel Type, page 16. In 2022, the ISO New England Internal Market Monitor calculated that a natural gas-fired unit was the marginal unit 80% of the time (8,760 hours). Over the last three years, on average, a natural gas unit is the marginal unit 78% during winter, 81% during spring, 86% during summer, and 81% during fall.

Sources: *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 ($2021 per short ton), p. 170; New York State Department of Environmental Conservation, Establishing a Value of Carbon (May 2022),* https://www.dec.ny.gov/docs/administration_pdf/vocguid22.pdf, *U.S. Social Cost of CO_2 by Discount Rate, Adjusted for New York State ($2020 per metric ton), p. 34; U.S. Environmental Protection Agency*, External Review Draft of Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances (September 2022) EPA-HQ-OAR-2021-0317, https://www.epa.gov/system/files/documents/2022-11/epa_scghg_report_draft_0.pdf, Table 4.2.1: Unrounded SC-CO_2, SC-CH_4, and SC-N_2O Values, 2020-2080, p.120.

Using the 2021 AESC New England-based marginal abatement cost for the electric sector of $128 per short ton CO_{2e} ($2021 dollars), the Project provides an estimated $84.6 million in social benefit from avoided CO_2 emissions before consideration of forest clearing at the Project site.[43]

Taking into account that approximately 43 acres 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}).[44] This is a conservative assumption, as it assumes that all cleared acreage is the same uniform forest type and density.[45]

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 less than one year.

Subtracting the released 13,889 short tons of emitted CO_{2e} from the avoided CO_2 emissions of 661,213 short tons over the 40-year operating life of the proposed Project, the net avoided CO_2 emissions of the Project would be approximately 647,324 short tons. The net estimated social benefit from avoided CO_2 emissions would be roughly $82.8 million over a 40-year operating life.

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[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] 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.

[45] 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.