<u>**Exhibit CS-HD-2**</u>

Life Cycle Greenhouse
Gas Assessment

Life Cycle Greenhouse Gas Assessment: Chelsea Solar project

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Project Summary

The primary objective of this analysis was to determine the potential change in greenhouse gas (GHG) emissions to the atmosphere (in Tonnes of CO_2e) that could result from the proposed Chelsea Solar LLC installation in Bennington, Vermont. The proposed site for the solar installation is a partially forested area that has not historically been managed for forest products (e.g. firewood) and is not projected to be a managed, working forest at the time of this project.

The Chelsea Solar project is being proposed as a means to add electricity generation capacity to the Vermont Green Mountain Power (GMP) grid from a renewable source, rather than adding generation capacity via conventional feedstocks such as natural gas. As such, the primary focus of this analysis was to model these two alternative means of adding capacity to the GMP grid to determine the relative life cycle GHG emissions of each option and to quantify the potential GHG emission benefits of the Chelsea Solar project. In addition, we have compared the relative GHG emissions of generating electricity from the Chelsea Solar project to the 2015 ISO-NE, which could be another source of power for GMP; 2015 Vermont Ownload, and 2016 GMP grid mixes.

To calculate the potential GHG benefits of this solar installation, we quantified the change in GHG emissions to the atmosphere over the study period associated with: 1) leaving the existing forest at the site and adding conventional electricity generation capacity equivalent to the proposed project to the GMP grid (baseline scenario); and 2) converting the forest site to a solar panel installation to supply additional generation capacity to the GMP grid (solar installation scenario). The difference between these two values is an estimate of the GHG reduction that the project can expect to achieve. The study period for this analysis was 25 years, which is the expected minimum service life of the solar installation. This project lifetime was extended to 40 years for a sensitivity analysis.

The life cycle GHG emissions calculations for both scenarios were modeled in SimaPro LCA software (www.pre.nl) and the results were calculated using the 2013 IPCC 100 year Global Warming Potential method (IPCC, 2013). Details of the life cycle inventory (LCI) are summarized briefly in this report.

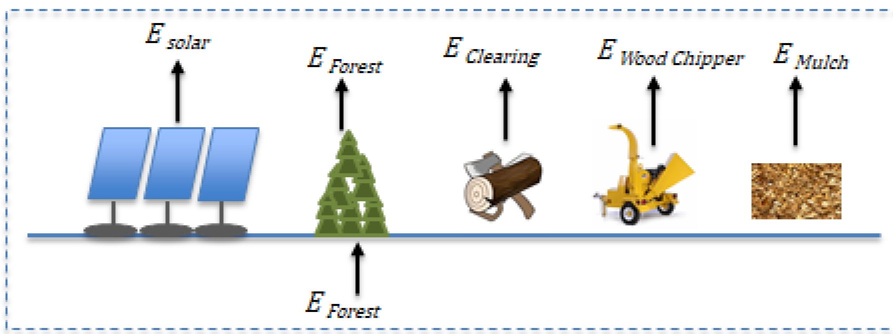
Solar Installation Scenario

Scenario Description

Under the solar installation scenario (Figure 1), it was assumed that 9.64 forested acres were cleared from the project site in Bennington, VT and that a 2 MW solar electricity generation array was installed for a 25-year period. The electricity generated in the solar installation scenario was assumed to be supplied as additional capacity to the GMP grid.

It was estimated that the 2 MW solar array could produce approximately 3,350 MWh/year in year 1, with a reduction in energy output of 18 MWh/year over the 25-year study period; resulting in a total of 78,350 MWh over the life of the project (Wilson, 2017). Wood biomass harvested from the forested area was assumed to be chipped into mulch and spread on-site, gradually releasing carbon into the atmosphere over the 25-year study period. It is likely that all of the carbon stored in the mulch would not be released during the 25-year period (Cleary & Caspersen, 2015); however, to create a conservative estimate of the GHG emissions from the solar installation scenario, it was assumed that 100% of the carbon from the mulch would be released during the study period. This assumption is tested by using 50% and 80% wood decomposition.

Solar Installation Scenario



$$\Delta\ GHG\ Emissions = E_{Solar} + E_{Forest} + E_{Clearing} + E_{Wood\ Chipper} + E_{Mulch}$$

Where:

E_{Solar} = *Carbon emissions by solar installation*
E_{Forest} = *Carbon emissions by forest (lost sequestration)*
$E_{Clearing}$ = *Carbon emissions by forest clearing*
$E_{Wood\ Chipper}$ = *Carbon emissions by wood chipper*
E_{Mulch} = *Carbon emissions by mulch*

Figure 1: System boundary for the solar installation scenario. The dotted line depicts the processes included in the GHG analysis.

Scope of GHG Emissions Assessment

The scope of the GHG emissions assessment for the solar installation scenario included the life cycle emissions associated with the solar technology, as well as the implications of changes to forest carbon stocks as a result of the land use change.

For the solar installation scenario, we quantified the following over the study period:

- Carbon emissions from harvested forest biomass (including above-ground carbon, live below-ground carbon, and soil organic carbon)
- Carbon no longer removed from the atmosphere due to loss of forest carbon sequestration
- Life cycle GHG emissions associated with mechanical harvesting activities during site clearing
- Life cycle GHG emissions associated with chipping wood

- Life cycle GHG emissions of manufacturing, transporting, installing, maintaining and decommissioning key solar installation components, including the solar panels, inverters, and other infrastructure (e.g. mounting racks, wiring, mounting pads, etc.)

Life Cycle Inventory

The life cycle inventory for the solar installation scenario is summarized in Table 1.

Table 1: Life cycle inventory data sources for modeling the solar installation scenario.

Life Cycle Stage	Data Source	Notes
Manufacturing of solar panels	Ecoinvent 3.3 Database (Wernet, 2016)	Scaled up the Ecoinvent values from an open-ground solar installation with a lower capacity.
Manufacturing of inverters	Ecoinvent 3.3 Database (Wernet, 2016)	Scaled up the Ecoinvent values from an open-ground solar installation with a lower capacity.
Manufacturing of mounting systems	Ecoinvent 3.3 Database (Wernet, 2016)	Scaled up the Ecoinvent values from an open-ground solar installation with a lower capacity.
Manufacturing of fuse box, electric cables and electric meters	Ecoinvent 3.3 Database (Wernet, 2016)	Scaled up the Ecoinvent values from an open-ground solar installation with a lower capacity.
Installation of solar panels and infrastructure at the site	Ecoinvent 3.3 Database (Wernet, 2016)	Scaled up the Ecoinvent values from an open-ground solar installation with a lower capacity.
Maintenance (replacement of inverters once during service life)	Ecoinvent 3.3 Database (Wernet, 2016)	Scaled up the Ecoinvent values from an open-ground solar installation with a lower capacity.
Disposal of solar panels and infrastructure at end of life	Ecoinvent 3.3 Database (Wernet, 2016)	Scaled up the Ecoinvent values from an open-ground solar installation with a lower capacity.
Carbon sequestration at the project site	(Vermont Agency of Natural Resources, 2017)	Average carbon sequestration of Vermont forests on an annual basis scaled to 9.64 acres
Below-ground forest carbon stock	(Vermont Agency of Natural Resources, 2017)	Average of live below-ground carbon content and soil organic carbon content of Vermont forests scaled to 9.64 acres
Above-ground forest carbon stock	(Vermont Agency of Natural Resources, 2017)	Average above-ground carbon content of Vermont forests scaled to 9.64 acres
Harvesting of trees during site clearing	Ecoinvent 3.3 Database (Wernet, 2016)	Modified USLCI process: *Roundwood {GLO}| harvest, primary forest | Alloc Rec, U*
Wood chipper to transform cleared trees into mulch	Ecoinvent 3.3 Database (Wernet, 2016)	*Wood chipping, chipper, mobile, diesel, at forest road {GLO}| market for | Alloc Rec, U*

Baseline Scenario

Scenario Description

Under the baseline scenario (Figure 2), it was assumed that additional electricity generation capacity is added to the New England grid by increasing natural gas generation over the 25-year study period by 78,350 MWh (equivalent to the total output of the solar installation scenario). It was assumed that the forest on the proposed Chelsea Solar site was left as is, and that there will be no forest management regime for the site during the 25-year study period. Sequestration by the forest was not considered, as it is included as emissions in the solar scenario.

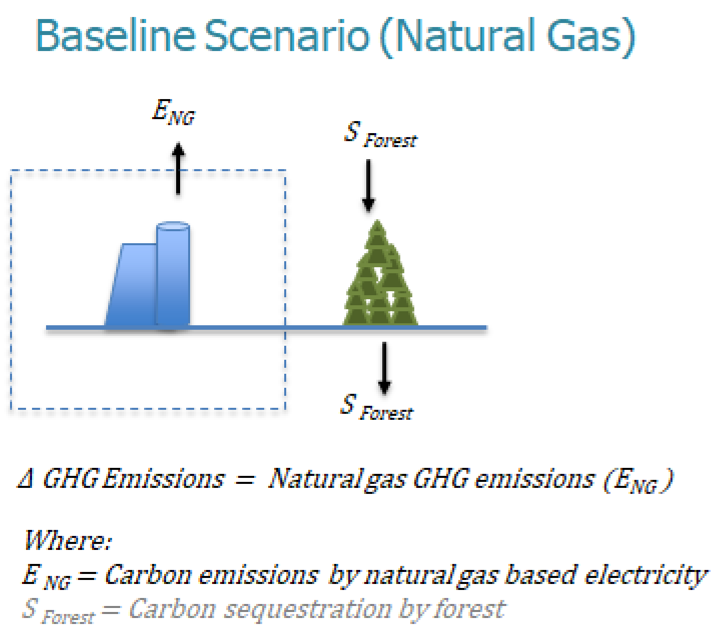


Figure 2: System boundary for the baseline scenario. The dotted line depicts the processes included in the GHG analysis.

Scope of GHG Emissions Assessment

For the baseline scenario, we quantified the following over the course of the study period:

- Life cycle GHG emissions associated with adding electricity generation capacity on the GMP grid equivalent to the proposed project based on average U.S. natural gas generation.

Life Cycle Inventory

The life cycle inventory data for natural gas are obtained from the DataSmart library (LTS, 2016) that includes the most up-to-date and detailed LCI data on natural gas production in the U.S. These data include all the production steps from natural gas extraction and processing to combustion in power plant. GHG emissions for combustion in a power plant are based on EPA's emission factors (EPA, 2016) and the upstream extraction and processing data is based on published sources, such as Skone et al., 2011 and Clark et al., 2011. These data include a conventional and shale gas mix of 54% and 46%, respectively (U.S.EIA, 2015). Sensitivity of

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the results to this data source is testing by considering the harmonized median values for conventional and shale gas (O'Donoughue et al., 2014 and Heath et al., 2014).

Results

Solar Installation Scenario Results

The results of the GHG emissions assessment for the solar installation scenario are summarized in Table 2. These results show total GHG emissions across the full 25-year life of the project expressed in Tonnes of CO_2e.

Table 2: Life cycle greenhouse gas emissions for the solar installation scenario for generation of 78,350 MWh of electricity over 25 years, including contribution analysis for the key sources of GHG emissions in the project life cycle

Life Cycle Stage	GHG Emissions (Tonnes CO_2e)
Solar Panels and Infrastructure	5,053
Forest above-ground carbon	1,542
Forest live below-ground carbon and soil organic carbon	145
Forest loss of carbon sequestration	265
Forest clearing	25
Wood Chipper	3
Total Life Cycle Emissions	**7,034**

**Note – Based on 100% decay rate for wood chips over 25 years. The actual GHG impact will be lower since all the wood chips will not decay over 25 years (Cleary & Caspersen, 2015)*

Total GHG emissions for generating 78,350 MWh of electricity from the solar installation scenario over the 25-year study period are approximately 7,034 Tonnes of CO_2e. The primary source of emissions is the manufacturing, installation, maintenance, and disposal of the solar panels and related infrastructure, accounting for about 72% of the life cycle GHG emissions. The primary source of GHG emissions within the solar technology life cycle is the manufacturing of the panels. The emissions associated with disturbance of forest above-ground biomass, below-ground biomass, and annual sequestration of biomass are the second largest contributor to total GHG emissions at about 28%. The GHG emissions associated with the clearing of forest and operation of wood chipper to make way for the solar installation accounted for less than 1% of total emissions.

Baseline Scenario Results

The results of the GHG emissions assessment for the baseline scenario are outlined in Table 4.

Table 4: Life cycle greenhouse gas emissions for the baseline scenario for generation of 78,350 MWh of electricity over 25 years using average U.S. natural gas

Life Cycle Stage	GHG Emissions (Tonnes CO2e)
Natural gas electricity (US/46% shale gas)	61,609
Total Life Cycle Emissions	**61,609**

Results of the GHG emissions assessment for adding natural gas electricity generation capacity to the New England grid show that this would result in 61,609 Tonnes of CO2e over 25 years.

Comparative Results

Solar Installation Scenario vs. Baseline Scenario

The primary objective of this analysis was to quantify the relative life cycle GHG emissions for adding 78,350 MWh of electricity generation capacity to the GMP grid by either the solar installation scenario or the baseline scenario using natural gas. Results of the screening analysis (Figure 3) indicate that significant reductions of nearly 90% in GHG emissions could be achieved by pursuing the solar installation scenario.

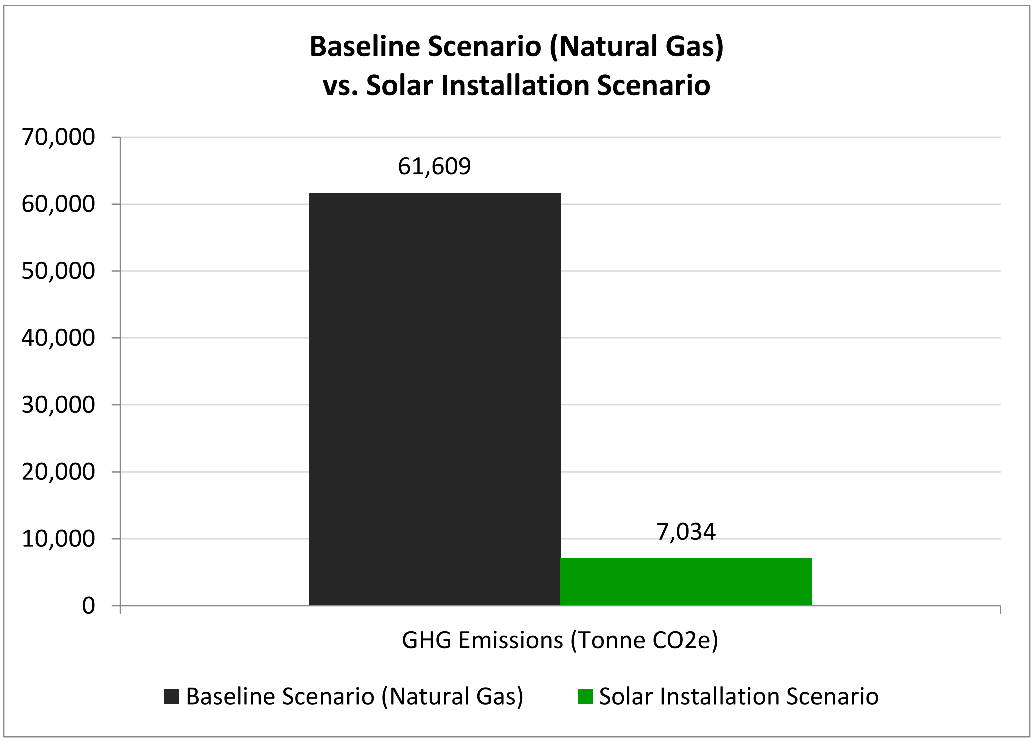

Figure 3: Life Cycle GHG Emissions for Baseline Scenario (Natural Gas) vs. Solar Installation Scenario per 78,350 MWh.

Solar Installation vs. Current NE, VT and GMP Grids

A secondary objective of this analysis was to understand how the life cycle GHG emissions of generating electricity with this type of solar installation compare with electricity produced by the current New England, Vermont and GMP grid mixes.

A summary of this analysis is provided in Figure 4. Relative to the ISO-NE grid, electricity generation with the solar installation would result in a reduction of about 81%. Relative to the Vermont Ownload grid, the solar installation would result in a reduction of about 73%. Relative to the Vermont GMP grid, the solar installation would result in a reduction of about 36%.

GMP purchases a significant portion of its electricity from New England (U.S.EIA, 2015). It should be noted that the new solar installation in Vermont will likely displace GMP's marginal electricity supply, represented here by the ISO-NE mix. The comparison shows the estimated GHG emissions reductions by the GMP grid if the GMP grid's marginal supply is replaced with solar power rather than the ISO-NE mix.

The additional comparison with the existing VT and GMP grids was conducted, at the request of the Vermont Agency of Natural Resources (ANR), to examine if there are GHG benefits associated with the solar installation relative to these grids. The results show that the GHG benefits are significant with the solar installation.

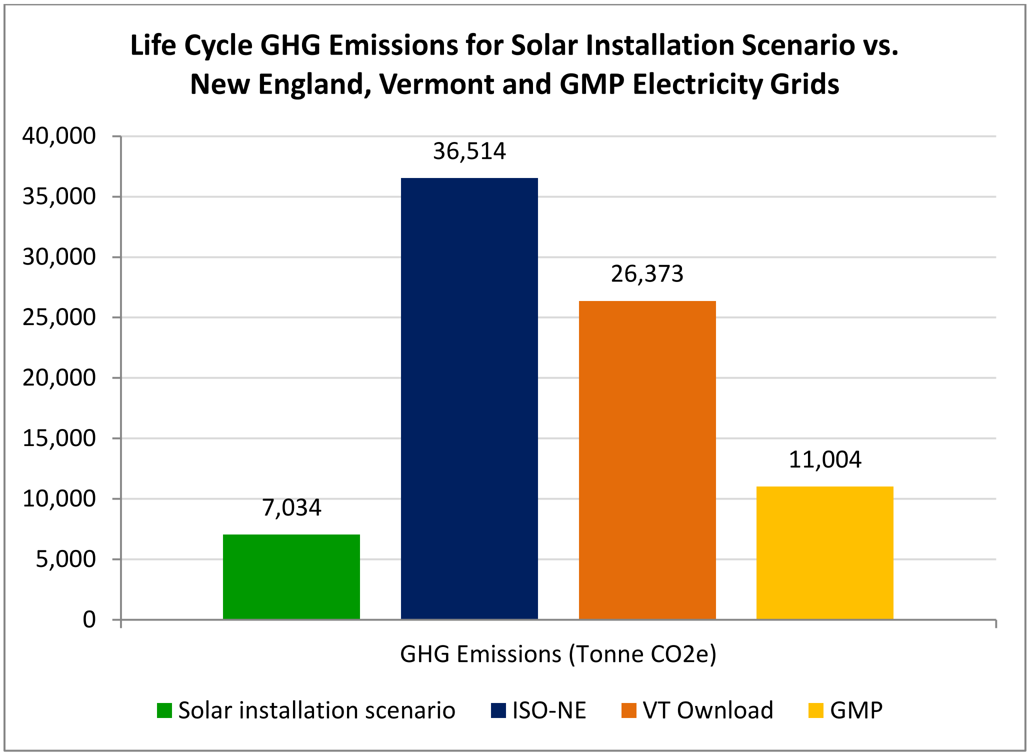

Figure 4: Comparative life cycle GHG emissions of the solar installation scenario relative to electricity generation from the existing New England (ISO New England Inc., 2015), Vermont Ownload (U.S.EIA, 2015) and Vermont GMP (Green Mountain Power, 2016) grids per 78,350 MWh.

Sensitivity Analyses

To test the sensitivity of the results to the main model assumptions, we considered alternative scenarios for key model parameters, such as mulch decay rate and project life. We also tested the sensitivity of the results to the natural gas data source by using the new harmonized median values (O'Donoughue et al., 2014; Heath et al., 2014).

Sensitivity to mulch decay rate

The solar installation scenario assumed 100% decay of the wood chips releasing all of the above ground forest carbon during the study period of 25 years. This assumption was tested by using decay rates of 80% and 50%. An 80% decay rate decreases the GHG emissions for the solar installation by 4% and a 50% decay rate further decreases GHG emissions for the solar installation by 11%.

These results indicate that the solar installation model is sensitive to the wood chip decay rate and the actual GHG emissions from the solar scenario may be lower in the next 25 year period than projected in the main analysis. That being said, the wood chips will eventually decay completely, releasing all of the stored carbon.

Sensitivity to solar project life

An increase in project lifetime from 25 to 40 years would decrease the solar installation scenario GHG emissions by 35%. It should be noted, that this sensitivity analysis does not include the additional maintenance needed which can possibly reduce the GHG benefits seen by extending the project lifetime. This analysis also does not include the potential carbon sequestration benefits of vegetation regrowth after the installation is complete.

Sensitivity to natural gas data

The DataSmart life cycle GHG emissions for natural gas, with 46% shale gas mix, yield 750 g CO2e/ KWh. To test the sensitivity of the results to this data source, we considered the harmonized median life cycle GHG values of 670 g CO2e/ KWh for conventional natural gas (O'Donoughue et al., 2014) and 465 g CO2e/ KWh for shale (Heath et al., 2014).

The results with the median harmonized values show that per 78,350 MWh, life cycle GHG emissions for natural gas with 46% shale mix are 45,106 Tonnes CO2e. These values are about 27% lower than the DataSmart value for natural gas (61,609 Tonnes CO2e per 78,350 MWh). When these harmonized values are compared with the solar installation scenario, we find that the solar scenario still has about 85% lower GHG impacts.

Conclusions

Results of the screening life cycle GHG assessment of the Chelsea Solar installation indicate that substantial GHG emissions reductions of 85-89% could be achieved over the 25-year study period relative to adding natural gas generation capacity to the GMP grid. The results also show that relative to the existing electricity grids in Vermont, New England and GMP grids, substantial GHG emission reductions of up to about 81% could be achieved over the life of the solar installation. The reductions relative to the Vermont Ownload are particularly notable given the relatively low-emission sources of electricity used to supply the Vermont grid. Nearly 45% of the grid is supplied by hydropower, while another 20% of the grid is supplied by a mix of renewables including wind, solar, and biomass. Although the solar installation is likely to displace the marginal electricity supplied to the GMP grid by ISO-NE, a comparison to the Vermont and GMP grids was included at the request of the Vermont ANR.

These significant reductions in GHG emissions can be achieved with the solar installation despite the proposed land use change for the 9.64 acres of partially forested land at the site, and despite reductions in 18 MWh/year in energy output over the study period beyond year 1. Results of the assessment show that the potential GHG emissions associated with converting this partially forested land to solar electricity production are orders of magnitude smaller than the life cycle GHG emissions associated with electricity from average U.S. natural gas generation, or from current ISO-NE, Vermont Ownload, and Vermont GMP grids. This is a result of the relatively small area of forest to be cleared and the relatively low carbon sequestration potential of the site in its current condition.

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Life Cycle Inventory and SimaPro Processes for Baseline Scenario Electricity

ISO-NE Grid - 2015

Data for the ISO-NE grid mix were obtained from the Electric Generator Air Emissions Report 2015 ISO New England (https://www.iso-ne.com/static-assets/documents/2017/01/2015_emissions_report.p

SimaPro processes are from the US-EI database, which is an amalgamated LCI dataset of newly developed data, expanded USLCI data, and modified Ecoinvent 2.2 data (EarthShift LLC. 2013)

Energy Source	Contribution	SimaPro Process
Natural Gas	43%	Electricity, natural gas, at power plant (23% shale)/US
Oil	2%	Electricity, oil, at power plant/US
Nuclear	34%	Electricity, nuclear, at power plant/US
Coal	5%	Electricity, hard coal, at power plant/US
Hydro	7%	Electricity, hydropower, at power plant/US
Wind	2%	Electricity, at wind power plant/US
Other Renewables	7%	Assumed mix of 3% wood biomass, 6% wind, 1% solar
Total	100%	

Vermont Ownload - 2015

Data for the Vermont Ownload were obtained from the US EIA 2015 Energy Consumption Overview: Estimates by Energy Source and End-Use Sector, 2015 (http://www.eia.gov/state/seds/seds-data-com

SimaPro processes are from the US-EI database, which is an amalgamated LCI dataset of newly developed data, expanded USLCI data, and modified Ecoinvent 2.2 data (EarthShift LLC 2013)

Energy Source	Contribution	SimaPro Process
Solar	0.70%	*Electricity, natural gas, at power plant (46% shale)/US*
Hydro	18.43%	*Electricity, hydropower, at power plant/US*
Wind	5.22%	*Electricity, at wind power plant/US*
ISO-NE	64.00%	See above table
Methane/biogas	11.30%	*Electricity, at cogen, biogas agricultural mix/US*
Total	99.7%	

Vermont Green Mountain Power (GMP) - 2016

Data for the Vermont GMP were provided by the Vermont Agency of Natural Resources (http://www.greenmountainpower.com/2016/12/01/fuel-mix/)

SimaPro processes are from the US-EI database, which is an amalgamated LCI dataset of newly developed data, expanded USLCI data, and modified Ecoinvent 2.2 data (EarthShift LLC 2013)

Energy Source	Contribution	SimaPro Process
Natural Gas	0.20%	*Electricity, natural gas, at power plant (46% shale)/US*
Solar	2.00%	*Electricity, natural gas, at power plant (46% shale)/US*
Oil	0.20%	*Electricity, oil, at power plant/US*
Nuclear	13.80%	*Electricity, nuclear, at power plant/US*
Hydro (from Quebec)	45.20%	*Electricity, hydro, reservoir/(CA-QC)*
Wind	8.20%	*Electricity, at wind power plant/US*
ISO-NE	27.40%	See above table
Methane/biogas	0.30%	*Electricity, at cogen, biogas agricultural mix/US*
Wood Biomass	2.60%	Electricity, biomass, at power plant/US
Total	99.9%	

Chelsea Project electricity output over 25 years:	78,350	MWh

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Forest Carbon Calculations

Above-Ground Carbon

Amount:	1542.4	MT CO2e	
Above-ground carbon/acre Vermont forest land:	160	MT CO2e/acre	*Source: Vermont Forest Carbon Assessment 2017*
Chelsea site acres to be cleared:	9.64	acres	*Source: ECOS Energy*

Below-Ground Carbon

Amount:	144.6	MT CO2e	
Total BGC and SOC per acre:	15.0	MT CO2e/acre	*Source: Vermont Agency of Natural Resources 2017*
Chelsea site acres to be cleared:	9.64	acres	*Source: ECOS Energy*

Tree Harvesting for Site Clearing (Solar Installation Scenario)

Amount:	1,232	m3	
SimaPro Process:	*Softwood logs with bark, harvested at medium intensity site, at mill, US PNW*		
Comment:	Process includes diesel consumption, use of lubricants for machinery, and transportation offsite		
Total volume of above-ground biomass, live trees	574,888,619	m3	*Source: Forests of Vermont 2015 - USDA*
Total area of Vermont forest land	4,500,000	acres	*Source: Forest Carbon Fact Sheet - Vermont Department of Forests, Parks & Recreation 2015*
Average Vermont volume of live trees	127.75	m3/acre	
Chelsea site acres to be cleared:	9.64	acres	*Source: ECOS Energy*

Lost Carbon Sequestration due to Site Clearing

Amount:	260	MT CO2e	
Annual carbon sequestration in Vermont forest:	4,840,000	MT CO2e	*Source: Vermont Forest Carbon Assessment 2017*
Total area of Vermont forest land	4,490,000	acres	*Source: Vermont Forest Carbon Assessment 2017*
Carbon sequestration/ acre Vermont forest land/ year	1.1	tons/acre/year	
Chelsea site acres to be cleared:	9.64	acres	*Source: ECOS Energy*
Life of project	25	years	