STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

Petition No. 1310

Company: Quinebaug Solar, LLC

Submission Date: October 10, 2017

Exhibit CSC-82
Life-Cycle GHG Assessment, Quinebaug Solar

Life Cycle Greenhouse Gas Assessment: Quinebaug Solar

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Objectives

- To calculate the potential GHG benefits of Quinebaug solar installation
  - To achieve this objective we quantified the change in GHG emissions over the study period associated with:
    1. impacts from the existing forest at the site and adding conventional electricity generation capacity, via natural gas, equivalent to the proposed project (baseline scenario);
    2. converting the partly forested and agricultural site to a solar panel installation to supply additional generation capacity to the grid (solar installation scenario).

    The difference between these two values is an estimate of the GHG reduction that the project can expect to achieve.

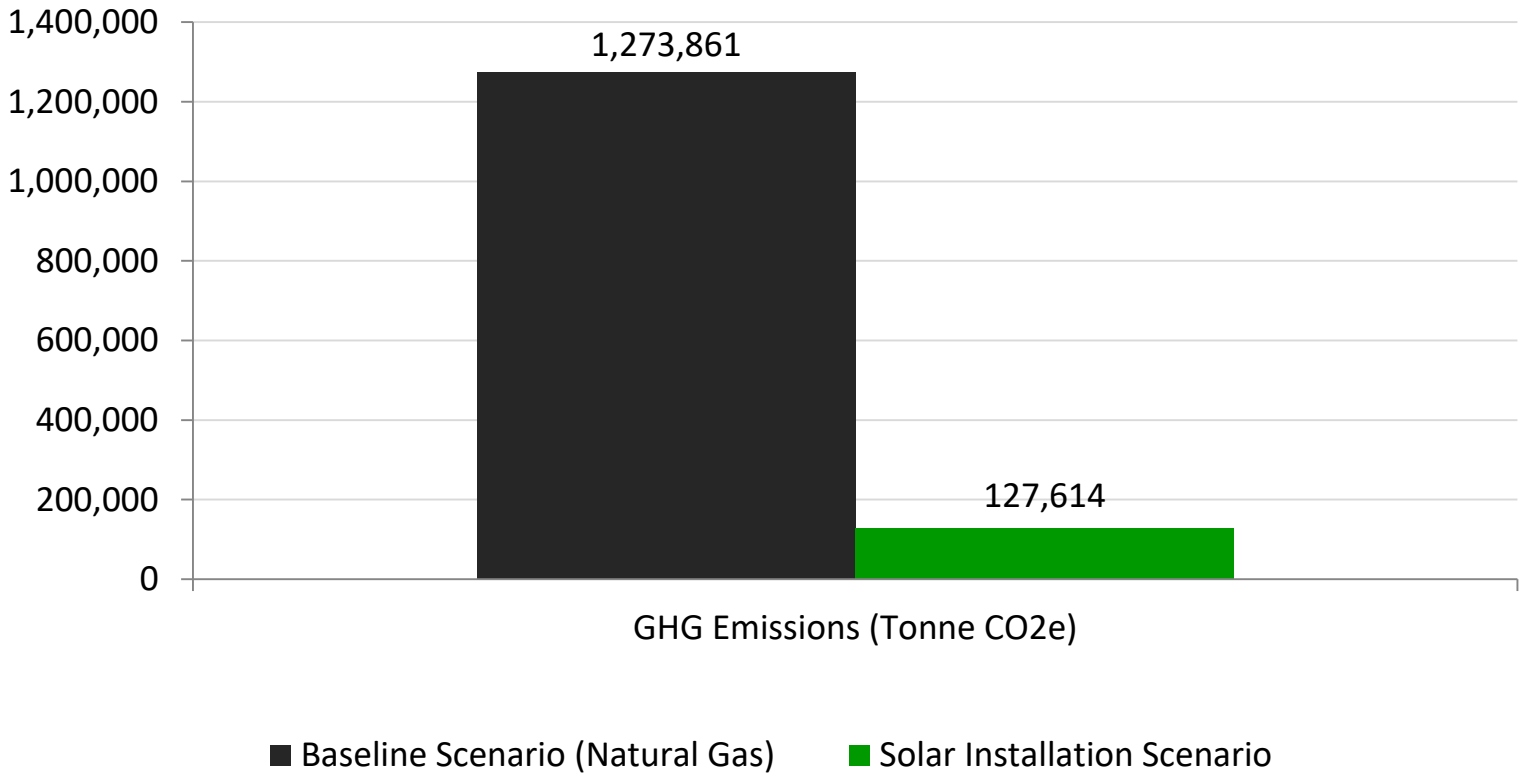
Assumptions

- Based on the USDA data, was estimated that about 83% of the forest are hardwood trees and the remaining17% are softwood (Forests of Connecticut, 2016 USDA)
  - Softwood trees were assumed to be chipped and spread on site and hardwood was assumed to be sold for milling purposes
  - About 20% of the wood products are expected to stay in-use or intact after 30 years and the remainder are expected to decay and release CO2 (Searle & Marlin 2011)

- Displaced corn and soybean
  - Corn cultivation is assumed to move to a nearby fallow land to meet the market demand
  - Soybean cultivation is expected to move to land out of State to meet the market demand. To model this change, we included the marginal suppliers of soybean, such as Brazil and included the land use change impacts from growing additional soybean in the country.

Results

Baseline Scenario (Natural Gas*) vs. Solar Installation Scenario per 1,620,000 MWh of electricity



**conventional, simple cycle combustion turbine*

Results

EarthShift Global
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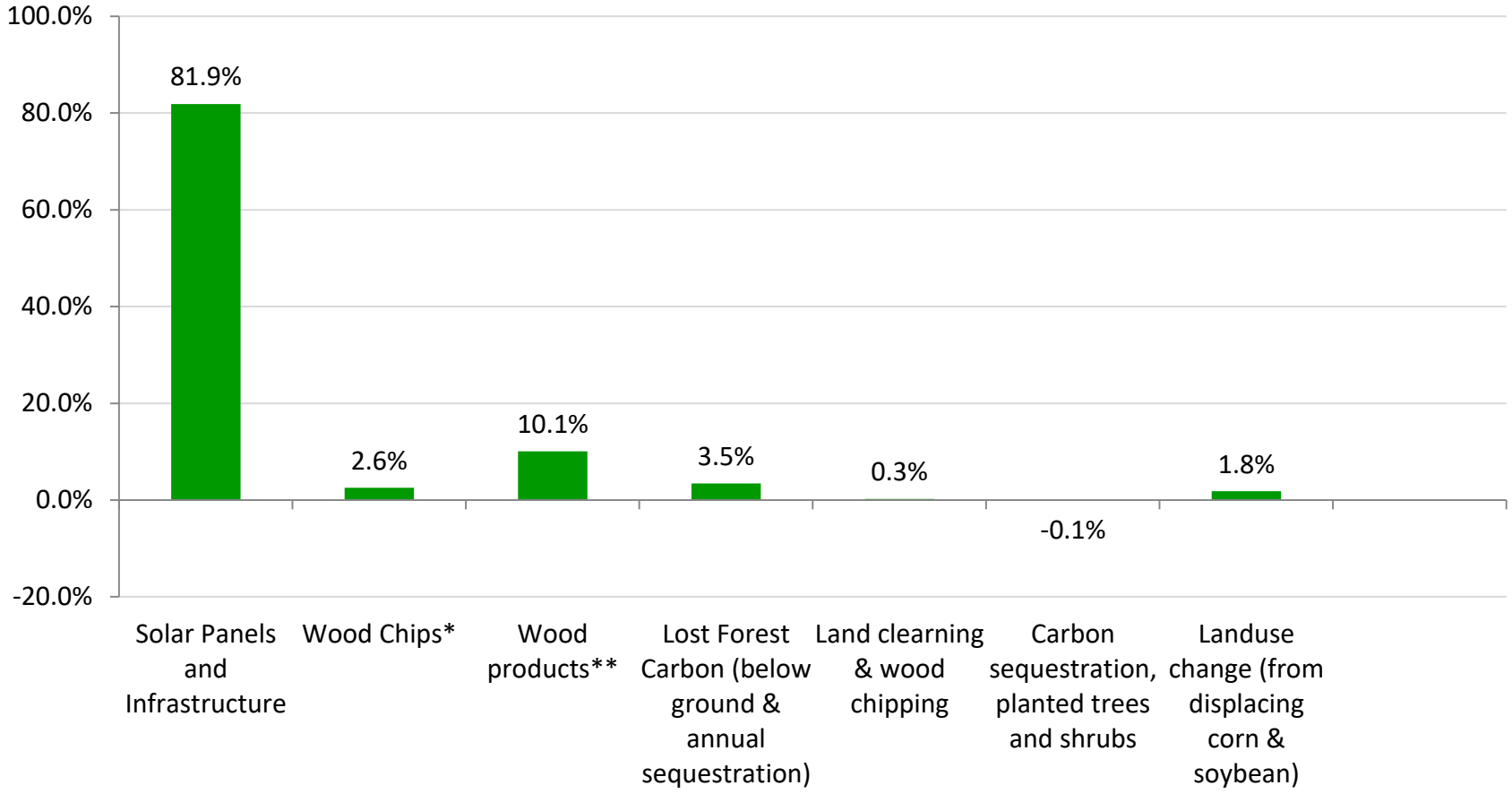
Solar Installation Scenario per 1,620,000 MWh of electricity



*woodchips assumed to decay completely and release CO2 during the 20 year period

** about 20% of the wood products are expected to stay in-use or intact after 30 years, the remainder expected to decay and release CO2 (Searle & Marlin 2011)

Results

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Solar Installation Scenario per 1,620,000 MWh of electricity

Life Cycle Stage	GHG Emissions ($MT CO_2e$)
Solar Panels and Infrastructure	104,488
Wood Chips	3,254
Wood Products	12,870
Lost Forest Carbon (below ground & annual sequestration	4,427
Land clearing & wood chipping	320
Carbon sequestration, planted trees and shrubs	-106
Land use change (from displacing corn & soybean)	3,005
Total Life Cycle Emissions	**127,614**

EarthShift Global's response

Carbon Debt Analysis

- CSC-78 In QS' response to Council interrogatory number 51, QS utilized an equivalent natural gas plant in its carbon debt analysis. Is the "equivalent natural gas plant" a simple cycle combustion turbine or a combined cycle facility?
- ESG: The equivalent natural gas plant is assumed to be a simple cycle combustion turbine. We will be including sensitivity analyses with a combined cycle facility in the final report.
- Petitioner's Response: CSC-79 Neglecting the equivalent natural gas plant, provide a simple carbon debt payback period by first computing the loss of carbon dioxide sequestration over the life of the facility due to tree clearing and then adding in the carbon dioxide used to manufacture the solar equipment. This would represent the "debt" to be paid back. Then divide by the annual carbon dioxide emission reductions due to the Class I renewable energy displacing the traditional grid generation to arrive at an approximate "payback period."
- ESG: Given the lost carbon dioxide sequestration over the life of the facility due to tree clearing and the carbon dioxide emitted from the manufacture of the solar equipment, the approximate payback period was calculated using regional weather data (http://pvwatts.nrel.gov/) and was found to be about seven years.
- Is it also correct to note that this is a simplified analysis and a rough approximation because grid emissions may decrease over time due to retirement of fossil fueled-generation and growth of renewables that are expected to occur in the future?
- ESG: This analysis compares the total MWh generated by solar over a period of 20 years and an equivalent amount generated via natural gas. Retirement of fossil fuel based generators and growth of renewables is expected in the future but is not captured in this analysis.

References

- Searle and Malins 2011 http://www.theicct.org/sites/default/files/publications/ICCT_carbon_storage_in_wood_products_August_2011.pdf

Thank You for Your Time

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