Pope Energy

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Re: SMART Program Revisions 2024

Dear Secretary Tepper and Commissioner Mahony:

The revised SMART program should be a 10-year, 1 GW per year, 10 GW solar program co-terminus with the Inflation Reduction Act terminating in 2034. To encourage continuous solar development while protecting ratepayer interest, the SMART program compensation should be reviewed every other year by a third-party energy economist to stay current with tariffs, global supply-chain issues, material cost, labor cost, and political ebbs and flows on clean energy.

The promulgated revised SMART regulations need to send a clear signal to the Electric Distribution Companies (EDCs), the Transmission Operators (TO), and ISO-NE that Massachusetts is responding to the legislature's requirements of St. 2021 c. 8 Next Generation Roadmap and Climate Act of 2022.

National Grid, in its Future Grid Plan, Page 18, September 2023, and recent Grid Modernization Advisory Council (GMAC) verbal testimony, forecast 4,000 MW of solar by 2035 and is basing it on current GMAC capital investments and CIP work on the 2025 and 2030 CECP, June 2022, which was informed by 2050 Decarbonization Roadmap of 2020 by EEA.

Figure 40 from the Energy Pathways Report is attached on Exhibit 1 and describes 300 MW of solar being installed per year until 2035.

Setting the revised SMART program size to 10 GW, 1 GW per year, over 10 years would shape the DOER's SMART program design, EDCs response to GMAC and influence ISO-NE disposition in accommodating state emission reduction requirements.

DOER SMART STAKEHOLDER QUESTIONS

DOER Question 1:

What project type incentive changes could improve program outcomes?

Answer 1:

Establish a long-term solar program which should shape and simplify the SMART program. Massachusetts solar programs were capacity size constrained due to a lack of knowledge and experience. The choppiness of solar policy and capacity size has led to on-again, off-again availability of solar policy and interconnection capability. Interconnection is tied to solar capacity size because the EDCs and DPU need to know what infrastructure to build in order to service public policy. In a post-Next Generation Roadmap and Climate Act of 2022 world, Governor Healey's proposal to install 10 GW of solar PV by 2030 should be adopted; although due to the interconnection issues and FERC 2023, the 10 GW program should run through 2034 and be concurrent with the Inflation Reduction Act (IRA) Investment Tax Credit (ITC) legislation. The development rate should be 1 GW per year. The 10 GW SMART regulation will inform procedures at GMAC, DPU, DEP, and ISO-NE to upgrade electrical infrastructure in conjunction with electrification of the building and transportation sectors.

Answer 2:

The last time the economics of the SMART compensation were reviewed and implemented was 2016. The declining block legislation was well-intended but ignored the realities of long interconnection timelines, political delay, rising prices on materials, labor, interest, and global supply chain issues.

To encourage continuous solar development and at the same time protect ratepayer interest, SMART compensation should be review by a third-party energy economist every 18 months with DOER and DPU finishing their processes within the following six months totaling two years. A lot of things can happen in two years, as current events have shown us.

A reasonable objection of DOER and DPU might be that both departments cannot be bothered touching SMART issues every two years, as they have enough to do with too little qualified staff. That point of view would be valid if it were not for the hundreds of companies and thousands of employees that have taken the signals from the legislature and are dedicating their careers to reducing emissions in Massachusetts and need a continuous flow of work for a generation. Every dollar spent in renewable energy yields three dollars in economic output.[1] The Healey Administration will create tens of thousands of jobs that will grow the economy and pay taxes with a ten-year, 10 GW revised SMART program.

The Healey Administration needs to establish a firm understanding between departments or ask the legislature for a law that establishes that DOER sets the policy and rates for the SMART program and DPU litigates a tariff. If the public policy issues and compensation are already established, why would litigating, and writing a tariff take longer than three months?

DOER Question 2:

The current SMART program structure includes a declining block model. Is a structure with fewer blocks and a greater decline between blocks preferable to a greater number of blocks with a smaller decline between blocks? Are there any other modifications to the declining block model structure that could more effectively support solar development?

Answer:

The declining block concept depends upon decreased cost due to the scaling of the solar sector, increased labor and management efficiency due to increased familiarity with installing solar, and therefore less project risk and an increasing labor pool of solar-interested workers keeping labor down due to competition for work.

Prices for materials stopped going down when, in January of 2018, the 30% tariffs against China and certain foreign sources solar materials was approved. Efficiencies in labor levelized between 2018 and 2019 amongst installers and EPCs. COVID changed installers disposition between project size; an installer that was interested in doing 500 kW solar projects would only look at 2 MW or larger size projects. During and after the pandemic, prices rose dramatically.

For developers, the declining block is a failure and represents pure risk as the interconnection queues and municipal abutter appeal processes all push out the issuance of the Preliminary Statement of Qualifications (PSOQ) which is the financial key to the ordering of materials and engagement of contracts. With approvals pushed out for years, the dartboard guess of 2 blocks being consumed by the time of issuance of the PSOQ could be meaningless due to a fast run on blocks due to release of EDC Group and ASO Studies. Remember the November 2018 run on National Grid SMART program size of nearly 900 MW in two weeks? That run cost this author 37 MW worth of projects.

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[1] Economic and Health Impacts Report, Page 5, A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study, December 2020

With a 1 GW-per-year solar PV development rate, there must be a means of encouraging continuous development. That means set the declining block at one quarter of 1% or 0.0025 and reset the SMART compensation every two years. Or appeal to the legislature, that because of forces outside the control of developers such as interconnection queues, tariffs and global supply chain issues, the declining block legislation needs to be removed from statute.

DOER Question 3:

Are any eligibility criteria in the SMART program barriers to participation? What are they, and how would you address these barriers? How would you streamline these eligibility criteria?

Answer 1: ASTGU

Not allowing the trees to be cut on farms for any kind of solar project and including ASTGU projects amounts to ignoring how farmers want to use their land. Farmers want to use their least productive lands for any kind of solar project and this means placing the project away from their fields planted and harvested by mechanized means. Unless the land is under some kind of conservation restriction, farmers do not need permission to cut the trees on their property. So why should the SMART program constrain the success of a farmer that public policy and the work of DOER's own program has an interest in helping succeed?

Before considerations of placing solar on the property, trees are often deliberately left standing by the farmer to provide shade for grazing animals and other reasons, including neglect or having no reason at the time to cut the trees on their property. When a solar project is placed on a farm, we need to cut the trees to avoid shading of the solar array. A 100-foot tree will throw a 300-foot shade line. Shade for animals in a solar project will be provided by the ASTGU solar array.

Allow for the return of wooded parcels held in private-sector ownership to farmland use with ASTGU projects without restriction, as it will help grow farms and support farmers' efforts. Farmers are conservationists too; they will not allow areas such as a maple sugar bush to be torn down. To that point, perhaps a maple tree sugar bush could be specifically excluded from ASTGU development.

Eliminate the "each square foot" language in the regulations. An ASTGU project that is designed for a highly mechanized commercial agricultural farm with rows 30 to 60 feet apart will need to have panels raised 8 to 10 feet high, with panel spacing closer together to be economic from both a development and farmer land-rent prospective.

The use of the term "forest" or "mature forest" in ASTGU regulations and Guidelines is a misnomer and a loaded term. Core forests are defined in Figure 16 Final Selection of Forest Cores and represent 325,449 acres of mapped and defined areas of core forest. See attached map on Exhibit 2. [2] The 1.3 million acres

[2] BioMap2 Technical Report, Building a Better BioMap, Mass Fish & Game and The Nature Conservancy, Page 62 and Table 1, Page 4.

of land held in permanent conservation representing 27% of Massachusetts land mass,[3] may be on their way to becoming or have become mature forest lands. But most wooded areas on farms are just that – woods.

Get away from the comparable crop standards in the ASTGU Guidelines. If an ASTGU is designed for grazing cattle, the comparable crops will be hogs, sheep, goats, and chickens. Regulations nor guidelines should be trying to make a vegetable farmer out of a grazing farmer whose entire operation of barns, trailers, tractors, freezers, and business relationships are set up for grazing and harvesting animals.

Farmers, a more opinionated group than solar developers, are unwilling to sign on to agreements that require making operational changes like changing crops or farming practices.

ASTGU designs for highly mechanized commercial farming will have the rows further apart and will by definition be more intensely farmed and allow for more varied crop and/or grazing but will not meet the "each square foot of sunlight" standard.

The annual reporting requirement is the management tool for compliance to the ASTGU regulations. A 5 MWac, 7 MWdc ASTGU system that costs over $15 million is going to have attorneys, bankers, CEOs, and COOs all focused on making sure the land inside the fence line of the ASTGU system is being farmed. Solar land leases are structured that if the farmer fails or is unable to farm inside the fence line for whatever reason, the owners of the ASTGU system will need to perform the farming work.

Farm productivity will change with weather, disease, and market conditions. DOER and MDAR should not be trying to micromanage the yield process. If a farmer, whose average age, according to MDAR, is 59 years old, has a heart attack during crucial times of the growing season, it will take several weeks for replacement management and labor to make required adjustments. Production will falter. We agree with Blue Wave's language for MDAR waiver conditions.

> *"Due to unforeseen circumstances, such as but not limited to weather events, pests, or change in crops, the projected agricultural yield for any given year may be substantially lower than stated in the agricultural plan. In these instances, when production falls below 80% of anticipated yields, an applicant can request a waiver to the Department for the decreased yields. The applicant must demonstrate to the satisfaction of the Department, and in consultation with MDAR, that a waiver is warranted for good cause."*

Simplify the ASTGU process. The question should be: Is there bona fide agricultural work going on inside the fence line of the ASTGU? Please do not try to turn a grazing farmer into a fruits and vegetable or U-pick farmer.

[3] Mass Audubon

Eliminate the 80 MW ASTGU program size.

Coordinate the efforts of DOER and MDAR to encourage ASTGU projects on farms. A $50,000 MDAR grant used to fund a farm store and equipment, with a ten-year restrictive agricultural covenant should not be used to block and hold up a $50,000 - $100,000 per year, 25-year ASTGU land lease that will help keep the farmer in business.

Question 3: Barrier to Participation (cont.)

Answer 2: BioMap2

Eliminate the BioMap2 restrictions in the SMART program. No other market or building sector is restricted from building in BioMap 2 areas; why the solar industry? Is this because environmental stakeholders have no other levers to stop development in other sectors? This means that environmental stakeholders will have no levers to stop the 1.7 billion square feet of building space forecasted by the 2050 Decarbonization Roadmap written by EEA in 2020[4] but they want to stop the potential of 130,000 acres of solar development that would be involved in 1 GW of solar until 2050. Solar development is the only construction activity that reduces emissions and yet there are those that want to restrict its development.

Massachusetts has 5,019,113 acres of land to which 1.3 million acres is held in permanent conservation representing 27% of Massachusetts land area.[5]

If 1 GW of ground-mount solar was developed per year until 2050 at 5 acres per MW that would equal: 1000 MW x 5 x 26 years = 130,000 acres or 10% of the land area currently under permanent conservation.

Onsite Mitigation:

For those projects in a BioMap 2 area, those sites would be subject to active on-site mitigation such as the planting of pollinators, milkweed for pre-listed endangered Monarch butterflies and food/habitat for migratory species. Given the 1.7 billion square feet of forecast to be developed in MA by the 2050 Decarbonization Roadmap including 374 million square feet of single-family and small residential multi-family by 2030, it is the opinion of this author that **all** development should be subject to active onsite species mitigation. Table 3 Projected Residential Development and Table 4 Projected Commercial Non-Residential Development attached on Exhibit 2.

No other kind of residential nor commercial development is constrained by simply being listed on a BioMap2 area. SMART solar projects should not be so constrained.

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[4] See Exhibit 5 for Table 3 and 4 from the Building Sector Technical Report, 2050 Decarbonization Roadmap published by EEA 2020.
[5] Mass Audubon

Over 1.3 million acres are now permanently protected in Massachusetts, approximately 27% of the state's land area.

If 1 GW of ground-mount solar was developed per year until 2050 at 5 acres per MW that would equal: 1000 MW x 5 x 26 years = 130,000 acres or **10% of the land area currently under permanent conservation.**

Massachusetts and non-profits have their own targets to place additional lands under conservation. We view the use of the BioMap2 solar development exclusion as a means of employing NIMBYism against any development and solar, through the incentive program, is the only lever those against the cutting of trees and the use of the BioMap2 study have to achieve their goals.

BioMap2 areas represent Core Habitat consisting of 1,242,000 acres and Critical Natural Landscape consisting of 1,783,000 acres. If politically DOER is unable to remove the BioMap2 Core Habitat restriction, because no other business sector is so constrained, please remove the Critical Natural Landscape of 1,783,000 acres from being excluded from SMART projects. See attached BioMap2 chart Exhibit 4.

Question 3: Barrier to Participation (cont.)

Answer: Cutting of Trees and Sequestration

Allow the cutting of trees in general and especially on farms. Carbon sequestration is aimed at sequestering carbon from fossils fuels not trees vs. solar. If Massachusetts desires to sequester carbon through the retention of treed areas, they should acquire through a land trust mechanism, forested lands outside the state either along transmission corridors servicing delivery of electricity to the state or in areas of land frequented by Massachusetts residents for recreation.

In the attached Exhibit 3, a 43.6-acre parcel of land covered with solar panels generating 19,320 MWh of electricity, sequesters 34.65 (242,631.63 mt / project life) times the amount of carbon the woods (7,001 mt / project life) would sequester. The entire report is attached to this comment letter.

To portend that trees sequester carbon from anthropogenic activity greater than a solar project simply ignores the data.

If trees are cut, on-site mitigation can take place for migratory avian and insect species.

When this author submitted our Comment Letter on the Interim 2030 CECP to the National Audubon Society, they understood on-site mitigation immediately because we are all in the Atlantic Flyway. (See Exhibit 6) When I brought the same issue up to the Mass Audubon, an independent organization, they did not care for the mitigation idea, as it did not fit their narrative. At a recent Raab Restructuring Roundtable, Eliza Donoghue, Esq. spoke eloquently about the importance of working with solar and other developers to saving the really important forest and not getting worked up about those areas "that are really just woods."

That should be the focus of the SMART program, save the really important forest and not focus on those areas that could otherwise be built for housing or commercial uses that are really just woods.

Question 3: Barrier to Participation (cont.)

Answer: Eliminate Growth Control Measures in SMART

The SMART program was conceived during a period in Massachusetts solar policy development where program sizes were constrained; and the SMART program is loaded with growth control measures. With a 1 GW per year, ten-year, 10 GW program size, get rid of growth control measures in SMART.

Eliminate the Project Segmentation adjacent parcel rule.
Eliminate the Greenfield Subtractor.
Eliminate the land siting criteria.
Eliminate the 80 MW ASTGU program size.
Remove the restrictions on public solar and storage projects relative to land ownership, solar system land ownership or participating in a Community Solar subscription.

DOER Question 4:

Is the current SMART reservation period (excluding any blanket extensions) adequate, given current development and construction timelines? If possible, please provide a representative project timeline inclusive of key project milestones, such as permitting, procurement, and interconnection, to help inform DOER's understanding of the development process and current project timelines.

Answer: Three Years

In previous SMART and SREC programs which were capacity constrained, DOER wanted developers to focus on executing so as not to slow down the constrained queue.

With a 1 GW annual program size, give developers three years to complete projects and relieve DOER of managing a deadline related system that really has no reason for continuing to exist.

In general, developers, investors, and ITC participants get paid when projects reach COD. Let the financial market drive completion of projects. Global supply chain issues will still exist but DOER will not need to manage that timeline.

DOER Question 5:

Are there any emerging technologies or project types that are not currently eligible for SMART that DOER should consider making eligible for the program? Please describe potential project applications, any suggestions for eligibility requirements, and what level of incentives if any would be needed to spur project development of the project type.

Answer: Charging with Grid Power

Energy storage systems in a solar + storage scenario should be able to receive off-peak energy from the grid to charge in the early AM to assist the forecasted winter AM peak. While this may be implicit in some GMAC proceedings, this is not discussed enough as an electrical system benefit. The SMART program should include "enabling" provisions so that when DPU establishes a tariff, the SMART program will allow for compensation for ESS payments for such grid charging revenue.

DOER Question 6:

Are program compliance requirements clear prior to program enrollment? What are the key challenges with satisfying the data and/or documentation requirements for various program compliance checks, such as compliance with the energy storage, low-income, or community solar requirements? Are there any modifications you would suggest to DOER's compliance processes, or alternative data/documentation you believe could satisfy the requirements?

Answer: Cutting of Trees and BioMap2 – Defying the Exercise of Commonsense.

If I have a homeowner with a 20-acre parcel of land that is treed with diseased trees that he intends to cut down this summer, is that site a "treed site" under SMART or suitable for solar development?

If I have a 100-acre parcel of land which has an approved subdivision planned for the property and 80% of the land has been cleared with some visible machine markings on the granite boulders, but there are still some trees that mark the multiple parcel boundaries and a GIS picture would show the land as treed, and there is a vein of gravel that traverses the property into a BioMap2 area, would this parcel qualify as a treed site and BioMap2 disqualified site? Since this site is on the A1 B2 Feeder which will take five years to rebuild, if the landowner extracts the gravel in a BioMap2 area, is this now a previously developed site?

The proponents of BioMap2 and tree cutting restrictions ignore the fact that those development constraints do not exist for private sector residential and commercial development. Those same proponents ignore the 1.7 billion square feet the 2050 Decarbonization Roadmap published by EEA forecast to be built by 2050.

DOER Question 7:

Answer: The basic structure and premises of the SMART program is innovative, well designed and well managed. Please see answer in Question 6 above.

DOER Question 8:

Are there solar canopy project types that currently fall outside the SMART program's definition of Solar Canopy that you believe should be eligible for the Canopy adder? Please provide example project types and describe their benefits.

Answer: Vehicle and Outside Storage

In addition to vehicular canopy applications, solar canopies should be used and encourage in any kind of exterior storage to cover truck facilities, landscaping material and equipment storage, lumber yards, manufacturing facilities with exterior storage facilities. Additions to buildings should be considered such as a landscaping area to a Walmart.

DOER Question 9 : No direct experience with agrivoltaic programs in place in other jurisdictions.

DOER Question 10:

What modifications to SMART incentive payment calculations, as currently set forth in 225 CMR 20.08, if any, are needed? Please provide examples formulas or calculations for DOER review.

Answer: Emergency Regulations Required

We participated in the SEA solar pricing survey.

DOER needs promulgate revised SMART regulations including compensation schedules on an emergency basis as new development activity has ceased due to no economic feasibility to a SMART project. One reaction might be that DPU is so far behind what is the rush. With revised SMART regulations in force, development can continue because the interconnection ISA, which is a requirement of the PSOQ, will not arrive earlier than 18 months.

DOER Question 11:

How could the program be designed to insulate projects and participants from unforeseen market circumstances that materially impact the value of the SMART program incentive? For example, global events impact supply chain and energy costs.

Answer: 10-year, 1 GW Per-Year SMART Program Size + SMART 2-Year Review

A 10-year, 1 GW per-year program size, with a SMART program written and designed for that size and duration will hopefully simplify the program and speed the completion of solar projects. The revised SMART program will inform deliberations and progress in the GMAC proceedings, with EDCs planning and ISO-NE transmission planning.

A SMART compensation review every other year will remove the politics, global events and supply chain issues historically experienced.

DOER Question 13: Are there any Commonwealth policies (e.g., renewable energy goals, land use priorities, housing policy) that you believe the SMART program inadvertently conflicts with? Please describe any potential modifications to SMART that would alleviate these conflicts.

Answer: We are aware of low-income status verification difficulties of low-income customers suitable for submission to SMART but are not knowledgeable enough to make an informed description of this problem in time for this deadline.

DOER Question 14:

Is there any additional feedback you wish to provide to DOER?

Answer:

Allow parcels of land, that have Prime, Unique, Soils of Statewide Importance and Important Local Soils, not currently farmed, to be returned to agricultural use under the dual-use Agricultural Solar Tariff Generation Unit (ASTGU) program. In this way farmland soils will be maintained and increased in state farmland soils inventory and not permanently developed under the 1.7 billion square feet of residential and commercial space forecasted to be built by EEA in the 2050 Decarbonization Roadmap.

File and promugate revised SMART regulations, adders and compensation schedules under Emergeny Regulations.

With regulations having the force of law, solar development will be able to continue even though the interconnection queues are long. The filing of tariffs by DPU will most likely take less time than the 18 months it will take to receive an ISA which is required for a PSOQ. The filing of Emergency Regulations will bridge the gap that is going to be caused by FERC 2023.

We just received notice February 1, from an EDC that a project we started in 2022 with a clear substation and feeder on a hosting capacity map and were supposed to be in a Group Study at this writing, that transmission congestion in southeastern Massachusetts is so bad that this project will not enter a DG Group Study until 2026. The presumption remains that ISO-NE is conducting these studies in series.

Because the simultaneous electrification of the building, transportation and electric sectors, with the doubling of electric consumption by 2050, the establishment of a cost causation model is going to be a contrivance. All solar installations over 25kW should pay a defined single interconnection amount on cost per kW. In the SMART program, the ratepayer pays for everything. Interconnection is a line item cost. That line item should be factored into the SEA solar feasibility economic model under consideration for inclusion into the SMART program. Whether that defined cost is $0.05 mentioned in previously proposed legislation, the average interconnection cost of $0.23 as mentioned by National Grid in DPU 20-75 or the 0.375 assigned in the Marion-Fairhaven CIP DPU Order 22-75 for system upgrades, assign a defined interconnection cost. Place that assigned cost into the SMART compensation model, hopefully reviewed every other year, and have that cost be the SMART interconnection cost for the duration of the SMART program. Unless otherwise changed at the 2-year review period.

Assigning a defined cost will save the EDC's, DPU, policy makers and solar, storage and other DG developers tens of thousands of hours in process management and reduce risk and thereby cost for developers.

This should be a Healey Administration, EEA policy, and not be siloed into a DPU or DOER SMART decision.

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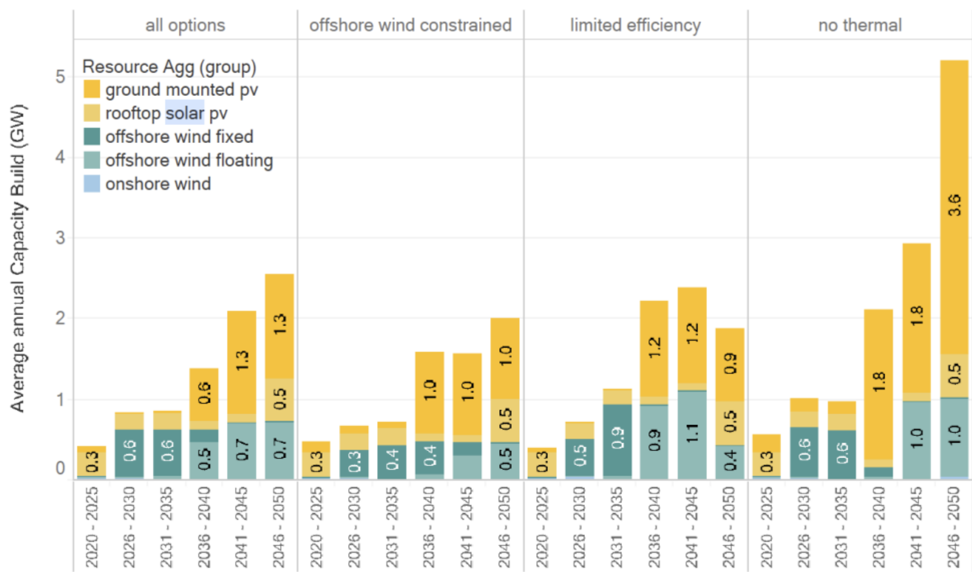
Exhibit 1: Energy Pathways to Deep Decarbonization, A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study, December 2020.

Figure 40 Average annual build rate by 5-year period for selected pathways. Taking the example of offshore wind in the All Options pathway during 2026-2030, the annual average build rate of 0.6 GW results in a total of 3 GW built during the five-year period.



89

Exhibit 2: BioMap2 Technical Report - Building a Better Biomap, Mass Fish & Game and The Nature Conservancy, Nov. 2011

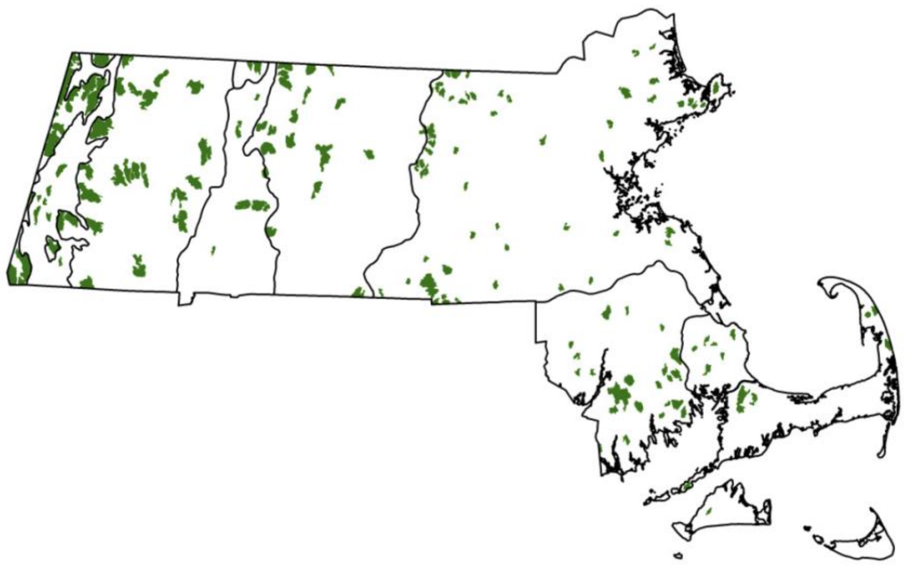


Figure 16. Final selection of Forest Cores
based on the largest 10% in each ecoregion, complemented by minimum size thresholds per ecoregion, and refined (post-processing) to define functional conservation units.

61

Exhibit 3: Sequestration – Carbon Debt Analysis, Net Wooded Lot vs. Net Solar

HDR **CARBON DEBT ANALYSIS** CALCULATIONS

Client: Silicon Ranch
Project Name: North Stonington Solar Project
Date: 05.19.2021

Loss of Carbon Sequestration - Annual

Forested Project Area (acres)	Carbon Sequestered by US Forest [1] (metric tons CO_2/acre forest/year)	Loss of Carbon Sequestration (metric tons CO_2/year)
43.6	0.85	37.06

[1] Source: "Greenhouse Gases Equivalencies Calculator - Calculations and References." EPA, Environmental Protection Agency, 18 Dec. 2018, www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references. This factor represents an average for U.S. forests in 2016 and may change in the future if the carbon stock significantly changes.

Avoided Emissions - Annual

Annual Production (MWh/year)	State	Output Emission Rate [1] (lb/MWh)	Avoided Emissions (metric tons CO_2e/year)
19,320	Connecticut	783.96	6,870.12

[1] The output emission rate reflects the average emission rate from natural gas electricity production in Connecticut, as calculated by the EPA's Emissions and Generation Resource Integrated Database (eGRID) for the year 2019.

Net Avoided Emissions - Annual

Avoided Emissions (metric tons CO_2e/year)	Loss of Carbon Sequestration (metric tons CO_2/year)	Net Avoided Emissions[1] (metric tons CO_2e/year)
6,870.12	37.06	6,833.06

[1] Net Avoided Emissions represents the difference between Avoided Emissions and Total Loss of Carbon Sequestration. A positive number indicates a net reduction; a negative number indicates a net increase.

Loss of Sequestered Carbon - Land Clearing

Forested Project Area (acres)	Carbon Sequestration Lost Due to Conversion of Forest to Clearing [1] (metric tons CO_2/acre)	Carbon Sequestration Lost Due to Converting Land Use from Forested to Project Use (metric tons CO_2e)
43.6	126.57	5,518.60

[1] Source: "Greenhouse Gases Equivalencies Calculator - Calculations and References." EPA, Environmental Protection Agency, 18 Dec. 2018, www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references. This factor represents the one-time loss of sequestered carbon in aboveground, belowground, dead wood, and litter biomass, as well as mineral soils. The factor assumes no carbon is sequestered by vegetation on cleared land (such as grass).

Avoided Emissions - Project Lifetime

Project Lifetime Production (MWh)	State	Output Emission Rate [1] (lb/MWh)	Avoided Emissions (metric tons CO_2e/Project Life)
702,011	Connecticut	783.96	249,632.62

[1] The output emission rate reflects the average emission rate from natural gas electricity production in Connecticut, as calculated by the EPA's Emissions and Generation Resource Integrated Database (eGRID) for the year 2019.

Net Avoided Emissions - Lifetime

Project Lifespan (years)	Avoided Emissions (metric tons CO_2e/Project Life)	Total Loss of Carbon Sequestration[1] (metric tons CO_2/Project Life)	Net Avoided Emissions[2] (metric tons CO_2e/Project Life)
40	249,632.62	7,001.00	242,631.63

[1] The Total Loss of Carbon Sequestration represents but the one time carbon loss resulting from land clearing and the annual loss from incremental forest sequestration.

[2] Net Avoided Emissions represents the difference between Avoided Emissions and Total Loss of Carbon Sequestration. A positive number indicates a net reduction; a negative number indicates a net increase.

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Exhibit 4: Executive Summary, BioMap2, Page 4

EXECUTIVE SUMMARY

The Massachusetts Department of Fish & Game's Natural Heritage & Endangered Species Program (NHESP) and The Nature Conservancy's Massachusetts Program developed *BioMap2* to protect the state's biodiversity in the context of projected effects of climate change.

BioMap2 combines NHESP's 30 years of rigorously documented rare species and natural community data with spatial data identifying wildlife species and habitats that were the focus of the Division of Fisheries and Wildlife's 2005 State Wildlife Action Plan (SWAP). *BioMap2* also integrates The Nature Conservancy's assessment of large, well-connected, and intact ecosystems and landscapes across the Commonwealth, incorporating concepts of ecosystem resilience to address anticipated climate change impacts.

Core Habitat consists of 1,242,000 acres that are critical for the long-term persistence of rare species and other Species of Conservation Concern, as well as a wide diversity of natural communities and intact ecosystems across the Commonwealth. Core Habitat includes

- Habitats for rare, vulnerable, or uncommon mammal, bird, reptile, amphibian, fish, invertebrate, and plant species;
- Priority Natural Communities;
- High-quality wetland, vernal pool, aquatic, and coastal habitats; and
- Intact forest ecosystems.

Critical Natural Landscape (CNL) consists of 1,783,000 acres complementing Core Habitat, including large natural Landscape Blocks that provide habitat for wide-ranging native species, support intact ecological processes, maintain connectivity among habitats, and enhance ecological resilience; and includes buffering uplands around coastal, wetland and aquatic Core Habitats to help ensure their long-term integrity. CNL, which may overlap with Core Habitat includes

- The largest Landscape Blocks in each of 8 ecoregions; and
- Adjacent uplands that buffer wetland, aquatic, and coastal habitats.

	Total Acres	*Percent of State*	*BioMap2 Acres Protected*
Core Habitat	1,242,000	24%	559,000
Critical Natural Landscape	1,783,000	34%	778,000
BioMap2 Total *(with overlap)*	2,092,000	40%	861,000

Protection and stewardship of ***BioMap2* Core Habitat** and **Critical Natural Landscape** is essential to safeguard the diversity of species and their habitats, intact ecosystems, and resilient natural landscapes across Massachusetts.

Exhibit 5: Buildings Sector Report. A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study, EEA, December 2020

Table 3. Projected Residential Growth by Decade in the Buildings Sector

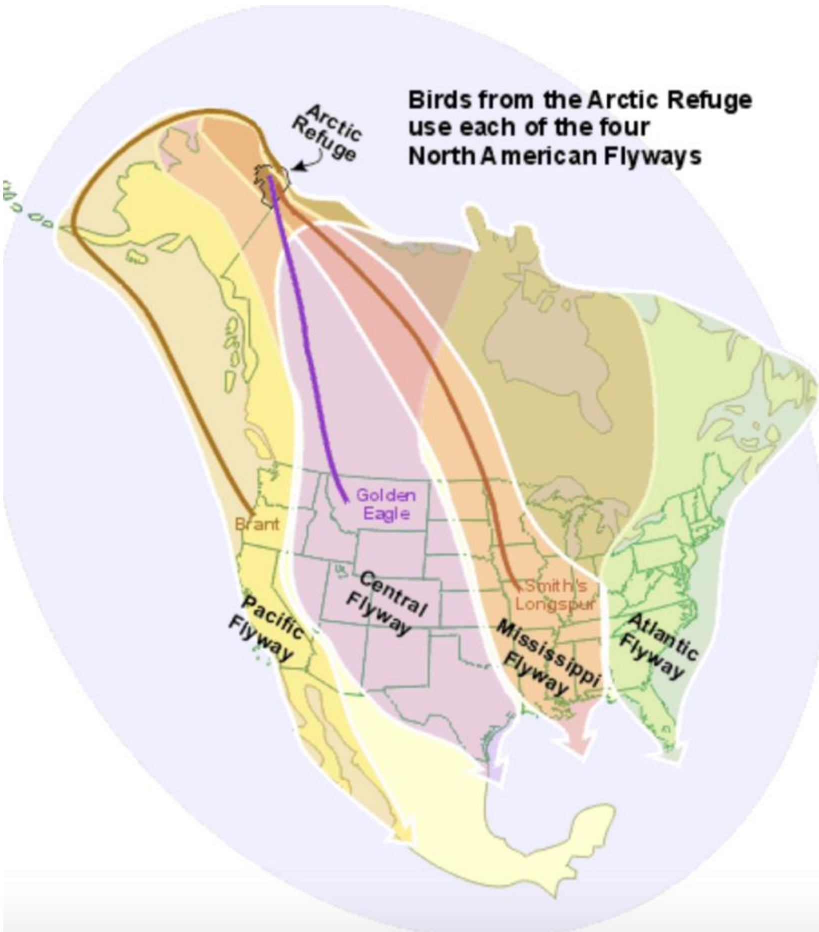
Total Building Area (Msf)	Single Family Residential	Small Multifamily Residential	Large Multifamily (5-19 family)	Large Multifamily (20+ wood)	Large Multifamily (20+ steel)
2017-2030	323	51	78	108	33
2030-2040	122	21	32	41	11
2040-2050	55	11	16	21	6
TOTAL	500	83	125	171	50
% residential growth	54%	9%	13%	18%	5%

28

Table 4. Projected Commercial Growth by Decade in the Buildings Sector

Total Building Area (Msf)	2017-2030	2030-2040	2040-2050	TOTAL	% of Commercial Sector Growth
Small Office	5.6	2.1	0.9	8.7	2%
Medium Office	27.5	10.6	5.1	43.2	10%
Large Office	102.8	40.7	22.1	165.6	39%
Hospital	5.3	2.1	1.1	8.6	2%
Laboratory	10.7	4.0	2.1	16.8	4%
Convention/Assembly	15.8	6.1	2.8	24.8	6%
Hotel	8.6	3.3	1.8	13.6	3%
Restaurant	4.6	1.8	0.8	7.2	2%
Retail	47.3	18.3	8.7	74.3	17%
K-12 School	3.2	1.2	0.5	4.9	1%
Supermarket	2.2	0.9	0.4	3.5	1%
Warehouse	36.7	14.2	6.4	57.3	13%
TOTAL	270.4	105.3	52.7	428.4	

Exhibit 6: North American Flyway – Atlantic Flyway



Carbon Debt Analysis

HDR completed a carbon debt analysis for the North Stonington, Connecticut (Project). This analysis compares the anticipated reduction in greenhouse gas (GHG) emissions from an activity compared to an associated temporary or permanent increase in GHG emissions (referred to as carbon debt). The Project will reduce GHG emissions by displacing electricity produced by natural gas-powered generation facilities with electricity produced by the photovoltaic system. Construction of the Project will require clearing 43.6 acres of forested land, thereby releasing stored carbon from the five carbon stocks of an established forest (aboveground biomass, belowground biomass, dead wood, litter and soil organic carbon) as well as preventing these trees from storing carbon over the life of the Project. The purpose of this analysis is to determine the net impact of adding solar electricity to the power grid and clearing a forested area from the Project area.

Avoided Emissions

Greenhouse gas (GHG) emissions displaced by the Project are calculated by using output emission rates for natural gas for the state of Connecticut. The output emission rates are obtained from the USEPA's Emissions and Generation Resource Integrated Database (eGRID) 2019 data[1]. The output emission rate for natural gas is not specific to peak load output; however, it is considered representative because it is anticipated that the operation of the photovoltaic system will displace the production of electricity using natural gas facilities. Total GHG emissions are expressed as carbon dioxide equivalent (CO_2e), which represents the cumulative impact of multiple greenhouse gases taking into account varying global warming potential, expressed as the amount of CO_2 that would create the same amount of warming. This analysis is not a lifecycle GHG emissions analysis and does not consider all upstream, operational and downstream effects of the Project or existing power generation resources on the regional grid.

Based on these estimations, the Project will displace 6,870 metric tons of CO_2e in the first year of operation. Over the 40-year expected life of the Project approximately 249,633 metric tons of CO_2e will be avoided.

Loss of Carbon Sequestration

Land use changes associated with the project, specifically the clearing of 43.6 acres of forested land, will cause an initial release of stored carbon at the time the forest is cleared. Clearing the forests releases the carbon that has already been stored by the forest system in the form of biomass (in four different stocks) and soil organic carbon. When the forest is cleared, the stored carbon is released. This value was calculated using a United States Environmental Protection Agency (USEPA) conversion factor of 126.57 metric tons CO_2 per acre of forest cleared.[2] Using

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[1] Emissions & Generation Resource Integrated Database (eGRID). (2021, February 23). Retrieved from https://www.epa.gov/egrid/data-explorer.

[2] "Greenhouse Gases Equivalencies Calculator - Calculations and References." EPA, Environmental Protection Agency, 18 Dec. 2018, www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

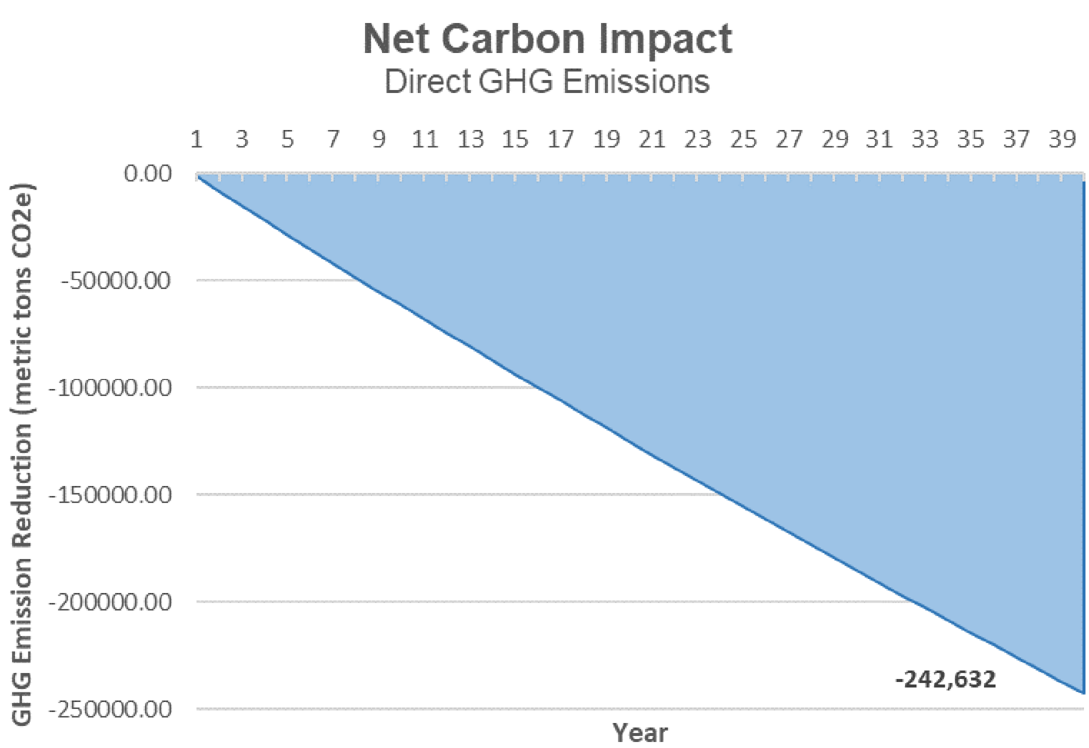
this emission factor assumes that all of the carbon stored by the forest is released and no carbon is stored by re-vegetation of the Project area. This loss occurs only once and is accounted for in the first year of the Project's life. Due to the clearing of this forested area, the Project will cause 5,519 metric tons of CO_2 to be released.

The removal of trees also results in a loss of future carbon sequestration because if the forest was not cleared, the trees would have continued to store additional carbon in the forest carbon stocks as they grew each year, in addition to the carbon the forest has already stored at the time of clearing. This value was calculated using a USEPA conversion factor of 0.85 metric tons CO_2/acre/year.[2] This emission factor is based on the average amount of carbon sequestered by U.S. forests in 2016. This loss will occur annually and is estimated to be approximately 37 metric tons of CO_2 per year. Over the 40-year life of the Project, 1,482 metric tons of CO_2 will not be sequestered.

Net Carbon Impact

Over its operational life, the Project will displace 249,633 metric tons of CO_2e and result in the loss of 7,001 metric tons of carbon sequestered. Therefore, the Project has a positive impact through a net reduction of 242,632 metric tons of CO_2e. It will take 409 days for the Project to offset its carbon debt from the operational phase of the Project.

Figure 1 – Direct Emissions, Net Carbon Impact (Solar vs Natural Gas Output)



Lifecycle Analysis Discussion

The National Renewable Energy Laboratory (NREL) recently published a harmonization of life cycle assessments (LCAs) of electricity generation technologies, including solar and natural gas[3]. NREL reviewed more than 2,100 published LCA studies on utility-scale electricity generation. The studies were screened by multiple experts using strict criteria of quality, relevance, and transparency. As a result, less than 15% of the 2,100 studies were included in the harmonization effort. The harmonization effort adjusted the estimates from published peer-reviewed literature to a consistent set of methods and assumptions specific to each technology. Harmonization did not significantly change the median value of the published data but did reduce the variability of GHG emissions estimates.

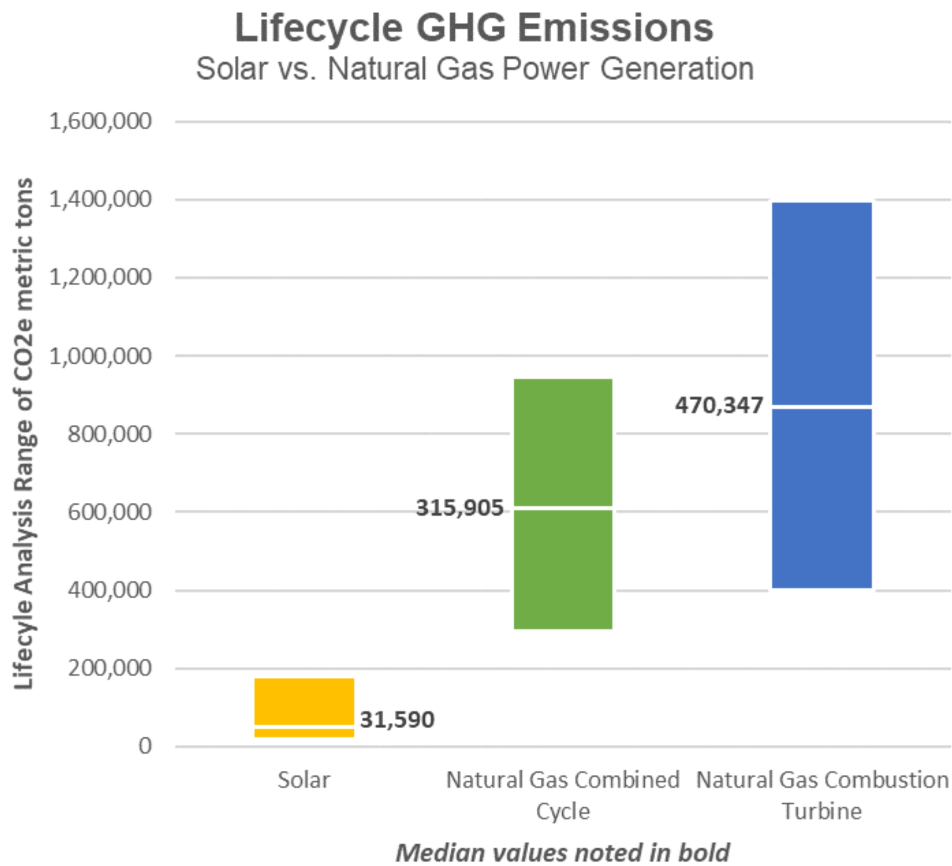
The harmonized studies employed a 'cradle-to-grave' approach to the LCA of crystalline silicon utility-scale solar panel arrays and electricity produced from conventionally produced natural gas. The LCAs included GHGs directly emitted during electricity generation, as well as indirect emissions from upstream processes such as material extraction, transportation, and plant construction, and from downstream processes such as plant decommissioning, recycling of materials, and waste disposal. The LCAs did not consider the removal of trees from a project site, as that is a site-specific factor.

The harmonized lifecycle greenhouse gas emission value of crystalline silicon solar panels ranged from 26 grams CO_2e per kWh (g CO_2e/kWh) to 183 g CO_2e/kWh with a median value of 45 g CO_2e/kWh. The Project is anticipated to produce 702,011 MWh of power over its 40-year life. Therefore, based on the NREL harmonization median value, the Project will result in 31,590,000 kilograms (kg) CO_2e over its lifetime. The harmonized lifecycle greenhouse gas emission value of electricity produced from conventionally produced natural gas ranged from 310 g CO_2e/kWh to 990 g CO_2e/kWh with a median value of 450 g CO_2e/kWh and 670 g CO_2e/kWh for combined cycle plants and combustion turbine plants, respectively. It is assumed for comparison purposes that a natural gas plant would produce an equivalent amount of power over a 40-year operational life as the Project. Based on the median value, a combined cycle natural gas plant would result in 315,905,000 kg CO_2e over its lifetime, and a combustion turbine plant would result in 470,347,000 kg CO_2e over its lifetime.

The lowest estimated lifecycle value for electricity produced from conventionally produced natural gas is higher (310 g CO_2e/kWh) than the highest estimated lifecycle value for electricity produced from crystalline silicon solar panels (183 g CO_2e/kWh). From an LCA perspective based on NREL harmonized numbers, the solar panel array would result in 90% fewer CO_2e emissions compared to a combined cycle natural gas plant and 93% fewer CO_2e emissions than a combustion turbine natural gas plant, as shown in Figure 2.

[3] "Lifecycle Assessment Harmonization." NREL, National Renewable Energy Laboratory, https://www.nrel.gov/analysis/life-cycle-assessment.html.

Figure 2 – Lifecycle Assessment of Natural Gas vs. Solar Electricity Production



The NREL harmonization studies did not include the loss of carbon sequestration due to land use changes. It is conservatively assumed that the construction of a natural gas power plant would result in no land use changes. If the land use change impacts associated with the Project (described above in the Loss of Carbon Sequestration section) are added to the NREL LCA number for the Project, then the Project would result in 37,109,000 kg CO_2e over its lifetime. This value is 90% lower than the NREL LCA number for a combined cycle natural gas plant and 92% lower than the NREL LCA number for a combustion turbine natural gas plant.

HDR **CARBON DEBT ANALYSIS** CALCULATIONS

Client: Silicon Ranch
Project Name: North Stonington Solar Project
Date: 05.19.2021

Loss of Carbon Sequestration - Annual

Forested Project Area (acres)	Carbon Sequestered by US Forest [1] (metric tons CO_2/acre forest/year)	Loss of Carbon Sequestration (metric tons CO_2/year)
43.6	0.85	37.06

[1] Source: "Greenhouse Gases Equivalencies Calculator - Calculations and References." EPA, Environmental Protection Agency, 18 Dec. 2018, www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references. This factor represents an average for U.S. forests in 2016 and may change in the future if the carbon stock significantly changes.

Avoided Emissions - Annual

Annual Production (MWh/year)	State	Output Emission Rate [1] (lb/MWh)	Avoided Emissions (metric tons CO_2e/year)
19,320	Connecticut	783.96	6,870.12

[1] The output emission rate reflects the average emission rate from natural gas electricity production in Connecticut, as calculated by the EPA's Emissions and Generation Resource Integrated Database (eGRID) for the year 2019.

Net Avoided Emissions - Annual

Avoided Emissions (metric tons CO_2e/year)	Loss of Carbon Sequestration (metric tons CO_2/year)	Net Avoided Emissions[1] (metric tons CO_2e/year)
6,870.12	37.06	6,833.06

[1] Net Avoided Emissions represents the difference between Avoided Emissions and Total Loss of Carbon Sequestration. A positive number indicates a net reduction; a negative number indicates a net increase.

Loss of Sequestered Carbon - Land Clearing

Forested Project Area (acres)	Carbon Sequestration Lost Due to Conversion of Forest to Clearing [1] (metric tons CO_2/acre)	Carbon Sequestration Lost Due to Converting Land Use from Forested to Project Use (metric tons CO_2e)
43.6	126.57	5,518.60

[1] Source: "Greenhouse Gases Equivalencies Calculator - Calculations and References." EPA, Environmental Protection Agency, 18 Dec. 2018, www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references. This factor represents the one-time loss of sequestered carbon in aboveground, belowground, dead wood, and litter biomass, as well as mineral soils. The factor assumes no carbon is sequestered by vegetation on cleared land (such as grass).

Avoided Emissions - Project Lifetime

Project Lifetime Production (MWh)	State	Output Emission Rate [1] (lb/MWh)	Avoided Emissions (metric tons CO_2e/Project Life)
702,011	Connecticut	783.96	249,632.62

[1] The output emission rate reflects the average emission rate from natural gas electricity production in Connecticut, as calculated by the EPA's Emissions and Generation Resource Integrated Database (eGRID) for the year 2019.

Net Avoided Emissions - Lifetime

Project Lifespan (years)	Avoided Emissions (metric tons CO_2e/Project Life)	Total Loss of Carbon Sequestration[1] (metric tons CO_2/Project Life)	Net Avoided Emissions[2] (metric tons CO_2e/Project Life)
40	249,632.62	7,001.00	242,631.63

[1] The Total Loss of Carbon Sequestration represents but the one time carbon loss resulting from land clearing and the annual loss from incremental forest sequestration.

[2] Net Avoided Emissions represents the difference between Avoided Emissions and Total Loss of Carbon Sequestration. A positive number indicates a net reduction; a negative number indicates a net increase.

HDR **CARBON DEBT ANALYSIS** DATA INPUTS

Client: Silicon Ranch
Project Name: North Stonington Solar Project
Date: 05.19.2021

Project Information

Project City	State	Zip Code
North Stonington	CT	06359

Energy Output in Year 1 of Operation

19,320 MWh

Energy Output in Project Lifetime

702,011 MWh

Expected Useful Life

40 years

Acres of Forested Land Removed due to Project Construction

43.6 acres

HDR **CARBON DEBT ANALYSIS** CALCULATIONS

Client: Silicon Ranch
Project Name: North Stonington Solar Project
Date: 05.19.2021

LCA GHG Emissions - Crystalline Silicon Solar Panels

LCA Value	Grams CO2e per kWh	Lifecycle 'Cradle to Grave' Emissions (metric tons CO_2/lifetime)
Low	26	18,252
Median	45	31,590
High	183	128,468

[1] Source: Lifecycle Assessment Harmonization." NREL, National Renewable Energy Laboratory, https://www.nrel.gov/analysis/life-cycle-

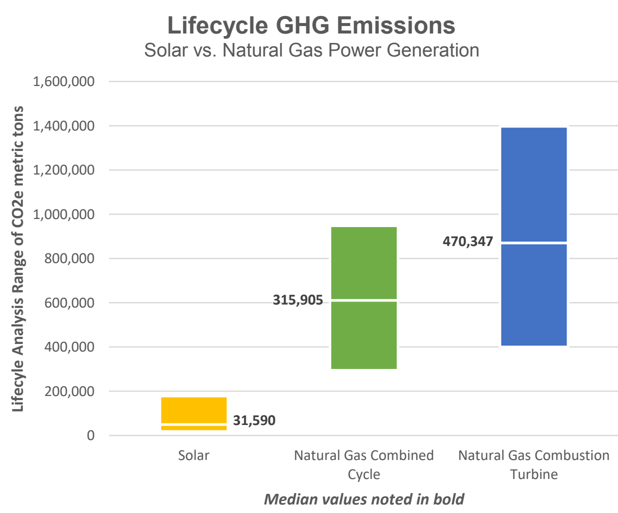
LCA GHG Emissions - Combined Cycle Natural Gas

LCA Value	Grams CO2e per kWh	Lifecycle 'Cradle to Grave' Emissions (metric tons CO_2/lifetime)
Low	420	294,845
Median	450	315,905
High	480	336,965

LCA GHG Emissions - Combustion Turbine Natural Gas

LCA Value	Grams CO2e per kWh	Lifecycle 'Cradle to Grave' Emissions (metric tons CO_2/lifetime)
Low	570	400,146
Median	670	470,347
High	750	526,508

LCA Value	Solar	Natural Gas Combined Cycle	Natural Gas Combustion Turbine	% Reduction
Low	18,252	294,845	400,146	-93.8%
Median	31,590	315,905	470,347	-90.0%
High	128,468	336,965	526,508	-61.9%



HDR **CARBON DEBT ANALYSIS** CALCULATIONS

Client: Silicon Ranch
Project Name: North Stonington Solar Project
Date: 05.19.2021

Year	Annual Output (MWh)	Avoided Emissions	Land Use Impact	Net Annual Impact	Net Cumulative Impact
1	19,320	-6870.123	5555.66	-1314.47	-1314.47
2	19223.4	-6835.772	37.06	-6798.71	-8113.18
3	19127.28	-6801.594	37.06	-6764.53	-14877.71
4	19031.65	-6767.586	37.06	-6730.53	-21608.24
5	18936.49	-6733.748	37.06	-6696.69	-28304.92
6	18841.81	-6700.079	37.06	-6663.02	-34967.94
7	18747.6	-6666.579	37.06	-6629.52	-41597.46
8	18653.86	-6633.246	37.06	-6596.19	-48193.65
9	18560.59	-6600.079	37.06	-6563.02	-54756.67
10	18467.79	-6567.079	37.06	-6530.02	-61286.69
11	18375.45	-6534.244	37.06	-6497.18	-67783.87
12	18283.57	-6501.572	37.06	-6464.51	-74248.38
13	18192.15	-6469.065	37.06	-6432.00	-80680.39
14	18101.19	-6436.719	37.06	-6399.66	-87080.05
15	18010.69	-6404.536	37.06	-6367.48	-93447.52
16	17920.63	-6372.513	37.06	-6335.45	-99782.97
17	17831.03	-6340.65	37.06	-6303.59	-106086.56
18	17741.87	-6308.947	37.06	-6271.89	-112358.45
19	17653.16	-6277.402	37.06	-6240.34	-118598.79
20	17564.9	-6246.015	37.06	-6208.96	-124807.75
21	17477.07	-6214.785	37.06	-6177.73	-130985.47
22	17389.69	-6183.711	37.06	-6146.65	-137132.13
23	17302.74	-6152.793	37.06	-6115.73	-143247.86
24	17216.23	-6122.029	37.06	-6084.97	-149332.83
25	17130.15	-6091.419	37.06	-6054.36	-155387.19
26	17044.5	-6060.962	37.06	-6023.90	-161411.09
27	16959.27	-6030.657	37.06	-5993.60	-167404.68
28	16874.48	-6000.504	37.06	-5963.44	-173368.13
29	16790.1	-5970.501	37.06	-5933.44	-179301.57
30	16706.15	-5940.648	37.06	-5903.59	-185205.16
31	16622.62	-5910.945	37.06	-5873.89	-191079.04
32	16539.51	-5881.391	37.06	-5844.33	-196923.37
33	16456.81	-5851.984	37.06	-5814.92	-202738.30
34	16374.53	-5822.724	37.06	-5785.66	-208523.96
35	16292.66	-5793.61	37.06	-5756.55	-214280.51
36	16211.19	-5764.642	37.06	-5727.58	-220008.09
37	16130.14	-5735.819	37.06	-5698.76	-225706.85
38	16049.49	-5707.14	37.06	-5670.08	-231376.93
39	15969.24	-5678.604	37.06	-5641.54	-237018.48
40	15889.39	-5650.211	37.06	-5613.15	-242631.63
Lifetime Output:	**702,011**	**-249,633**	**7,001**	**-242,632**	