Meeting New England's Solar Needs on Contaminated Sites and Rooftops

September 2020

Acadia Center
Advancing the Clean Energy Future

Rapidly scaling up New England's solar photovoltaic (PV) resources to meet the region's decarbonization goals will require developing solar projects in a way that minimizes negative impacts on open space, forests, and farmlands. Through the Smart Solar Siting Project for New England, Acadia Center is working in partnership with American Farmland Trust, Conservation Law Foundation, Vote Solar, and Vermont Law School to reduce conflicts over siting of solar facilities by reaching agreement among multi-stakeholders on smart solar siting principles, policies, and programs. Project partners prepared a number of research summaries, performed policy analyses, and assembled additional resources that together assess each New England State's potential to meet their climate and solar generation goals while protecting the region's best farm and forest land.

Synopsis and Summary of Results

There is no single category of solar site that could or should be the sole focus for solar development. Efforts to achieve the necessary levels of solar deployment must consider the full range of possible sites for development. The analysis presented here seeks to quantify the portion of the region's solar generation goals that could potentially be met through development on rooftops and contaminated sites as available alternatives to development on farms and forest land. Specifically, the analysis described below presents initial estimates of how much of the region's projected solar generation needs in 2030 could be developed on residential rooftops or using ground-mounted solar PV on contaminated sites. Acadia Center concludes that solar installations on single-family residential rooftops have the potential to meet around 20% of the region's rooftop PV needs, and that, depending on some key assumptions, 25-75% of the region's utility scale needs could potentially be met through development on contaminated sites. Because solar generation projects on contaminated sites and rooftops face their own unique barriers, achieving these levels of development will require policies that address those specific challenges. That said, the results presented below indicate that developing solar generation on these two types of sites should be encouraged and prioritized in order to relieve development pressure on farms and forested land with high value.

EnergyVision 2030 Background

Acadia Center's EnergyVision 2030 recommends a path to reduce emissions by using market-ready technologies to build a cleaner, more modern energy system. Acadia Center's EnergyVision 2030 analysis offers pathways for states to meet their greenhouse gas reduction requirements, while contributing meaningfully to global efforts to avoid catastrophic climate change. The Accelerated Scenario from EnergyVision 2030 shows a pathway to reach a 50% reduction in economy-wide emissions from 1990 levels, which aligns with the Intergovernmental Panel on Climate Change (IPCC) recommendation for limiting global temperature rise to 1.5°C. To develop this scenario, Acadia Center modeled the entire energy system of the Northeast, including buildings, transportation, industries and electricity generation.

The EnergyVision 2030 Accelerated Scenario concludes that meeting New England's economy-wide emissions reduction target of 50% will require 6 GW of installed utility-scale solar and 14 GW of installed distributed solar. Its increased ambition means that capacity estimates for both distributed and utility-scale solar in EnergyVision 2030 are greater than those forecast by New England's Independent System Operator (ISO-NE), which bases its estimates of future capacity on historic trends and current state solar policies.[1] To reach a 50% reduction in GHGs economy-wide, the EnergyVision 2030 Accelerated Scenario suggests that by 2030, distributed solar capacity will need to be about three times higher than ISO-NE forecasts, while utility-scale solar capacity will need to be about twice as high.

State Solar Capacity Needs Analysis

The original EnergyVision 2030 modeling did not analyze solar capacity needs by state, so Acadia Center developed the following estimates for illustrative purposes before analyzing approximate contaminated land or rooftop area requirements.

2030 INSTALLED SOLAR CAPACITY NEEDS BY STATE AND PROJECT TYPE (MW)

		Distributed					Utility-Scale
	Total Distributed & Utility-Scale*	Residential Rooftop	Community Solar (Ground-Mount)	Commercial Roof-Mount	Commercial Ground-Mount	**Total Distributed**	**Total Utility-Scale**
CT	**4236**	810	422	1478	810	**3520**	**716**
ME	**3013**	300	156	547	300	**1303**	**1710**
MA	**9340**	1532	799	2797	1532	**6660**	**2680**
NH	**1619**	300	157	548	300	**1304**	**315**
RI	**1260**	238	124	435	238	**1035**	**224**
VT	**968**	141	74	258	141	**614**	**355**
New England	**20436**	3320	1732	6063	3320	**14436**	**6000**

*In this analysis, Acadia Center considered utility-scale solar to be any solar installation in front of the customer meter that participates in the wholesale electricity market. Distributed solar comprises installations behind the customer meter and includes both ground-mounted and roof-mounted projects.

Acadia Center allocated the region's total 2030 distributed solar capacity needs using each state's share of total regional population (as a proxy for electricity demand), and further subdivided that capacity into four categories using the following percentages: residential rooftop – 23%; community solar – 12%; commercial roof-mounted – 42%; commercial ground-mounted – 23%.[2] Residential rooftop and community solar include residential electricity customers, while commercial solar includes other commercial and industrial customers, such as municipal and government users. Commercial rooftop solar capacity was not within the scope of this analysis.

Acadia Center based utility-scale solar capacity estimates in each state on three sources: U.S. Energy Information Administration's total solar generation,[3] National Renewable Energy Laboratory's (NREL's) technical potential for solar,[4] and the state's share of New England's population.[5]

---

[1] See for example, ISO-NE "2019 Regional System Plan," available at: https://www.iso-ne.com/static-assets/documents/2019/10/rsp19_final.docx

[2] For more information, see Acadia Center assumptions, EnergyVision 2020 Technical Appendix. May, 2017.

[3] U.S. Energy Information Administration, Net Generation by State by Type of Producer by Energy Source. Available at: https://www.eia.gov/electricity/data/state/

[4] Technical potential does not include availability of transmission infrastructure, costs, reliability or time-of-dispatch, current or future electricity loads, or relevant policies.

[5] U.S. Census data.

Ground-Mounted Solar Potential on Contaminated Sites

Using the U.S. Environmental Protection Agency's (EPA's) RE-Powering America screening dataset,[6] Acadia Center estimated the total ground-mounted solar potential on contaminated lands in New England, and compared this to the EnergyVision 2030 ground-mounted solar requirements (including community solar, commercial ground-mount and utility-scale). For the assessment, Acadia Center assumed each megawatt requires 5 acres of land.[7] Brownfield sites, Superfund sites, and landfills were included; Resource Conservation and Recovery Act sites were excluded due to access constraints and other prohibitive surface conditions common with these areas.[8] Finally, contaminated sites of 500 acres or larger were scrutinized individually, excluding several of them based on site-specific characteristics, such as being a body of water or already in use (see Appendix for more information). Acadia Center then applied the following additional constraints to assess the range of solar potential on contaminated sites:

- a maximum project size of 150 MW per site;
- a minimum project size of 5 MW per site;
- a high potential screen representing a maximum allowable distance of 3 miles to the nearest electric substation of 3.0 miles; and
- a low potential screen representing a maximum allowable distance of 0.5 miles to the nearest substation.

POTENTIAL GROUND MOUNTED SOLAR ON CONTAMINATED SITES					
State	Installed Ground-Mounted Solar by 2030 (MW)	High Potential (≤3 miles to substation)		Low Potential (≤0.5 miles to substation)	
		Potential MW	% of 2030	Potential MW	% of 2030
CT	1948	2280	117%	571	29%
ME	2166	785	36%	346	16%
MA	5011	4122	82%	1293	26%
NH	771	590	77%	274	36%
RI	587	499	85%	149	25%
VT	569	232	41%	45	8%
New England	11053	8508	77%	2678	24%

With the Low Potential constraints applied, development of contaminated sites could potentially meet nearly one quarter of New England's ground-mounted solar needs, even when considering only sites that are within 0.5 miles from an existing substation. When this condition is relaxed to include sites up to 3 miles away (High Potential), over three quarters of states' needs could be met, although it is not currently standard industry practice to site projects this far from substation interconnection points. For example, in Connecticut, contaminated land

[6] Available at: https://www.epa.gov/re-powering/re-powering-mapping-and-screening-tools#tab-3

[7] Acadia Center assumption based on NREL's Land Use Requirements for Solar Power Plants in the United States, 2013. These assumptions should be considered conservative given the rapid deployment of solar generation over the last three years, subsequent updates to ISO-NE forecasts, and continuous improvements in technology cost and performance.

[8] Data definitions can be found at: https://www.epa.gov/sites/production/files/2015-04/documents/repowering_mapper_datadocumentation.pdf

could potentially host all of state's ground-mounted solar needs through the year 2030. However, closer review of site-specific data will be necessary to understand how on-the-ground conditions at these sites would ultimately lead to solar development. For example, it was beyond the scope of this analysis to evaluate crucial factors such as topography and ease of access that significantly affect a given site's developable potential.

Residential Rooftop Analysis

Acadia Center next analyzed the number of residential rooftop solar installations would be needed to reach the capacity called for by EnergyVision 2030, assuming 5 kW per rooftop installation on average.[9] To provide a point of reference, Acadia Center compared these data to the total number of detached single-family houses in each state.[10] The EnergyVision 2030 rooftop solar goal could be met by installing 5 kW projects on nearly 20% of single-family detached homes in the region.

This is not to imply that single-family detached houses are the only residential structures that can or should host rooftop solar installations. The analysis illustrates that single-family rooftop space is one of the site types available to meet a meaningful portion of states' residential solar needs in 2030. Further analysis considering the availability of other residential buildings beyond detached single-family houses would presumably increase the portion of residential rooftops to meet state goals.

RESIDENTIAL ROOFTOP NEEDS TO REACH 2030 TARGET				
	Installed Rooftop Solar by 2030 (MW)	Residential Rooftops Needed for Solar Development (5 kW/rooftop)	Single-family (SF) Detached Houses	% SF Rooftops Needed
CT	810	161,910	816,706	20%
ME	300	59,938	439,459	14%
MA	1532	306,356	1,374,479	22%
NH	300	59,996	341,299	18%
RI	238	47,628	241,202	20%
VT	141	28,228	193,229	15%
New England	3320	664,056	3,406,374	19%

[9] Acadia Center assumptions, EnergyVision 2020 Technical Appendix. May, 2017.

[10] U.S. Census data.

Appendix – Contaminated Land Acreage

The following tables show the total acres under different contaminated land categories in each state, excluding large sites (over 500 aces) covered by water or due to other site-specific conditions, based on research conducted by American Farmland Trust. Table A-1 includes land within 3 miles of an electric substation, while Table A-2 reflects contaminated land within 0.5 miles of a substation.

Table A-1

State	Acres of Contaminated Land Within 3 Miles of Substation				
	Superfund	Brownfields	Landfill Methane Outreach Program	Total State Specific Programs	Total
CT	728	1,730	662	11,318	14,438
ME	13,167	2,774	223	-	16,164
MA	7,537	2,696	2,045	21,507	33,786
NH	1,256	1,886	344	-	3,486
RI	2,212	894	356	-	3,462
VT	228	1,377	146	-	1,752
Total	**25,128**	**11,358**	**3,776**	**32,825**	**73,087**

Table A-2

State	Acres of Contaminated Land Within 0.5 Miles of Substation				
	Superfund	Brownfields	Landfill Methane Outreach Program	Total State Specific Programs	Total
CT	542	495	118	2,146	3,301
ME	9,500	1,380	-	-	10,880
MA	5,014	659	502	6,077	12,252
NH	541	878	93	-	1,512
RI	370	162	291	-	823
VT	55	286	-	-	341
Total	**16,023**	**3,861**	**1,004**	**8,223**	**29,110**