thevpc.org | info@thevpc.org | 410.337.6877
118 W. Pennsylvania Avenue, Towson, Maryland 21204
P.O. Box 5402 Towson, Maryland 21285-5402

VALLEYS
PLANNING COUNCIL

Committee: Environment and Transportation
Testimony on: HB0990 "Small Solar Energy Generating System Incentive Program – Eligibility and Generating Capacity"
Position: Favorable
Hearing Date: March 3, 2026

Valleys Planning Council, a non-profit that conserves land and resources, preserves historic character and maintains the rural feel and land uses in northwestern Baltimore County, encourages a favorable report on HB0990. Agricultural land is an easy target for solar installations — easy, but inappropriate. **If this bill will result in more solar on rooftops, especially commercial rooftops, it's easy to support it**.

Please see attached the study Valleys Planning had done to demonstrate that in Baltimore City and Baltimore County, solar can be located in many places (including rooftops, brownfields, and over parking lots) without sacrificing prime and productive farmland, rural views, or habitat.

I fear this bill will somehow be subverted and will result in more applications for 1.95 mw solar facilities on agricultural land, sized to avoid requiring a CPCN and other oversight. These smaller facilities are still large enough for solar companies to make enough money to continue offering head-turning amounts of money to owners of farmland (who are not necessarily farmers themselves) instead of putting solar where it belongs.

Valleys Planning Council encourages a favorable report on HB0990.

Renée Hamidi
Executive Director
Valleys Planning Council

Optimal Solar Siting for Maryland

A Pilot for Baltimore County and City

Susan Minnemeyer and Emily Wiggans
ChesapeakeConservancy.org

October 2020

Acknowledgments

This publication was made possible thanks to the support of the Valleys Planning Council. The authors would like to thank Teresa Moore of the Valleys Planning Council for providing valuable insight and assistance.

We are indebted to all who provided data and review feedback during the design and development of this study.

Authors

Susan Minnemeyer is the Vice President for Technology and leads Chesapeake Conservancy's Conservation Innovation Center (CIC). She leads the CIC's geospatial support program for the Chesapeake Bay Program and the development of innovative approaches for conservation and restoration.

Emily Wiggans is a Geospatial Analyst and represents Chesapeake Conservancy on the Water Data Collaborative, an initiative to support community science for water quality monitoring. She helps to manage the CIC's web mapping infrastructure and provides geospatial analysis for conservation and restoration projects.

Chesapeake Conservancy

We believe that the Chesapeake is a national treasure that should be accessible for everyone and a place where wildlife can thrive. We use technology to enhance the pace and quality of conservation, and we help build parks, trails and public access sites.

Our mission is to conserve and restore the natural and cultural resources of the Chesapeake Bay watershed for the enjoyment, education, and inspiration of this and future generations.

The Chesapeake Conservancy serves as a catalyst for change, advancing strong public and private partnerships, developing and using new technology, and driving innovation throughout our work. We empower the conservation community with access to the latest data and technology.

Conservation Innovation Center

The Chesapeake Conservancy's Conservation Innovation Center (CIC) was established in 2013 to use cutting-edge technology to empower data-driven conservation and restoration. Just as the use of technology changed the corporate world and made it more efficient, technology can do the same for the conservation movement. Through national and international partnerships, the CIC makes this data accessible for restoration professionals to practice precision conservation, yielding greater impact with less resources.

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Summary

Maryland's updated Renewable Portfolio Standard (RPS) will require 50 percent of electricity to be generated from renewable sources by 2030, with a 14.5 percent carve-out for solar energy. The Power Plant Research Program report on the RPS standard has projected that 9,000 gigawatt hours per year (GWh/yr), or 8,946 MW of installed solar capacity, will be required to come from solar energy generation by 2030, from a mix of residential, commercial, community, and utility-scale sources. Baltimore City and County could be expected to provide a portion of solar energy installations; a reasonable goal based on share of energy consumption would be for 1,967 GWh/yr of solar energy to be provided from the Baltimore region.

Maryland's current solar capacity stands at 1,250 MW, or enough energy to generate 1,258 GWh/yr of energy annually, about 14 percent of the goal to be reached by 2030. Baltimore City and County could potentially contribute a significant share of the area needed to scale up solar, but where exactly would such solar arrays be located?

In the absence of incentives for siting future solar arrays elsewhere, prime agricultural farmland will likely be key, compounding the loss of farmland to residential and commercial development and the stresses on food production likely to come with climate change.

To produce the additional solar energy capacity needed in less than a decade, utility-scale solar promises to scale up quickly at the lowest cost, compared to other options. But to meet the full range of potential benefits from solar energy and to avoid environmental tradeoffs, maximizing the amount of solar energy captured in the built environment can achieve renewable energy goals with the fewest adverse impacts, while also providing the greatest number of jobs and the opportunity for more residents to access the economic benefits of solar energy. Ground-mounted solar arrays on preferred sites that avoid prime farmland, forested areas, and ecologically valuable areas can also contribute to rapid solar expansion.

According to this study, Baltimore City and County offer nearly 33,806 acres of potential optimal solar sites located on rooftops, parking lots, and degraded lands (see Table 2). An additional 3,400 acres of preferred ground-mounted sites could provide options for solar energy development without displacing agriculture on prime farmland while also minimizing environmental impacts by avoiding forested and ecologically sensitive lands.

Optimal solar energy sites in Baltimore City and County could generate more than 22,789 GWh/yr of electricity from solar energy, which would far exceed even the statewide solar carve-out goal of 9,000 GWh/yr. It is likely, however, that only a small portion of the pool of identified sites will prove to be viable development locations for a variety of reasons, ranging from property owner willingness, site feasibility, building suitability for rooftop installations, or other factors. We compared the total potential energy generation for optimal and preferred ground-mounted sites in comparison with the solar energy generation, 1,967 GWh/yr, that would be reasonable to expect from Baltimore City and County based on the region's share of statewide energy consumption.

Based on this goal, just 8.6 percent of optimal sites, or 7.0 percent of optimal and preferred ground-mounted sites combined, would need to prove viable for Baltimore County and City to provide their estimated share of the state's future solar carve-out by 2030. The analysis demonstrates that a sufficient number of optimal locations for solar energy siting exist to meet the state's renewable energy goals.

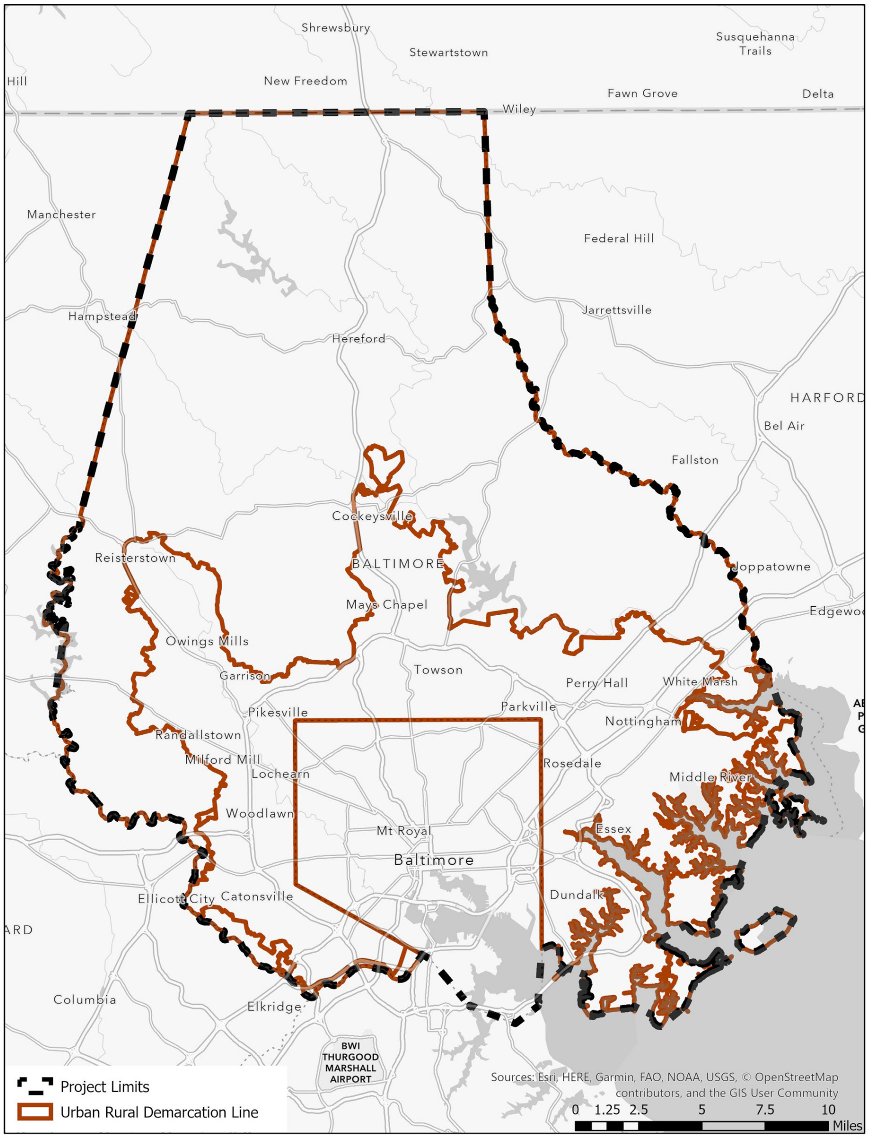


Figure 1. Study area: Baltimore County and City, with urban-rural demarcation line shown outside city borders

An additional component of preferred ground-mounted sites could provide further options for siting that would avoid key adverse tradeoffs associated with land use and solar energy development—the loss of forest, ecologically sensitive lands, or prime farmlands. However, any use of open land will involve some land use tradeoffs. Therefore, these are considered second-tier options relative to optimal sites in the built environment or on degraded lands.

Policies and incentives that would guide solar energy development toward these optimal and preferred solar sites could ensure that solar energy expansion provides the greatest possible benefit for Maryland's citizens. Promising approaches toward guiding solar energy development to preferred locations have been developed in a number of states, with New Jersey and Massachusetts potentially serving as case studies for guidance development.

Introduction

Maryland's new Renewable Portfolio Standard, established as part of the Clean Energy Jobs Act of 2019, will require 50 percent of electricity generation to come from renewable energy sources by 2030, with 14.5 percent coming from solar energy.[1] Our objective in this study is to identify suitable locations for solar energy development, while avoiding undesirable environmental tradeoffs. Ground-mounted solar energy projects can be land-intensive, highlighting the need for careful consideration of siting to maximize benefits and minimize potential adverse impacts. We approached this objective with a high-resolution geospatial analysis of criteria for optimal and preferred solar siting for Baltimore City and County (Figure 1) and measure developable area to determine potential renewable energy generation. This approach may be used by decision makers to evaluate solar energy development proposals and to develop incentives to encourage development in preferred locations. Our study followed these principles:

- Solar energy development is critical to meeting Maryland's renewable energy goals.
- Careful siting of solar development can maximize benefits and reduce adverse impacts.
- Solar development should avoid adverse environmental impacts wherever possible by making the most of opportunities on already-developed or degraded lands.
- Consideration of equity and opportunity will help ensure solar energy benefits are available to all residents.

Our analysis is not intended to be exhaustive of all criteria used to select sites, and further screening will be needed. Policies or incentives may be required to guide solar development to preferred sites.

Our approach to determine optimal solar siting involves first identifying potential solar sites that meet both legal and technical criteria for allowing solar energy development, and then evaluating potential solar sites on environmental, equity, and efficiency criteria to determine optimal siting (Figure 2). We obtained geospatial data from a variety of sources—notably, the Baltimore County and City data portals, the Maryland Departments of Natural Resources (DNR), Planning (MDP), Environment (MDE), the Power Plant Research Program's SmartDG+ planning tool, and the Maryland iMAP data collection.

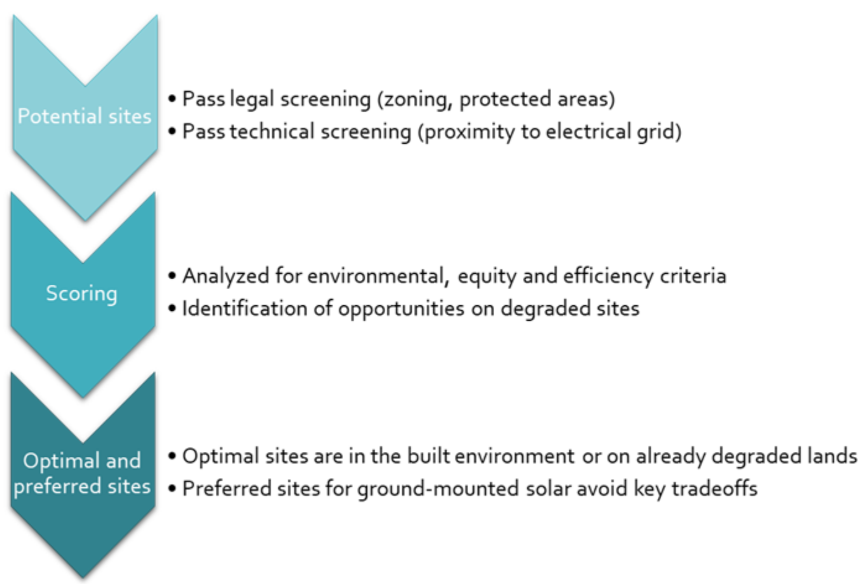


Figure 2. Approach to identifying optimal and preferred sites for solar energy development

[1]Dance, S. "Maryland bill mandating 50% renewable energy by 2030 to become law, but without Gov. Larry Hogan's signature." The Baltimore Sun. May 22, 2019. https://www.baltimoresun.com/news/maryland/environment/bs-md-renewable-energy-law-20190522-story.html. Accessed May 28, 2019.

Potential solar energy development sites for our study area were identified using zoning data along with screening layers of protected areas, easements, and other areas where solar development would not be permitted. We also screened out ecologically important areas such as Maryland's Targeted Ecological Areas, identified by the state as being high-priority conservation areas.

Next, for parcels more than five acres in size, we overlaid potential solar sites with Chesapeake Conservancy's high-resolution (one meter) land-cover data and the soil survey data from the U.S. Department of Agriculture (USDA) to generate metrics for land area composition, including tree canopy cover, non-forest vegetation cover, prime farmland, and non-prime soils, on each parcel. We ranked parcels by their available solar opportunity area (SOA) or amount of land available in the parcel without either prime farm soils or tree cover. We also calculated building footprint area and the amount of impervious surface area along with city and county parking lot data to identify parcels with significant opportunities for rooftop or parking-canopy solar arrays. For properties smaller than five acres, we combined parcels by zoning category (residential, residential multifamily, commercial, industrial, mixed use, and resource conservation) to identify total rooftop and parking-canopy area opportunity by zone.

We evaluated opportunities on degraded sites—including landfills, Voluntary Cleanup Program (VCP) sites, underutilized industrial sites, and other contaminated, underutilized, or abandoned sites—by collecting data on relevant properties in consultation with city and county planning and GIS staff. In addition, we considered some special classes of properties, including public buildings such as schools, firehouses, and other public properties, where this information was available.

Results were tallied into three categories considered optimal siting opportunities: degraded lands, parking canopies, and rooftops. Land parcels more than five acres in size offering significant solar opportunity area not located on degraded sites, prime farmland, or forest were considered "preferred ground-mounted sites." These areas did not meet the criteria for optimal sites, but they offer large areas suitable for ground-mounted solar arrays while avoiding the most adverse environmental impacts (Table 1).

Table 1. Ranking of optimal and ground-mounted solar energy sites with respect to land use tradeoffs

	Ranking	Land use tradeoffs
Optimal sites	High	Few to none
Preferred ground-mounted sites	Medium	Lowest among ground-mounted options
Other sites	Low	Loss of prime farmland Loss of environmentally sensitive areas

Finally, we developed metrics for each category of optimal and preferred sites for solar energy capacity, measured in megawatts (MW) and annual energy generation in gigawatt hours per year (GWh/yr). We then evaluated the ability for Maryland state and regional governments to meet solar energy requirements through development on optimal and preferred sites to meet the state's Renewable Portfolio Standard goals for solar energy.

Challenges for Scaling Solar Energy Generation

Improving affordability, advances in technological efficiency, and a wide array of federal, state, and local incentives have led to rapid growth in installed solar capacity across Maryland. Solar installations range in size from small-scale residential and community rooftop systems, to small and large rooftop commercial installations, large community ground-mounted systems, and utility-scale large solar photovoltaic (PV) facilities operating as power plants. Residential and commercial installations are typically "behind the meter" (BTM) resources, while larger community and utility-scale solar resources connect directly to the grid.[2]

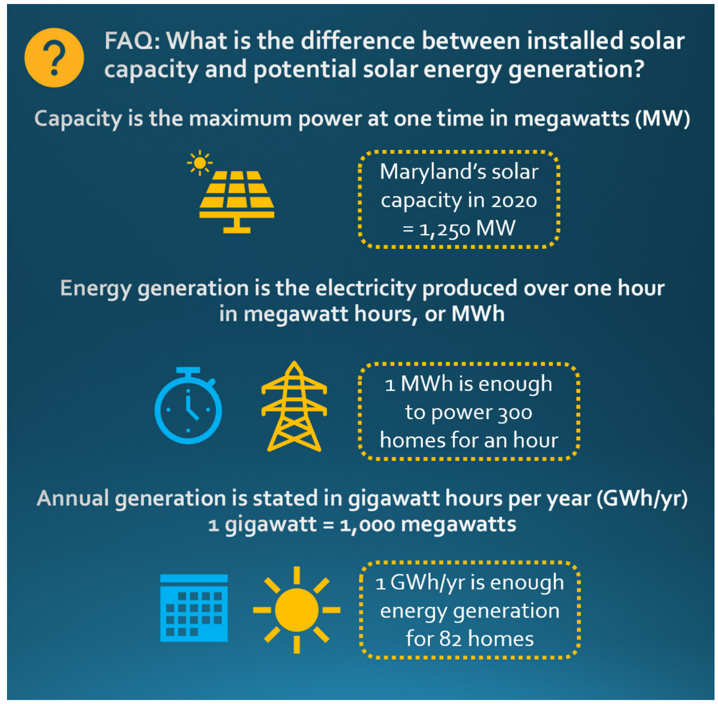
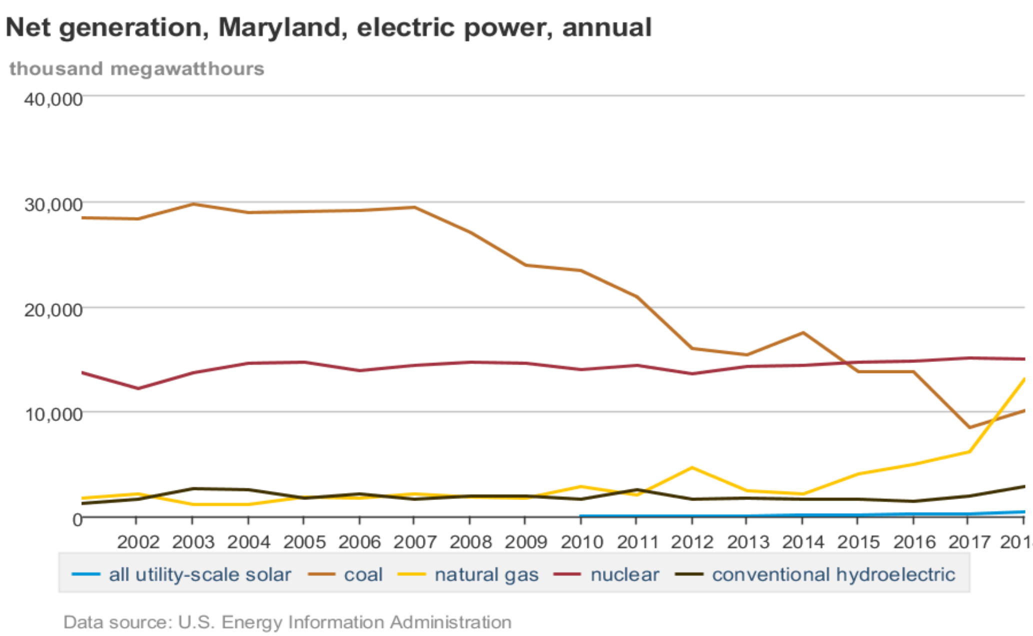


Figure 3. Frequently asked question about solar capacity and potential electricity generation

According to the U.S. Energy Information Administration, utility-scale solar in Maryland generated 448,000 MWh in 2018, or 1.3 percent of Maryland's total net electricity generation of 34.1 million MWh (Figure 4). However, the amount of energy from utility-scale solar is growing rapidly (Figure 5). A cost-benefit analysis of solar energy in Maryland assumed an additional 2.4 GW of solar energy resources will be installed between 2019 and 2030, and projects this growth will generate more than $7 billion in economic returns to the state.

Figure 4. Maryland annual net generation for electric power, all major sources



[2]"Benefits and Costs of Utility Scale and Behind the Meter Solar Resources in Maryland." Daymark Energy Advisors, RLC Engineering, and ESS Group. Nov. 2, 2018, https://cleantechnica.com/files/2018/11/MDVoSReportFinal11-2-2018.pdf. Accessed May 30, 2019.

To meet the goals of Maryland's RPS standard, it is estimated that the 14.5 percent solar carve-out would require 9,000 GWh/yr of electricity to be generated by solar statewide (Figure 6), starting in 2028. To set a goal for this study, we estimated the share of future solar energy generation that would be needed to meet the RPS goals for Baltimore City and County by three methods: electricity consumption, land area, and population (Table 2). The combined energy generation that would be required for the area ranged from a low of 619.8 GWh/yr, when calculated as a portion of land area, to 2131.2 GWh/yr, when calculated as a portion of population. We chose to use energy consumption as the prospective goal for the desirable amount of solar energy generation opportunities for our study area, to identify enough optimal locations to generate at least 1,967 GWh/yr of electricity. However, there is no requirement that solar development to meet the RPS be distributed by any of these methods.

Figure 5. Maryland annual net generation for electric power from utility-scale solar

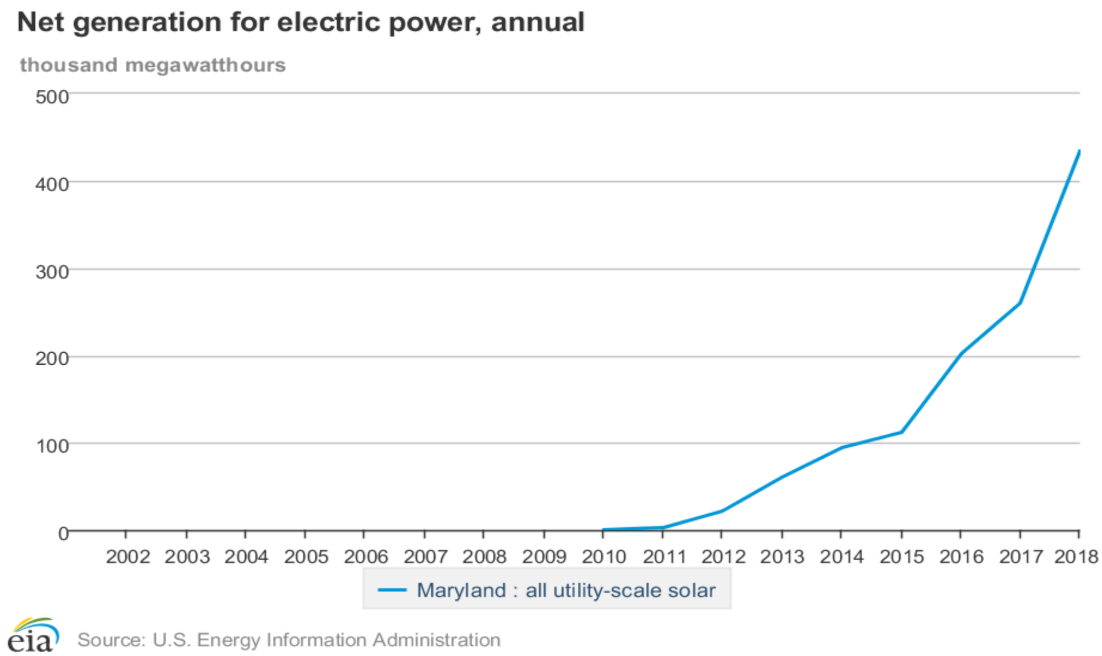


Figure 6. 14.5% solar carve-out Tier 1 requirements in Maryland compared to projected Maryland solar generation, 50% RPS Scenario

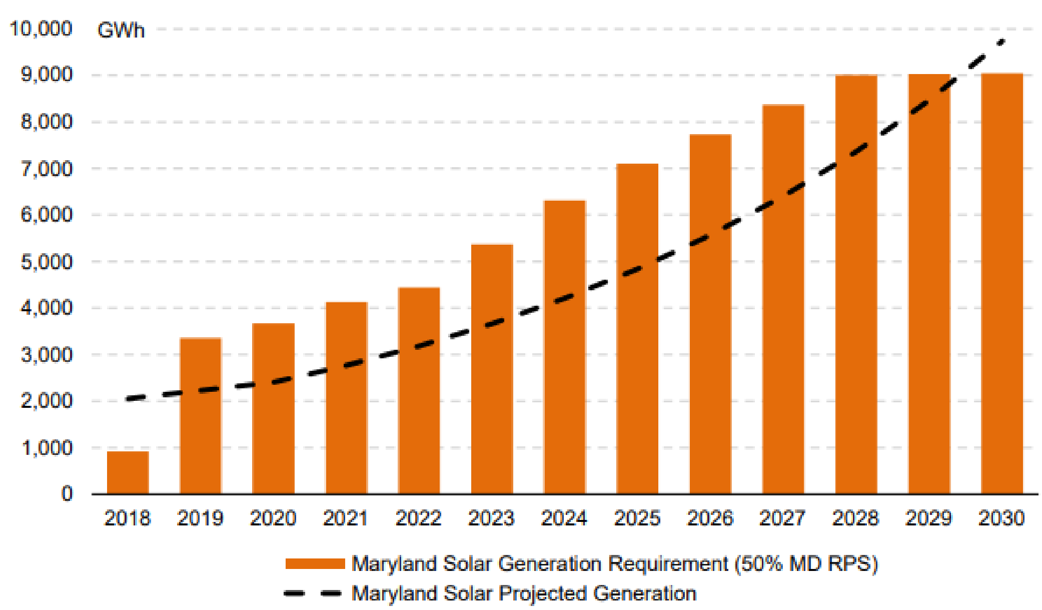


Table 2. Baltimore City and County share of solar carve-out calculated as share of Maryland total by electricity consumption (the method chosen for study goals), land area, and population

Electricity consumption (EIA, BGE)

	Consumption (GWh/yr)	% of state consumption	Solar carve-out share (GWh/yr)
Baltimore City	6,271.5	10.1%	909.1
Baltimore County	7,295.5	11.8%	1,057.5
Baltimore City and County combined	13,567.0	21.9%	1,966.6
Maryland	62,086.5	100.0%	9,000.0

Land Area (Maryland Geological Survey)

	Land area (square miles)	% of state land area	Solar carve-out share (GWh/yr)
Baltimore City	80.3	0.8%	73.5
Baltimore County	597.6	6.1%	546.4
Baltimore City and County combined	677.9	6.9%	619.9
Maryland	9,844.0	100.0%	9,000.0

Population 2018 (US Census)

	Population	% of state population	Solar carve-out share (GWh/yr)
Baltimore City	602,495	10.0%	897.4
Baltimore County	828,431	13.7%	1,233.9
Baltimore City and County combined	1,430,926	23.7%	2,131.3
Maryland	6,042,718	100.0%	9,000.0

Source: “Final Report Concerning the Maryland Renewable Portfolio Standard…” Maryland Department of Natural Resources. https://dnr.maryland.gov/pprp/Documents/FinalRPSReportDecember2019.pdf. Accessed 8 Mar. 2020.

Siting Concerns

States and counties across the country are working to address the need to increase their solar PV energy capacity rapidly while addressing concerns about how and where solar facilities are developed. The potential for rapidly scaling up the amount of renewable energy produced, as the cost of solar PV panels rapidly declines, makes utility-scale solar an attractive option. But it carries environmental trade-offs in the land required for siting, especially in land-constrained regions. The majority of solar power plants are on privately held land but are subject to approval by state and local agencies. The permitting process, including environmental review, can take three to five years to complete.[3]

Estimates of the land required per MW of electricity generated vary from less than five up to eight acres. A Maryland Public Service Commission study found large solar projects in Maryland at the higher end of estimates.4 The amount ultimately needed for ground-mounted utility-scale solar will depend on a variety of factors, including future energy use and the portion of solar energy development that will occur on agricultural land. The Governor's Task Force on Renewable Energy Development and Siting estimates the amount of land required may range from 7,500 to 35,000 acres.

Meanwhile, rooftop solar installations in urban and suburban areas are able to meet a great amount of electricity demand with relatively few adverse environmental impacts. Significant potential exists to continue expanding rooftop solar in residential, community, and commercial installations. According to the National Renewable Energy Laboratory (NREL), Maryland has the potential to offset 38.7 percent of statewide electricity sales with rooftop solar, with a 17.3 percent potential offset from medium to large buildings.[5] Solar parking canopies are a relatively new option for solar energy generation, with grants available from the Maryland Energy Administration to offset installation costs for businesses and nonprofits.[6]

Tradeoffs of land use demand for solar

Designating increasing amounts of land for solar energy development will take land out of other uses. Without siting guidelines and incentives, the majority of future land used for solar energy development is likely to come from agriculture. Loss of forest cover, wetlands, and ecologically sensitive areas have additionally been identified as undesirable environmental tradeoffs. Loss of forests and wetlands additionally will result in greenhouse gas emissions associated with land clearing, which counteracts the climate mitigation benefits provided by increasing renewable energy.

Loss of prime farmland to solar energy development is a key concern related to Maryland's efforts to scale up solar rapidly to reach the goals of the RPS. According to the USDA National Agricultural

[3] "Final Report Concerning the Maryland Renewable Portfolio Standard..." Maryland Department of Natural Resources (DNR). Dec. 2019. https://dnr.maryland.gov/pprp/Documents/FinalRPSReportDecember2019.pdf. Accessed Mar. 8, 2020.

[4] "Governor's Task Force on Renewable Energy Development and Siting: Interim Report." Dec. 1, 2019. https://governor.maryland.gov/wp-content/uploads/2019/12/Final-Interim-Report.pdf.

[5] Gagnon, P., Margolis, R., Melius, J., Phillips, C., and Elmore, R. "Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment." NREL. Jan. 2016. https://www.nrel.gov/docs/fy16osti/65298.pdf. Accessed May 27, 2019.

[6] Parking Lot Solar PV Canopy with EV Charger Grant Program. Maryland Energy Administration. https://energy.maryland.gov/business/Pages/incentives/PVEVprogram.aspx. Accessed Sept. 26, 2020.

Statistics Service, the acreage of cropland harvested in Maryland has decreased by more than 280,000 acres between 1997 and 2017, or 14 percent.[7] Prime farmland, or the land best suited to agriculture, makes up about 20 percent of Maryland's land, and is found mainly on the Eastern Shore and in north central Maryland. The main source of the loss of prime farmland has historically been suburban development, but solar expansion is likely to be a growing cause of farmland loss in the future. The Governor's Task Force on Renewable Energy Development and Siting, in its interim report, projects that while half of current solar capacity comes from large-scale solar arrays, in the future 75 percent may come from utility-scale solar, and a range of 60 to 100 percent of solar development may occur on agricultural lands.[8]

The main source of greenhouse gas emissions associated with solar energy is the manufacture and shipping of the panels, which results in 45 grams of carbon dioxide emitted for every kWh of energy produced. Clearing forest increases these emissions by an estimated 73 percent (Figure 7) from the biomass of forest lost, plus lost future carbon sequestration. Compared to fossil-fuel–based energy sources, however, solar energy results in fewer carbon dioxide emissions, even when established on forest land. But for Maryland's overall energy-related carbon dioxide emissions to fall as rapidly as possible, limiting loss of forest cover related to solar energy establishment is critical.

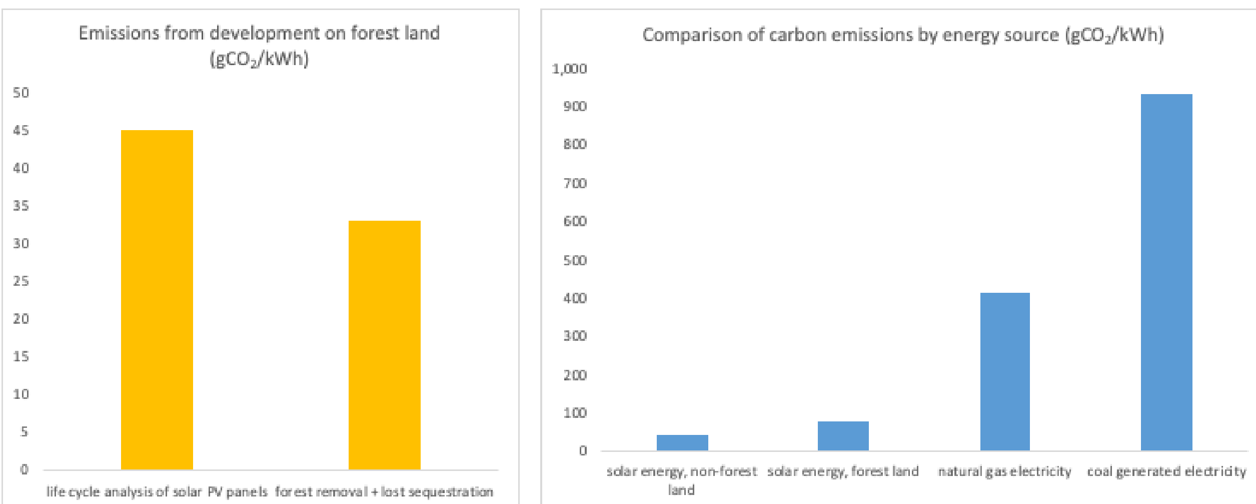


Figure 7. Carbon dioxide emissions associated with solar energy development and conversion of forest land

Solar development in the built environment

One of the most attractive aspects of solar energy systems is their potential to be co-located with other land uses within cities and suburban areas. This includes residential solar, but also larger-scale community and commercial solar installations on building rooftops and over parking lots in solar canopy installations. Contaminated lands and brownfields, including landfills and former industrial sites, offer additional opportunities for solar development.

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[7] USDA's National Agricultural Statistics, Maryland Field Office. Updated Nov. 5, 2019, https://www.nass.usda.gov/Statistics_by_State/Maryland/index.php. Accessed Mar. 13, 2020.

[8] "Governor's Task Force on Renewable Energy Development and Siting: Interim Report." Dec. 1, 2019. https://governor.maryland.gov/energy-task-force/.

Encouraging the use of contaminated and degraded lands for solar energy is one of the best ways to minimize the land use effects of development. Environmentally contaminated lands affected by the improper handling or disposal of hazardous materials or waste are tracked by the U.S. Environmental Protection Agency (EPA) and state voluntary cleanup programs (VCPs). An NREL analysis, "Solar Development on Contaminated and Disturbed Lands," found 20 million acres of such lands that could be suitable for the deployment of solar PV and concentrated solar power (CSP) systems.[9] The U.S. EPA RE-Powering America's Land Initiative identifies opportunities to site renewable energy on contaminated lands, landfills, and mine sites, with 130,000 sites located nationwide. Completed solar PV projects in Maryland on these sites include Fort Detrick, a Superfund site, and former landfills in Ellicott City, Hagerstown, and Williamsport.[10] Solar energy development on brownfield and closed landfill sites promises new opportunities for making productive use of and generating income from long-abandoned land areas.

In densely populated areas of the country, there may be sufficient opportunities on already-developed or previously degraded lands to preclude the necessity of converting large areas of rural land for solar. A recent study of opportunities for solar development in California identified sufficient opportunities for photovoltaic and concentrated solar power within the built environment to exceed current statewide electricity demand.[11] This study is the first to conduct this type of analysis for Baltimore City and County, and such an analysis could potentially be conducted for Maryland statewide, providing valuable information to guide the development of policies for solar energy development. The demonstration of sufficient opportunities for solar energy generation within the built environment could provide a strong alternative to rural land conversion, especially if coupled with financial incentives and regulatory provisions to reduce project costs and ease the permitting process.

Solar development policies to encourage development in optimal locations

There appears to be broad consensus on several principles for solar energy siting, as reflected in the findings of the Governor's Task Force on Renewable Energy Development and Siting Interim Report[12] and the Abell Foundation report, "An Opportunity for Maryland to Get Solar Siting Right."[13] The Maryland Department of Natural Resources report on the Renewable Portfolio Standard provided estimates of the potential land use impacts of the RPS, economic impacts of solar energy development, and options for extending solar energy benefits to low- and moderate-income communities.[14]

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[9] Macknick, J., Lee, C., Mosey, G., and Melius, J. "Solar Development on Contaminated and Disturbed Lands." National Renewable Energy Laboratory (NREL). Dec. 2013.

[10] "RE-Powering America's Land Initiative: Benefits Matrix." EPA. Oct. 2018. https://www.epa.gov/sites/production/files/2018-10/documents/benefits_matrix_final_101818_web.pdf.

[11] Hernandez, R., Hoffacker, M. & Field, C. "Efficient use of land to meet sustainable energy needs," Nature Climate Change 5, 353. Mar. 16, 2015. https://doi.org/10.1038/nclimate2556.

[12] "Governor's Task Force on Renewable Energy Development and Siting: Interim Report." https://governor.maryland.gov/energy-task-force/.

[13] Schmidt-Perkins, D. "An Opportunity for Maryland to Get Solar Siting Right," The Abell Report, Vol. 32:7, Sept. 2019. https://www.abell.org/publications/getting-solar-siting-right-maryland. Accessed Sept. 3, 2020.

[14] "Final Report Concerning the Maryland Renewable Portfolio Standard..." DNR. https://dnr.maryland.gov/pprp/Documents/FinalRPSReportDecember2019.pdf. Accessed Sept. 3, 2020.

Ground-mounted solar competes with desirable land uses for food production and environmental services.

- Conversion of prime farmland for solar energy development should be avoided because it removes the best land needed for food production.
- Loss of forest cover and ecologically sensitive lands are undesirable environmental tradeoffs for lands critical to environmental protection and climate mitigation and resilience.

However, solar energy development is an opportunity to put degraded or contaminated lands and underutilized industrial sites to productive use.

- Capped landfills, contaminated lands, sites adjacent to wastewater treatment plants, and other abandoned sites can be repurposed for solar energy production.

Solar energy development in the built environment does not interfere with the productive use of developed lands.

- Solar energy production is compatible with residential, commercial, and public building uses it co-exists with and enhances these property uses.
- Solar parking canopies provide benefits including shaded parking, urban heat island reduction, and opportunities for electric vehicle charging.

With proper siting, solar energy development contributes to economic growth and provides opportunities for economic equity.

- Solar energy produced through distributed generation with net metering, including virtual net metering, provides significant economic benefits to homeowners and commercial property owners as well as considerable cost savings for public buildings and services.
- Solar energy development is an important and growing source of employment.
- Skilled jobs within or accessible to low- to moderate-income areas provide significant equity benefits.
- Nonprofit community solar offers significant equity opportunities when savings or income from net metering, renewable energy credits (RECs), and investment tax credits (ITCs) are passed on to subscribers.

The New Jersey Board of Public Utilities has been a leader in creating incentives for solar energy development on preferred sites through its Community Solar Energy Pilot Program, administered by New Jersey's Clean Energy Program.[15] The program developed a system for reviewing applications to the program, which assigned points to projects meeting criteria for equity, preferred siting, and other benefits (Box 1).

According to data provided during a stakeholder engagement hearing on July 27, 2020, the board received 252 applications for the Community Solar Energy Pilot Program, including 232 applications for low- and moderate-income (LMI) projects; 112 applications for projects located on rooftops; 54 applications sited on landfills, brownfields, historic fill areas, or parking canopies; and 75 in whole or in part on farmland. Following evaluation, the board approved 45 community solar projects, all of which were LMI projects, with 30 sited on rooftops, 9 sited on landfills, and 6 sited on parking canopies, brownfields, or other degraded lands[16]

[15] New Jersey's Clean Energy Program. https://njcleanenergy.com/. Accessed Sept. 1, 2020.

[16] "New Jersey Community Solar Energy Pilot Program: Program Year 1 Lessons Learned." New Jersey Board of Public Utilities. July 9, 2020. https://www.bpu.state.nj.us/bpu/pdf/publicnotice/Notice%20Community%20Solar%20Request%20for%20Comments%20PY1%20Lessons%20Learned%2007-09-2020.pdf. Accessed Sept. 1, 2020.

Box 1. New Jersey Board of Public Utilities: Community Solar Energy Pilot Program Rules

The application form outlines the requirements for projects within the pilot program, including a criteria rubric by which applications will be evaluated and ranked for selection by the board. New Jersey is the first state ever to utilize an evaluation rubric for its community solar program, as opposed to a first-come, first-served process. The rubric will ensure an intentional selection approach and fair access to the program among diverse solar vendors and project types, and it will help maximize the state's knowledge gained from the pilot program.

- *Low- and moderate-income and environmental justice inclusion (30 points max.);*
- *Siting, with priority given to landfills, brownfields, areas of historic fill, rooftops, parking lots, and parking decks (20 points max., with a potential five-point bonus for landscaping, land enhancement, pollination support, storm water management, soil conservation, and/or decommissioning plans);*
- *Product offering, with priority given to those that guarantee savings of greater than 10 percent (15 points max.);*
- *Community and environmental justice engagement (10 points max.);*
- *Subscribers, with priority given to projects with a majority of residential subscribers (10 points max.);*
- *Other benefits, with priority given to projects providing local jobs, job training, or demonstration of co-benefits such as paired with storage or a microgrid project (10 points max.); and*
- *Geographic limit within EDC service territory, with priority given to projects with subscribers in the same municipality or an adjacent municipality to the project's location (five points max.).*

Projects must receive at least 30 points to be considered for participation in the pilot program. Projects that receive more than 30 points will be awarded capacity in the pilot program in order, starting with the highest-scoring project and proceeding to the lowest-scoring project.

Source: "NJBPU Unveils Application Process for New Statewide Pilot Community Solar Plan." New Jersey Board of Public Utilities. Mar. 29, 2019. https://www.nj.gov/bpu/newsroom/2019/approved/20190329.html.

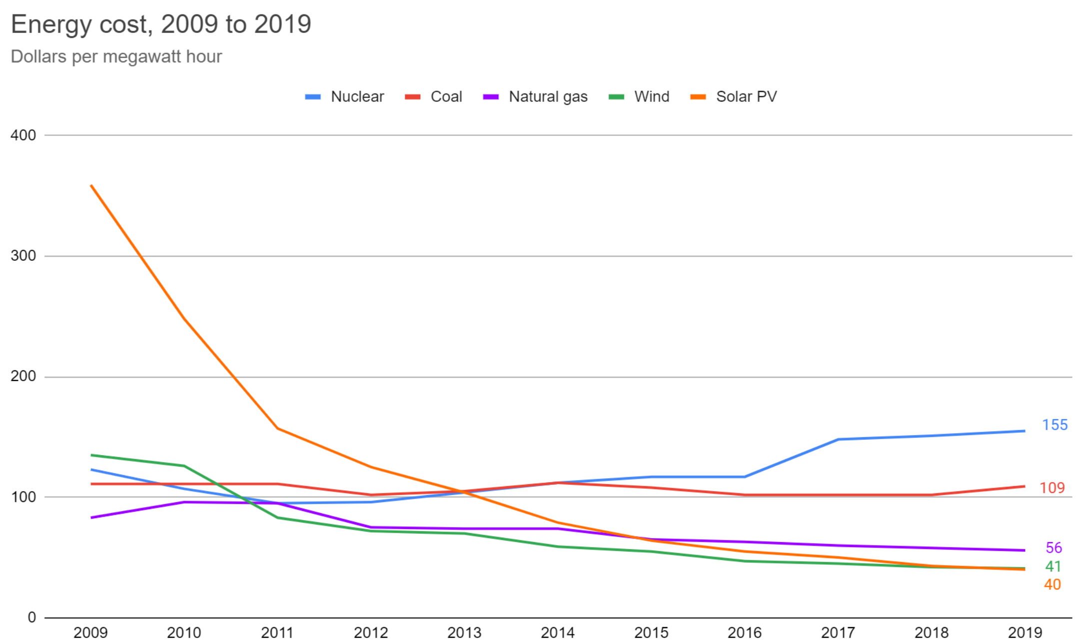
A considerable barrier to expanding solar energy access to low- and moderate-income households is access to financing for LMI solar projects. The Climate Access Fund (CAF)[17] is an initiative based in Baltimore that provides discounted energy access to lower-income households in Maryland through community solar power. The fund serves as a nonprofit Green Bank[18] to help secure low-cost capital for solar energy projects at favorable rates and terms to traditional market financing. CAF raises funding for community solar projects, provides guaranty capital, and also offers low-cost debt with flexible terms. With these offerings, CAF solar projects are able to serve 100 percent LMI customers, whereas other community solar programs typically will require only a portion of LMI customers; for example, New Jersey's Community Solar Energy Pilot Program requires 51 percent LMI subscribers for a project to receive LMI points in their ranking system.

[17] Climate Access Fund. https://climateaccessfund.org/. Accessed Sept. 3, 2020.

[18] Green Banks. https://www.nrel.gov/state-local-tribal/basics-green-banks.html. NREL. Accessed Sept. 3, 2020.

Figure 8. The average cost of utility-scale solar is rapidly declining and is now less expensive than fossil fuels[19]

Source: Lazard's Levelized Cost of Energy Analysis, 2019



Solar Development in Baltimore County and Baltimore City

According to the PJM, the regional electricity transmission organization for Maryland, the state had 1,250 MW capacity in installed solar projects in March 2020.[20] The state ranks fifteenth in the nation in solar power, and sixteenth in solar jobs. Maryland's solar capacity is projected to more than double within the next five years.[21] Baltimore County has 98 MW of solar capacity and the city of Baltimore has an additional 15.4 MW, for a total of more than 8,400 individual solar installations in the region. Large rooftop solar installations include Amazon's fulfillment facility at Sparrow's Point, General Motors' transmission assembly plant in White Marsh, IKEA's Baltimore location, and several other commercial projects such as Target and Macy's locations. At this time, Baltimore County's largest operating utility-scale solar power plant is nearly 3 MW in capacity, while statewide, the largest facility registered in PJM GATS is a 100 MW Great Bay Solar installation in Somerset County.

Most projects for ground-mounted solar within Baltimore County are still in the planning stages. Maryland's Community Solar Energy Pilot Program allows projects with up to 2 MW capacity. There were a total of eighteen applications for BGE's Community Solar Pilot Program in Baltimore County, primarily for ground-mounted solar projects, including a 1 MW operating facility in Kingsville, Maryland. Baltimore County passed solar legislation in June 2017 (Bill 37-17).[22] The bill limited "commercial" solar facilities to ten per council district. The third council district, which has the bulk of the county's farmland, was the first to have ten applications for community solar projects.

[19] Berke, J. "Renewable energy is getting cheaper and it's going to change everything." World Economic Forum. May 14, 2018. https://www.weforum.org/agenda/2018/05/one-simple-chart-shows-why-an-energy-revolution-is-coming-and-who-is-likely-to-come-out-on-top. Accessed June 28, 2019.

[20] Renewable Generators Registered in GATS. PJM Generation Attribute Tracking System. https://gats.pjm-eis.com/gats2/PublicReports/RenewableGeneratorsRegisteredinGATS. Accessed Mar. 14, 2020.

[21] "State Solar Spotlight: Maryland." Solar Energy Industries Association. https://www.seia.org/sites/default/files/2019-12/Maryland.pdf. Accessed Feb. 26, 2020.

[22] County Council of Baltimore County, Maryland, Bill No. 37-17. http://resources.baltimorecountymd.gov/Documents/CountyCouncil/bills/bills%202017/b03717.pdf.

As of March 2020, fifteen of these projects have had their zoning petitions for solar installations granted, two are pending, and one has been withdrawn.[23] Because land use is managed by each county in Maryland, there is wide variation as to how solar power plants are regulated. In some counties, they are treated as industrial use and allowed only in industrial zones as a principal use, while other counties, including Baltimore County, allow them by special exception in agricultural and other zones. This use was not contemplated in most local comprehensive plans, and many local jurisdictions had to scramble to get regulations on the books. Some have gone back to revise regulations to address concerns, particularly about the use of prime soils and forested lands as the first choice for such facilities. The Governor's Task Force on Renewable Energy Development and Siting is expected to provide recommendations for policies and incentives at the state and local scale.

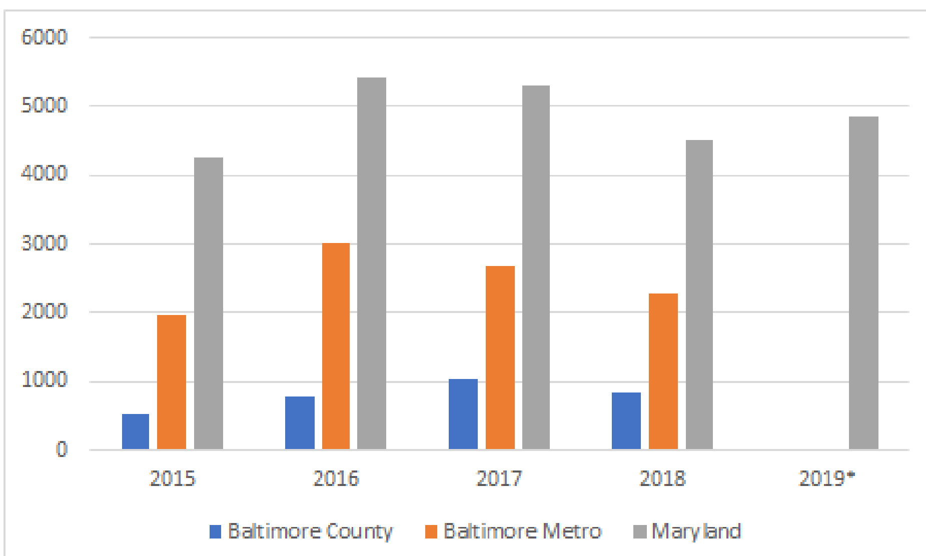
Employment in the Solar Industry

Employment trends in Baltimore County, the Baltimore metropolitan region, and Maryland reflect trends in the solar industry nationwide. Baltimore County solar industry employment declined in 2018, while in the Baltimore metropolitan region, employment declined in both 2017 and 2018. Statewide, solar industry employment rebounded 7.5 percent in 2019, following declines in the two previous years. Tariffs on imported solar panels imposed in January 2018 are cited as the main reason for recent employment trends. Nationally, the solar industry employs nearly 250,000 workers, showing a rebound in 2019 of 2.3 percent, somewhat less than the projected 7 percent increase in 2018.[24]

Within Maryland, the newly passed Renewable Portfolio Standard is expected to boost solar energy jobs significantly in the state. According to a study by the Maryland Public Service Commission, the new RPS standard is expected to generate 22,563 job-years (a job year is equivalent to one person being employed for one year) over the next ten years, through the addition of 2.4 GW of solar energy generating capacity.[25]

Figure 9. Solar industry employment, 2015–2019

*2019 data provided statewide employment figures only



[23] Baltimore County - My Neighborhood. https://myneighborhood.baltimorecountymd.gov/. Accessed Mar. 14, 2020.

[24] National Solar Jobs Census 2019. The Solar Foundation. Feb. 2020. http://www.SolarJobsCensus.org.

[25] "Benefits and Costs of Utility Scale and Behind the Meter Solar Resources in Maryland." Daymark Energy Advisors, RLC Engineering, and ESS Group. Nov. 2, 2018,

Equity and Opportunity

The rapid growth in solar energy provides an opportunity to ensure that all people have access to affordable, renewable energy. Low-income communities have borne many of the adverse effects of energy production in the past—for example, from increased exposure to pollution related to energy production and low rates of employment in lucrative energy-related fields.

Access to affordable energy. Solar energy provides opportunities to incorporate equity concerns into the placement of solar energy resources and the equitable distribution of solar energy economic benefits. Maryland's Community Solar Pilot Program and aggregate net energy metering (ANEM) policies increase the affordability of energy by allowing customers to access the financial benefits of excess generation credits.[26]

However, community solar may not be providing access to many low- and moderate-income customers. According to a survey by the Smart Electric Power Alliance (SEPA), only 44 percent of community solar programs have low- and moderate-income (LMI) subscribers. To expand participation to LMI customers, SEPA recommends, the subscription price for solar energy must be equal to or lower than the prevailing electricity cost. NREL has found, however, that utility-supplied green power products, which typically supply energy from both solar and wind, have premium pricing, costing the average home $18 a month more than standard pricing.[27,28]

Employment opportunities. Solar energy development is also providing rapid growth in green energy jobs in the United States. Planning for equity and opportunity in solar site planning, by prioritizing the inclusion of lower-income and urban communities as well as sites accessible by public transportation in solar project plans, could provide much-needed employment opportunities. Locating projects within IRS Opportunity Zones, which are economically distressed communities where new investments may be eligible for preferential tax treatment, is another potential way to generate benefits for lower-income communities. Community solar projects can increase access to solar energy and energy cost savings to all residents, including those who are not homeowners—an important equity consideration.

Policies and incentives to guide solar siting. Thirty states, the District of Columbia, and three territories have renewable portfolio standards that provide targets for electricity generation from renewable sources.[29] Policies and regulations vary widely across states. Massachusetts and New Jersey have been lauded for their policies, rebates, and incentives that guide solar energy development toward preferred sites. Solar Power Rocks is an organization that provides annual rankings of states in terms of solar energy policies, and in 2019 the site piloted an evaluation of policies for low-income families.[30]

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[26] "Report on the Status of Net Energy Metering in the State of Maryland." Public Service Commission of Maryland. Sept. 1, 2018, https://www.psc.state.md.us/wp-content/uploads/FINAL-2018-Net-Metering-Report.pdf. Accessed Feb. 26, 2020.

[27] O'Shaughnessy, E., Liu, C., and Heeter, J. "Status and Trends in the U.S. Voluntary Green Power Market." NREL. Oct. 5, 2016. https://www.nrel.gov/docs/fy17osti/67147.pdf. Accessed Apr. 30, 2020.

[28] Green Power Pricing. U.S. EPA. Apr. 15, 2019, https://www.epa.gov/greenpower/green-power-pricing. Accessed Apr. 30, 2020.

[29] State Renewable Portfolio Standards and Goals. National Conference of State Legislatures (NCSL). Apr. 17, 2020. https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx. Accessed Sept. 26, 2020.

[30] Solar Power Rocks. https://www.solarpowerrocks.com/. Accessed Mar. 17, 2020.

Results and Discussion

Our analysis found 33,806 acres of optimal sites for solar energy development in Baltimore County and the city of Baltimore (Table 3). Of this total, the great majority is within the built environment, either on rooftops (65.6 percent) or in large parking lots greater than once acre in size or on parking garages (31.1 percent). An additional 1,116 acres (3.3 percent) fall within degraded lands. We estimate a total of 22,789 GWh/yr of electricity could be generated from these sites, demonstrating that extensive opportunities exist within optimal and preferred sites to contribute proportionally to Maryland's RPS goals.

We identified an additional 3,400 acres of preferred locations for ground-mounted solar energy development. These potential sites, at least five acres in size, offered significant land acreage avoiding prime agricultural soils, forested land, and important ecological areas. Many of these sites contain pasture on marginal agricultural land, so they would offer fewer land use tradeoffs related to agriculture or environmental impacts. Solar energy production on sites such as these could provide an additional 5,237 GWh/yr of electricity generation.

Of the potential optimal and preferred ground-mounted sites identified, only a portion will prove to be viable sites for solar energy development. In Table 2, we estimated Baltimore County and City's respective shares of Maryland's solar carve-out as 1,058 GWh/yr of electricity generated from solar for Baltimore County and 909 GWh/yr for Baltimore City. Table 4 shows the percentage of optimal and preferred ground-mounted sites that would be needed to meet Maryland's solar energy goals. Even if the region restricted solar energy development only to optimal sites, just 8.6 percent of these would need to be developed to meet the regional share of the state's RPS goal.

	Total area (acres)	Potential electricity generation (GWh/yr)
Baltimore County		
Optimal		
Parking	6,904	3,949
Rooftop	14,405	9,762
Degraded lands	1,116	1,719
Total optimal	**22,425**	**15,430**
Preferred ground-mounted	**3,400**	**5,237**
Baltimore City		
Optimal		
Parking	3,611	2,066
Rooftop	7,809	5,292
Degraded lands	—	—
Total optimal	**11,420**	**7,358**
Preferred ground-mounted	**—**	**—**
Baltimore County and City (combined)		
Optimal		
Parking	10,515	6,015
Rooftop	22,214	15,054
Degraded lands	1,116	1,719
Total optimal	**33,845**	**22,788**
Preferred ground-mounted	**3,400**	**5,237**
Total optimal and preferred	**37,245**	**28,025**

Table 3. Potential energy generation from preferred and optimal sites

Table 4. Percentage of optimal solar sites that would reach renewable energy goals, based on energy consumption

	Baltimore County	Baltimore City	Total
Energy generation potential (Optimal)	15,431	7,358	22,789
Energy generation potential (Preferred ground-mounted)	5,237	—	5,237
Generation goal, based on energy consumption	1,058	909	1,967
% optimal sites to reach goal	6.9%	12.4%	8.6%
% optimal + preferred sites to reach goal	5.1%	—	7.0%

Figure 10a. Total optimal sites for solar energy development in Baltimore County and City (acres)

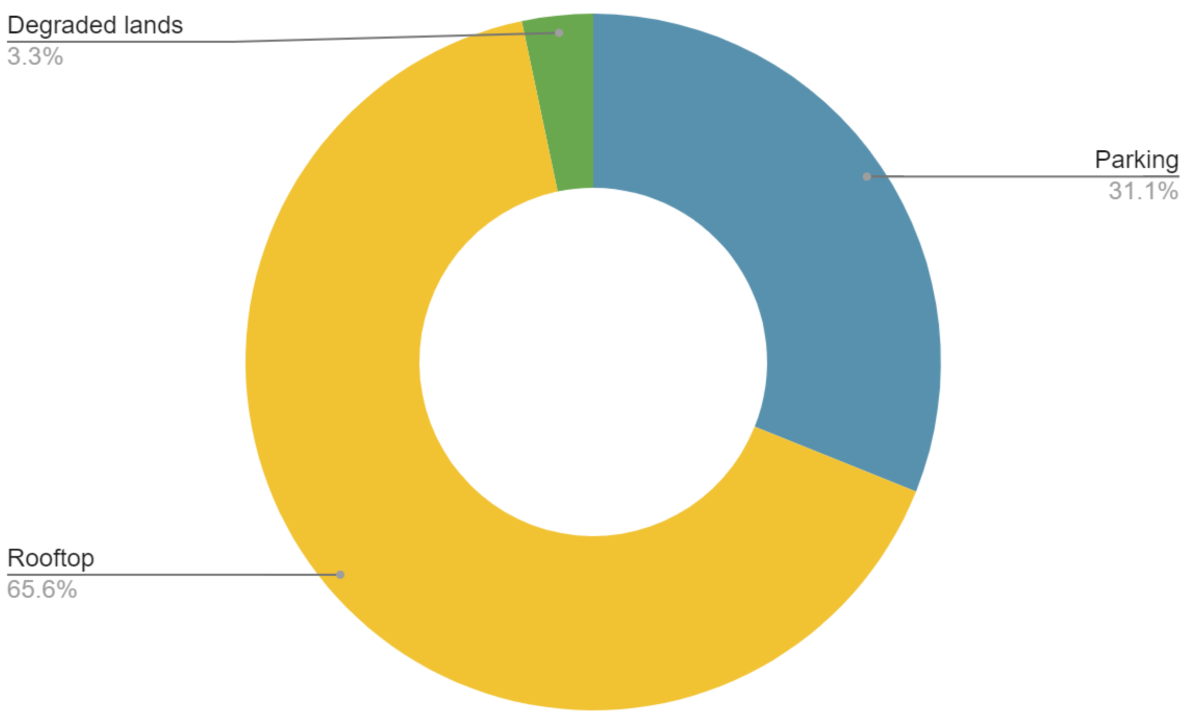
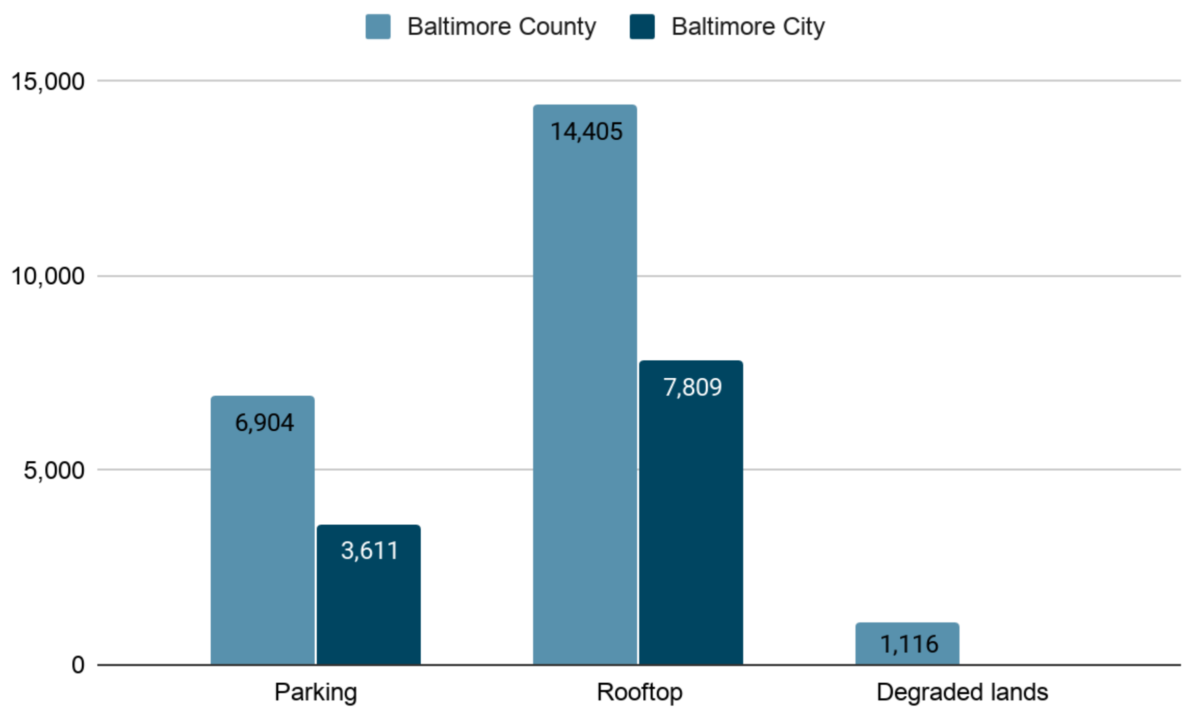


Figure 10b. Optimal sites for solar energy development in Baltimore County and City (acres)



Optimal Solar Sites on Degraded Lands

Baltimore County offers 1,116 acres of degraded lands with potential for solar energy development. These include closed landfills, Hernwood and Parkton, the decommissioned Pikesville Reservoir, and land at the wastewater treatment plant. Similar locations have been developed for solar throughout Maryland. Of these, we have identified 182 acres of underutilized industrial sites as well as 570 acres of brownfield sites. Some of these locations could potentially be used for solar energy development, either as an interim land use or as part of cleanup or redevelopment projects. We did not assess degraded lands opportunities within Baltimore City, as most properties in the Voluntary Cleanup Program (VCP) are on small sites and data on underutilized industrial sites were not available.

Rooftop Solar

Rooftop solar offers the largest opportunity at more than 22,000 acres, with 7,809 acres in the city of Baltimore and 14,405 acres in Baltimore County. According to PJM GATS, Baltimore City has 15.4 MW of installed solar capacity, or 26 watts per capita, using 2018 U.S. Census population estimates. In comparison, Washington, D.C., has 82 MW of installed solar capacity, or 117 watts per capita, a rate more than quadruple that of Baltimore, indicating significant capacity for growth.

Across Baltimore City and County, residential rooftops make up the majority of rooftop area, with nearly 58 percent in Baltimore County and more than 60 percent in Baltimore City. Commercial and industrial sites offer the potential for large installations, some of which rival the size of utility-scale solar. Taking advantage of roof space on large public buildings offers a major opportunity for city and county governments to contribute toward solar energy goals, with more than 750 acres of rooftop available on Baltimore County public schools, firehouses, and other county buildings.

We estimate potential energy production from Baltimore City rooftops as 5,292 GWh/yr, and for Baltimore County, 9,762 GWh/yr. This likely overestimates potential energy generation, as we did not take into account roof angle or shading by tree canopy. Previous estimates of solar energy potential for Baltimore rooftop solar are available from Google Project Sunroof (2,800 GWh/yr)[31] and NREL (2,549 GWh/yr).[32]

Figure 11. Rooftop area for Baltimore County and City (acres)

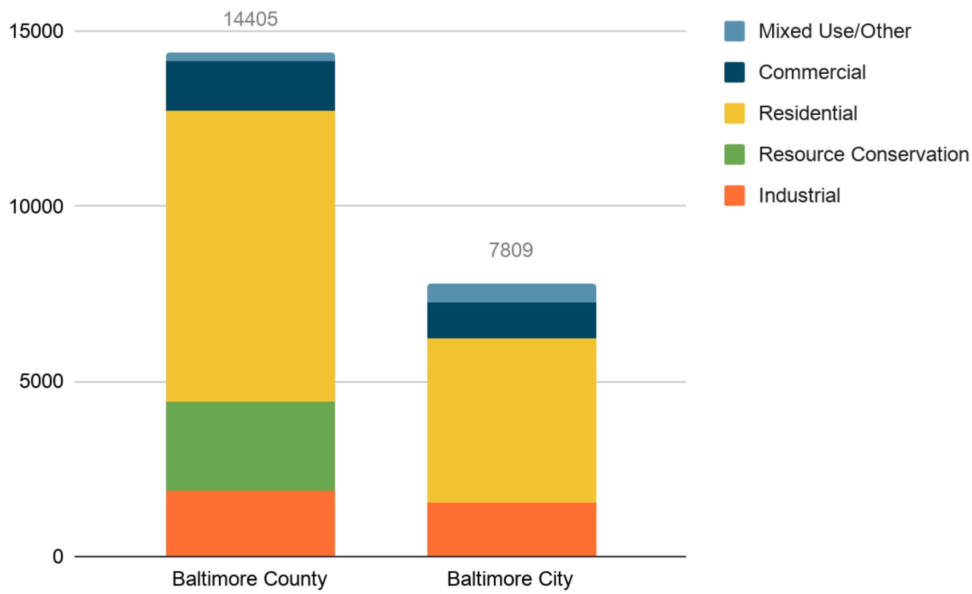


Table 5. Baltimore County potential rooftop solar area

Zoning Group	Acres
Residential	8,298
Resource Conservation	2,557
Industrial	1,870
Commercial	1,436
Mixed Use/Other	244
Total	**14,405**

Table 6. Baltimore City potential rooftop solar area

Building Type	Acres
County Public Schools	297
Firehouses	14
Other County-Owned Buildings	131
Total	**442**

Table 7. Rooftop solar development area on public buildings in Baltimore County

Zoning Group	Acres
Commercial	1,018
Educational Campus	130
Hospital Campus Zoning District	110
Industrial	1,522
Mixed Use	270
Open Space and Environmental Districts	59
Residential	1347
Residential Multifamily	3,353
Total	**7,809**

[31] Google Project Sunroof. https://www.google.com/get/sunroof/data-explorer/. Accessed Mar. 8, 2020.

[32] Google Project Sunroof. https://www.google.com/get/sunroof/data-explorer/. Accessed Mar. 8, 2020.

Parking Canopy Opportunities

Parking lots offer more than 28 percent of the optimal solar energy development area identified in Baltimore County and City. The estimate was restricted to lots less than one acre in size and parking garages with an open-top deck. While parking canopies are among the most expensive types of solar installations, they offer desirable amenities, including shaded parking spaces and the potential to charge electric vehicles.

Solar panels can generate approximately 2 kW per parking space.[33] Assuming 150 parking spaces per acre, 300 kW can be generated per acre of parking lot.[34] With 10,515 acres of parking lots more than one acre in size, Baltimore County and City have the potential for 3,507 GWh/yr of solar generation from parking canopy solar.

Table 8. Solar energy development area for parking canopies (acres)

	Baltimore County	Baltimore City	Total
Parking lots > 1 acre	6,898	3,578	10,476
Garages	6	33	39
Total	6,904	3,611	10,515

Preferred Ground-Mounted Solar Sites

Our analysis of ground-mounted solar development opportunities identified 3,400 acres of land parcels suitable for solar projects of 1 MW or more that would offer the fewest environmental tradeoffs. Parcels identified as preferred sites passed initial screens for legal and technical feasibility, and they were among the highest-ranking sites for additional criteria, including low portions of land occupied by tree canopy and prime farmland. A significant number of sites identified included active farms (horses or other grazing animals, with open land in pasture) as well as large residential properties. It is likely that only a small portion of these parcels would be available for solar energy development.

Preferred sites for ground-mounted solar represented just 0.8 percent of Baltimore County's land area, highlighting the challenge of identifying lands with the fewest environmental tradeoffs. Many additional opportunities exist for solar energy use of a portion of these lands, with on-farm solar used for only part of the land. Rooftop opportunities were also assessed for all rural lands.

We identified only 20 acres of ground-mounted solar opportunities in low- and moderate-income areas or IRS Opportunity Zones, as well as 76 acres of large rooftop opportunities. Because these tracts in Baltimore County and City are largely in urban and close-in suburban areas, the primary opportunities in these areas are likely to be for rooftop solar, including residential, community, and commercial opportunities.

[33] Shoup, D. Parking and the City. Routledge, 2018.

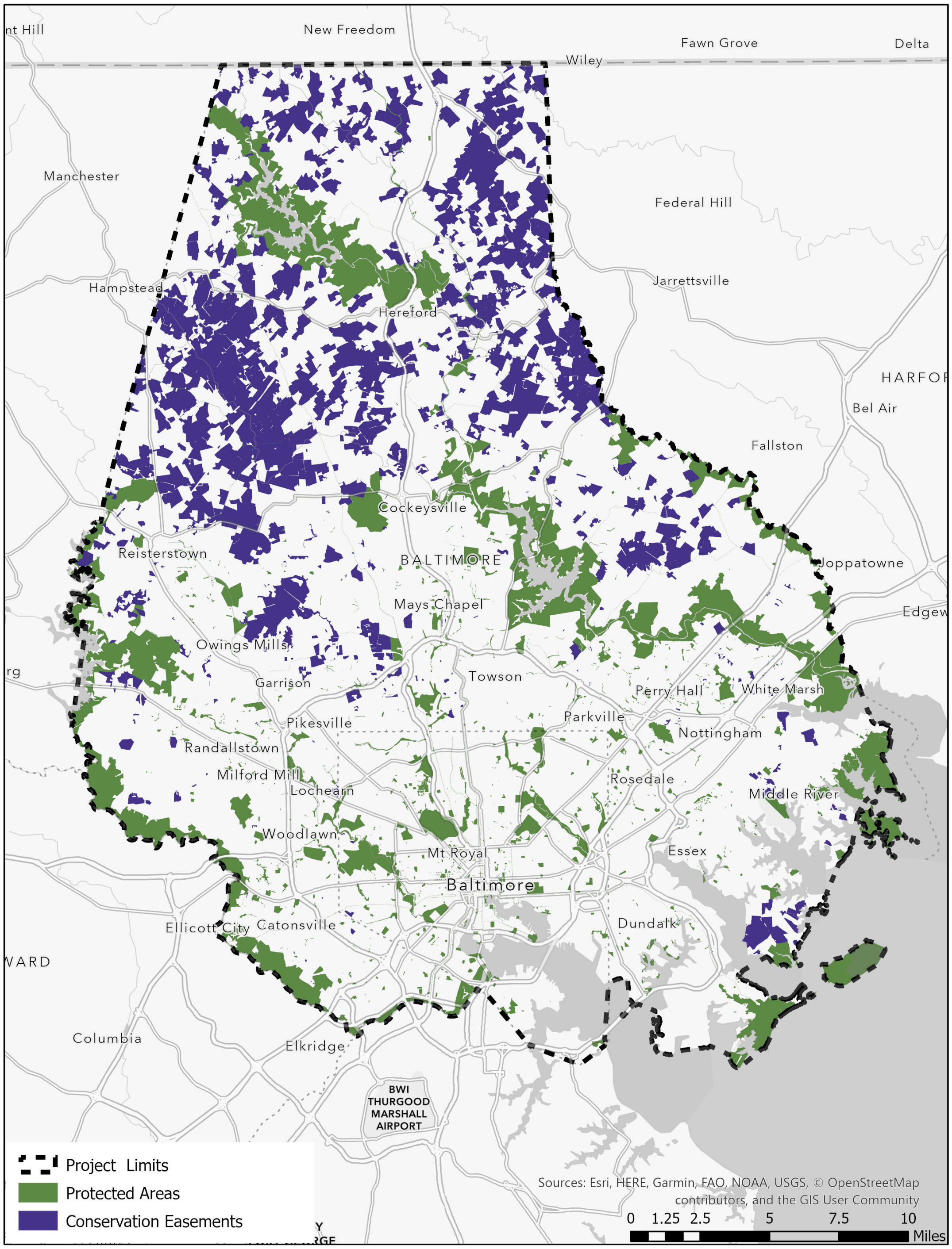
[34] Holland, R. "Estimating the Number of Parking Spaces per Acre." UT Extension. May 2014. https://ag.tennessee.edu/cpa/Information%20 Sheets/CPA%20222.pdf. Accessed Mar. 7, 2020.

Conclusions

Maryland's new Renewable Portfolio Standard creates strong incentives to ramp up solar energy development quickly to meet the requirements of generating 50 percent of electricity from renewable energy, with a 14.5 percent carve-out for solar energy. Key benefits of solar energy development include the flexibility to install solar PV panels in a variety of environments and settings, from residential home installations to utility-scale deployments. The potential to co-locate solar energy facilities with other land uses would enable both the reuse of long-abandoned degraded or contaminated lands, as well as using commercial, multi-family residential, and governmental facilities to meet renewable energy goals. This would avoid competition with alternate land uses or the generation of adverse environmental effects. Community solar programs and prioritizing development on desirable sites within low- and moderate-income areas can increase access to energy savings as well as provide job opportunities. Finally, quantifying and mapping both potential and optimal solar sites across Baltimore County provides valuable information for planning the development of sufficient solar energy capacity. It is clear from this analysis that thoughtful siting of solar projects can maximize environmental and economic benefits and minimize undesirable tradeoffs that cause conflict and significantly delay solar projects. By utilizing less than 10 percent of the available optimal sites, Baltimore County and City can meet their respective shares of the state's solar contribution toward renewable energy goals.

Appendix A: Maps

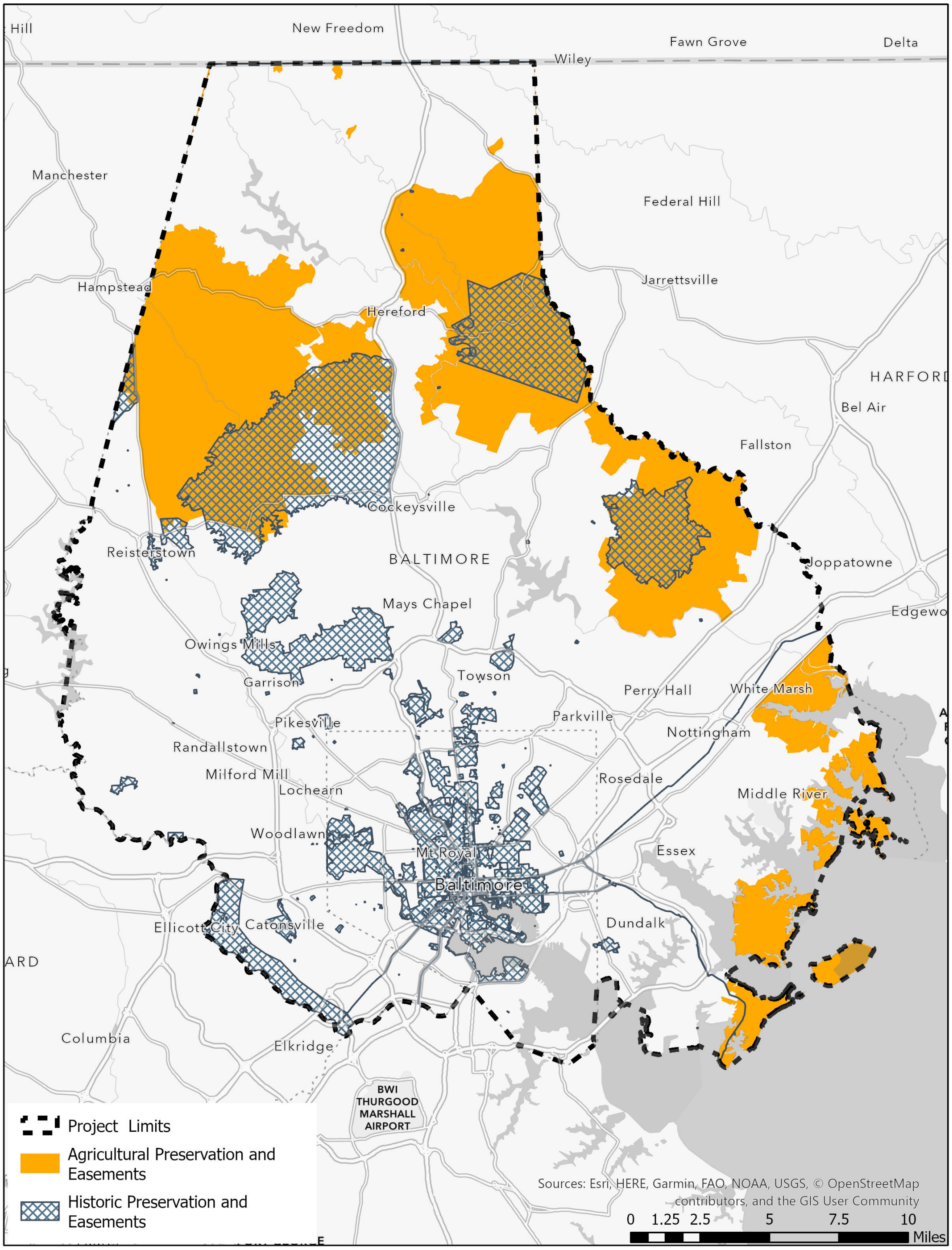
Map 1. Protected areas and conservation easements



Data: Federal, state, and local protected areas, State Scenic Rivers, State Scenic Byways, publicly managed conservation lands, Maryland Environmental Trust Easements, other conservation easements

Sources: Maryland Department of Natural Resources (DNR), Chesapeake Conservation Partnership

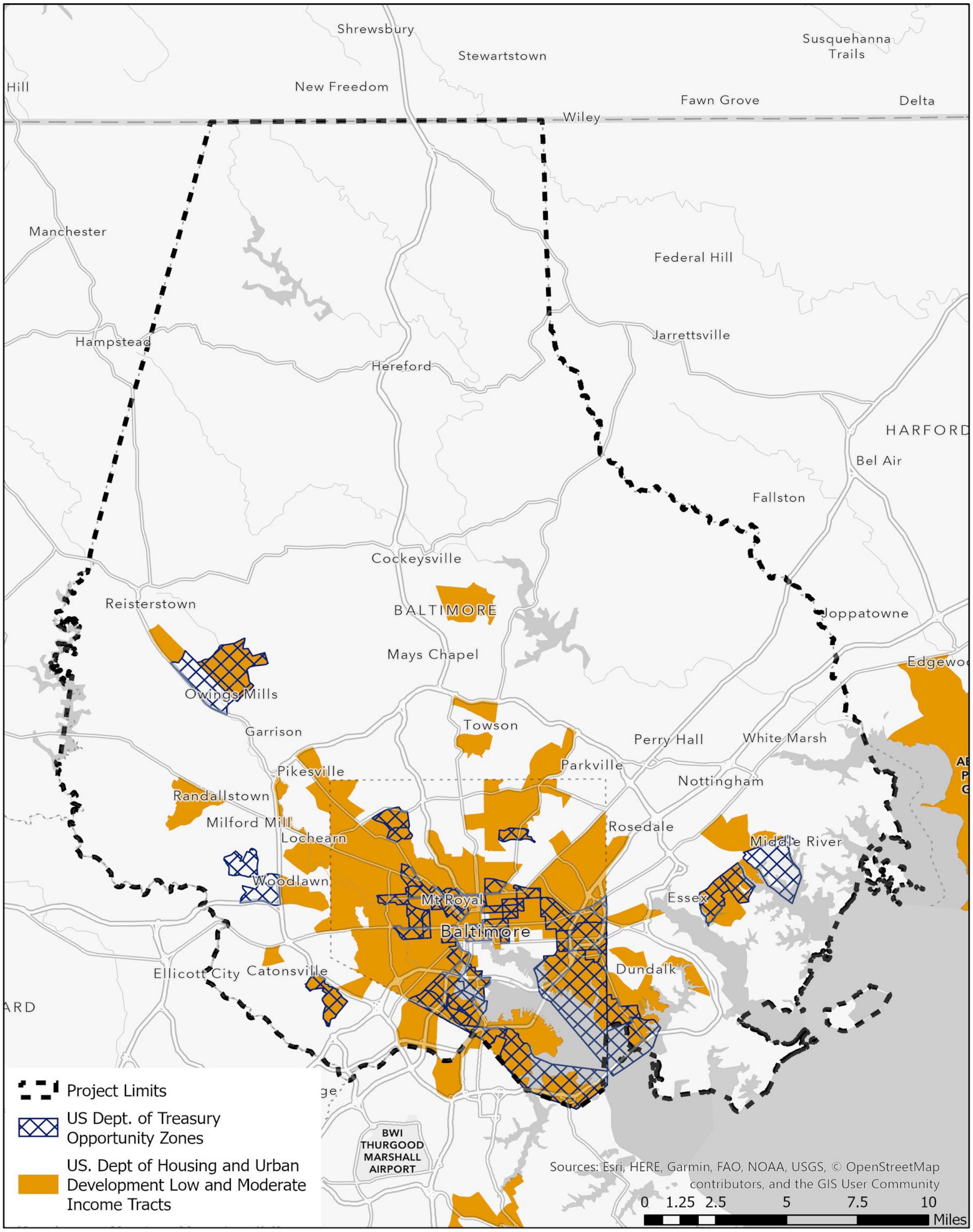
Map 2. Agricultural and historic preservation and easement areas



Data: Maryland Agricultural Land Preservation Foundation (MALPF) easements, Rural Legacy Areas, National Register of Historic Places: Historic Districts, National Register of Historic Places, National Historic and Scenic Trails, State Heritage Areas, National Historic Landmarks

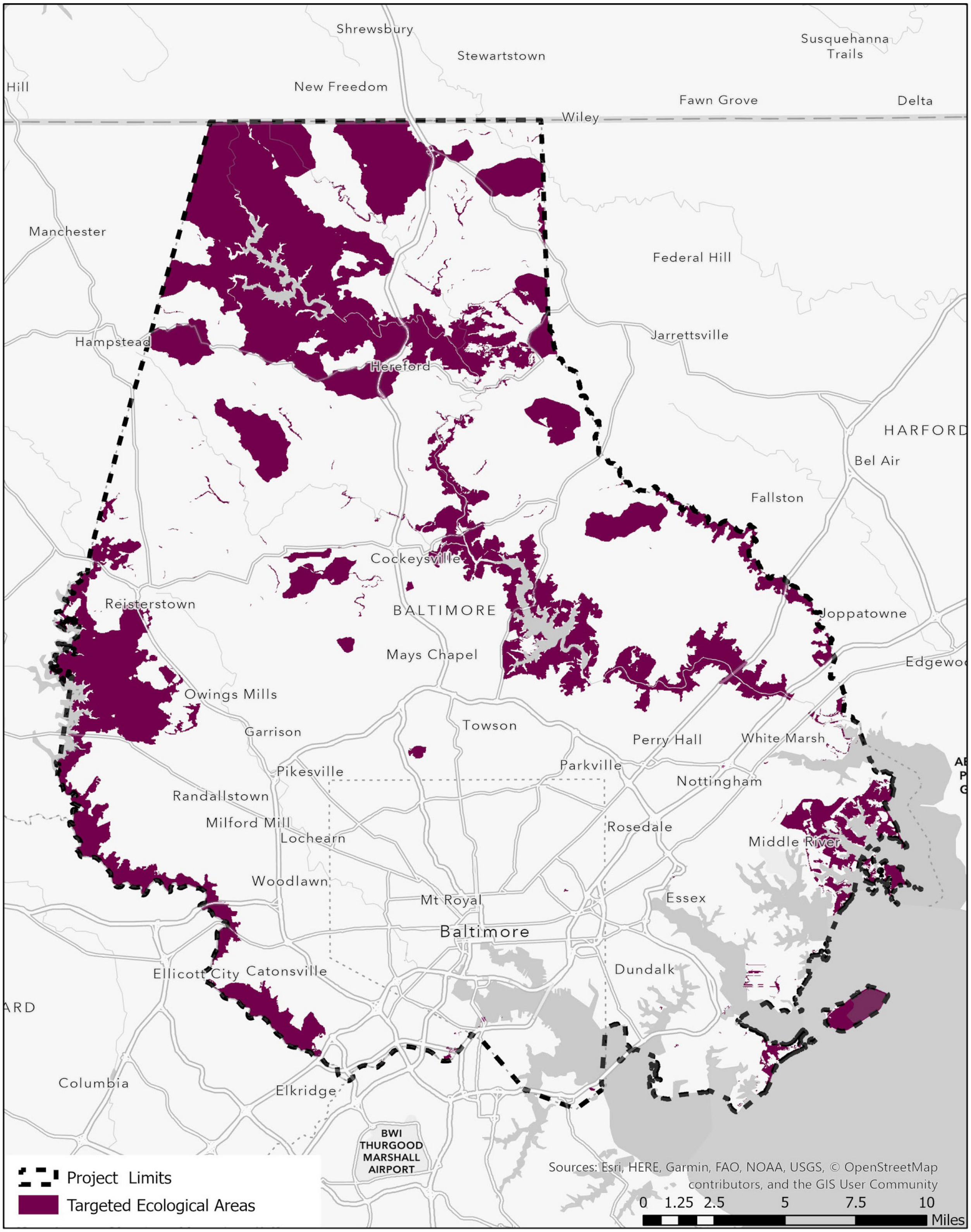
Sources: Maryland DNR, Chesapeake Conservation Partnership

Map 3. Equity criteria: Low- and moderate-income areas



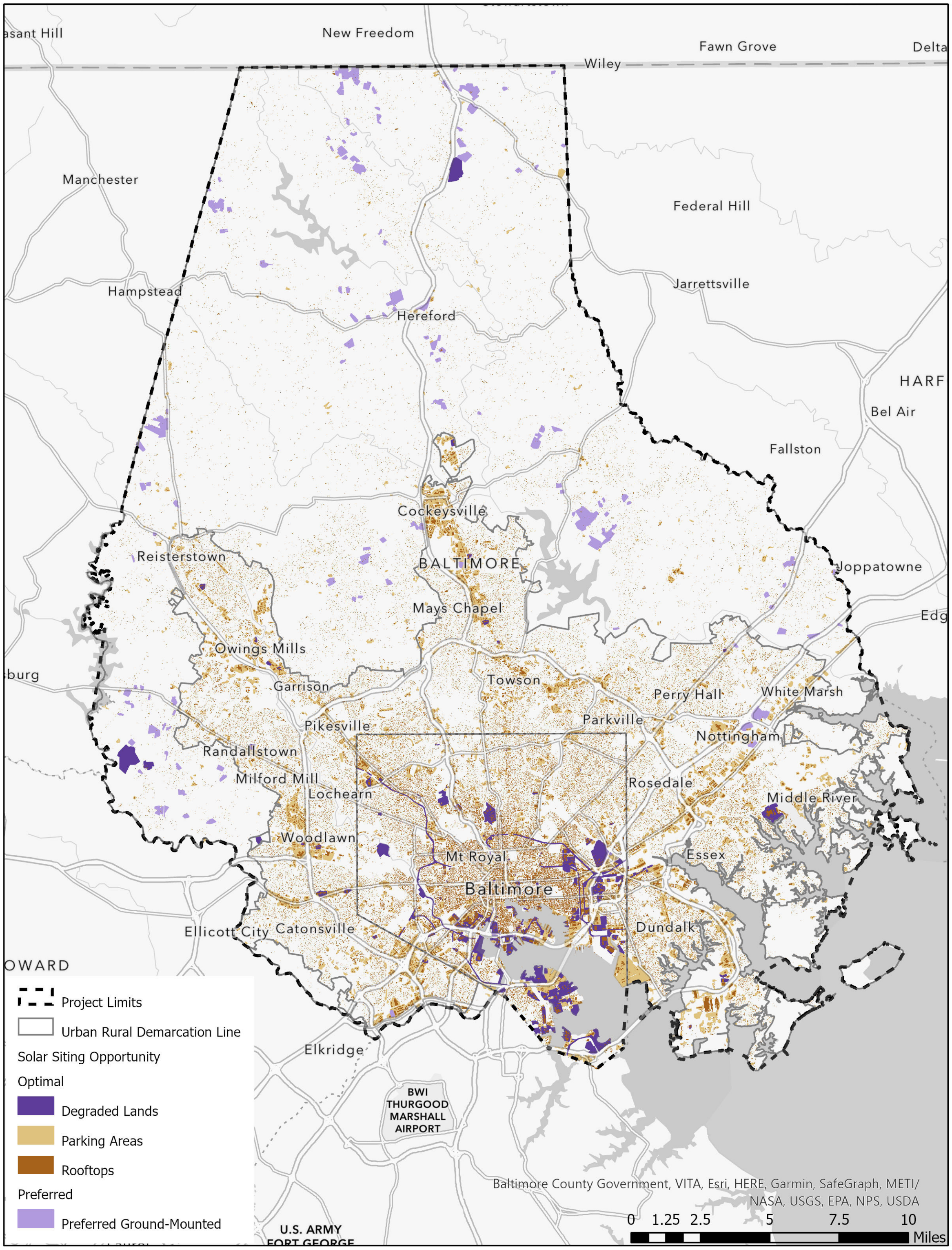
Sources: U.S. Department of Treasury, IRS; U.S. Department of Housing and Urban Development

Map 4. Environmental criteria: Targeted Ecological Areas (TEAs)



Source: Maryland Department of Natural Resources

Map 5. Results: Optimal and preferred ground-mounted solar energy development sites

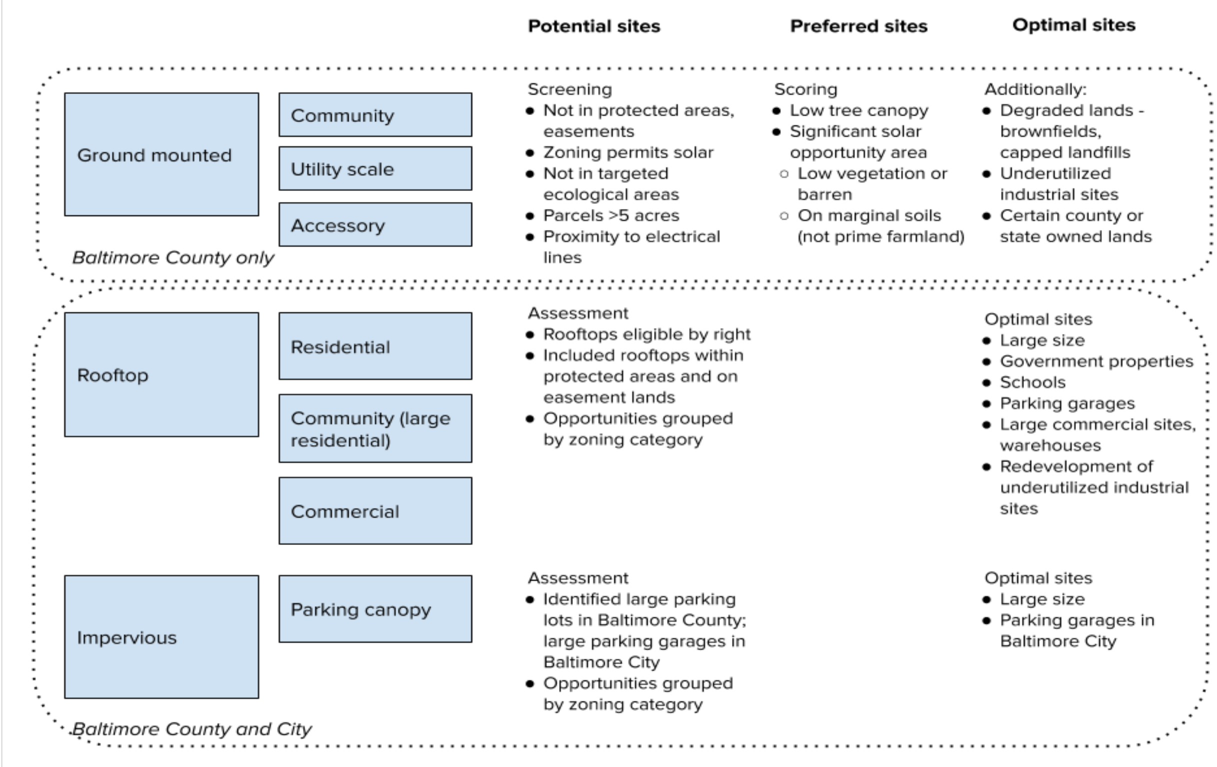


Sources: Chesapeake Conservancy analysis results displayed using Baltimore City and County parcel and building footprints data

Appendix B: Methods

This study followed a stepwise approach in analyzing opportunities for solar energy development in Baltimore County and City, with the overall approach provided in Figure 1 and additional details provided in Figure 12.

Figure 12. Methods workflow for identification of potential, preferred, and optimal solar sites



First, potential solar sites were identified by analyzing parcels that passed initial screening, removing lands where zoning would not permit solar, and assessing proximity to the electrical grid. Next, sites were scored according to environmental, equity, and efficiency criteria to determine high scoring sites with sufficient solar opportunity. Additionally, degraded lands were considered for solar development potential.

GIS data for this project was acquired from a variety of reliable sources—notably, Baltimore City and County data portals, as well as the Maryland Department of Planning, for parcel data. The core analysis for solar suitability determination involved reviewing all parcels in Baltimore City and County, and selectively removing them based on characteristics that would preclude or make solar development less preferable. Due to differences in data availability, not all of the methods utilized in Baltimore County translated to Baltimore City. The best possible alternatives and solutions were considered to determine viable suitable solar siting in Baltimore City.

Identification of preferred sites for ground-mounted solar

We identified opportunities for ground-mounted solar in Baltimore County only. The analysis began with a screening process to identify parcels where solar energy development would be legally and technically feasible. We reviewed solar zoning regulations, removing parcels where ground-mounted solar panels would not be permitted. Next, we screened out protected local, state, and federal lands, as well as conservation, agricultural, and historic easements. Parcels less than five acres in size were not considered to ensure a minimum energy generation capacity of approximately 1 MW.

Next, we assessed remaining parcels for suitability based on environmental data, including tree canopy cover and the presence of prime agricultural soils. Land cover was analyzed within the remaining parcels using Chesapeake Conservancy's high-resolution (1 meter) Chesapeake Bay land cover dataset to document the vegetation coverage of each parcel. From the land cover data, the total Solar Opportunity Area (SOA) was calculated, considering the following land cover types most suitable for placement of solar PV panels: herbaceous vegetation, shrubland, and barren land. The area in structures (homes, commercial buildings, etc.), impervious surface such as parking lots, and tree canopy was also determined for each parcel. A ranking system with values of 1 to 5 was calculated based on 20 percent thresholds for tree canopy and SOA, with a higher rank indicating parcels more suited to solar development.

For example, a site containing 25 percent tree canopy was assigned a value of 4, whereas a 25 percent SOA value was assigned a 2. Those two land cover characteristics were assigned inverse rankings, as sites with more trees would be less suitable for development. Conversely, parcels with a higher portion of SOA contain more land that was already cleared of trees, reducing the environmental impacts of solar panel installation.

Next, parcels were assessed for proximity to existing electrical grid resources based on datasets developed for the Smart DG+ website application, provided by ERM and the Maryland Power Plant Research Program. Sites remote from the electrical grid were removed from further analysis.

Next, parcels were assessed for the presence of prime farmland soils, using 10-meter Gridded Soil Survey Geographic (gSSURGO) data. Soils described as "prime farmland" or "farmland of statewide importance" were considered the least suitable for solar energy development and ranked accordingly. For example, parcels with the highest proportion of prime farmland were ranked 0, while parcels with no prime farmland were given a rank of 4.

Equity analysis of low-and moderate-income tracts

Using data from the U.S. Department of Housing and Urban Development on low- and moderate-income areas, and from the U.S. Department of Treasury on Opportunity Zones, parcels were given a point if they intersected either dataset. Those datasets were used as proxies for equity in solar development.

By totaling the ranks for each factor across the remaining parcels, a tiered scheme of most-to-least preferred solar parcels can be sorted and displayed to distinguish easily between differently ranked opportunities. The highest value was 14, where a parcel had extremely low tree cover, extremely high SOA, and no valuable soils. Based on a review of parcels and their values, all parcels with a value of 10 or higher were selected as preferred solar opportunities. The final step for the preferred data was to determine if the opportunity the parcel presented was more likely a ground-mounted solar construction project or a rooftop or parking canopy, based on the parcel's portion of impervious surface. From the remaining parcels, a threshold of 20 percent or less impervious surface was used to categorize a parcel as "likely ground-mounted," where the remaining were "likely rooftop/canopy solar." Some small manual adjustments were made based on parcels with a high area in structures that outweighed what would otherwise be a high impervious value as well (shopping mall/big box store).

Identification of degraded lands and other opportunity sites

Finally, degraded lands were considered, using data from Maryland Department of the Environment's Voluntary Cleanup Program and data from the Utility-Scale Solar Energy Coalition's analysis for solar potential on Maryland's contaminated lands. These sites are considered optimal for solar development from the analysis, though more study will be necessary at the located sites to determine the validity and feasibility of solar. This is especially true in Baltimore City, where many contaminated and environmentally degraded lands have obstructions, such as railroad tracks, that would reduce feasibility for development. This analysis was intended to be a first step in determining possible best-suited solar locations, and any specific site may require more scrutiny to determine suitability.

Other GIS analysis involved using data from the Baltimore County and Baltimore City data portals to determine structure footprint area, with specific breakouts for public schools and parking garages. Within Baltimore County, landfills, the wastewater treatment plant, and fire department facilities were also broken out specifically. Using data provided by the localities, and with results from the process above, under-utilized industrial opportunities were also identified.

Rooftop analysis

Rooftop area was calculated as the area classified as structures in Chesapeake Conservancy's 2013–14 land cover classification for the Chesapeake Bay watershed.

Energy generation potential

We used a formula provided by the U.S. EPA Green Power Partnership to calculate annual solar PV system output as a function of the equation E = A * r * H * PR, in which A = Total solar panel Area (m2); r = Solar panel efficiency (%); H = Annual average solar radiation on tilted panels (shadings not included); PR = Performance ratio, coefficient for losses (range between 0.5 and 0.9); and E = Energy (kWh).[35] Based on feedback on a review draft presented to the Governor's Task Force on Renewable Energy Development and Siting, we calculated energy generation potential as detailed below.

- For parking canopies, we assumed 15 percent solar panel efficiency and a density of 150 parking spaces per acre with a size of 16.7m2 each. We used the NREL Annual Technology Baseline (ATB) for Chicago (the closest of the scenario cities to Baltimore in terms of annual solar radiation), and used the moderate scenario for 2020.[36]
- For rooftop solar, we assumed solar panel efficiency of 11% percent, based on a recommendation from the Solar Energies Industry Association (SEIA).
- For ground-mounted solar, including on degraded sites or land meeting criteria for preferred ground-mounted solar, we assumed a solar panel efficiency of 25 percent. This value was chosen based on SEIA and other feedback and values provided in the NREL 2020 ATB.[37]

[35] Green Power Equivalency Calculator - Calculations and References. EPA. https://www.epa.gov/greenpower/green-power-equivalency-calculator-calculations-and-references. Accessed Mar. 8, 2020.

[36] "2020 Annual Technology Baseline Electricity Data Now Available." NREL. July 9, 2020. https://www.nrel.gov/news/program/2020/2020-annual-technology-baseline-electricity-data-now-available.html. Accessed Sept. 13, 2020.

[37] "2020 Annual Technology Baseline Electricity Data Now Available." NREL. July 9, 2020, https://www.nrel.gov/news/program/2020/2020-annual-technology-baseline-electricity-data-now-available.html. Accessed Sept. 13, 2020.