Photo: Melinda Brooks

USING SOLAR PV TO CREATE ECONOMIC OPPORTUNITY AND ENERGY DIVERSITY IN WEST VIRGINIA

FIVE POLICY RECOMMENDATIONS

THE MOUNTAIN INSTITUTE
CONSERVATION. CULTURE. COMMUNITY.

Downstream Strategies
building capacity for sustainability

Aaron Sutch, Jeff Simcoe, Evan Hansen

Aaron Sutch, M.A., Energy Program Manager, The Mountain Institute, Appalachia Program. Mr. Sutch specializes in developing high-profile energy efficiency and renewable energy projects. He helped develop and implement West Virginia's first solar-powered farmers market in Morgantown and is currently working on a number of projects to mitigate rising energy costs, create economic opportunity, and preserve natural resources in the Appalachian region.

Jeff Simcoe, M.S., Energy Program Project Manager, Downstream Strategies. Mr. Simcoe has diverse experience in both the private and government sectors focusing on environmental analysis and solutions. He has held senior executive positions with companies focused on renewable energy, emerging carbon markets, and forest technology. Resource management has been a constant theme throughout his career, which includes expertise in energy, natural resources, and technology.

Evan Hansen, M.S., President, Downstream Strategies. Mr. Hansen founded Downstream Strategies, an environmental consulting company in West Virginia, in 1997. He explores resource and environmental problems and solutions in three areas: water, energy, and land. He manages interdisciplinary research teams, performs quantitative and qualitative policy and scientific analyses, provides expert testimony, facilitates stakeholder meetings, and performs field monitoring.

The Mountain Institute

The Mountain Institute works with mountain communities to address their most critical challenges. Founded in 1972 on the slopes of Spruce Knob, West Virginia, we utilize education and on-the-ground initiatives to conserve mountain environments and support mountain cultures through sustainable economic development. The Appalachia Energy Program is helping residents and businesses in the region use renewable energy and efficiency to mitigate rising energy costs, expand employment opportunities, and protect natural resources.

Aaron Sutch
asutch@mountain.org

Downstream Strategies

Downstream Strategies is a West Virginia-based environmental consulting firm that combines sound interdisciplinary skills with a core belief in the importance of protecting the environment and linking economic development with natural resource stewardship. Our projects fit within one or more of our program areas—energy, water, and land—and most projects also utilize one or more of our tools, which include geographic information systems, monitoring and remediation, and stakeholder involvement and participation.

Jeff Simcoe
jsimcoe@downstreamstrategieies.com

Evan Hansen
ehansen@downstreamstrategies.com

Solar energy has the potential to be part of a shared vision for a bright economic future of West Virginia—a future built on a thriving and just economy rooted in the Mountaineer spirit of self-sufficiency and respect. This report explains the benefits of solar energy and provides an overview of the policies needed to expand its deployment in West Virginia.

THE PV EFFECT

Solar photovoltaic (PV) cells get their name because they convert light (photons) into electricity (voltage), which is called the PV effect.

Solar panels produce electricity year-round—even during cloudy days and in cold temperatures. Typically, solar panels produce more electricity in the summer because they are exposed to more sunlight due to longer days.

INTRODUCTION

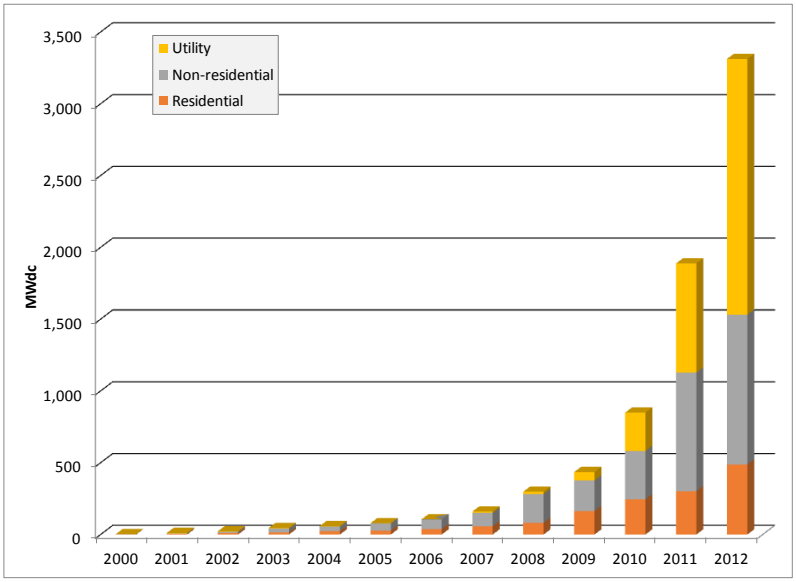
The earth gets most of its energy from the sun in the form of solar radiation. This energy can be used to create heat and produce electricity. Buildings can be designed to use solar energy to heat air or water. Solar PV systems, in contrast, convert sunlight into electricity for use in homes and businesses.

Solar PV systems generate electricity in residential, commercial, and utility settings. Most PV applications in the U.S. are grid-tied systems, which use the utility grid to absorb excess power and provide electricity when the sun is not shining. In contrast, off-grid systems do not connect to the utility grid and require batteries to store excess generation for use when the sun is not shining.

Across the U.S., more and more electricity is generated from sunlight. Over 9,370 megawatts (MW) of solar electric capacity has been installed in the U.S., enough to power more than 1.5 million average American homes.[1]

In 2012, solar PV capacity additions grew 76% over 2011, to total 3,311 MW. This represents a substantial investment, with an estimated market value of $11.5 billion.[2] 2013 was forecasted to be another record year for the solar industry, with first quarter reports showing a 33% growth over the same time period in 2012.[3]

YEARLY INSTALLED SOLAR PV CAPACITY IN THE UNITED STATES (2000-2012)[4]



MEASURING SOLAR CAPACITY

The size of solar generating systems is measured as installed capacity in kilowatts (kW). Each kilowatt is 1,000 watts.

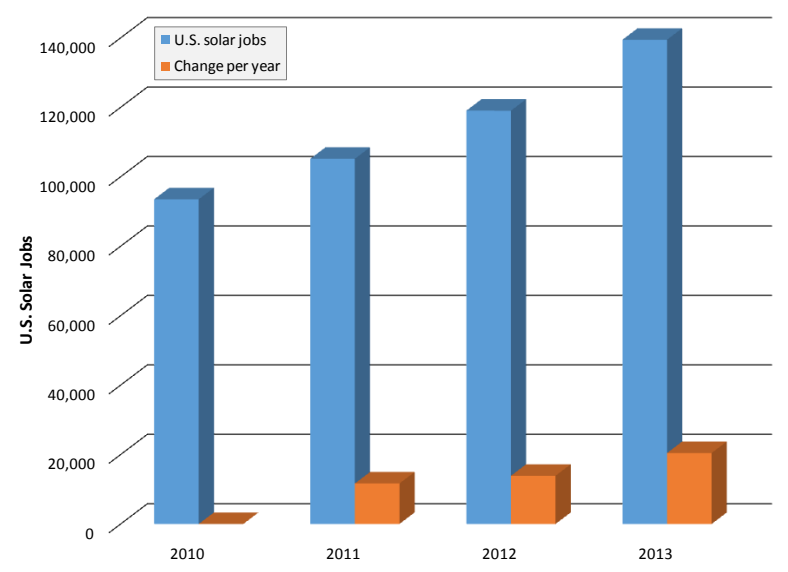
Installed capacity represents the maximum output the array is capable of instantaneously producing at any time. For example, a solar array consisting of four 250-watt panels would have an installed capacity of 1 kW and would be capable of producing a maximum power of 1 kW (1,000 watts) at any given moment.

Electricity generated from solar is measured in kilowatt-hours (kWh), which is the same unit you see on your utility bill. A 10-kW system in West Virginia will produce approximately 11,000 kWh of electricity per year, depending on site characteristics.[a]

The solar industry's growth is boosting the national economy and creating local jobs. In fact, solar PV technology creates more jobs per unit of energy output than any other technology—including fossil fuels and other renewables.[5]

The solar industry, which in 2012 employed approximately 120,000 workers across the U.S., continues to hire faster than the overall economy; solar employment was expected to grow at more than 10 times the rate of the U.S. economy from late 2012 through late 2013.[6] These jobs are nearly impossible to outsource. Although solar panels can be built elsewhere, installation requires local and regional workers to design systems, procure the equipment, and install the systems.

REALIZED AND EXPECTED SOLAR JOBS (2010-2013)[7]



In addition to its economic benefits, solar PV offers an increasingly cost-effective strategy for diversifying national energy resources. The capital cost of solar is dropping dramatically, while its fuel source is free and immune to the supply shocks of non-renewable commodity fuels such as coal and natural gas. At the same time, many companies anticipate the price of non-renewable fuels to rise as their market price is forced to reflect costs imposed to the environment and public health.[8]

The installed price per watt for solar PV has continued to decrease over time and can be attributed to a combination of cost reductions associated with both installation-related and solar panel costs. From 1998 to 2012, the installed median price per watt, across all system sizes, fell almost 60%. More recently, from 2009 to 2012, there was a 38% reduction in costs that can be mostly attributed to the drastic reduction in solar panel costs alone.[9]

BENEFITS OF DISTRIBUTED GENERATION

Solar PV is classified as distributed generation, which produces electricity at or near the site of use.

Distributed generation enables a diverse mix of generation fuels, thereby improving grid resilience in the face of extreme weather and empowering local ownership and control of energy production.

Distributed generation benefits the electric grid and ratepayers by minimizing transmission losses and reducing peak power demand, which can stress grid infrastructure and lead to costly investments in transmission, distribution, and generation facilities.

INSTALLED MEDIAN PRICE PER WATT FOR SOLAR PV (1998-2012)[10]

Its rapid adoption across the U.S., as well as other positive market indicators, signal that the time is right to adopt favorable public policy to help expand solar PV in West Virginia. The five policy recommendations covered in more detail below include:

Recommendation 1—Binding Renewable Portfolio Standard with a Solar Carve-Out. A binding RPS with a designated solar carve-out would require that utilities obtain a certain percentage of electricity from solar projects located within the state.

Recommendation 2—Tax Incentives for Individuals and Businesses to Implement Solar Onsite. Tax incentives would reduce the overall cost associated with solar PV systems.

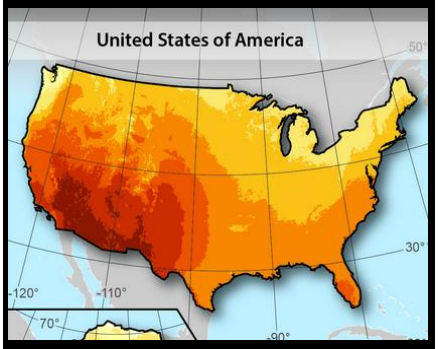
Recommendation 3—Third-Party Financing to Benefit Nonprofit and Local Government Projects. Third-party financing would reduce upfront costs and increase business opportunities associated with solar PV systems.

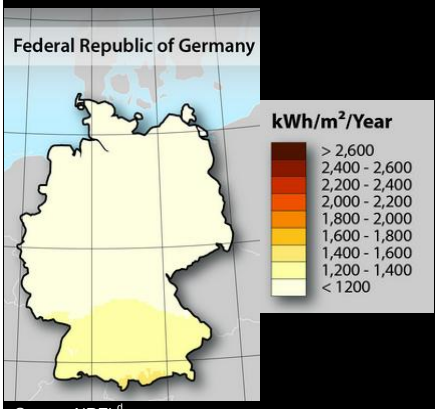
Recommendation 4—Expansion of Net Metering to Allow "Virtual Net Metering" for Offsite Solar Projects. New "Virtual Net Metering" policies would allow for offsite energy production using solar PV.

Recommendation 5—Other Policy Options: Feed-in Tariffs and Time-of-use Pricing. Feed-in tariffs and time-of-use pricing policies would shorten system payback periods and attract investment.

WEST VIRGINIA'S SOLAR RESOURCE

With an average of 4.3 kW of solar insolation per square meter, West Virginia's solar resource is greater than that of Germany—the largest and most successful solar market in the world.[b] Due to its policies, Germany has more solar PV capacity installed than the rest of the world combined.[c] With supportive policies, solar PV capacity could increase substantially in West Virginia.





Source: NREL[d]

SUPPORTIVE STATE POLICIES CAN HELP WEST VIRGINIA SPUR THE DEVELOPMENT OF SOLAR PV

West Virginia is an energy-producing state—the second-largest coal producer in the U.S, a net exporter of electricity, and a producer of natural gas. With the right policies, the state can also benefit from the economic opportunity and energy diversity associated with solar PV.

While West Virginia has favorable solar resources, solar PV is vastly underutilized in the Mountain State, due mostly to the lack of state-level policies and incentives encouraging the growth of the technology. As of 2012, West Virginia's total installed solar capacity was estimated to be approximately 2 MW.[11] Because so little solar has been developed in West Virginia, the state ranks 49th in total solar jobs and 51st in solar jobs per capita.[12]

In contrast, neighboring states with robust policy incentives have been rapidly deploying solar PV and reaping the benefits in job growth and increasing energy diversity. Pennsylvania, which has similar solar resources to West Virginia, has installed over 212 MW of solar capacity (enough to power 23,600 homes) and counts more than 4,000 jobs related to solar.[13] Ohio, which has slightly weaker solar resources than West Virginia, ranks 15th in the country in installed solar capacity and counts more than 2,900 solar jobs—the 10th most in the U.S.[14] In 2012 alone, Maryland installed 79 MW of solar, ranking it in the top ten nationally. Maryland's solar industry counts more than 1,900 jobs and is bigger than the state's famous crab industry.[15]

As illustrated in the following chart, which shows solar capacity additions per capita in 2012, six of the top 12 states are located in the eastern U.S. Each of these states has employed aggressive policies and incentives to encourage the growth of solar and other renewable technologies. One might think that the number of sunny days i s the driving factor in solar energy development. Although more sun is certainly helpful, strong state policies are more important and have spurred significant solar development nationally.

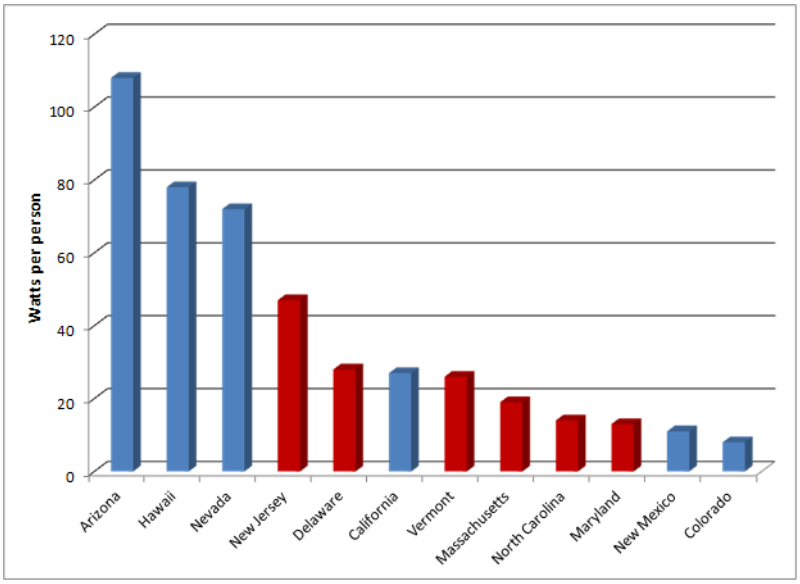
THE U.S. MILITARY USES SOLAR

The U.S. military has aggressively adopted solar PV to diversify its energy sources, reduce fuel costs, and improve combat readiness.

Photo: The Pew Charitable Trusts[e]

Richard Kidd, Army Deputy Assistant Secretary in charge of energy security, states: “There is no supply chain vulnerability, there are no commodity costs and there’s a lower chance of disruption. A fuel tanker can be shot at and blown up. The sun’s rays will still be there.”[f]

PER-CAPITA SOLAR PV CAPACITY ADDITIONS IN 2012[16]



Policies that provide consumers easy entry into the market and that indicate a state’s long-term commitment to renewable energy development have spurred considerable growth in solar PV. On the other hand, states where consumers are not paid fair value for electricity supplied to the grid, where utilities present obstacles to selling solar electricity, where public policies are unpredictable, or where homeowners and businesses have no choice but to bear the upfront cost of solar energy alone are seeing much slower growth in solar PV.[17]

Photo: MTV Solar

WEST VIRGINIA'S CURRENT ENERGY POLICY LANDSCAPE AFFECTS SOLAR PV DEPLOYMENT

West Virginia's electric utilities operate as monopolies and have the sole right to sell electricity to ratepayers within their service territories. These utilities are regulated by the Public Service Commission, which oversees their rates, services, and operations.[18] The Public Service Commission also has the authority to establish net metering rules.[19]

Electricity rates in West Virginia are below the national average. This hinders the development of solar PV as the monetary value of electricity produced by systems is lower. However, rates have risen nearly 50% in the last five years[20] and are expected to continue on this path due to the rising price of coal, which is used to generate 94% of the state's electricity .[21] As rates rise, solar PV systems become more cost-competitive.

From a policy perspective, the basic building blocks for solar development are in place in West Virginia. These building blocks make it possible for homeowners and businesses to develop solar projects as they address solar rights, interconnection standards, and net metering.

Existing policy	Definition
Solar rights	In 2012, West Virginia code went into effect that renders housing association governing documents containing covenants or restrictions on the installation of a solar energy system unenforceable.[22]
Interconnection standards	Interconnection standards specify the technical and procedural process by which a customer connects an electricity generating unit to the grid. The West Virginia Public Service Commission adopted the most recent interconnection standards in 2010.[23]
Net metering	For electric customers who generate their own electricity, net metering allows for the flow of electricity both to and from the customer—typically through a single, bi-directional meter. When generation exceeds use, electricity from the customer flows back to the grid, offsetting electricity consumed at other times. The customer is only charged for the net electricity used over the long-term. Net metering in West Virginia is available to all electricity customers.[24]

Even though these building blocks are in place, solar PV development has proceeded much slower than in many neighboring states. In the following section, we present five recommendations that will:

- provide statewide incentives and binding policy goals (Recommendation 1);
- address market access and the valuation of solar energy (Recommendations 3, 4, and 5); and
- lower the up-front cost of solar (Recommendations 2, 3, and 4).

Together, implementing these recommendations would significantly and rapidly increase the development of solar PV systems in West Virginia.[25]

RECOMMENDATION 1—BINDING RENEWABLE PORTFOLIO STANDARD WITH A SOLAR CARVE-OUT

In 2009, West Virginia enacted its Alternative and Renewable Energy Portfolio Standard (ARPS), which requires investor-owned utilities with more than 30,000 residential customers to supply 25% of retail electric sales from eligible alternative and renewable energy resources by 2025. While this law contains some provisions similar to other states' renewable portfolio standards (RPSs), it does not require a minimum contribution from renewable energy resources. In fact, the standard could be met entirely using "alternative fuels," including waste coal, tire-derived fuel, and coal bed methane. As a result, the ARPS acts like a non-binding goal and is not spurring the growth of solar and other renewable resources.[26] In contrast, solar carve-outs in nearby states range from 0.34% to 3.38% by 2020.

SOLAR CARVE-OUTS FOR NEARBY STATES[27, 28, 29, 30]

State	2020 solar carve-out
New Jersey	3.38%
Maryland	2%
Pennsylvania	0.5%
Ohio	0.34%

We recommend a binding RPS with designated solar carve-out, which would require that utilities obtain a certain percentage of electricity from solar projects located within the state. In West Virginia, even a very small carve-out would have a significant impact on the state's solar generating capacity. With just a 0.75% carve-out, West Virginia's solar capacity would grow to approximately 210 MW—slightly more than Pennsylvania's 2012 solar capacity and significantly less than New Jersey's 2012 solar capacity. This would create jobs and help diversify the state's energy portfolio.

A binding RPS with a solar carve-out would spur an active in-state market for Solar Renewable Energy Credits (SRECs), which would help incentivize solar by providing another revenue stream for owners of solar systems (in addition to the value of the electricity produced). SRECs represent a non-energy value for each MWh of electricity generated from solar systems and are used by utilities to comply with RPS goals. Utilities may purchase SRECs to satisfy their solar carve-out requirement, thereby supporting the installation of solar PV systems across the state. In ten states with SREC markets, more than 4,300 MW of solar capacity will be required by 2020.[31]

WEST VIRGINIA UNIVERSITY AT THE SOLAR DECATHLON

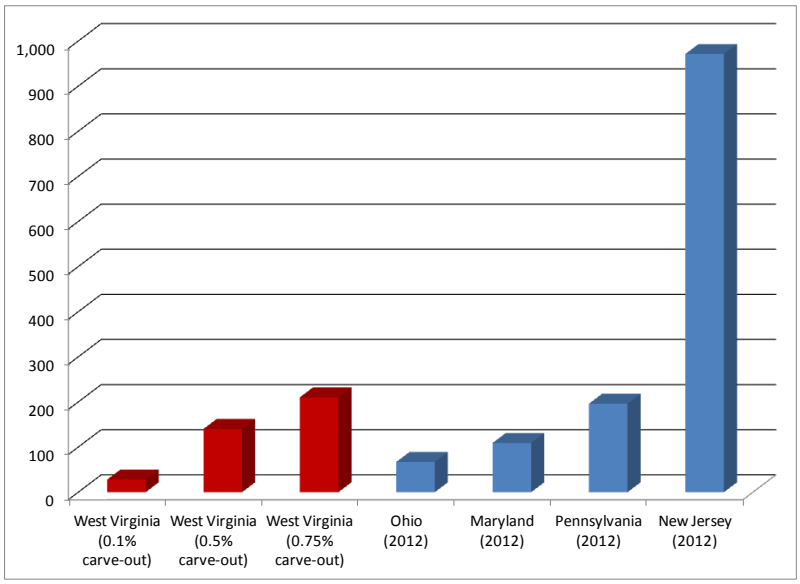
West Virginia University (WVU) participated in the 2013 U.S. Department of Energy Solar Decathlon, which challenged international teams to design, build, and operate solar-powered houses that are cost-effective, energy efficient, and attractive.

Photo: Amber Archangel

The WVU entry was completely powered from the sun and featured a solar-powered electric vehicle charging station.

Let's Go Mountaineers!

WEST VIRGINIA SOLAR CAPACITY UNDER DIFFERENT SOLAR CARVE-OUT SCENARIOS, AS COMPARED WITH 2012 SOLAR CAPACITY IN NEARBY STATES (MW)[32, 33]



SREC prices have varied considerably. Historically, SRECs from New Jersey have seen the highest prices, topping over $650 before declining to less than $150. In Pennsylvania, SREC spot prices dropped to less than $50 in 2011.[34] In Ohio, in-state SRECs are worth more th an those generated out of state.

Each year, a 10-kW solar system in West Virginia will produce approximately 11 MWh of electricity and could therefore sell 11 SRECs. Referencing the data above from New Jersey and Pennsylvania, if these SRECs were worth $650 each this would provide $7,150 per year in additional revenue to the system owner. If the SRECs were worth $150, they would provide $1,650 per year. Even if they were only worth $50, SRECs would provide $550 per year in additional income.

Currently, West Virginians can only sell their SRECs out of state to either Ohio or Pennsylvania. SRECs sold to Ohio from West Virginia are worth less than in-state SRECs. Also, without a West Virginia market, the value of SRECs is entirely determined by policymakers in other states.

RECOMMENDATION 2—TAX INCENTIVES FOR INDIVIDUALS AND BUSINESSES TO IMPLEMENT SOLAR ONSITE

Many solar system owners have taken advantage of the federal renewable energy tax credit to reduce installation costs. Commercial PV systems and residential installations have commonly seen 56% and 30% reductions in solar project costs, respectively, through this federal program.[35] These tax credits are particularly attractive to those with large tax liabilities. State and local governments as well as non-profit organizations cannot take advantage of this incentive, as they do not have a tax liability to offset.

West Virginia enacted a 30% residential tax credit in 2009, which offset up to $2,000 of the costs associated with solar water heating, solar space heating, and PV systems. This tax credit expired in 2013, however, and has not been renewed. When active, it represented the only significant state incentive for residential solar system owners in West Virginia.[36] One goal in the 2013-2017 West Virginia State Energy Plan was the continuation of this tax credit, but at this point it remains expired.[37]

According to self-reported data, a total of 88 projects were built during the eligibility period.[38] Even if every one of these projects took full advantage of the $2,000 maximum tax credit, the cost to the state over this four-year period would have been less than $200,000—a very small amount of money compared with other tax incentives.[39] Further, lost tax revenue would at least be partially made up through other revenue streams associated with an increase in employment in the industry. Other non-tax benefits include increased grid resiliency and reduced emissions.

In addition to reactivating the residential incentive, this program should be expanded to business owners because solar systems can reduce business-related energy costs and would free up capital that could be reinvested into the business to create additional jobs.

Other types of tax incentives—including property and sales tax incentives—could also be explored to reduce both the upfront and overall costs of solar systems. Property tax incentives for solar systems include exemptions, tax abatements, and tax credits. Sales tax incentives include exemptions from or refunds of sales tax for purchasing and installing solar energy components and systems. Property tax incentives encourage customers to install these technologies by reducing overall project costs, while sales tax incentives encourage solar installations by reducing upfront and overall equipment costs. When combined, these incentives make solar systems even more affordable.

RECOMMENDATION 3—THIRD-PARTY FINANCING TO BENEFIT NONPROFIT AND LOCAL GOVERNMENT PROJECTS

The largest barrier associated with building solar systems is the high up-front costs associated with the purchase and installation of solar equipment. While individuals and businesses can take advantage of tax credits, nonprofits and local governments cannot.

Third-party financing mechanisms can help non-profits, local government, and individual homeowners and businesses benefit from solar without incurring the up-front costs associated with the purchase of solar equipment. Under a third-party financing program, the project host does not purchase the solar system, but instead enters into an arrangement with a company or individual that purchases and owns the equipment installed at the host site. The equipment owner (third-party) is able to monetize applicable federal and state tax incentives and receives compensation from the host site for the value of electricity produced by the system. As part of the arrangement, known as a power purchase agreement (PPA), the site host is commonly charged a below-market rate for electricity.

While there are many variations, third-party financing contracts often benefit both the system host and system owner. The system host benefits from the ability to utilize solar energy at no up-front cost and often at a flat or reduced retail rate, while the system owner gains the opportunity to create a new revenue stream and reduce tax liability. In spite of these benefits and the potential to spur increased business opportunities, West Virginia's regulated monopoly utility structure discourages third-party financing mechanisms.

Conversely, in West Virginia's neighboring states of Ohio, Pennsylvania, and Maryland, third-party finance structures are facilitating projects that benefit non-profits, residences, and businesses. For example, the City of Athens, Ohio installed a 225-kW solar array on its community center with no capital investment thanks to a PPA in which a private firm provided the financing to purchase the equipment.[40] Similar structures are being used in Pennsylvania to encourage solar development on public works, universities, and non-profit entities.[41] In Maryland, growth of residential solar has been attributed to third-party financing.[42]

Another example can be found in Virginia, where a pilot program allows private companies to finance solar systems between 50 kW and 1 MW for nonprofits and local governments. Virginia has a similar regulated monopoly utility structure as West Virginia, yet it has moved forward with third-party financing structures.[43]

West Virginia would benefit from clear policies that encourage third-party financing structures so that the state's non-profits and local governments—as well as residents and business—would be free to reduce up-front costs of solar and increase business opportunities.

RECOMMENDATION 4—EXPANSION OF NET METERING TO ALLOW "VIRTUAL NET METERING" FOR OFFSITE SOLAR PROJECTS

Virtual net metering (or "aggregate metering" or "shared renewables") allows utility customers to share the electricity output from a single project (which may be offsite), typically in proportion to their ownership of the shared system.[44] With virtual net metering, renters, homeowners with shaded roofs, tenants of apartment buildings, and others can invest in community solar projects.

Virtual net metering would expand on the current net metering policy that allows electric customers who invest in and generate their own electricity to bank excess electricity on the grid, usually in the form of credits.[45] Under net metering, if a solar system is generating more electricity than is being used, the system owner will accumulate credits that can be used to offset electricity usage during nighttime or other times when the sun is not shining. Expansion of net metering is hindered, however, because only 22% to 27% of residential rooftop area is suitable for PV systems due to structural, shading, or ownership issues.[46] Virtual net metering overcomes this challenge by allowing proportional ownership or compensation for energy produced at an ideal or more favorable site.

Current West Virginia statute allows net metering for multiple meters owned by the same individual or entity—but only if the meters are within two miles of each other.[47] Virtual net metering would allow multiple individuals to invest in and get credit for a portion of a system developed by someone else and located more than two miles away.

In a typical virtual net metering situation, energy production is tracked at the host meter, and credits are allocated per individual share of the system. The utility then applies a credit to participants' energy bills for their portion of solar production—just as they would for individually metered systems.

Washington, D.C.'s Community Renewables Act of 2013 facilitates virtual net metering and associated community solar projects. The justification for this policy is that all residents should have an equal opportunity to participate in solar renewable energy generation projects.[48]

West Virginia could benefit from clear and supportive policies regarding community solar and virtual net metering. Presently, there is no clear guidance around these types of structures, and the need for additional legal and financial support to address this issue has been a deterrent.

RECOMMENDATION 5—OTHER POLICY OPTIONS: FEED-IN TARIFFS AND TIME-OF-USE PRICING

Feed-in tariffs (FITs) are gaining popularity in the U.S. based on their successful implementation in other countries such as Spain and Germany. A FIT requires retail energy suppliers to buy electricity produced from renewable resources at a fixed price per kWh, usually over a period of 10 to 20 years. While it does not reduce up-front system costs, it guarantees a revenue stream for solar developers, which is essential to securing long-term financing.

A FIT is an example of a performance-based incentive, where payments are calculated from a system's electricity production, rather than its installed capacity. Producers of solar and other forms of renewable energy are paid a predetermined price (tariff) for the electricity they produce and send to the grid. The compensation price includes a reasonable rate of return and varies based on the type and scale of the generation technology as well as the underlying motivation and goals of the particular FIT program.[49]

FIT programs can be mandated statewide or offered by local municipal utilities or as voluntary programs by investor-owned utilities. This flexibility allows them to be used in conjunction with an RPS or as a stand-alone policy. California is one of the only states with a statewide FIT to help satisfy its RPS requirements. In West Virginia, a FIT would encourage the construction of solar systems—even with the current ARPS. Seven U.S. states (Maine, Vermont, California, Washington, Oregon, Rhode Island, and Hawaii) have enacted some type of statewide FIT framework. Numerous municipal utility and voluntary FIT programs are also active in at least 14 states, including West Virginia's neighboring states of Kentucky and Virginia.[50]

Time-of-use (TOU) pricing is a general policy in which electricity customers pay varying rates for electricity based on the time of day, day of the week, or season of the year. Under a TOU pricing structure, rates correspond to the cost the utility incurs to generate and transmit electricity during a specific time frame. This gives customers an opportunity to adjust their electricity usage to the most favorable times of day and helps utilities send price signals to customers when they have to use more expensive generators and/or when the electric grid is stressed.

TOU pricing incentivizes grid-tied solar generation because the maximum output of solar panels closely corresponds to when the value of electricity is highest. A typical TOU pricing structure charges a higher rate for electricity during daytime hours in the hot summer months, when air conditioner use is widespread and the electric grid is near capacity.[51] Solar system owners would therefore displace the most electricity when they otherwise would have had to pay a higher price per kWh. This would result in a quicker return on investment for system owners. In addition, solar PV systems provide a valuable service to utilities and other ratepayers by reducing peak demand—which can stress grid infrastructure and lead to blackouts—and by helping to avoid the use by utilities of more expensive power generators.[52]

ENDNOTES

[1] Resch, Rhone. September 2013. “New Market Report Shows Huge Gains in U.S. Solar Deployment.” Solar Energy Industries Association (SEIA). http://www.seia.org/blog/new-market-report-shows-huge-gains-us-solar-deployment. This capacity figure, along with many other figures in this report, are based on grid-tied solar PV systems.
[2] Greentech Media (GTM) Research and SEIA. 2013. “U.S. Solar Market Insight Report, 2012 Year in Review, Executive Summary.”
[3] GTM Research and SEIA. 2013. “U.S. Solar Market Insight Report, Q1 2013, Executive Summary.”
[4] GTM Research and SEIA. 2013. “U.S. Solar Market Insight Report, 2012 Year In Review, Executive Summary.”
[5] Wei, Patadia, Kammen. 2010. “Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Clean Energy Industry Create in the U.S.?”
[6] The Solar Foundation. November 2012. “National Solar Jobs Census 2012, A Review of the U.S Solar Workforce.” Defined as employees spending at least 50% of their time on solar related work.
[7] The Solar Foundation. November 2012. “National Solar Jobs Census 2012, A Review of the U.S Solar Workforce.” The number of employees in 2013 is expected, not actual.
[8] CDP North America. December 2013. “Use of Internal Carbon Price by Companies as Incentive and Strategic Planning Tool: A Review of Findings from CDP 2013 Disclosure.” https://www.cdp.net/CDPResults/companies-carbon-pricing-2013.pdf.
[9] Kasper and koronowski. August 2013. “It’s Getting Cheaper to Install Solar Panels in the U.S.” Climate Progress. http://thinkprogress.org/climate/2013/08/13/2455121/solar-getting-cheaper/.
[10] Barbose, Darghouth, Weaver, and Wiser. July 2013. “Tracking the Sun VI: An Historical Summary of the Installed Price of Photovoltaic in the United States from 1998 to 2012.” Lawrence Berkeley National Laboratory. This chart includes residential and commercial systems and is reported in 2012 $/W.
[11] Jeff Herholdt interview. August 2013. “Looking to the Sky to Power West Virginia Homes and Businesses.” WCHS 8. http://www.wchstv.com/newsroom/eyewitness/130822_18508.shtml. Jeff Herholdt states that there are 1.71MW of grid tied capacity currently installed in West Virginia and the additional capacity up to the 2MW figure reflects an estimate of undocumented off grid systems located within the state.
[12] The Solar Foundation. 2012. “State Solar Jobs: West Virginia”. http://thesolarfoundation.org/solarstates/west-virginia.
[13] SEIA. 2013. “State Solar Policy, Pennsylvania Solar”. http://www.seia.org/state-solar-policy/pennsylvania.
[14] SEIA. 2013. “State Solar Policy, Ohio Solar”. http://www.seia.org/state-solar-policy/ohio.
[15] SEIA. 2013. “State Solar Policy: Maryland Solar”. http://www.seia.org/state-solar-policy/maryland.
[16] Shahan, Zachary. “Top Solar States Per Capita vs Top Solar Policy Leaders”. Clean Technica. http://cleantechnica.com/2013/06/25/solar-power-by-state-solar-rankings-by-state/
[17] Dutzik and Sargent. July 2013. “Lighting the Way: What We Can Learn from America’s Top 12 Solar States.” Frontier Group and Environment America Research & Policy Center.
[18] Public Service Commission of West Virginia. “Commission History”. http://www.psc.state.wv.us/hist.htm.
[19] West Virginia Legislature. 2013. “West Virginia Code, §24-2F-8, Net metering and interconnection standards.” http://www.legis.state.wv.us/WVCODE/ChapterEntire.cfm?chap=24&art=2F&section=8.
[20] Energy Efficient West Virginia. “Why the Rate Hikes?” http://www.eewv.org/why-the-rate-hikes.
[21] Bowen, Manzi, Meinert, and Witt. 2012. “Fossil Energy Opportunities for West Virginia”. WVU Bureau of Business and Economic Research.
[22] West Virginia Legislature. 2013. “West Virginia Code, §36-4-19. Solar energy covenants unenforceable; penalty.” http://www.legis.state.wv.us/WVCODE/ChapterEntire.cfm?chap=36&art=4&section=19#04
[23] West Virginia Legislature. 2013. “West Virginia Code, §24-2F-8. Net metering and interconnection standards.” http://www.legis.state.wv.us/WVCODE/ChapterEntire.cfm?chap=24&art=2F&section=8#02F
[24] West Virginia Legislature. 2013. “West Virginia Code, §24-2F-8. Net metering and interconnection standards.” http://www.legis.state.wv.us/WVCODE/ChapterEntire.cfm?chap=24&art=2F&section=8#02F. Database of State Incentives for Renewables and Efficiency (DSIRE). “Net-metering”. http://dsireusa.org/solar/solarpolicyguide/?id=17
[25] Many other policies can also be considered, including cash incentives, Property Assessed Clean Energy (PACE) financing, low-interest loans, and group purchasing.
[26] DSIRE. 2012. “West Virginia, Alternative and Renewable Energy Portfolio Standard.” http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=WV05R&re=0&ee=0.
[27] DSIRE. 2012. “New Jersey, Renewables Portfolio Standard.” http://dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=NJ05R&re=0&ee=0
[28] DSIRE. 2013. “Maryland, Renewable Energy Portfolio Standard.” http://dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=MD05R&re=0&ee=0
[29] DSIRE. 2012. “Pennsylvania, Alternative Energy Portfolio Standard.” http://dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=PA06R&re=0&ee=0
[30] DSIRE. 2012. “Ohio, Alternative Energy Portfolio Standard.” http://dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=OH14R&re=0&ee=0
[31] Bird, Heeter, Kreycik. November 2011. “Solar Renewable Energy Certificate (SREC) Markets: Status and Trends.” The 4300MW by 2020 capacity requirements in SREC markets in Delaware, Massachusetts, Maryland, Missouri, North Carolina, New Hampshire, New Jersey, Ohio, Pennsylvania, and Washington, D.C. are included in this figure.
[32] West Virginia capacities are calculated based on 2012 retail sales of 30,817,241 MWh (EIA: 2012 Electricity Consumption Estimates) and the estimate that each MW of solar capacity would produce 1,098.474 MWh/year (Based on NREL: PV Watts using Elkins as the reference site). Solar capacities of other states in 2012 from http://cleantechnica.com/2013/06/25/solar-power-by-state-solar-rankings-by-state/.
[33] Shahan, Zachary. “Top Solar States Per Capita vs Top Solar Policy Leaders”. Clean Technica. http://cleantechnica.com/2013/06/25/solar-power-by-state-solar-rankings-by-state/. Solar capacities of other states are from this reference.
[34] Bird, Heeter, Kreycik. November 2011. “Solar Renewable Energy Certificate (SREC) Markets: Status and Trends.”
[35] United States Department of Energy. November 2010. “A Guide to Community Solar: Utility, Private, and Non-profit Project Development.” The commercial tax credit includes rapid depreciation, which accounts for the boost in project cost savings from the standard 30% to the stated 56%.
[36] With the exception of the tax credit tied to an electric vehicle charging station, which was also discontinued by the Legislature in 2013.

[37] West Virginia Division of Energy. March 2013. "West Virginia Energy, Energy Plan 2013-2017." http://www.legis.state.wv.us/legisdocs/reports/agency/E08_CY_2013_1929.pdf
[38] NREL: The Open PV Project. Data was queried for West Virginia using the time period, June 1, 2009 to June 30, 2013, which was the effective period for the West Virginia Residential Solar Energy Tax Credit.
[39] 88 projects were listed under the Open PV project database, which is a self-report system. All eligible systems may have not been accounted for under this example. The 88 projects does not include solar water or space heating.
[40] Dovetail Wind and Solar. "Athens Community Center, 225kW Solar Car Canopies." http://dovetailsolar.com/Our-Work/Sample-Installations.aspx?fileid=35
[41] Scalo Solar Solutions, LLC. "Projects." http://www.scalosolar.com/projects/
[42] Campbell, Carolyn. October 2011. "Maryland Solar: Big Residential Growth, Positive 2012 Outlook." Greentech Media. http://www.greentechmedia.com/articles/read/maryland-big-residential-growth-positive-2012-outlook
[43] Commonwealth of Virginia State Corporation Commission. November 14, 2013. Order Establishing Guidelines Concerning the establishment of a renewable energy pilot program for third party power purchase agreements. Case No. PUE-2013-0045. http://www.scc.virginia.gov/pue/ppa/ppa_order.pdf
[44] Farrell, John. August 2012. "Virtual Net Metering." Institute for Local Self Reliance. http://www.ilsr.org/virtual-net-metering/.
[45] Database of State Incentives for Renewables and Efficiency (DSIRE). "Net-metering". http://dsireusa.org/solar/solarpolicyguide/?id=17
[46] United States Department of Energy. November 2010. "A Guide to Community Solar: Utility, Private, and Non-profit Project Development."
[47] West Virginia Legislature. 2013. "West Virginia Code, §24-2F-8. Net metering and interconnection standards." http://www.legis.state.wv.us/WVCODE/ChapterEntire.cfm?chap=24&art=2F&section=8#02F
[48] DC SUN. July 2013. "Community Renewables Energy Act of 2013." https://sites.google.com/site/dcsolarunitedneighborhoods/key-issues-and-committees/community-renewable-energy-act-of-2012
[49] U.S. Energy Information Administration. May 2013. "Feed-in Tariff: A Policy Tool Encouraging Deployment of Renewable Electricity Technologies." http://www.eia.gov/todayinenergy/detail.cfm?id=11471
[50] U.S. Energy Information Administration. May 2013. "Feed-in Tariffs and Similar Programs." http://www.eia.gov/electricity/policies/provider_programs.cfm
[51]West Penn Power. 2012. "Small Business – Time-Of-Use Pricing Options." https://www.firstenergycorp.com/content/customer/customer_choice/pennsylvania/west_penn_power/information_for_small_business/small_business_-time-of-usepricingoptions.html
[52] Farrell, John. June 2011. "Value of Solar Power Far Exceeds the Electricity." http://www.renewableenergyworld.com/rea/blog/post/2011/06/value-of-solar-power-far-exceeds-the-electricity

SIDEBAR ENDNOTES

[a] NREL: PV Watts. "Station Identification: Elkins, WV." http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/US/West_Virginia/Elkins.html
[b] West Virginia Full-Scale Solar Energy Team. April 2012. "WV Solar Market Analysis Report." Rooftop Solar Challenge Initiative.
[c] Jones and Bouamane. May 2012. "Power from Sunshine: A Business History of Solar Energy." Harvard Business School.
[d] Roberts, Billy. November 2012. "Photovoltaic Solar Resources of Countries Around the World." NREL. http://www.nrel.gov/gis/images/pv_germany_spain_china_us.jpg.
[e] The Pew Charitable Trusts. http://www.pewenvironment.org/uploadedImages/PEG/Campaigns/nsec-solar-panels-military-585-mfk011911.jpg.
[f] Goossens, Ehren. October 2013. "U.S. Army Moves Toward Solar Energy to Save Lives." http://www.renewableenergyworld.com/rea/news/article/2013/10/us-army-moves-toward-solar-energy-to-save-lives.

ACKNOWLEDGEMENTS

The authors thank Anya Schoolman of Community Power Network, Bill Howley of Coalition for Reliable Power, and Dan Conant of Solar Holler for their help researching and editing this report.