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Let the Sun Shine: Methods for Expansion of Small-Scale Solar Electricity to Reduce Fossil Fuel Dependence, Ease Financial Energy Burdens, and Enhance Community Resiliency

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LET THE SUN SHINE: METHODS FOR EXPANSION OF SMALL-SCALE SOLAR ELECTRICITY TO REDUCE FOSSIL FUEL DEPENDENCE, EASE FINANCIAL ENERGY BURDENS, AND ENHANCE COMMUNITY RESILIENCY

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INTRODUCTION

Renewable energy sources, such as wind, water, and solar, have become integrated into the framework of America's electricity generation.[1] Large-scale solar electricity production is now part of many utilities' power supply and on-site self-generation of many large corporations.[2] At the national level, there are many well-known benefits to the expanded use of solar energy: reduction of carbon emissions, reduced risk of environmentally destructive oil spills and gas leaks, and reduced dependance on foreign powers.[3] On a more local level, there are additional benefits tied to the use of solar generated electricity, particularly for lower-income and weather vulnerable communities. It reduces airborne particulate pollution into surrounding communities, reduces electricity costs for homes and businesses, and increases community resiliency in the aftermath of extreme weather events.

Solar power is a highly reliable source of renewable energy, particularly in sunny climates.[4] As the technology for harnessing solar power has evolved, and the costs of solar infrastructure has decreased, use of solar electricity across the country has soared. One reason for such popularity is its ability to be used on a small-scale for direct immediate capture and use by buildings

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[1] *Electricity Explained: Electricity Generation, Capacity, and Sales in the United States*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php [https://perma.cc/MJ9J-YLVP].

[2] *Id.*

[3] Energy production and use constitutes two-thirds of the global greenhouse emissions. Paul Nillesen & Michael Pollitt, *New Business Models for Utilities to Meet the Challenge of the Energy Transition*, *in* FUTURE OF UTILITIES—UTILITIES OF THE FUTURE: HOW TECHNOLOGICAL INNOVATIONS IN DISTRIBUTED ENERGY RESOURCES WILL SHAPE THE ELECTRIC POWER SECTOR 283 (Fereidoon P. Sioshansi, ed., 2016).

[4] Emily Kerr, *The Future of Solar Is Bright*, SCI. IN THE NEWS, HARV. UNIV. (Mar. 21, 2019), https://sitn.hms.harvard.edu/flash/2019/future-solar-bright/ [https://perma.cc/W835-3UK8].

located on the same site as the solar generation infrastructure.[5] This Article will focus on this type of small-scale on-site solar generation.[6]

The use of solar energy to provide electricity to homes and small businesses brings a myriad of benefits to a community. First, there are environmental and health benefits. Electricity generated through solar power does not emit carbon dioxide nor particulate pollution, helping to slow international global temperature rise and, more locally, reduce air pollution.[7] Further, solar electricity generation does not create waste by-products, such as the coal ash left by coal-based energy.[8] The lack of harmful emissions from solar electricity generation leads to better health and quality of life in our communities.[9]

Another benefit derived from small-scale solar is an increase in neighborhood resiliency in the aftermath of extreme weather events.[10] When destructive weather events such as hurricanes, blizzards, wildfire, and floods disrupt the traditional utility power supply, thousands—sometimes millions—of

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[5] Some other fuel sources can also be stored and generated on-site, such as propane and firewood. However, such fuels do not create electricity and therefore are rarely capable of powering an entire building. Nor are they clean fuel sources. Larry Pynn, *Evolution of the Campfire: Propane Is Safer, Easier, Cheaper and Healthier than Wood*, VANCOUVER SUN, https://vancouversun.com/news/local-news/evolution-of-the-campfire-propane-is-safer-easier-cheaper-and-healthier-than-wood [https://perma.cc/66FV-VHQW] (June 24, 2018).

[6] Today's technology allows such a micro level of solar electricity generation that even personal devices, such as radios, fans, and phones can be powered or recharged by small solar panels. *Photovoltaic Applications*, NAT'L RENEWABLE ENERGY LAB'Y, https://www.nrel.gov/pv/applications.html [https://perma.cc/AL79-SKPU]. While not yet in widespread distribution, solar powered automobiles and planes have also been successfully developed. *Id.* In this Article, the term "small-scale" refers to the limited size of the solar PV system while "on-site" referred to the location of the system on the same property to which it provides electricity. Some authors also refer to these types of PV systems as "residential systems."

[7] Malek Kamal Hussien Rabaia et al., *Environmental Impacts of Solar Energy Systems: A Review*, 754 SCI. TOTAL ENV'T 1, 3 (2021).

[8] The use of solar electricity is not wholly without environmental problems. The fabrication and transportation of solar PV panels emit greenhouse gasses. Muhammad Tawalbeh et al., *Environmental Impacts of Solar Photovoltaic Systems: A Critical Review of Recent Progress and Future Outlook*, 759 SCI. TOTAL ENV'T 1, 3 (2021); Subin G. DeVar, *Equitable Community Solar: California & Beyond*, 46 ECOLOGY L.Q. 1017, 1027 (2019). The end-of-life treatment of solar panels is also an environmental problem due to the presence of lead which can leach into soil and water if not properly stored or recycled. Rong Deng et al., *A Techno-Economic Review of Silicon Photovoltaic Module Recycling*, 109 RENEWABLE & SUSTAINABLE ENERGY REVS. 532, 533 (2019). Solar batteries often include lead and sulfuric acid. DANIEL CHIRAS, SOLAR ELECTRICITY BASICS: POWERING YOUR HOME OR OFFICE WITH SOLAR ENERGY 100 (2d ed. 2020).

[9] Deng, *supra* note 8, at 532.

[10] DeVar, *supra* note 8, at 1027.

homes and businesses can be left without power for days or weeks.[11] The widespread loss of electricity can reduce community health, safety, and quality of life as people lose the ability to heat and cool buildings, refrigerate foods and medicines, or even generate electric light. Loss of power also leads to economic business losses as employee productivity without computers, phones, and internet is not feasible. However, on-site solar generation systems can be designed to operate independently of the central electricity grid and therefore continue to supply electricity directly to homes and businesses after an extreme weather event.[12]

Small-scale solar generation also creates local economic benefits. Although there are costs involved in the installation and maintenance of a solar system, the actual generation of solar electricity is free throughout the life of that system.[13] Such savings can be of critical importance in low-income or high-rent communities where saving one hundred dollars per month in home electricity costs can make the difference to housing affordability.[14] Beyond just electricity savings, small-scale solar electricity generation can create a revenue stream for property owners when they are able to sell surplus

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[11] Kara Consalo, *Vulnerable Populations: Climate Change and Extreme Weather Threats Facing Urban Communities*, 11 CHICAGO-KENT J. ENV'T & ENERGY L. 1, 2–5 (2022); Cecilia Turchetti, *Here Comes the Sun: Bringing Efficiency and Renewable Energy Solutions to Affordable Housing in the U.S.*, 32 GEO. ENV'T. L. REV. 399, 403 (2020); Mike Jacobs, *13 of the Largest Power Outages in History —and What They Tell Us About the 2003 Northeast Blackout*, UNION OF CONCERNED SCIENTISTS: THE EQUATION (Aug. 8, 2013, 11:18 AM), https://blog.ucsusa.org/mike-jacobs/2003-northeast-blackout-and-13-of-the-largest-power-outages-in-history-199/ [https://perma.cc/BT3M-WETP].

[12] *See Solar Photovoltaic Technology Basics*, U.S. OFF. ENERGY EFFICIENCY & RENEWABLE ENERGY, https://www.energy.gov/eere/solar/solar-photovoltaic-technology-basics [https://perma.cc/G55K-3DMS] [hereinafter Solar Photovoltaic].

[13] As will be discussed below, the actual generation of solar electricity is free. The costs incurred with a solar electricity system arise from installation costs and maintenance costs. These costs vary based upon location, installer, and type of system. Inclusion of one or more batteries increases both installation and maintenance costs. *See infra* Section I.B.

[14] According to the U.S. Energy Information Administration, the average residential energy consumption of U.S. households costs approximately $1,900 per year ($160 per month). Average energy costs tend to increase in cooler states which require more heating energy, with the highest average found in Alaska at approximately $3,200 per year ($270 per month). Greg Lawson & Mickey Francis, *U.S. Households in Warmer States Consume Less Site Energy than Households in Colder States*, U.S. ENERGY INFO. ADMIN. (May 4, 2023), https://www.eia.gov/todayinenergy/detail.php?id=56380# [https://perma.cc/8WNV-58HD]. Reductions in electricity costs for installation of small-scale solar infrastructure can be passed along to tenants. Tenants with lease obligations to pay their own utility costs will reap the most direct benefit from reduced utility bills. However, landlords who pay utilities directly can also pass the cost of reduced power to tenants through reduced rents. Both are of great benefit to tenants in lower income communities and may make the difference in a family's ability to afford rental housing. *See generally* DeVar, *supra* note 8.

electricity generation back to the local utility.[15] Finally, there is documented increase to the value of properties on which solar generation systems have been installed.[16]

With so many benefits to solar electricity generation, it behooves state and local governments across America to explore laws and policies which encourage small-scale solar deployment. To help guide development of such laws and policies, Part I of this Article will explain the mechanics and the financing involved with the installation, operation, and maintenance of an on-site solar system. Part II explores the unique benefits and challenges of small-scale solar usage in low-income and weather vulnerable communities. Part III explains the legal and financial governance of American electric companies and how existing frameworks may lead utilities to erect hurdles to prevent on-site solar electricity generation. Part IV explores strategies, specifically laws and financing tools, used successfully by Hawaii, California, and Illinois to encourage widespread investment in on-site solar systems. Finally, Part V presents recommendations on how best to incorporate legal and political tools in jurisdictions seeking to expand use of small-scale solar, with an emphasis on benefiting low-income and weather vulnerable communities.

I. THE MECHANICS AND COSTS OF SMALL-SCALE SOLAR INSTALLATIONS

An understanding of best policy incentives for on-site solar generation requires an understanding of how such systems operate and the costs involved in installation and maintenance of such systems.

A. The Mechanics of Small-Scale Solar Generation

At the core, the mechanics of solar electricity generation are similar to any other source of electricity generation, whether renewable or fossil fuel. The fuel source, solar radiation from the sun, is harnessed and converted into electricity.[17] There are two types of solar electricity generation: solar-thermal

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[15] Agustin J. Ros & Sai Shetty Sai, *Residential Rooftop Solar Demand in the U.S. and the Impact of Net Energy Metering and Electricity Prices*, 118 ENERGY ECON. 1, 1 (2023).

[16] DeVar, *supra* note 8, at 1027; Rebecca Brill & Corinne Tynan, *Do Solar Panels Increase Your Home's Value?*, FORBES HOME, https://www.forbes.com/home-improvement/solar/does-solar-increase-home-value/ [https://perma.cc/J3RA-FTU9] (Sept. 14, 2023, 12:57 PM).

[17] According to the United States Office of Energy Efficiency & Renewable Energy, an office of the Department of Energy, the amount of sunlight landing on the earth's surface in 90 minutes provides enough energy to satisfy the world's energy needs for a year. *How Does Solar Work?*, U.S. OFF. ENERGY EFFICIENCY & RENEWABLE ENERGY, https://www.energy.gov/eere/solar/how-does-solar-work [https://perma.cc/5X9Y-SZHA]. Yet in 2021, only 2.8 percent of the world's electricity generation was from solar power. HENRY SCOTT & HUANBO ZENG, RENEWABLE ENERGY 2023, LEXOLOGY (2023).

or photovoltaic.[18] The solar-thermal process uses mirrors to harness sunlight and convert it to heat.[19] The heat is used to warm water to a boiling point, producing steam to drive a turbine and electrical generator which produce electricity.[20] Solar thermal generation is used by electric utilities and large industrial facilities, rather than as a method for on-site solar generation at residential and office facilities.

The other type of solar electricity generation, photovoltaic ("PV"), is the type of solar electricity generation which can be readily used in residential and office capacities. Photovoltaic generation converts solar photons, or light energy, to electricity.[21] During this process, solar photons are absorbed into PV panels, which are wired together and protected by a glass panel on the top and a plastic covering on the bottom.[22] The connected panels are mounted on a rack and installed as a "solar array" on the selected surface, typically the ground, a rooftop, or a floating surface.[23] These arrays are highly flexible in size such that they can range from a single panel to thousands of panels.[24]

Photovoltaic panels are composed of layers of silicon cells which have both positive and negative charges.[25] These cell layers create an electric field so that electrons are released when solar photons hit the panel, creating an electric current.[26] This current is harnessed by wires within the panel to route electricity to a grid.[27]

The energy flow resulting from conversion of solar energy to electricity is known as "watts" or "wattage."[28] A watt denotes the amount of energy flow,

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[18] K.R. PADIYAR & ANIL M. KULKARNI, DYNAMICS AND CONTROL OF ELECTRIC TRANSMISSION AND MICROGRIDS 535 (2019); *How Does Solar Work?*, *supra* note 17.

[19] PADIYAR & KULKARNI, *supra* note 18.

[20] *Id.* at 536.

[21] *Id.*

[22] CHIRAS, *supra* note 8, at 37–38. The silicon used in PV panels is extracted from silicon dioxide. *Id.* Like most conversions of fuel to electricity, the initial electricity produced by PV panels is direct current ("DC") electricity. *Id.* at 5. Most American homes operate on alternating current ("AC") electricity system and so it is necessary for an on-site solar system to include an "inverter" to convert the DC to AC current. *Id.*

[23] *Id.* at 3. As noted by Daniel Chiras, there are many evolving solar generation systems which are likely to decrease costs and increase popularity of on-site solar. These include PVs integrated into buildings, such as part of the exterior walls and windows, as well as various types of roofing treatment, such as PV roof tiles and PV laminate. *See id.* at 52–56.

[24] Solar Photovoltaic, *supra* note 12. The largest PV systems in America are both located in California: the Solar Star PV Power Station produces 579 megawatts and the Desert Sunlight Solar Farm produces 550 megawatts. *Id.*

[25] *Id.*

[26] *Id.*

[27] *Id.*

[28] CHIRAS, *supra* note 8, at 2.

with a higher wattage indicating a greater electricity flow.[29] Watts or wattage is also used to describe how much electricity is generated by an energy source.[30] Electricity demands in modern society are so great that wattage is often described in exponential increases. A kilowatt ("kW") is composed of 1,000 watts and a kilowatt-hour ("kWh") is enough energy to power a typical home appliance for an hour.[31] A megawatt ("MW") is composed of 1 million watts and is sufficient electricity to power 1,000 homes a day.[32] A gigawatt ("GW") is equivalent to 1 billion watts, which is sufficient electricity to power 1 million homes a day.[33] Electricity generation by power companies is typically on a "large scale" or a "utility scale," meaning capacity to generate at least 1 megawatt upon demand.[34] "Small-scale" electricity generation is generally considered any amount less than 1 megawatt.[35]

Like electricity generated by other fuel sources, the electricity generated by solar PV systems can be routed into the central electricity grid for common usage.[36] Electricity grids form an interconnected network of high voltage transmission lines, lower voltage distribution lines, and associated structures and equipment across the U.S. enable utility providers to transmit electricity in a cooperative and synchronized fashion.[37] Consumers receive electricity though property connections to the central grid, delivered by a local utility.[38] Grid operators seek to provide safe, continuous, and reliable electricity supply to consumers. However, a significant problem with reliance on this type of central grid is that a disruption at one point in the grid can halt power distribution to thousands of customers, an occurrence commonly referred to as a "blackout." Multiple grid disruptions can lead to catastrophic failure affecting millions of properties.[39] This weakness in the central utility grid has led to

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[29] *Id.*

[30] *See id.* Conversely, "voltage" is a term used to describe the flow of electrons within wires and electrical devises. A higher voltage indicates a greater flow. *See id.* at 5.

[31] U.S. ENERGY INFO. ADMIN, *supra* note 1.

[32] *Id.*

[33] *Id.*

[34] *Id.*

[35] *Id.*

[36] *See* PADIYAR & KULKARNI, *supra* note 18, at 28, 535.

[37] *See* U.S. DEP'T ENERGY, OFF. ELECTRICITY DELIVERY & ENERGY RELIABILITY, UNITED STATES ELECTRICITY INDUSTRY PRIMER (2015); *see also* PADIYAR & KULKARNI, *supra* note 18, at 28, 49.

[38] *Electricity Explained: How Electricity is Delivered to Consumers*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php [https://perma.cc/MD24-F3C8] (Aug. 11, 2022).

[39] The American grid system is old in many places, some portions over one hundred years old. Turchetti, *supra* note 11, at 403. This age, combined with growing energy demands and more frequent extreme weather events, has led to blackouts around the country. *Id.*

rising interest in "microgrids" which creates resiliency to central grid disruptions. Microgrids are discussed in more detail below.

While solar electricity generation and distribution is similar to other types of electricity generation, solar infrastructure is more flexible than most other energy sources. Solar panels can be located on many types of surfaces. Utilities and large businesses can "ground mount" thousands of solar panels on acres of land, commonly known as "PV plants" or more colloquially, as "solar farms."[40] These farms can generate hundreds of megawatts.[41] An innovative concept of floating solar arrays mounted on barges and other floating devices on rivers and lakes add the benefits of being able to travel with the sun and avoid the need for extensive areas of land.[42] Photovoltaic infrastructure can also be located directly on the ground adjacent to, or on the roof of, the structure to which it provides electricity. Solar generators which are not utility-owned, such as on-site generation facilities, are commonly referred to as a "distributed solar" facilities.[43]

Small-scale on-site PV systems typically generate between 1,000–15,000 watts of solar electricity on a daily basis.[44] These systems can be sized to power a building ranging in size from a few hundred to a few thousand square feet, depending upon the energy efficiency rating of building materials and the level energy conservation by the building's occupants.

Although on-site solar electricity generation has many benefits, it has one weakness when compared to fossil-fuel and hydro electric energy sources: storage. Fossil fuels, such as coal, oil, and gas are tangible and can be stored for unlimited periods of time for use on demand. Hydropower is also fueled by a tangible source, water, which can be stored for use in times of demand.[45] However, sunlight is an intangible fuel, and it cannot be stored to draw upon

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[40] Many utilities operate large solar farms as do large corporations such as Microsoft, Toyota, and Google. CHIRAS, *supra* note 8, at 6.

[41] PADIYAR & KULKARNI, *supra* note 18, at 535; Deng, *supra* note 8, at 1; *see also* Solar Photovoltaic, *supra* note 12.

[42] *See, e.g.*, FLA. STAT. § 163.32051 (2023).

[43] *See* SCOTT & ZENG, *supra* note 17, at 2, 7. "Distributed [g]eneration" is generally located at or near to the site of the energy usage and can be combined with other energy generation and distribution systems. Turchetti, *supra* note 11, at 410–11. Such on-site electricity generation is arguably more ecologically beneficial in comparison to utility-level solar fields since it does not require clearing land or damaging ecosystems. Sammy Roth, *California Just Slashed Rooftop Solar Incentives. What Happens Next?*, L.A. TIMES (Dec. 15, 2022, 4:20 PM), https://www.latimes.com/business/story/2022-12-15/california-just-slashed-rooftop-solar-incentives-what-happens-next [https://perma.cc/54CL-JKEM].

[44] CHIRAS, *supra* note 8, at 1.

[45] U.S. OFF. OF ENERGY EFFICIENCY & RENEWABLE ENERGY, TYPES OF HYDROPOWER PLANTS, https://www.energy.gov/eere/water/types-hydropower-plants [https://perma.cc/4WW3-JB29].

at-will. Since periods of access to sunlight are limited to daytime hours and affected by geography, weather, and seasonal fluctuations, this fuel source is unavailable for lengthy periods of time. To overcome this weakness, it is important for a PV system to include batteries to store electricity generated during sunlight hours for use during periods of low sunlight.[46]

Since batteries can only store a finite amount of solar electricity, most on-site solar systems are connected to a central utility grid from which utility-supplied power can be drawn at times when the self-generated electricity is insufficient to meet the property's demand. Such need for utility-supplied electricity may occur during peak periods of the day when demand is greatest, or at times battery-storage is depleted, or when overcast weather prevents sufficient solar generation.[47] Connection to the grid may also be necessary if the PV system is undersized for the building's electricity needs.

Connection to the central grid also allows the on-site solar generator to route their surplus solar energy back to the local utility, a process known as "backfeeding" or "output."[48] The ability to output surplus electricity to a grid is one method to protect the on-site system from overloading when the solar generated electricity is greater than the building's electricity demand.[49] As will be discussed in Parts IV and V below, there is wide variety among states and utilities regarding how and when PV systems can be connected to the grid, how and when backfed electricity will be allowed, and the rate which self-generators will be compensated for such backfed electricity. However, there are some common procedures when an on-site system is permitted to output surplus electricity to a utility grid.

When a PV system is connected to the utility grid, the property owner will typically enter into an "interconnection agreement" with the utility detailing the requirements on the property owners regarding output electricity and any payment or "feed-in tariff" from the utility for such electricity.[50] The most common feed-in tariff is a "Net Electric Metering" ("NEM") policy

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[46] CHIRAS, *supra* note 8, at 101–02.

[47] Peak energy demand varies by region and by season but is generally in the afternoon. *See Hourly Electricity Consumption Varies Throughout the Day and Across Seasons*, U.S. ENERGY INFO. ADMIN (Feb. 21, 2020), https://www.eia.gov/todayinenergy/detail.php?id=42915 [https://perma.cc/9CPS-QUCU].

[48] CHIRAS, *supra* note 8, at 89–90. There is typically an electric meter which tracks the amount of backfed solar electricity and which may, if allowed by the utility rate structure, result in payments to the property owner for the solar power they provide to the utility. *See id.* at 91.

[49] *Id.* at 90.

[50] *Id.* at 96.

which pays a set rate for each watt of solar electricity backfed to the grid.[51] The rate of payment depends on the rates allowed or required by the state, which may range from no payment (the excess electricity is simply gifted to the utility), to a rate consistent with the prevailing retail price (the rate paid by utility customers for electricity), to the wholesale price (the rate paid by the utility to purchase electricity on the wholesale market), or as an avoided cost (representative of the savings to the utility because it did not have to produce that electricity).[52] Retail rates are higher than wholesale rates which are higher than the avoided cost rate.[53] Compensation to solar generator is typically rendered as a credit against any electricity supplied by the utility to the property. The reconciliation of payment for surplus solar electricity backfed to the utility versus the cost for electricity provided to the property by the utility can be done on a monthly basis or only annual basis. Some jurisdictions allow the property owner to roll-over surplus electricity credits as an additional incentive.[54]

Despite the security of the grid, and potential for payment from the utility for backfed electricity, there are some on-site PV systems which remain off-grid. These systems have the advantage of electricity independence and energy resiliency during a central grid disruption. However, they also present some risk of insufficient electricity during long periods of little or no sunlight, such as short daylight hours in the winter months or extended periods of rainy and overcast weather. Therefore, off-grid PV systems should include multiple batteries, or "battery banking," to secure sufficient storage of electricity for long periods. In addition to ample battery storage, off-grid systems should have back-up fuel systems for energy supply. For example, an off-grid

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[51] *Id.* at 96. Net electric metering can be in the form of "net metering" in which a bi-directional electric meter is used to record the property's electrical output to the central grid by spinning forwards and the property's withdraw of electricity from the central grid by spinning backwards. *Grid-Connected Renewable Energy Systems*, U.S. DEPT. ENERGY, https://www.energy.gov/energysaver/grid-connected-renewable-energy-systems [https://perma.cc/RHM2-E6V9]. At the end of the month, the property owner will either owe the utility money if the meter indicates they have withdrawn more central energy than they output, or the utility will owe the customer a credit if the output of solar electricity is greater than the withdraw. *Id.* Under a net metering system, the rate used for the property owner's fees or credits will be the same. *Id.* The other process is a "[n]et purchase and sale" through which two uni-directional meters are installed, one to record electricity drawn from the grid, and the other to record solar electricity fed back into the grid. *Id.* The property owner pays the utility the retail rate for electricity drawn from the grid but the utility may only compensate the property owner at its wholesale or avoided cost for energy output to the grid. *Id.*

[52] CHIRAS, *supra* note 8, at 97–98; SCOTT & ZENG, *supra* note 17, at 8.

[53] *See* CHIRAS, *supra* note 8, at 96–97.

[54] *See id.* at 97.

property could supplement solar electricity with an on-site wind turbine, firewood, and/or propane gas.

Before moving on to a discussion of costs associated with an on-site solar system, it is important to address the symbiotic role of a "microgrid" toward maximizing the benefits of small-scale solar energy. As discussed above, most electricity in America is delivered through a countrywide interconnected electricity grid system composed of high voltage transmission lines, lower voltage distribution lines, and connection lines to customers' buildings. A significant problem with the American grid system is that it is, in many areas, an aging structure subject to failure from manmade error, extreme weather events, and cyber threats.[55] A failure in one part of the grid can result in widespread black-outs. Multiple disruptions to a central grid, which are likely during a strong hurricane, blizzard, or other extreme weather event, can cause black-outs to millions of properties.[56]

Microgrid technology presents a solution to this problem.[57] A microgrid is an electrical grid system which connects a limited number of properties within a geographical area.[58] Microgrids are often used in connection with distributed electricity sources, such as small-scale solar facilities, so that electricity loads can operate independently of the central grid.[59] Optimally, a microgrid is integrated into and can operate seamlessly with, the central utility grid, and also function as an electricity island which can be disconnected from the central grid when the central grid is disrupted.[60] Once disconnected, the microgrid can operate independently and without disruption.[61]

The size and inclusiveness of microgrids is highly flexible. A traditional microgrid may connect a few city blocks of homes and businesses. However, microgrids can also be used within a single large building, such as a hospital or apartment complex. Microgrids can also be established for a single property owner with many buildings, such as a corporate or university campus.[62]

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[55] SCOTT & ZENG, *supra* note 17, at 7–8.

[56] Consalo, *supra* note 11; Turchetti, *supra* note 11, at 399–400; Jacobs, *supra* note 11.

[57] SCOTT & ZENG, *supra* note 17, at 7.

[58] PADIYAR & KULKARNI, *supra* note 18, at 567.

[59] *Id.*; SCOTT & ZENG, *supra* note 17, at 7.

[60] PADIYAR & KULKARNI, *supra* note 18, at 567–68. Microgrids also benefit the utility both by absorbing electricity load fluctuations and by offsetting peak electricity demands—providing additional stability and reliability to the central grid. *See id.*

[61] *Id.* at 573. A microgrid must have sufficient sources of electrical "load" in order to supply users on the microgrid. So, any microgrid system primarily intended to provide power during a blackout must have a sufficient number of electricity generation sources connected directly to it.

[62] *Id.* at 571.

For most users, particularly those in weather vulnerable communities, an optimal electricity system would be one which 1) incorporates an on-site PV system, 2) has sufficient battery storage, and 3) is connected to a microgrid with a central grid connection which can be disconnected in the event of a central grid disruption. Such a system would allow the property owner to self-generate and use (as well as potentially sell) solar electricity, thereby reducing utility bills, securing reliable electricity when there are disruptive events, and affording access to utility electricity when necessary.

B. Financing of Small-Scale Solar Infrastructure

Although prices have decreased over the last twenty years, a full building PV solar generation system, with sufficient battery storage, is still a significant investment for property owners. The up-front cost of installation includes equipment, such as panels, inverters, and batteries, as well as soft costs such as the permitting fees and installation labor. Depending on the construction of the building and location of the system, new structures or retrofitting of existing structures may be needed to accommodate the size and operational requirements of the system. Once the solar infrastructure is installed, harnessing of solar energy into useable electricity will be free, but like any complex system, there will be maintenance and replacement costs over time.[63]

The installation cost of a PV solar system is dependent upon many factors: the size of the system, whether the system will include one or more batteries, the prevailing market rates for the equipment and labor in the region, and whether the property owner qualifies for any federal, state, or local incentives. As a guidepost, an average residential PV system without batteries will cost approximately $20,000.[64] A residential battery typically costs $10,000–$15,000.[65] A commercial PV system with battery storage can easily reach $1

[63] Batteries in PV systems wear down and need to be replaced every five to ten years. CHIRAS, *supra* note 8, at 105.

[64] In California, a standard residential solar panel system will cost $20,000 or more. Sammy Roth, *How California's New Rooftop Solar Rules Will Affect You*, L.A. TIMES (Dec. 22, 2022, 6:00 AM), https://www.latimes.com/environment/newsletter/2022-12-22/how-californias-new-rooftop-solar-rules-will-affect-you-boiling-point [https://perma.cc/6PN2-HFT3]. In Hawaii, a system of 6kW costs approximately $18,000. *Summary of Hawaii Solar Incentives 2024*, SOLARREVIEWS, https://www.solarreviews.com/solar-incentives/hawaii [https://perma.cc/34TR-PN7W].

[65] VIGNESH RAMASAMY ET AL., NAT'L RENEWABLE ENERGY LAB'Y, U.S. SOLAR PHOTOVOLTAIC SYSTEM AND ENERGY STORAGE COST BENCHMARKS: Q1 2021 50 (2021).

million.[66] Most PV systems are designed to last twenty-five to thirty years and most batteries will require replacement by ten years of use.[67]

There are many mechanisms by which an on-site PV solar system can be financed. Like any home or business improvement, the system can be purchased from an installer with an upfront payment or through financing similar to any type of home improvement loan. However, such traditional purchase or financing options can be a daunting economic encumbrance for many property owners, particularly when on-site solar is not considered a necessary part of property ownership, like a new roof. The financial hurdles to installation of on-site solar is particularly acute in lower-income communities where households have less disposable income and less access to credit. Further, in communities with a predominance of rental properties, landlords may not recognize a direct financial benefit to installation of solar and therefore lack interest in investing in a PV system.

In communities where expansion of clean electricity generation is a priority, it is necessary for state and local government to provide economic incentives and other assistance to facilitate the financial feasibility for property owners. In 2005, Congress created a solar investment tax credit under the Energy Policy Act, which has been modified and extended in subsequent years.[68] The most recent extension was the Inflation Reduction Act, passed in 2022, which continued the offer of a tax credit of 30 percent for the cost of the residential solar system.[69] Rather than an up-front payment or rebate, this Solar Tax Credit allows homeowners to reduce their year-end tax debt.[70] The credit can be rolled over to the next year(s) if there is not enough tax debt in a single year to claim the full amount of the credit.[71]

This federal tax credit can be supplemented by state and local incentives. Such incentives may be in the form of sales tax exemptions on materials, which can be paid to the installation contractor to reduce the cost of the

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[66] *Id.* at 32.

[67] Sultan Büşra Artaş et al., *Why PV Panels Must Be Recycled at the End of Their Economic Life Span? A Case Study on Recycling Together with the Global Situation*, 174 PROCESS SAFETY AND ENV'T PROTECTION 63, 64 (2023); CHIRAS, *supra* note 8, at 109.

[68] Energy Policy Act of 2005, H.R. 6, 109th Cong. § 1335.

[69] Inflation Reduction Act of 2022, H.R. 5376, 117th Cong. § 13102 (2022). The Inflation Reduction Act of 2022 allows individuals a tax credit for 30 percent of expenditures made for certain residential clean energy projects, including photovoltaic panels, solar water heaters, and fuel cells. The tax credit amount will reduce to 26 percent in 2033 and to 22 percent in 2034. *Home Energy Tax Credits*, IRS, https://www.irs.gov/credits-deductions/home-energy-tax-credits [https://perma.cc/ME69-EVM6] (Jan. 31, 2024).

[70] *See* IRS, *supra* note 69.

[71] *Residential Clean Energy Credit*, IRS, https://www.irs.gov/credits-deductions/residential-clean-energy-credit [https://perma.cc/Z62C-P99R] (Aug. 28, 2023).

system or to the property owner, as well as tax exemption for labor on the system installation. In addition, the government may grant a property tax break for the increased property value resulting from the solar installation.[72] State and local governments can also provide direct financial assistance toward installation costs in the form of equipment rebates, low-interest loans, grants to the customer, or cost-offsets to the installer.[73]

The ongoing savings on electricity bills is a motivating factor for most property owners installing an on-site system. Therefore, states can further incentivize distributed solar by allowing property owners to directly access the electricity generated by their PV system and by allowing property owners to sell their surplus electricity to the local utility at favorable retail rates.

It is important to note some of the unique financing challenges facing residents in lower income communities. The first hurdle, as noted above, is that the initial cost of the system which is not financially feasible for low-income households. Another hurdle in many jurisdictions is that local rules and/or incentive programs require property ownership in order to install a PV system. The theory behind such requirement is that the government wants to ensure long-term use and maintenance of the system. This requirement for property ownership can be an insurmountable hurdle to lower income residents who cannot afford property ownership. Lower income residents may also face the hurdle of being perceived as credit risk to potential financiers.[74]

To assist households in overcoming these hurdles, governments may opt to provide greater incentives to lower-income communities, with recognition that up-front grants or low-interest loans are more useful than tax breaks in low-income households.[75] Since low credit, limited financial reserves, and a lack of security can render private financing difficult, it is important to consider non-traditional methods to secure the funding for low-income consumers. For example, a state might maintain a fund for "loan loss reserves" to assure installers and financiers of payment in the event of a private default.[76]

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[72] Dan Simms & Kristina Zagame, *2024 Solar Incentives and Rebates (Top 9 Ranked States)*, ECOWATCH, https://www.ecowatch.com/solar/incentives [https://perma.cc/MV45-RN4K] (Feb. 12, 2024).

[73] *Id.*

[74] Eric Hangen et al., *Bringing Solar Energy to Low- and Moderate-Income Communities*, UNIV. N.H. CARSEY SCH. PUBL. POL'Y: CARSEY PERSPS. (Apr. 23, 2021), https://scholars.unh.edu/cgi/viewcontent.cgi?article=1431&context=carsey [https://perma.cc/L6YY-BVPA].

[75] *Id.*

[76] *Low- and Moderate-Income Community Solar Policies*, NAT'L RENEWABLE ENERGY LAB'Y, https://www.nrel.gov/state-local-tribal/lmi-solar.html [https://perma.cc/7B3C-J7VC].

States may also consider rendering state-sponsored loans with lower thresholds for lower-income households, such as reduced or removed credit score requirements.[77] States can also encourage the private sector to assist in reducing the costs of PV systems by requiring installation of such systems in affordable housing projects.[78]

Careful and phased planning for on-site PV systems can render such systems more affordable for lower income households. To keep initial costs low, a PV system could be installed with less capacity (fewer PV panels) than necessary to power the entire building and without batteries. Installation of fewer panels and no batteries lowers the initial installation cost and/or financing obligation. Any unmet electricity demand would be supplied by the local utility. Once payment for the initial system is completed, it can be enlarged with more panels, and eventually with battery storage, to optimize all benefits. Such incremental increase to the system allows the consumer to pay less initially while gaining some benefits of an on-site PV system.[79]

Government policies can also encourage solar businesses which benefit lower-income residents. For example, businesses which lease PV systems to customers are a financially feasible option for property owners or tenants who seek the benefits of a solar system without the installation and maintenance costs.[80] Through what is commonly referred to as a "Power Purchase Agreement," the private company installs and maintains PV panels on private property, then sells the power generated by those PV panels back to the property owner or tenant.[81] Assuming that the cost for a watt of on-site generated solar electricity is less than the cost of a watt of utility provided electricity, the power purchase agreement provides electricity savings without upfront costs.

Another private business model which can assist in development of distributed solar is "community solar" (also referred to as "community shared solar" or a "solar consortium").[82] Community solar is a term for a large solar

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[77] *Id.*

[78] *Id.*

[79] *See* CHIRAS, *supra* note 8, at 111–12.

[80] *Low- and Moderate-Income Community Solar Policies, supra* note 76.

[81] Roth, *supra* note 64.

[82] DeVar, *supra* note 8, at 1025. In this article, DeVar distinguishes between solar communities, which are cooperatives amongst neighbors who share their solar resources; and solar consortiums, which are private solar farms which sell solar power to several members of the local community. Both solar communities and solar consortiums create avenues for non-property owners to make direct use of solar electricity even when they lack the ability to install an on-site solar system. *Id.* Not all government programs define a distinction between a solar community and a solar consortium, and as a result, most shared solar arrays are referred to as community solar. DeVar posits that a successful solar community must include three elements: 1) defining its goals and objectives to ensure long term feasibility,

array which sells solar electricity to the local utility in exchange for utility credits.[83] The members or "subscribers" of the community solar array share these utilities credits for savings on their respective electric bills.[84] Such community solar can be established in many ways, but the most common arrangements are: 1) allowing members to purchase power generated by certain PV panels within the array, or 2) sharing a pro rata amount of the solar generation credits amongst all members.[85] Another iteration of the solar consortium is a so-called "virtual power plant" whereby many property owners allow a private company to install PV systems on their properties in exchange for a lease payment from the company and/or access to the electricity at a lower rate than utility-supplied electricity.[86]

Financing an on-site PV system can be an expensive hurdle to all the benefits of self-generated solar electricity. However, there are many policy initiatives which state and local governments can employ to reduce that hurdle. In Part IV below, the specific financing and incentive programs developed by the states of Hawaii, California, and Illinois will serve as examples of how solar policies can be used to stimulate widespread investment in distributed solar generation.

2) a focus on benefit to marginalized communities, and 3) community ownership and governance, with limited corporate involvement. *Id.* at 1031–32; Katherine Lee Goyette, *Community Solar Policy and the Low- and Moderate-Income Customer*, 36 NAT. RES. & ENV'T 13 (2021).

[83] DeVar, *supra* note 8, at 1025.

[84] Turchetti, *supra* note 11, at 403. Community solar is an excellent option for landlord-owned but tenant-occupied properties. Oftentimes, a landlord lacks the incentives to expend money to install a solar generation system on the rental property since it will be the tenant, not the landlord, who benefits from it. Conversely, tenants may lack the funds or the legal authorization to install solar infrastructure on their rented property. Tenants may also lack incentive to install a solar system since they would lose its benefits when their lease ends. Community solar is a way to allow tenants to benefit from distributed solar generation without the need to install their own PV system.

[85] DeVar, *supra* note 8, at 1026–27. Like individual small-scale solar, community solar systems rely upon net metering to allocate costs of solar electricity among the solar community customers.

[86] *Introducing VPPieces: Bite-Sized Blogs About Virtual Power Plants*, U.S. DEP'T OF ENERGY (May 12, 2022), https://www.energy.gov/lpo/articles/introducing-vppieces-bite-sized-blogs-about-virtual-power-plants [https://perma.cc/24JJ-B882]; Nichola Groom, *Explainer: What is a Virtual Power Plant?*, REUTERS, https://www.reuters.com/business/sustainable-business/what-is-virtual-power-plant-2023-01-31/ [https://perma.cc/M36Y-W4QY] (Jan. 31, 2023, 4:06 AM).

II. THE BENEFITS OF ON-SITE SOLAR GENERATION, PARTICULARLY FOR LOW-INCOME AND WEATHER VULNERABLE COMMUNITIES

There are significant benefits to local communities from the widespread use of on-site solar electricity generation. These benefits include reduction or elimination of monthly electricity costs, opportunities for revenue generation from selling surplus electricity, reduced local air pollution as less fossil fuels are burned for utility electrical generation, and greater access to electricity after grid disruptions, such as destructive weather events. While such benefits accrue to all solar generators, they have a greater impact in low-income and weather vulnerable communities.[87]

A. Economic Benefits of On-Site Solar Generation

The most obvious benefit of an on-site PV system is the ability of a property owner to eliminate ongoing electricity bills. Studies show that energy costs can be a significant burden for households, especially low-income households.[88] Once installed at the correct capacity and with sufficient battery storage, an on-site PV system will power the entire building without any cost for fuel. There may be ancillary costs, such as maintenance and utility fees, but the daily conversion of sunlight into electricity is free. The average retail cost of electricity in the continental U.S. is approximately twelve cents/kWh.[89] The average American uses 899 kWh of electricity per month.[90] For a household of four, the savings of conversion to 100 percent self-generated solar electricity would be approximately $400 per month or nearly $5,000 per year. These savings reoccur annually, and the potential long-term savings are immense.

In addition to household electricity savings, on-site PV systems have the potential to earn money for the system owner. Surplus electricity can be back fed to the local utility for payment or credit against other utility charges. In highly incentivized states, the utility would be required to pay retail, or at least wholesale, prices to the on-site generator for the energy purchased. It is imperative for governments and private interests to provide targeted financial

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[87] The fair and equitable distribution of opportunities for on-site solar generation is part of a movement seeking "energy justice" or "energy equity." *See* DeVar, *supra* note 8, at 1020.

[88] Douglas Gagne & Alexandra Aznar, *Low-Income Community Solar: Utility Return Considerations for Electric Cooperatives*, NAT'L RENEWABLE ENERGY LAB'Y (Apr. 2018), https://permanent.fdlp.gov/gpo105589/70536.pdf [https://perma.cc/BFX2-SAMX].

[89] *2022 Total Electric Industry—Average Retail Price (cents/kWh)*, U.S. ENERGY INFO. ADMIN. (Oct. 5, 2023), https://www.eia.gov/electricity/sales_revenue_price/pdf/table_4.pdf [https://perma.cc/Y3JE-JDFB] [hereinafter 2022 Total Electric Industry].

[90] *How Much Electricity Does an American Home Use?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=97&t=3 [https://perma.cc/L4S6-5XUA] (Jan. 8, 2024).

incentives, such as generous tariffs, for lower-income communities to ensure energy equity in the deployment of small-scale solar.[91] Efforts by California and Illinois to ensure solar generation options are available in lower income communities are discussed in Part IV below.

B. Weather Resiliency from On-Site Solar Generation

In recent years, extreme weather events have become increasingly destructive forces affecting nearly every state.[92] These weather events include hurricanes, flash floods, blizzards, wildfires, and prolonged periods extreme heat.[93] As rising land and water temperatures alter global climate patterns, extreme weather events are more frequent and stronger.[94] These events inevitably result in loss of central grid-provided power to thousands, and occasionally millions of homes and businesses, due to downed electrical lines.[95] For example, downed trees and equipment flooding caused by Hurricane Sandy in 2012 caused 8.2 million people, across seventeen states, D.C., and Canada to lose power, some for up to two weeks.[96] Just a year earlier, trees and electric wires downed by heavy snows in New England and Mid-Atlantic states resulted in a blackout affecting more than 3 million people, some for up to ten days.[97] Weather-induced outages often last for several days and may stretch into weeks, particularly in remote areas.[98] Such widespread blackouts caused by disruptions in America's interconnected power grid can result in a complete breakdown of electricity distribution.[99]

In many areas, the American power grid system is aging and outdated.[100] Most connection wires are still above-ground and vulnerable to strong winds

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[91] *See* DeVar, *supra* note 8, at 1029.

[92] Consalo, *supra* note 11, at 1–5; Turchetti, *supra* note 11, at 399–400; Jacobs, *supra* note 11.

[93] Consalo, *supra* note 11, at 1–5; Turchetti, *supra* note 11, at 399–400; Jacobs, *supra* note 11.

[94] Consalo, *supra* note 11, at 3–4; *see also* Turchetti, *supra* note 11, 399–400.

[95] Jacobs, *supra* note 11. Grids can also fail without any weather cause, such as the errors of judgment and technology failures. A devastating example occurred in 2003, when human error and technical failure at a single utility in Ohio led to a cascade of grid failures which eventually caused power loss to 50 million people in both the U.S. and Canada for two days and an estimated $6 billion in losses. JR Minkel, *The 2003 Northeast Blackout--Five Years Later*, SCI. AM. (Aug. 13, 2008), https://www.scientificamerican.com/article/2003-blackout-five-years-later/ [https://perma.cc/ZQP2-RLEX].

[96] Jacobs, *supra* note 11.

[97] *Id.*

[98] *Id.*

[99] *Id.*

[100] *See* U.S. GOV'T ACCOUNTABILITY OFF., GAO-21-423T, ELECTRICITY GRID RESILIENCE: CLIMATE CHANGE IS EXPECTED TO HAVE FAR-REACHING EFFECTS AND DOE AND FERC SHOULD

caused by hurricanes, tropical storms, nor-easters and blizzards, as well as threatened by floods caused by many of the same forces.[101] Even additional electricity demands, such as greater usage of air conditioning during a prolonged heat waves, can cause the central grid to fail.[102]

On-site solar generation provides an immediate alternative to utility-supplied power and can operate in isolation from the rest of the utility grid.[103] With installation of the proper hardware, such as inverters and batteries, an on-site solar panel array can provide electricity directly into to the building it serves without the need to access any electricity grid.[104] Such electricity resiliency could provide relief to millions of homes after extreme weather events. As discussed above, micro-grids can further enhance this electricity resiliency by linking distributed solar generation sources together so that electricity can be stored and shared amongst buildings on that micro-grid.[105]

C. Health and Environmental Benefits from Distributed Solar

For vulnerable members of the population, such as the elderly, the young, and those with health issues, reliable electricity is necessary to maintain health and well-being.[106] Keeping the heat running in cold climates, air conditioning running in hot climates, and refrigeration of food and medicine can be life-saving for vulnerable populations—and afford a basic quality of life for everyone.[107] The use of on-site solar electricity generation directly connected to the on-site building ensures that such electricity needs are met and vulnerable members of the population are safe.

TAKE ACTIONS, 1, 5–9 (2021); *see also* René Marsh, *Energy Experts Sound Alarm About US Electric Grid: 'Not Designed to Withstand the Impacts of Climate Change'*, CNN, https://www.cnn.com/2022/05/31/us/power-outages-electric-grid-climate-change/index.html [https://perma.cc/4ZQJ-BAQ2] (June 2, 2022, 1:36 PM).

[101] *See* U.S. GOV'T ACCOUNTABILITY OFF., *supra* note 100; *see also* Marsh, *supra* note 100.

[102] *See* U.S. GOV'T ACCOUNTABILITY OFF., *supra* note 100; *see also* Marsh, *supra* note 100.

[103] *See* CHIRAS, *supra* note 8, at 106–09.

[104] *See id.* at 106–08.

[105] Arvind R. Singh et al., *Microgrid System*, *in* MICROGRID: OPERATION, CONTROL, MONITORING AND PROTECTION 3 (Papia Ray & Monalisa Biswal eds., 2020). In many jurisdictions, a micro-grid which can be detached from the central utility grid is necessary for on-site solar generation to continue to work after a central grid outage because most utilities will automatically shut down individual grid-connected electricity sources during the outage in order to protect workers. *Solar PV at Home*, FLA. DEPT. AGRIC. AND CONSUMER SERVS., https://www.myfloridahomeenergy.com/help/library/energy-services/home-solar-pv [https://perma.cc/PWL2-YEUG].

[106] Turchetti, *supra* note 11, at 400–01.

[107] *See* Julianne Skarha et al., *Association of Power Outage with Mortality and Hospitalizations Among Florida Nursing Home Residents After Hurricane Irma*, JAMA HEALTH F. 1, 2, 6 (2021).

Another benefit toward long term community health is the reduction of particulate pollution in local air when less electricity is generated by burning fossil fuels.[108] Widespread use of clean solar energy generation reduces the need for local utilities to extract and burn fossil fuels and thereby reduces particulate pollution in the community.[109]

III. THE AMERICAN UTILITY AND HOW DISTRIBUTED SOLAR CAN BE INCORPORATED INTO THE TRADITIONAL UTILITY SYSTEM

In November 2023, distributed solar generation accounted for 4,962 thousand MWh of electricity generated in the U.S.[110] The total utility electricity generation in the U.S. that same month was 321,806 thousand MWh.[111] These numbers were consistent with other monthly measurements of electricity usage, indicating that less than 3 percent of the electricity generated by utilities is sourced from distributed solar sources.[112] Considering all of the environmental, economic, and health benefits of on-site solar installations, one must ask: why does small-scale solar still remain a fraction of the electricity used in America? The answer lies in the law, specifically utility law.

Electric utility companies, or electric utilities, serve three primary roles: 1) to obtain electricity, 2) to transmit electricity, and 3) to distribute electricity.[113] A successful electric utility seeks to provide safe and reliable electricity to their customers at reasonable rates.[114] Utilities obtain electricity either through their own generation or through purchase on the wholesale energy market.[115] Utilities have traditionally relied upon power plants to meet their customers' electricity demand. Power plants can be designed to generate electricity from different types of fuels, including coal, gas, nuclear, solar, and wind. After the generation or purchase of electricity, utilities transmit it to customers through the transmission and distribution lines of the central grid.[116]

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[108] Karn Vohra et al., *Global Mortality from Outdoor Fine Particle Pollution Generated by Fossil Fuel Combustion: Results for GEOS-Chem*, 195 ENV'T. RES. 1, 4–6 (2021).

[109] *See id.*

[110] *Electricity Data Browser*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/electricity/data/browser/ [https://perma.cc/ZR2F-EGXK] (referring to Table: "Net generation, United States, all Sectors, monthly") [hereinafter Net Generation Solar].

[111] *Id.*

[112] *Id.*

[113] *See* STEVEN SIM, ELECTRIC UTILITY RESOURCE PLANNING: ECONOMICS, RELIABILITY, AND DECISION-MAKING 11, 11 (2012).

[114] *See id.* at 16. A utility criticism of solar electricity is that it is not a reliable source of electricity since it can only be harnessed when the sun is shining. Conversely, once coal, oil, or gas are removed from the earth, they can be harnessed as fuel to generate electricity at any time. *See id.* at 20.

[115] *See id.* at 11.

[116] *See id.*

Utility law involves a complex interplay of federal, state, and local legislative bodies, as well as administrative agencies, addressing a variety of policy matters such as safety and environmental concerns, electricity rates, capital improvements, and consumer needs.[117] Federal and state governments establish laws and administrative rules, which may range from safeguards for nuclear energy; to environmental protections for transport, use, and disposal of fuels; to authorization for capital improvements; to the rates utilities may charge for electricity; to incentive programs for electricity conservation, expansion of clean energy, and other policy goals.[118] The greater share of such regulation falls on the states.[119] Utilities may be public, meaning run by a government or quasi-government entity, or they may be a privately owned corporate structure, often referred to as "investor owned" utilities.[120] Utility customers, often referred to as "ratepayers," are the purchasers of the electricity supplied by the utility.[121]

There is a wide diversity of utility frameworks among states.[122] Many states create a monopoly for certain utilities to operate without competition

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[117] *See* STEVEN SIM, ELECTRIC UTILITY RESOURCE PLANNING 1 (2012).

[118] *See* FRANK R. SPELLMAN, FUNDAMENTALS OF PUBLIC UTILITIES MANAGEMENT 21, 24 (2021).

[119] *See* SIM, *supra* note 113, at 112–113. The Public Utility Act of 1935 formed the Federal Power Commission, a forerunner to today's Federal Energy Regulatory Commission ("FERC"). JONATHAN A. LESSER & LEONARDO R. GIACCHINO, FUNDAMENTALS OF ENERGY REGULATION 5 n.5 (2nd ed. 2013). Today, FERC has regulatory authority over the transmission and sale of electricity in interstate commerce. *Electric*, FED. ELEC. REGUL. COMM'N, https://www.ferc.gov/electric [https://perma.cc/9KSS-W3BF] (July 1, 2021). However, for the most part, matters of in-state electricity regulation, such as ensuring generating capacity, the licensing of generation facilities, and retail ratemaking, fall under a state's purview. Pac. Gas & Elec. Co. v. State Energy Res. Conservation & Dev. Comm'n., 461 U.S. 190, 191 (1983) (acknowledging the authority of states over in-state electricity regulation with certain exceptions for nuclear power). Most states have a utility commission, often called Public Utility Commission, which establishes specific rules and regulations for the operation of utilities within that state. *See* SCOTT HEMPLING, REGULATING PUBLIC UTILITY PERFORMANCE: THE LAW OF MARKET STRUCTURE, PRICING AND JURISDICTION 3–5 (2013). Local governments may become involved in electricity provision in several ways. Municipalities, as well as specially created units of local government, may operate or share in operation of a local public utility. *Investor-Owned Utilities Served 72% of U.S. Electricity Customers in 2017*, U.S. ENERGY INFO. ADMIN. (AUG. 15, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40913 [https://perma.cc/A7UD-FSD7] [hereinafter Investor-Owned]. Local governments are often part of the permitting process for new generation facilities. *See* CHIRAS, *supra* note 8, at 191–94.

[120] Investor-Owned, *supra* note 119. In 2017, 72 percent of the electricity customers in the U.S. were serviced by an investor-owned utility. *Id.*

[121] SPELLMAN, *supra* note 118, at 6–7.

[122] Some states are considered "regulated" states in which a utility company has a monopoly or near-monopoly on all three elements of electricity provision: generation, transmission, and distribution. *See* SIM, *supra* note 113. In recent decades, same states have tried to reduce the monopoly status of electric utilities by requiring separate companies provide these services (i.e., one company generates electricity while another company distributes the electricity). *See id.* at 11–12. Such states are commonly referred to as "deregulated."

in a designated geographical area.[123] This near-monopoly status of utilities means that consumers have limited choices as to which utility they purchase their electricity from, and even less role in choosing what rate they will pay for electricity or what fuel source they would choose to use to generate their electricity.[124] Other states, like Texas, do not grant monopolies and, therefore, allow extensive consumer choice amongst utility providers.[125]

Utility rates also vary extensively amongst states and ratepayers in different states, and even amongst customers of different utilities within the same state.[126] Similarly, there is a wide disparity of interest amongst states and utilities in renewable electricity generation as a supplement or replacement for traditional fossil fuels. There is also diversity in the extent to which consumers are allowed to make personal use of electricity generated by on-site solar facilities. Under highly incentivized policy frameworks, consumers are allowed to install on-site solar, are provided with direct financial assistance toward installation costs, are allowed to draw personal electricity directly from the on-site infrastructure to power their building, and sell the surplus to the local utility at favorable rates. As will be discussed in the case studies in Part IV below, such lucrative incentives can and have led to rapid and dramatic expansion of on-site solar generators. Under the least incentivized policy frameworks, consumers are provided no financial assistance to offset PV installation costs, nor are they allowed to directly power their own building from the on-site system, and any power they generate for the local utility is credited only as an offset to the electricity they have purchased from the grid. This type of regime offers little to no financial incentive for the installation of a PV system.

In addition to state legislatures, utilities also play a significant role in incentivizing or disincentivizing distributed solar generation. Self-generation through on-site solar infrastructure may be viewed as disruptive technology from the traditional model of a utility providing all electricity needs.[127] Fossil fuels are the traditional and well-understood method of electricity generation. Thousands of power plants that burn fossil fuels have been built at great expense around the country. Institutional and personal relationships have evolved between fossil fuel suppliers and utilities.

See id. at 12. However, as noted by Sim, the terms regulated and deregulated can be misleading as all electric utilities are subject to regulation. *Id.*

123 *See id.* at 11.

124 *See id.* at 12. The monopoly status of utility providers has been allowed since the Supreme Court opinion in Munn v. Illinois, 94 U.S. 113, 151–52 (1876) in which the Court determined that certain industries were so important to the public interest that a monopoly status could be allowed for public policy reasons.

125 *See What Is Energy Choice?*, ENERGY TEX., https://www.energytexas.com/get-to-learni n/what-is-energy-choice [https://perma.cc/46JM-U2CE].

126 2022 Total Electric Industry, *supra* note 89 (referring to table 6: "2022 Utility Bundled Retail Sales—Residential").

127 *See* Nillesen & Pollitt, *supra* note 3, at 283–84.

Additionally, traditional frameworks for utility profits are tied to greater energy sales and associated investment in capital improvements to generate and transmit electricity.[128] Since property owners who generate their own electricity do not purchase as much power from the local utility, loss of those customers reduces the utilities' profits.[129] Even in jurisdictions where on-site solar generators are prohibited from using their electricity directly to power their own home, the utility still must credit the on-site generator for the electricity backfed to the grid, reducing the utility's income from that customer. The need to continually sell more electricity to reap more profits creates incentives for utilities to invest in infrastructure, or "capital expenditures," like new power plants, new substations, wires, poles, and transformers as well as improvements to their existing infrastructure.[130] These infrastructure improvements enable the utility to make greater electricity sales, enhancing their ability to turn a profit.[131] In addition, utilities are generally permitted to charge customers both their pro rata share of the new or improved infrastructure, as well as an additional percentage of such capital improvements which the utility can retain as profit.[132] With regulatory frameworks and profit structures driving utilities to build more centralized infrastructure and retain more customers, it is little wonder utilities are reluctant to embrace distributed electricity sources.

Many factors determine the capital improvement needs of a utility: projected growth or decline of a customer base, projected need for repairs or replacement of aging and/or inefficient electricity generating units and infrastructure, projected increases or decreases in fuel costs, or anticipated

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[128] Christina Simeone, *Rate Decoupling: Economic and Design Considerations*, KLEINMAN CTR. FOR ENERGY POL'Y 5 (2016); Pamela Morgan, *A Decade of Decoupling for U.S. Energy Utilities: Rate Impacts, Designs, and Observations*, GRACEFUL SYS. LLC 2 (2013).

[129] Some scholars assert that electric utilities were actively involved in disinformation campaigns designed to reduce understanding of climate change, the role of fossil fuels in accelerating climate change, and forestalling replacement of fossil fuels with renewable energy sources. *See* Emily L. Williams et al., *The American Electric Utility Industry's Role in Promoting Climate Denial, Doubt, and Delay*, 17 ENV. RSCH. LETTERS 1, 1 (2022). The largest of these utilities were Southern Company, AEP, Ameren, Duke, APS, DTE, FirstEnergy, and Dominion. *See id.* at 10. Research found that the utilities which engaged most actively in climate change denial in the early 2000s are the same utilities which today continue to rely predominantly on fossil fuel sources and avoid use of renewable fuel sources. *See id.* at 9. This ongoing reluctance by many utilities to divest from fossil fuels leads to the question of whether an electricity provision framework without utilities or a central grid would be better public policy. *See* Nillesen & Pollitt, *supra* note 3, at 284–86.

[130] *See* ROY L. NERSESIAN, ENERGY ECONOMICS: MARKETS, HISTORY AND POLICY, 37–39 (2016); *see also* J.C. Kibbey, *Utility Accountability 101: How Do Utilities Make Money?*, NAT. RES. DEF. COUNCIL (Jan. 20, 2021), https://www.nrdc.org/bio/jc-kibbey/utility-accountability-101-how-do-utilities-make-money [https://perma.cc/29GZ-HCTB].

[131] *See* J.C. Kibbey, *Utility Accountability 101: How Do Utilities Make Money?*, NAT. RES DEF. COUNCIL (Jan. 20, 2021), https://www.nrdc.org/bio/jc-kibbey/utility-accountability-101-how-do-utilities-make-money [https://perma.cc/29GZ-HCTB].

[132] *Id.*

environmental regulations requiring cleaner electricity generation.[133] Expansion of on-site solar generation can negatively affect both the utility's customer base by removing or reducing those customers' demand for utility generated electricity. More distributed generation of solar electricity also reduces the need for a utility to invest in new or expanded electricity generating and transmitting infrastructure.[134] Therefore, under the traditional rate setting framework, the expansion of distributed solar electricity generation has a negative impact on a utility's profitmaking.[135] Further, if the utility already has high debt loads resulting from previous investments in capital improvements, such as new power plants, the loss of customers and decreases in revenue can adversely impact the utility's ability to repay bonds on those existing capital improvements.[136]

Many states have made regulatory efforts to remove the financial driver for utilities to retain more customers and build more capital improvements. One such effort is known as "decoupling."[137] Decoupling typically separates the utility's profits from its electricity sales.[138] While frameworks for decoupling vary, most are based upon a state-approved revenue structure which the utility can rely upon for its annual profit, regardless of electricity sales.[139] The utility is empowered to make customer rate adjustments, through refunds or surcharges, to match the pre-established revenue structure.[140] Decoupling can render a utility "indifferent to fluctuations in sales, freeing them to run more effective programs that yield deep energy savings."[141]

Another solution is for legislatures to work with the utilities and utility regulators in planning for long-term expansion of on-site solar facilities. This requires a recognition that as more property owners generate their own electricity, there will be less revenue sales to the utility company to invest in capital improvements. However, it also means there will be less demand for utility-generated electricity, and therefore, less need for new capital improvements.[142] This recognition that there is less need to build more power plants is a paradigm shift for utilities, but it is necessary to ensure distributed solar

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133 *See* SIM, *supra* note 113, at 37.

134 *See* Nillesen & Pollitt, *supra* note 3, at 285–86.

135 *See id.* at 284.

136 *See id.* at 286.

137 Simeone, *supra* note 128; Morgan, *supra* note 128.

138 Simeone, *supra* note 128; Morgan, *supra* note 128.

139 Simeone, *supra* note 128; Morgan, *supra* note 128.

140 Simeone, *supra* note 128; Morgan, *supra* note 128.

141 Samantha Williams, *The Evidence Is In: Decoupling Spurs Energy Efficiency Investment*, NAT. RES. DEF. COUNCIL (Apr. 4, 2016), https://www.nrdc.org/bio/samantha-williams/evidence-decoupling-spurs-energy-efficiency-investment [https://perma.cc/FR34-SH8U].

142 Such regulatory planning is already occurring in some American jurisdictions. The State of New York is actively planning and soliciting distributed sources of self-generated energy to meet electricity needs. *See* Nillesen & Pollitt, *supra* note 3, at 285.

can be woven successfully into a community's electricity supply. Utilities which recognize that distributed solar can be a reliable source of electricity generation can be valuable collaborators in the expansion of on-site solar. As discussed in more detail in the next Part, states where the utilities are collaborators in the expansion of distributed solar have had great success in developing the on-site solar energy sector.

IV. STATE CASE STUDIES

Many state and local governments supplement the federal Solar Tax Credit with additional incentives in the form of direct assistance toward installation costs, rebates, state tax breaks, solar tariffs, and other policies. States with more ambitious clean energy goals often have multiple incentive programs to encourage consumer investment in distributed solar. The states leading the effort toward renewable energy are California, Hawaii, Massachusetts, Nevada, New York, Washington, Virginia, Oregon, and Maine, each of which have enacted legislation seeking to achieve 100 percent carbon-free electricity by 2050 or sooner and enacted policies to accelerate growth of distributed solar generation.[143] This Part will explore the successful policies of both Hawaii and California to expand statewide small-scale solar energy usage, along with energy equity policy initiatives used by Illinois to make on-site solar feasible for low income households.

A. Hawaii's Meteoric Increase in Distributed Solar Generation

A leader in renewable energy expansion is the State of Hawaii, which seeks to achieve 100 percent carbon-free electricity by 2045.[144] Due to its reliably sunny climate and desire to limit dependance on foreign energy, distributed solar electricity generation is a significant part of Hawaii's energy strategy.[145] There are some unique features of Hawaii which contribute both to its being a leader in the advancement of on-site solar facilities, as well as

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[143] *What are You Waiting for?*, STATE OF HAW.: CLIMATE CHANGE PORTAL, https://climate.hawaii.gov/hi-mitigation/goals-and-progress/ [https://perma.cc/EV6N-JPMY].

[144] An Act Relating to Renewable Standards, H.B. 623, 2015 Leg., 28th Sess. (Haw. 2015) [hereinafter Act 97]. *See generally* STATE OF HAW.: CLIMATE CHANGE PORTAL, *supra* note 143.

[145] To borrow from author Dan Cross-Call and his colleagues, "[b]y necessity, this report is an incomplete telling of the Hawaii energy story—too many events and untold numbers of individuals and organizations have been instrumental to the unfolding narrative." DAN CROSS-CALL ET AL., POWERING PARADISE: HOW HAWAII IS LEAVING FOSSIL FUELS AND FORGING A PATH TO A 100% CLEAN ENERGY ECONOMY 11 (2020). The pages of this Article devoted to review of Hawaii's (and California's and Illinois') efforts to expand distributed solar facility are not sufficient to provide a fully comprehensive description of the efforts of these states. Rather, it is the author's intent to highlight some of the most significant achievements and hurdles encountered in official efforts to encourage distributed solar so as to provide guidance to future policy makers seeking to imitate the successful endeavors and avoid similar hurdles.

the challenges which have arisen as Hawaiians expanded their use of distributed solar. First, the state is spread across several islands, the largest of which are Hawai'i, Maui, Lanai, Molokai, Oahu, and Kauai.[146] Due to this geographical composition, electricity distribution is allocated amongst four utilities across six independent power grids.[147] These grids are smaller than most utilities grids in mainland American states.[148] As discussed in more detail below, the smaller grid systems initially presented significant hurdles to rapid expansion of distributed solar electricity generation.

Second, the State's geographic composition of islands has rendered it particularly vulnerable to the adverse coastal impacts caused by rising sea levels as warming global temperatures melt icecaps.[149] Hawaii residents and politicians have a very real and immediate interest in slowing the carbon emissions which lead to warming ocean temperatures.[150] This strong political will to divest use of fossil-fuels and rely upon carbon-neutral energy sources has resulted in Hawaiian utilities being more supportive of distributed solar than many mainland utilities.[151]

Third, both the location and isolation of Hawaii have forced it, historically, to be highly dependent upon foreign fuel imports, specifically fossil-fuel imports from Asia, to meets its electricity needs.[152] This led to economic vulnerability, due to having the highest electricity costs in the nation, and energy vulnerability since fuel supply could be disrupted due to foreign affairs or political battles.[153] Thus, Hawaii has had, and continues to have, strong incentives to move quickly toward widespread use of renewable energy

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146 *Id.* at 9.

147 *Id.* at 9, 41; *see also* John Fialka & E&E News, *As Hawaii Aims for 100% Renewable Energy, Other States Watching Closely*, SCI. AM. (Apr. 27, 2018), https://www.scientificamerican.com/article/as-hawaii-aims-for-100-renewable-energy-other-states-watching-closely/ [https://perma.cc/EV9J-LW5L].

148 *See* Groom, *supra* note 86.

149 An Act Relating to Greenhouse Gas Emissions, H.B. 226, 2007 Leg., 24th Sess. (Haw. 2007); CITY AND CNTY. OF HONOLULU CLIMATE CHANGE COMM'N, CLIMATE CHANGE BRIEF (June 5, 2018), https://static1.squarespace.com/static/5e3885654a153a6ef84e6c9c/t/5ef1277ad4a0d82c8ed6afa5/1592862588461/Climate+Change+Brief.pdf [https://perma.cc/UUD8-PCUU] [hereinafter CLIMATE CHANGE BRIEF]; *What We Do*, HAW. STATE ENERGY OFF., https://energy.hawaii.gov/what-we-do/ [https://perma.cc/9JFV-NNSZ]; Nichola Groom, *Clouds over Hawaii's Rooftop Solar Growth Hint at U.S. Battle*, SCI. AM. (Dec. 16, 2013), https://www.scientificamerican.com/article/analysis-clouds-over-hawaiis-roofto/ [https://perma.cc/5VNR-GBD2 [hereinafter Groom II].

150 *See* CLIMATE CHANGE BRIEF, *supra* note 149.

151 Groom II, *supra* note 149.

152 *Id.*; HAW. STATE ENERGY OFF., *supra* note 149.

153 As stated by the Hawaii Legislature in 2009: "Hawaii is the state most dependent on petroleum for its energy needs. It pays the highest electricity prices in the United States, and its gasoline costs are among the highest in the country." An Act Relating to Energy Resources, H.B. 1464, 2009 Leg., 25th Sess. (Haw. 2009) [hereinafter Energy Resources]; *see also* CROSS-CALL ET AL., *supra* note 145, at 10.

sources which can be generated within its own borders. Solar was an obvious source of such domestic electricity generation due to its abundance of year-round sunshine. Hawaii has had great success in expanding use of on-site solar over the last twenty years.[154]

The driving institutional powers behind Hawaii's expanded use of solar generation have been the state's legislature, agencies, and utilities. The legislature has passed multiple acts establishing goals for the expansion of distributed solar as part of its larger goal of achieving a clean energy, carbon negative economy. These legislative goals have been implemented by the Hawaii Public Utilities Commission ("HPUC"), the Hawaii State Energy Office ("Energy Office"), and the Hawaii Green Infrastructure Authority. The PUC is tasked with ensuring "essential utility services are delivered to consumers in a safe, reliable, economical, and environmentally sound manner."[155] Under this scope of authority, the PUC has created numerous programs to encourage distributed solar.[156] The Energy Office "leads statewide energy security and resilience initiatives while catalyzing energy independence and decarbonization."[157] This agency develops programs and policies to encourage statewide transition to clean energy.[158] The Green Infrastructure Authority operates a "green bank" through which the State can assist in financing renewable energy initiatives.[159]

Another powerful force driving distributed solar in Hawaii are its utility companies. Hawaiian Electric Companies ("HECO Companies") own three for-profit utilities in Hawaii: the Hawaii Electric Light Company ("HELCO"), serving the island of Hawai'i; the Maui Electric Company ("MECO"), serving

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[154] BINSHENG LI, STATUS OF RENEWABLE PRIMARY ENERGY AND RENEWABLE ELECTRICITY IN HAWAII, DEP'T OF BUS., ECON. DEV. & TOURISM RSCH. & ECON. ANALYSIS DIV. (2022), https://files.hawaii.gov/dbedt/economic/data_reports/reports-studies/Renewable_Energy_2022_Final.pdf [https://perma.cc/HKH8-AKUC].

[155] *Introduction*, STATE OF HAW. PUB UTILS. COMM'N, https://puc.hawaii.gov/about/introduction/ [https://perma.cc/2HCT-V75B] (Mar. 2023) [hereafter PUC Introduction]. Among other jobs, the PUC regulates almost 2,000 public utilities companies, including approval of rates, tariffs, and fees. *See id.*

[156] *Id.*; *see also* Pub. Util. Comm'n Instituting a Proceeding to Investigate Distributed Energy Resource Policies, No. 2014-0192, Order No. 33258, Haw. Pub. Util. Comm'n, 151, 162, 164–65 (Oct. 12, 2015) [hereinafter Order 33258] (capping NEM and creating new incentives for on-site solar installations, including self-supply, grid-supply, and time-of-use tariffs).

[157] HAWAI'I STATE ENERGY OFF., https://energy.hawaii.gov/ [https://perma.cc/859X-PHSQ]; *see also Energy Efficiency Programs, Rebates, and Solar Initiatives*, HAW. STATE ENERGY OFF., https://energy.hawaii.gov/what-we-do/financial-assistance-and-grants/financial-assistance-resources/energy-efficiency-programs-rebates-and-solar-initiatives/ [https://perma.cc/S3GX-AEEF].

[158] *About HSEO*, HAWAI'I STATE ENERGY OFF., https://energy.hawaii.gov/who-we-are/ [https://perma.cc/BKG8-D5NY].

[159] *About Us*, HAWAI'I GREEN INFRASTRUCTURE AUTH., https://gems.hawaii.gov/about-us/ [https://perma.cc/CNM4-KMJ9].

the islands of Molokai, Lanai, and Maui; and the Hawaiian Electric Company ("HECO"), serving the island of Oahu.[160] A not-for-profit utility cooperative called the Kauai Island Utility Cooperative ("KIUC") operates on the island of Kauai.[161] Beyond just compliance with state directives, state utilities work in conjunction with state agencies to develop programs incentivizing customer use of on-site solar. Such a collaborative effort has had a significant impact on the speed and success of distributed solar programs.

State efforts to expand distributed solar began in 2001 when the Hawaiian Legislature created a Renewable Portfolio Standard ("RPS") which required its utilities to ensure a certain percentage of their electricity supply was generated from renewable sources.[162] The original 2001 legislation had a modest goal that required incremental increases in RPS from 7–9 percent between 2003 and 2010.[163] The legislature also required utilities to create NEM policies for distributed solar generators.[164] The initial NEM credits were generously established at the retail rate in order to stoke interest in rooftop solar.[165]

However, these early renewable energy laws did not remain stagnant, and Hawaii has demonstrated an ongoing flexibility to be responsive in policy and legislation to changing needs and conditions. In 2008, Hawaii and the federal Department of Energy jointly launched the Hawaii Clean Energy Initiative which established a goal that 40 percent of Hawaii's energy would be

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[160] PUC Introduction, *supra* note 155; CROSS-CALL ET AL., *supra* note 145, at 9. Of Hawaii's utilities, HECO on the island of Oahu has the most customers (over 300,000), and the most power demand (approximately 1,200 MW at times of peak demand). *Id.* HECO also has the most on-site customer generated solar, at over 500 MW. *Id.* The HECO companies are sometimes referred to as Hawaiian Electric. *See, e.g.*, *Our History and Timeline*, HAWAIIAN ELEC., https://www.hawaiianelectric.com/about-us/our-history [https://perma.cc/6CBP-2F7K].

[161] CROSS-CALL ET AL., *supra* note 145, at 9.

[162] An Act Relating to Renewable Energy Resources, H.B. 173, 21st Leg. Sess. (Haw. 2001) [hereinafter Hawaii Renewable Energy]; CROSS-CALL ET AL., *supra* note 145, at 9.

[163] Hawaii Renewable Energy, *supra* note 162.

[164] *Id.*

[165] *See id.*; *see also* CROSS-CALL ET AL., *supra* note 145, at 32. Since electricity rates were the highest in the country, such NEM credits were also some of the highest in the country. *See id.*

generated from renewable resources by 2030.[166] Thus, in 2009, the legislature passed Act 155, increasing utilities required RPS to 40 percent by 2030.[167]

By 2011, a solid foundation of financial incentives were available to Hawaii residents interested in installing an on-site solar system, including retail-rate NEM credits, a 35 percent state renewable energy tax credit, a then-30 percent federal investment tax credit, and generally declining commercial costs for on-site PV systems.[168] However, public interest in these incentives had remained low. Then, in 2011, the disaster at the Japanese Fukushima Daiichi nuclear power plant served as an unexpected catalyst for rapid and exponential growth of on-site solar facilities in Hawaii.[169] The disaster in Japan drove imported fuel costs higher and caused Hawaii's already high electricity prices to reach unprecedented levels, encouraging more Hawaiians to self-generate electricity.[170] Within two years, approximately 10 percent of households in Hawaii were operating a rooftop PV system.[171]

Unfortunately, it became apparent that the utility circuits and grid distribution system could not safely or reliably handle such an increase in the amounts distributed power backfed to the system.[172] Yet, Hawaiian utilities had no way to limit the flow of individual PV systems back feeding power, at time up to 200 megawatts, into the central grids.[173] Exacerbating the problem was that the comparatively small grids used on the Hawaiian islands were less able to absorb the additional energy than a larger utility grid.[174]

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[166] Energy Resources, *supra* note 153; *see also* An Act Related to Greenhouse Gas Emissions, H.B. 226, 2007 Leg., 24th Sess. (Haw. 2007) (setting a goal to reduce greenhouse gasses to 1990 levels by 2020). Subsequent Act 32 built upon Hawaii's renewable energy legislation by adding more ambitious carbon-reduction targets inspired by the 2015 U.N. Framework Convention on Climate Change (Paris Agreement). An Act Relating to Climate Change, S.B. 559, 2017 Leg., 29th Sess. (Haw. 2017); *see also* STATE OF HAW.: CLIMATE CHANGE PORTAL, *supra* note 143. In 2022, the legislature unanimously passed House Bill 1800 which set a new goal of achieving a carbon-negative economy by 2045. An Act Relating to Climate Mitigation, H.B. 1800, 2022 Leg., 31st Sess. (Haw. 2022).

[167] Energy Resources, *supra* note 153. Through Act 155, the legislature also set a new energy efficiency goal to reduce electricity use by 4,300 GWh by 2030. *Id.*

[168] CROSS-CALL ET AL., *supra* note 145, at 29.

[169] CROSS-CALL ET AL., *supra* note 145, at 28. In March 2011, a 9.0 earthquake hit Japan and damaged the Fukushima Daiichi nuclear plant to such a risk level that Japan shut down all nuclear power generation. *Id.* To make up the power shortage, Japan increased production from oil-fired power plants which led to massive increases in Japan's oil demand, which in turn, led to dramatically increased worldwide oil prices. *Id.* At that time, petroleum composed 80 percent of Hawaii's electricity generation and as oil prices rose, so did Hawaii's electricity costs—to on average $.037 kWh (three times the national average on the mainland). *Id.* at 29.

[170] CROSS-CALL ET AL., *supra* note 145, at 29.

[171] Order 33258, *supra* note 156, at 7.

[172] Groom II, *supra* note 149.

[173] *Id.*

[174] *Id.*

Although the goal of displacing traditional fossil fuels with renewable fuel sources remained unchanged, it was clear that modifications needed to be made with regard to the speed of installing new distributed PV connections to the grid. Thus, in 2013, the HPCU imposed a cap which restricted permitting of new grid-connected PV systems until grid safety and reliability studies could be completed and any necessary upgrades to the grid could be installed.[175]

Hawaii undertook a study of the best methods to grow on-site solar generation while ensuring a safe and reliable grid. It determined that through modified incentives and requirements for technological changes, it could achieve both goals. First, it was recognized that a significant force in the rapid expansion of distributed solar was highly generous retail-rate NEM credits. It was also recognized that the then-existing NEM structure threatened to increase the costs of electricity to non-solar generating customers and failed to encourage solar customers to invest in on-site battery storage. While the NEM program had "been an extraordinary success" and achieved its goal of rapid expansion of on-site solar installations, it was no longer the best financing tool to drive grid-safe solar generation.

Thus, in 2015, the HPUC terminated the NEM program for new PV connections.[176] The HPUC only maintained limited incentives for new solar installations which would not adversely affect the grids, including expedited permitting for PV systems that would not output to the grid and limited energy credits for customers exporting energy to the grid on an "as needed" basis by the utility.[177] Additionally, the state worked with utilities to use grid planning and inverter technologies to continue to expand distributed solar. "Smart inverters," which allow the utility to adjust output from distributed energy sources, were required for new grid-connected PV systems.[178] Greater

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[175] *Id.*; *see also* Pub. Utils. Comm'n Instituting a Proceeding to Investigate Distributed Energy Resource Policies, No. 2014-0192, Order No. 34924, Haw. Pub. Utils. Comm'n (Oct. 20, 2017); Haw. Elec. Cos. Application for Approval of Demand Response Program Portfolio Tariff Structure, Reporting Schedule, and Cost Recovery of Program Costs Through the Demand Side Mgmt. Surcharge, Docket No. 2015-0412, Application Verification Exhibits A-I (Dec. 30, 2015); *Gridlock by the Power Grid: Why Hawaii's Solar Energy Industry Is at a Crossroads*, PBS NEWSHOUR (Apr. 11, 2015, 11:21 AM), https://www.pbs.org/newshour/show/gridlocked-power-grid-hawaiis-solar-energy-industry-crossroads [https://perma.cc/S4QE-M2LG].

[176] *See, e.g.*, Order 33258, *supra* note 156; CROSS-CALL ET AL., *supra* note 145, at 35. The Hawaii Legislature had previously set a sunset for the original NEM in 2009. Energy Resources, *supra* note 153, at 463 (Providing that "beginning January 1, 2015, electrical energy savings shall not include customer-sited, grid-connected renewable-energy systems . . . ."). At that time, many solar system owners and advocates voiced concerns that the sudden shift in state policy would cause detrimental effects to solar industries. Groom II, *supra* note 149. Indeed, solar installations slowed and some of Hawaii's solar companies folded. CROSS-CALL ET AL., *supra* note 145, at 35.

[177] Order 33258, *supra* note 156.

[178] Fialka & E&E News, *supra* note 147; *Customer Renewable Programs: Customer Energy Resource (CER) Equipment*, HAWAIIAN ELEC., https://www.hawaiianelectric.com/products

incorporation of batteries in on-site systems to keep electricity on-site during peak solar hours was also deemed necessary to prevent grid overload. In addition to modifying incentives and requiring smart inverters, utilities worked with policy makers to make planning decisions anticipating significantly more distributed solar systems as the state moved toward its 100 percent clean energy goal. After using both planning and technology to overcome the mixed-blessing of too much solar electricity being supplied by on-site generators, the state was able to refine and re-initiate on-site solar incentives. In 2015, the Hawaii Legislature took the unprecedented step of increasing the RPS to a goal of 100 percent by 2045.[179]

One of the current incentive programs is the Green Energy Market Securitization Program ("GEM$"), which provides financing for on-site PV systems for owner and tenant-occupied homes, nonprofits, and small businesses.[180] GEM$ is part of Hawaii's initiative to create energy equity for underserved households.[181] Therefore, the residential program is limited to households earning less than 140 percent of the median household income.[182] Both non-property owners and residents with low-credit may take advantage of the program to access the benefits of solar electricity.[183]

GEM$ is overseen by the Hawaii Green Infrastructure Authority ("Authority"), a state-run bank established in 2014 for the purpose of financing renewable energy initiatives.[184] The GEM$ program provides easy financing through: 1) low interest rates, 2) long repayment options (up to twenty years), 3) absence of a down payment requirement, and 4) linking monthly financing bills directly to the utility bill for customer convenience.[185] To benefit the consumer with energy savings and continue to advance Hawaii's goal of clean energy, any solar improvement funded by GEM$ must result in an energy savings of at least 10 percent.[186] Conceptually, monthly energy savings will

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-and-services/customer-renewable-programs/rooftop-solar/customer-energy-resource-(cer)-equipment [https://perma.cc/Z2HK-GUHN].

179 Act 97, *supra* note 144.

180 *Homeowners or Renters*, HAW. GREEN INFRASTRUCTURE AUTH., https://gems.hawaii.gov/participate-now/for-homeowners [https://perma.cc/HC9P-V27U]; *Nonprofit, Small Business, & Commercial Tenant*, HAW. GREEN INFRASTRUCTURE AUTH., https://gems.hawaii.gov/participate-now/gems-inquiry-form-nonprofit/ [https://perma.cc/B639-TZST]. The commercial financing element of the program is aided by Commercial Property Assessed Financing ("C-Pace") administered by the Authority. *Financing Navigator: Commercial Property Assessed Clean Energy*, U.S. DEP'T OF ENERGY, https://betterbuildingssolutioncenter.energy.gov/financing-navigator [https://perma.cc/4TQT-UJ2J].

181 *Homeowners or Renters*, *supra* note 180.

182 *Id.*

183 *Id.*

184 *About Us*, *supra* note 159.

185 *Solar Power for All*, HAW. GREEN INFRASTRUCTURE AUTH., https://gems.hawaii.gov/wp-content/uploads/2020/09/HGIA-GEM-On-Bill-Payment-Program-Handout-Consumer_Final.pdf [https://perma.cc/AEM6-CTQY].

186 *Id.*; *Homeowners or Renters*, *supra* note 180.

then be used to repay the GEM$ loan.[187] Since the financing bill is incorporated into the monthly electric bill, any monthly savings from the solar system can be automatically applied to the monthly financing.[188] Thus, in an ideal model, the GEM$ customer will have zero out-of-pocket costs for their new solar system.

The GEM$ program is wide-ranging in regard to what type of solar systems may be financed, including entire-building systems, water heater-only systems, and heat pump-only systems.[189] However, to ensure reputable installation and quality solar improvements, any system must be an authority-approved model and must be installed by authority-approved contractors.[190]

In addition to the GEM$ program, Hawaii has made community solar available to residents and businesses of all income levels.[191] The Community-Based Renewable Energy program ("CBRE") allows utility subscribers to participate in an off-site solar array.[192] Under this program, interested solar businesses can propose a solar array, which if approved, are authorized to sell solar electricity to the local utility.[193] Subscribers can lease or purchase shares of the solar array and receive a credit on their utility bill for their share of the solar electricity which the array sold to the utility.[194]

In 2017, the HPUC created two successful programs to incentivize residential solar systems with batteries included.[195] The first program, deemed a "Smart Export" program, allowed customers to sell their battery-stored solar power back to the utility during non-daylight hours under a new NEM credit system.[196] This program is targeted to encourage installation of on-site solar systems with batteries due to the high NEM credits customers can earn by saving energy on-site and then back feeding it to the grid in the evening. Such on-site battery storage helps to limit how much solar electricity is output to the grid during daylight hours. Customers who participate in the Smart

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187 *Solar Power for All*, *supra* note 185.

188 *Id.*

189 *Id.*

190 *Homeowners or Renters*, *supra* note 180.

191 A Bill for an Act Relating to Energy, S.B. 1050, 28th Leg. Sess. (2015); *Community-Based Renewable Energy*, HAWAI'I STATE ENERGY OFF., https://energy.hawaii.gov/get-engaged/community-based-renewable-energy/ [https://perma.cc/Y38Y-6973].

192 CROSS-CALL ET AL., *supra* note 145, at 39.

193 *Community-Based Renewable Energy*, *supra* note 191. The approval process and approving entity vary depending on the size of the solar array. *Id.*

194 *Id.*

195 Press Release, Public Utilities Commission, HPUC Expands Options for Customers to Install Rooftop Solar and Energy Storage (Oct. 20, 2017) (on file with Nevada Law Journal) [hereinafter Energy Storage].

196 *Id.* Customer credits under the Smart Export program were $0.15 in O'ahu, $0.11 in Hawai'i Island, $0.14 in Maui, $0.17 in Moloka'i, and $0.21 in Lana'i. *Id.*

Export programs must use smart inverter technology in order to allow the utilities to control when the solar electricity is backfed to the grid.[197]

The HPUC also revamped the previous NEM "Customer Grid Supply" program into the "Controllable CGS" program to better regulate distributed solar electricity output to the grid during daylight hours.[198] Like the popular Customer Grid Supply program, on-site solar generators can export energy to the central utility grid during daylight hours through another new NEM credit.[199] However, this credit for electricity exported during daylight hours is set to the lesser amount of the utility's avoided costs.[200] Thus, the program includes a financial incentive to install an on-site PV system, but even more incentive to include a battery for daytime storage in order to hold electricity for sale during the more lucrative evening hours. In order to participate in the Controllable CGS program, customers must agree to utilize smart inverters, allowing the utility to manage the backfeed in order to protect the grid from too much current. [201]

Through collaborative planning with the HPUC, which included decoupling in 2008, Hawaiian Electric has been able to close fossil-fuel burning power plants as more electricity demand can be met by distributed solar and other clean fuels.[202] The oil-firing Honolulu Power Plant was deactivated in 2014 and replaced by a combination of utility generated solar, wind, and biofuel, as well as distributed solar.[203] In 2022, the state's last coal-fired power plant was closed on the island of Oahu.[204] This plant had previously powered approximately 20 percent of the island's electricity.[205] HECO opted to rely upon the growing use of distributed solar rather than build a new fossil-fuel

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197 *Id.*; CROSS-CALL ET AL., *supra* note 145, at 38.

198 Energy Storage, *supra* note 195.

199 *Id.*

200 *Id.* Customer credits under the Controllable CGS program were $0.10 in O'ahu, $0.11 in Hawai'i Island, $0.12 in Maui, $0.17 in Moloka'i, and $0.21 in Lana`i. *Id.*

201 *Id.*

202 Pub. Utils. Comm'n Instituting a Proceeding to Investigate Distributed Energy Resource Policies, No. 2008-0274, Final Decision and Order (Aug. 31, 2010). The decoupling was the result of an agreement between the HECO companies and various state agencies. Pub. Utils. Comm'n Instituting a Proceeding to Investigate Distributed Energy Resource Policies, No. 2013-0141, Order No. 31289 (May 31, 2013).

203 *Hawaiian Electric to Deactivate Honolulu Power Plant*, HAW. NEWS NOW (Sept. 3, 2013, 8:36 PM), https://www.hawaiinewsnow.com/story/23330542/hawaiian-electric-to-deactivate-honolulu-power-plant/ [https://perma.cc/R7WT-5873]. "Deactivation" of a power plant indicates that it is removed from routine use but may be activated if needed to avoid a power shortage. *Id.* "Retirement" or "decommission" indicates a permanent closure of the plant. *Id.*

204 Zoe Sottile, *Hawaii Receives Its Last Shipment of Coal Before Shuttering Last Power Plant*, CNN (July 30, 2022, 4:37 PM), https://www.cnn.com/2022/07/30/us/hawaii-last-coal-shipment-trnd/index.html [https://perma.cc/36L9-BBFS].

205 Stewart Yerton, *Thousands of New Rooftop Solar Systems Could Be Going Up on Oahu*, HONOLULU CIV. BEAT (July 2, 2021), https://www.civilbeat.org/2021/07/thousands-of-new-rooftop-solar-systems-could-be-going-up-on-oahu/ [https://perma.cc/JZ38-PNQG].

plant. To aid in the transition from coal to solar fuel, the utility offered residential rooftop solar generators payment for installation of new batteries on new or existing solar systems, provided that the stored power could be accessed by the utility during peak evening hours.[206] Payment for installation of the battery or batteries would be made at the start of the contract and would represent the anticipated value of electricity to be backfed to the utility over a period of ten years.[207] In anticipation of high numbers of permitting applications for new solar batteries, the utility also worked with the local building department to ensure there would be sufficient staffing to quickly process the on-site battery permits.[208] HECO also has plans to convert the six oil-fired generators of the Waiau Power Plant on O'ahu into a renewable energy power plant, likely fueled by biodiesel and hydrogen.[209]

The Kaua'i Island Cooperative ("KIUC") has two programs which continue to encourage on-site solar but in a manner which protects the safety and reliability of the grid. The "Right-Sized Program" encourages property owners to limit the size of their onsite PV system to the size needed to power that building.[210] PV systems which exceed the KIUC measurements for a right sized system are considered to be energy exporting systems and will be required to install a second meter, referred to as a curtailment meter, which enables the utility to limit output of electricity from the on-site system.[211] When the curtailment meter is shut off by the utility, it also shuts off PV generated electricity to the on-site building, requiring the building to draw electricity from the utility.[212] Such loss of the revenue from selling output, and cost of utilizing utility-supplied electricity (as well as the costs of installation of the curtailment meter), can serve as a deterrent to installation of a

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206 *Id.*

207 *Id.* By official estimate, the average ten-year upfront payment to participating consumers would be $4,250. *See id.*

208 *Id.*

209 *Hawaiian Electric Proposes to Repower Waiau Power Plant*, HAWAIIAN ELEC. (May 18, 2023), https://www.hawaiianelectric.com/hawaiian-electric-proposes-to-repower-waiau-power-plant [https://perma.cc/QY7D-CGVR]; *Oil to Renewables: Hawaii Utility Aims to Transform 85-Year-Old Power Plant*, ASSOC. PRESS (May 19, 2023, 1:01 PM), https://apnews.com/article/hawaiian-electric-renewable-energy-17f1825052582436329e94b34cf52cc9 [https://perma.cc/S64M-Z4Y5].

210 CROSS-CALL ET AL., *supra* note 145, at 40.

211 *Options for Sizing Rooftop Solar*, KAUA'I ISLAND UTIL. COOP., https://kiuc.coop/sites/default/files/documents/RightSizingOptions.pdf [https://perma.cc/DB23-5WPD]. KIUC provides quantitative standards for the "right size" for PV systems. For example, a building which will have an average monthly electricity usage of less than 500kWh should be no larger than 2.5 KW while a building which will have an average monthly electricity usage of 1100-1200 kWh should be no larger than 4.25 KW. *Id.* KIUC does offer credits for backfed electricity from small-scale solar facilities, as set forth in "Schedule Q" of the program. David Bissell, Kaua'i Island Util. Coop., No. 8332, Schedule "Q" Modified (2012); CROSS-CALL ET AL., *supra* note 145, at 40.

212 *Id.*

larger-than-needed PV system.[213] KIUC does allow split systems in which on-site generated electricity can continue to power the building even if the utility shuts down output to the grid.[214] However, this duel system adds to the cost of PV installation. These HECO and KIUC programs demonstrate that utilities can collaborate with government officials and customers to expand use of distributed solar electricity generation.

Hawaii continues to be a leader in the movement toward a clean economy and lifestyle devoid of reliance on fossil fuels. In April of 2023, small-scale distributed solar in Hawaii accounted for 76,000 MWh of electricity generation within the state—within the top 20 percent of U.S. states.[215] This statistic is particularly impressive when viewed with the understanding that Hawaii falls within the lowest 10 percent of states in terms of population.[216] Clearly, Hawaii's laws and policies to encourage distributed solar have been highly successful in moving the state toward 100 percent clean energy, serving as a model for other communities interested in stimulating on-site solar generation.

B. California's Success in Widespread Distributed Solar

Like Hawaii, California has established highly ambitious goals for conversion from fossil-fuels to renewable energy sources.[217] And like Hawaii, a significant part of California's plan is to encourage use of on-site solar generation.[218] As a result of its efforts, in 2022 California generated the highest amount of distributed solar electricity in the U.S.—over fourteen thousand megawatts.[219] The California legislature began encouraging use of solar power fifty years ago and has experimented with many programs to encourage use of on-site solar over the decades.[220] Under direction from the California

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[213] *Id.*

[214] *Id.*

[215] U.S. ENERGY INFO. ADMIN., ELECTRIC POWER MONTHLY (2023).

[216] *See* U.S. CENSUS BUREAU, ANNUAL ESTIMATES OF THE RESIDENT POPULATION FOR THE UNITED STATES, REGIONS, STATES, DISTRICT OF COLUMBIA AND PUERTO RICO: APRIL 1, 2020 TO JULY 1, 2023 (2023).

[217] S.B. 100, 2018 Leg. (Cal. 2018); *see also* Turchetti, *supra* note 11, at 411. Senate Bill 100 increased the state's clean energy goals to a 60 percent target by December 31, 2030, and to a 100 percent target by 2045. S.B. 100, 2018 Leg. (Cal. 2018).

[218] *California Solar Initiative (CSI)*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/california-solar-initiative [https://perma.cc/XEY2-AFFS].

[219] *Solar Explained: Where Solar Is Found and Used*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/solar/where-solar-is-found.php [https://perma.cc/NQ38-7YX2] (indicating in the table titled "[s]mall-scale solar photovoltaic electricity generation by state, 2022" that California generated more than 10 billion kilowatthours of solar electricity); *California Leads the Nation in Distributed Generation*, CAL. DISTRIB. GENERATION STATS., https://www.californiadgstats.ca.gov [https://perma.cc/96G6-LDC3].

[220] *See About*, CAL. ENERGY COMM'N, https://www.energy.ca.gov/about [https://perma.cc/3KSQ-TTTR]; *see also* Turchetti, *supra* note 11.

Legislature, two state agencies have primary responsibility for implementation of small-scale solar development: the California Public Utilities Commission ("CPUC"), an agency which regulates privately-owned electric utilities, and the California Energy Commission ("Energy Commission"), the agency tasked with advancing the state's climate and clean energy goals.[221] Among its initiatives, the Energy Commission maintains an Integrated Energy Policy Report which reflects the state's current and ten-year future energy needs for purposes of data-driven energy planning and collaboration with other state agencies, federal agencies, and utilities.[222]

The Energy Commission created a Renewable Portfolio Standard ("RPS") to implement California's legislative directives, which is promoted as "one of California's key programs for advancing renewable energy."[223] Under the RPS, all "load-serving entities," meaning public or private entities which sell electricity, are required to procure a certain amount of their electricity from renewable energy sources which have been certified by the state.[224] At present, the RPS requires load-serving entities to procure at least 50 percent of their electricity from renewable energy sources by 2030, and further that all retail sales of electricity be 100 percent from renewable energy sources by 2045.[225] Failure to properly report or failure meet the RPS requirements can result in enforcement actions and penalties.[226] The effect of this rule is that electricity providers must constantly procure a certain amount of renewable electricity and must plan to incorporate greater amounts of renewable electricity in the future. This obviously incentivizes utilities to plan for greater

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[221] *About the California Public Utilities Commission (CPUC)*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/about-cpuc/cpuc-overview/about-us [https://perma.cc/R9SV-UWRB] [hereinafter CPUC]; *Core Responsibility Fact Sheets*, CAL. ENERGY COMM'N, https://www.energy.ca.gov/about/core-responsibility-fact-sheets [https://perma.cc/MU9T-DXKG] [hereinafter CEC]. Both agencies have responsibilities beyond development of solar initiatives: the CPUC also regulates natural gas, telecommunications, water resources, railroads, rail transit, and other passenger transportation, while the Energy Commission has a broad focus on many types of renewable energy fuels, energy efficiency measures, grid infrastructure, and emergency planning. CPUC, *supra*; CEC, *supra*.

[222] *Advancing State Energy Policy*, CAL. ENERGY COMM'N, https://www.energy.ca.gov/about/core-responsibility-fact-sheets/advancing-state-energy-policy [https://perma.cc/6CQV-CUYR].

[223] *Renewables Portfolio Standard - RPS*, CAL. ENERGY COMM'N, https://www.energy.ca.gov/programs-and-topics/programs/renewables-portfolio-standard [https://perma.cc/KRM8-FU3T] [hereinafter RPS]. The RPS was initially created under S.B. 1078, 2002 Leg., Reg. Sess. (Cal. 2002) and amended multiple times: S.B. 1038, 2002 Leg., Reg. Sess. (Cal. 2002); S.B. 1250, 2006 Leg., Reg. Sess. (Cal. 2006); S.B. 107, 2006 Leg., Reg. Sess. (Cal. 2006); S.B. X1-2, 2011 Leg., Spec. Sess. (Cal. 2011); S.B. 350, 2015 Leg., Reg. Sess. (Cal. 2015); S.B. 1393, 2016 Leg., Reg. Sess. (Cal. 2016).

[224] RPS, *supra* note 223.

[225] EDMUND G. BROWN JR., CAL. ENERGY COMM'N, RENEWABLES PORTFOLIO STANDARD ELIGIBILITY vi (9th ed. 2017) [hereinafter 2017 Guidebook]; *see also* RPS, *supra* note 223; S.B. 100, 2018 Leg., Reg. Sess. (Cal. 2018).

[226] *See generally* CAL. CODE REGS. tit. 20, §§ 3200–3206 (2021).

use of large and small-scale renewable energy sources and disincentives planning for continued or expanded reliance on fossil fuel electricity sources.

Unsurprisingly, solar energy is an approved energy resource that load-serving entities may use to meet their RPS requirements.[227] Any solar "facility may qualify for RPS certification if it generates electricity using either a photovoltaic or solar thermal process to produce electricity."[228] This simplicity of approval renders the purchase of on-site PV generated electricity attractive to utilities.

The HPUC and Energy Commission work collaboratively to implement the RPS and both agencies rely on a variety of solar electricity programs and policies to ensure success of the RPS. The Energy Commission promotes PV installations through required Building Energy Efficiency Standards.[229] For example, under these standards, the majority of new single-family homes, multifamily buildings, hotels, and less-than-four story non-residential buildings must be constructed to include a "solar zone."[230] A solar zone is an area of the building designed and set-aside for installation of on-site solar generation infrastructure, providing sufficient access, space and ventilation.[231]

As California began its initiative to encourage private solar electricity generation, it provided direct incentives for purchase and installation of such systems, significantly impacting the successful deployment of PV generation in California. In 2007, the state launched the California Solar Initiative ("CSI").[232] This initiative, with a total allocation of state funding which eventually reached $1.947 billion, required utilities to make direct payments to customers who installed new PV generation for on-site use.[233] Its goal was to incentivize installation of 1,750 MW of small-scale solar generated power.[234] The general CSI program closed to new applications in 2016 upon a determination that reduced costs for PV systems rendered further direct incentives unnecessary.[235] However, specific CSI programs, such as incentives for solar contractors and affordable housing PV installations, remain in effect and are discussed in greater detail below.

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227 RPS, *supra* note 223; 2017 Guidebook, *supra* note 225, at 4.

228 RPS, *supra* note 223; 2017 Guidebook, *supra* note 225, at 21.

229 *Solar Energy*, CAL. ENERGY COMM'N, https://www.energy.ca.gov/programs-and-topics/topics/renewable-energy/solar-energy [https://perma.cc/FL2V-WSAR].

230 EDMUND G. BROWN JR., CAL. ENERGY COMM'N, 2019 BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS § 110.10 (2018).

231 *Id.*

232 *About the California Solar Initiative*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/-/media/cpuc-website/about-cpuc/documents/transparency-and-reporting/fact_sheets/csifactsheet_v4.pdf [https://perma.cc/S668-4GE5].

233 S.B. 1, 2006 Leg. (Cal. 2006). Legislation required such payment to be at least $2.80 per installed watt, with a pre-set decrease each year. *Id.*

234 *California Solar Initiative (CSI)*, *supra* note 218.

235 *Id.*

Although most of California's direct payments for new system installations have ended, the state continues to use NEM programs to provide ongoing solar generation incentives. Since 1995, the CPUC has allowed customers with on-site solar generation to fuel their own property with solar generated electricity and receive a NEM credit for surplus electricity backfed to the local utility.[236] The NEM is set at a generous retail rate and includes both a monthly credit and an end-of-year "true up" for a "net surplus compensation."[237]

Like Hawaii, California has modified its NEM program, as necessary, to meet changing needs for distributed solar generation. In 2016, the CPUC adopted "NEM2," requiring utilities to adopt the new NEM program for new on-site solar generators when its NEM generating capacity exceeded the aggregate peak electricity demand by 5 percent.[238] NEM2 still rendered on-site solar generator financially beneficial by continuing to allow retail credits.[239] However, NEM2 refined the program by instituting "time-of-use" utility rates to encourage use of self-generated power and energy conservation during the day.[240] NEM2 also imposed certain utility charges on self-generating utility customers in an attempt to balance costs with non-generating utility customers.[241] PV system owners under the original NEM had the option to remain on their original NEM terms for twenty years or switch to NEM2.[242] As a result of the NEM programs, by the start of 2020, over 1 million California distributed solar generators were connected to the state's grid.[243]

At the end of 2022, the CPUC again revised its tariff program by replacing NEM with a "Net Billing Tariff" ("NBT") for new solar generators connecting to the grid.[244] The NBT is designed to credit distributed solar at "a rate

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[236] VERDANT ASSOCIATES, LLC, NET-ENERGY METERING 2.0 LOOKBACK STUDY 1 (2021) [hereinafter LOOKBACK STUDY]; *Customer-Sited Renewable Energy Generation*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/customer-generation [https://perma.cc/TR7C-GPWV] [hereinafter California Renewable Energy].

[237] California Renewable Energy, *supra* note 236; Ord. Instituting Rulemaking to Dev. a Successor to Existing Net Energy Metering Tariffs Pursuant to Public Utils. Code Section 2827.1, and to Address Other Issues Related to Net Energy Metering, Decision 16-01-044, Pub. Utils. Comm'n Cal. (2016) [hereinafter Decision 16-01-044].

[238] Assemb. B. 327, 2013–14 Leg., Reg. Sess. (Cal. 2013); Decision 16-01-044, *supra* note 237; California Renewable Energy, *supra* note 236. Major California utilities have all reached this threshold and switched to NEM2. LOOKBACK STUDY, *supra* note 236, at 15.

[239] LOOKBACK STUDY, *supra* note 236, at 2.

[240] *Id.*; *Electric Rates*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-rates [https://perma.cc/BN5H-YMYH].

[241] LOOKBACK STUDY, *supra* note 236, at 42–43.

[242] California Renewable Energy, *supra* note 236.

[243] LOOKBACK STUDY, *supra* note 236, at 2–3. Approximately 60 percent of these systems were installed under the original NEM and 40 percent during NEM 2.0. *Id.* at 3.

[244] Ord. Instituting Rulemaking to Revisit Net Energy Metering Tariffs Pursuant to Decision 16-01-044, and to Address Other Issues Related to Net Energy Metering, Decision Revising Net Energy Metering Tariff and Subtariffs, Rulemaking 20-08-020, Decision 22-12-056, Pub. Utils. Comm'n Cal. (Dec. 15, 2022). An electricity tariff is a rate schedule,

reflecting the value of this generation to the grid."[245] Like Hawaii's Controllable CGS crediting system, California's NBT credit is set to the lesser amount of the utility's avoided costs during daylight hours. However, the NBT allows a higher credit during evening hours when there is less solar electricity being generated but high electricity demand.[246] The NBT tariff provides multiple benefits for California. First, it encourages expanded use of on-site battery storage since on-site generators will be paid significantly more per kilowatt-hour during evening hours than daylight hours.[247] Second, it enhances grid reliability by reducing strain from too much current during peak solar-generating hours as more on-site generators are incentivized to hold their electricity on-site until the evening. Third, it increases utilities' ability to draw on solar generated power during non-daylight hours since more of such energy will be available from storage batteries. Finally, the NBT tariff helps utilities avoid overpayment for solar electricity during daylight hours, saving money for the utilities and the non-solar generating customers.[248] However, observers anticipate that the revised incentives will slow the rate at which PV system owners reap a return on their investment from savings in their utility bill from a four to six year period, to a nine year period.[249] Environmental critics claim that this longer period to earn a return on investment will slow growth of the solar market.[250]

In addition to incentivizing property owners, California has an incentive program for homebuilders called the New Solar Homes Partnership ("NSHP").[251] This program was started in 2007 by the Energy Commission as part of the CSI to encourage developers and contractors to construct energy-efficient and solar-powered homes.[252] Incentives under the NSHP are in the form of rebates based on the expected energy performance of the system, taking into account both specifications of the PV system and building efficiency

along with any terms and conditions, for the provision of specified electricity service. *See Community-Based Renewable Energy*, *supra* note 191. To encourage property owners to install solar generation in the near future, the benefits of the NBT tariff are only available to those who sign up in the next five years. *CPUC Modernizes Solar Tariff to Support Reliability and Decarbonization*, CAL. PUB. UTILS. COMM'N (Dec. 15, 2022), https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-modernizes-solar-tariff-to-support-reliability-and-decarbonization [https://perma.cc/QC7Y-QSZK].

245 California Renewable Energy, *supra* note 236.

246 *Id.*

247 Roth, *supra* note 64. Only 14 percent of on-site solar systems in California were installed with batteries. *See* Roth, *supra* note 43.

248 California Renewable Energy, *supra* note 236; Roth, *supra* note 43.

249 Roth, *supra* note 64.

250 *Id.*

251 SAMANTHA DONALDS, CAL. ENERGY COMM'N, THE CALIFORNIA ENERGY COMMISSION'S NEW SOLAR HOMES PARTNERSHIP PROGRAM CASE STUDY: PROMOTING GREENER, BETTER HOUSING IN CALIFORNIA (2015), https://www.energy.ca.gov/sites/default/files/2021-06/CEC-300-2015-002.pdf [https://perma.cc/W9C7-5CCF].

252 *Id.* at 1.

measures, as well as affordability of the home.[253] By 2015, the NSHP incentivized nearly 25,000 new homes with installed total solar capacity.[254]

These programs have had a dramatic effect on the deployment of on-site small-scale solar facilities and solar electricity generation in California. By the end of 2022, California rooftop solar generated approximately 13,500 megawatts—the equivalent of two large coal burning power plants.[255] From a consumer perspective, California's efforts have also reduced the average cost of a watt of electricity from approximately $12 to $5 between 2007 and 2015.[256] California's solar policies and programs serve as a valuable model for other states seeking to expand their distributed solar facilities and reduce consumer costs.

C. California's Efforts Toward Creating Energy Equity

In addition to its general objective to increase use of renewable energy, in 2013, the California Legislature directed the CPUC to take steps to render on-site solar installations more affordable for lower-income households and all customers "in disadvantaged communities."[257]

One such initiative is the 2013 Green Tariff/Shared Renewables ("GTSR") program intended to make solar electricity available "to all ratepayers who are currently unable to access the benefits of onsite generation."[258] The Enhanced Community Renewables ("ERC") component of the GTRS led the state's first community solar initiative in 2016, which allows renters and lower-income residents to purchase electricity from offsite solar arrays for a savings on their electricity bill.[259] The CSGT uses "green tariffs" to provide participating customers a 20 percent discount on their utility bill.[260] In addition to electricity savings, customers were able to be part of the movement

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[253] *Id.* at 3, 13. Rebates ranged based upon the year the house was constructed, the type of housing, and other facts. *Id.* at 13. Generally, rebates ranged from $2.05 to $3.10 per watt. *Id.* at 13, 15.

[254] *Id.* at 2.

[255] *See* Roth, *supra* note 43; *How Is Electricity Measured?*, UNION OF CONCERNED SCIENTISTS, https://www.ucsusa.org/resources/how-electricity-measured [https://perma.cc/HQH7-YXFH] (Oct. 22, 2013).

[256] *California Distributed Generation Statistics: Cost Per Watt*, CAL. ENERGY COMM'N, https://www.californiadgstats.ca.gov/charts/csi/. More recent data has not been published.

[257] *See* DeVar, *supra* note 8, at 1032 (quoting CAL. PUB. UTIL. CODE § 2827.1(b)(1)); Roth, *supra* note 64.

[258] Electricity: Green Tariff Shared Renewables Program, S.B. 43 § 1(b), 2013–14 Leg., Reg. Sess. (Cal. 2013).

[259] *Green Tariff/Shared Renewables Program (GTSR)*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-rates/green-tariff-shared-renewables-program [https://perma.cc/J7SC-J84V]; *see also* DeVar, *supra* note 8, at 1032, 1036. The ERC is not limited to low-income residents. It is available to any residents who cannot, due to cost or location, install on-site solar panels. *Id.*

[260] *See* DeVar, *supra* note 8, at 1036.

toward cleaner air and lower carbon footprint, without the need for property ownership or expense and maintenance of an on-site PV system.

The NTB program also incorporated a more financially lucrative option for qualifying lower-income households in which the credit for on-site solar-generated electricity was nearly double the per kilowatt-hour payment than other NTB customers.[261] This higher rate of compensation for backfed solar electricity enables lower-income households to regain a full return on their solar infrastructure investment in approximately five to six years (rather than the nine to eleven years anticipated for other NTB customers).[262]

To aid low-income single-family homeowners in solar installations, the CPUC also established the Single-Family Affordable Solar Homes Program ("SASH"), which operated from 2017 to 2021.[263] SASH provided assistance in the form of upfront payments from the utility to cover up to the full installation cost of an on-site PV system for low-income households (defined as 80 percent or less of the area median income and residing in a defined "affordable housing").[264] The program was so popular that its original sunset date of 2015 was extended until 2021 and it eventually provided funding to nearly 10,000 low-income households for installation of on-site solar systems.[265]

The SASH program was superseded by the Disadvantaged Communities-Single-Family Solar Homes ("DAC-SASH") program, established by the CPUC in 2018.[266] While the DAC-SASH was modeled after the SASH program, rather than incentives based solely upon an individual household's income, the DAC-SASH provides funding to households with low incomes only

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[261] Roth, *supra* note 64.

[262] The incentive structure for lower income households is complex and based upon factors such as income, location, and utility provider. For some low-income customers already paying lower electricity rates under benefit programs established by their utility, there will not be as much incentives under the new rule. *See* Roth, *supra* note 43. Recent studies indicate that in 2021, only 12 percent of new on-site solar installations were for households with incomes less than $50.000. *See id.*

[263] *CSI Single-Family Affordable Solar Homes (SASH) Program - Closed*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/california-solar-initiative/csi-single-family-affordable-solar-homes-program [https://perma.cc/8ZS9-MHLW]; Ord. Instituting Rulemaking Regarding Policies, Procs. and Rules for the Cal. Solar Initiative, the Self-Generation Incentive Program and Other Distributed Generation Issues, Decision Modifying Decision 07-11-045 Regarding Low Income Single Fam. Solar Incentive Program Within the Cal. Solar Initiative, Decision 09-03-034, Pub. Utils. Comm'n Cal. (Mar. 27, 2009).

[264] Incentive payments were based upon three dollars per watt and could not exceed the entire cost of system installation. CAL. PUB. UTILS. COMM'N, (SASH) 2.0 PROGRAM HANDBOOK APPENDIX D: SINGLE-FAMILY AFFORDABLE SOLAR HOMES 2, 7–8 (2013).

[265] *SASH*, GRID ALTS., https://gridalternatives.org/what-we-do/program-administration/sash [https://perma.cc/968N-3WH2].

[266] *Solar in Disadvantaged Communities*, CAL. PUB. UTILS. COMM'N, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/solar-in-disadvantaged-communities [https://perma.cc/E55G-H69B].

in certain "disadvantaged communities."[267] Designation as a disadvantaged community is based on a matrix of factors, including "geographic, socioeconomic, public health, and environmental hazard criteria."[268]

California has also developed incentives for on-site solar installations on multi-family affordable housing projects through the Solar on Multifamily Affordable Housing program ("SOMAH").[269] SOMAH has a goal of 300 MW of solar installations by 2030 and a budget of up to $1 billion to achieve that goal.[270] "SOMAH provides fixed, upfront, capacity-based incentives for qualifying solar [energy] systems," which are available to multi-family housing owners, tenants and solar installers.[271] Multifamily affordable housing owners must qualify under several criteria, particularly that the housing is deed-restricted to low-income occupants and that either a) 80 percent of the residents have incomes 60 percent or less of the area median income or b) the housing is within a "disadvantaged community," as defined by law.[272] Further, at least 51 percent of the solar system's electric output must directly offset tenant load. Owners who qualify for this program receive free technical assistance, including referrals to eligible solar installers, assistance with sizing and financial estimates, and feasibility evaluations.[273]

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[267] *Solar in Disadvantaged Communities*, *supra* note 266.

[268] California Global Warming Solutions Act of 2006: Greenhouse Gas Reduction Fund, S.B. 535, 2011–12 Leg. Sess. (Cal. 2012); *SB 535 Disadvantaged Communities List (2022)*, CAL. OFF. ENV'T HEALTH HAZARD ASSESSMENT, https://oehha.ca.gov/calenviroscreen/sb535 [https://perma.cc/7TEE-QP8Q]. The criterion is more highly specified in the states' "Data Dictionary" which includes consideration of factors such as a community's ozone concentration; air particulate pollution; diesel emissions; drinking water particulates; potential for exposure to lead, pesticides, and other toxins; traffic density; health concerns such as asthma, low birth weight, cardiovascular disease; education levels; English proficiency levels; poverty levels, and unemployment levels. *Id.*

[269] CAL. PUB. UTILS. COMM'N, SOMAH PROGRAM HANDBOOK 12 (2023) [hereinafter SOMAH PROGRAM HANDBOOK]. California's earlier Multi-family Affordable Solar Housing program ("MASH"), created in 2008, has reached capacity and is closed to new applications. SOMAH is the successor to MASH. SB 92, adopted with the 2017–18 State Budget, further clarified program funding. Decision 17-12-022 (December 14, 2017) implemented AB 693 and changed the name of the program to the Solar on Multifamily Affordable Housing ("SOMAH") to distinguish it from other state clean energy and low-income solar programs. *California Distributed Generation Programs*, CAL. DISTRIBUTED GENERATION STAT., https://www.californiadgstats.ca.gov/programs/ [https://perma.cc/EVS2-G8UE].

[270] SOMAH PROGRAM HANDBOOK, *supra* note 269, at 12.

[271] *Cost and* Savings, SOMAH, https://calsomah.org/start-your-application [https://perma.cc/MQ53-GQN8]. The SOMAH program has reduced the cost of multi-family on-site solar installations for affordable housing project dramatically. In 2023, the average cost of such system was over $200,000 but reduced to approximately $10,000 once SOMAH incentives were incorporated. CALIFORNIA DISTRIBUTED GENERATION STATISTICS, STATISTICS AND CHARTS: SOMAH AVERAGE PROJECT COST BEFORE AND AFTER INCENTIVES, https://www.californiadgstats.ca.gov/charts/somah/ [https://perma.cc/4W9D-CHSP].

[272] *Program Overview & Requirements*, SOMAH, https://calsomah.org/program-overview-requirements [https://perma.cc/M7PY-QLSM].

[273] SOMAH PROGRAM HANDBOOK, *supra* note 269.

Tenants can also receive direct financial benefits from the SOMAH Program if their building has qualified for it. Tenants benefit from lower energy bills and opportunities for solar job training, both with no out-of-pocket costs.[274]

Distributed solar has immense benefits for local communities but it is unavoidable that the cost of a total residential PV system remains beyond the financial reach of lower-income households. To ensure energy equity and the full community benefits of distributed solar, governments must provide financial assistance and expert guidance to lower income households and communities.

D. Illinois' Efforts to Ensure Solar Energy Equity

There are several states with programs designed to foster energy equity by making on-site PV installations affordable to lower-income homeowners and tenants. Amongst such states, Illinois stands out for incentivizing multiple parties: property owners, tenants, non-profits and contractors, to work together to provide solar electricity in lower-income households and communities. The program, called "Solar for All," includes detailed parameters to ensure all parties are protected while working toward the state's energy equity objective.

The Solar for All program was created through state legislation in 2016 and launched by the Illinois Power Agency in 2017 to bring on-site PV systems to low-income communities.[275] The program provides financing for owners of residential properties occupied by households with incomes 80 percent or less of the area median income to install PV systems and to be guaranteed a certain amount of electricity credit from the system, with little to no upfront costs.[276] The program extends this benefit to owner-occupied housing, tenant-occupied housing, and residential non-profits and public facilities.[277] There is not a minimum or maximum number of units required to participate, although multifamily properties must have at least half of the units

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[274] *Tenants*, SOMAH, https://calsomah.org/tenant-benefits# [https://perma.cc/JNS7-ANDE].

[275] APPLIED PUB. POL'Y RSCH. INST. FOR STUDY AND EVALUATION (APPRISE), ILLINOIS SOLAR FOR ALL EVALUATION SUMMARY REPORT (2021); Illinois Power Agency Act, 20 ILL. COMP. STAT. 3855/ §§ 1-56 & 1-75 (2016).

[276] *For Homeowners and Building Owners*, ILL. SOLAR FOR ALL, https://www.illinoissfa.com/programs/for-homeowners-and-building-owners/ [https://perma.cc/3CZY-GCG6]; Illinois Power Agency Act, § 1-56; *Community Solar*, ILL. POWER AGENCY (2022), https://www.illinoissfa.com/app/uploads/2019/10/0919-ILSFA-infosheet-low-income-community-solar-v11.pdf [https://perma.cc/E73V-GKJF] [hereinafter IPA Community Solar]. The Solar for All program underwent a minor amendment in 2023. H.B. 3351, 103rd Gen. Assemb. (Ill. 2023).

[277] *Residential Solar for Income-Eligible Homes*, ILL. POWER AGENCY (2022), https://www.illinoissfa.com/app/uploads/2019/05/0419-ILSFA-infosheet-distributed-generation-v10.pdf [https://perma.cc/G4HX-Z34L] [hereinafter IPA Income-Eligible].

meet the income requirements.[278] The program offers different methods of participation. For property owners who seek to install a PV system on-site, they have the option to purchase the system or lease the system from a third party.[279] For those who do not have interest or ability to install an on-site system, the Solar for All program offers the ability to engage in a community solar initiative, either by leasing panels in an off-site solar array or through participation in a Power Purchase Agreement, as described below.[280]

Regardless of which option the participant, or "subscriber," chooses, the Solar for All program provides similar benefits. First, Solar for All provides direct financial incentives to participating solar contractors, or "venders," to initiate the solar installation. For small housing units (four or less units) the program pays installation costs.[281] For larger housing units, the program pays a significant portion of installation.[282] Second, the state guarantees that participation in the program will save the owner or tenant money on their monthly electricity bills.[283] The Illinois Power Agency estimates an average annual savings of more than $1,000 to program participants.[284] Third, subscribers receive assurances that the selected contractor has been vetted by the state, extensive consumer protections vis-a-vis the contractor, as required by the state, and state assistance in the event of a dispute with the contractor.[285]

The program does not require credit checks for subscribers and generally requires little or no up-front payments, rendering participation financially feasible in low-income communities.[286] However, there are certain requirements for participation. Due to safety concerns, the property where the solar system is to be installed must meet certain building standards. For example, the applicant for a roof-mounted system must demonstrate that there is a modern electrical panel and the roof is in good condition and free from shade.[287] An applicant for a ground-mounted system must also demonstrate there is a modern electrical panel, as well as good foundation to limit risk of

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278 *Id.*; *For Homeowners and Building Owners*, *supra* note 276.

279 IPA Income-Eligible, *supra* note 277.

280 *Id.*

281 *Id.*

282 *Id.*

283 The state's estimate is that an average household with a monthly electricity demand of 600 kWh will save sixty dollars on their monthly bill after the solar is installed. *Id.*

284 *For Illinois Residents*, ILL. POWER AGENCY (2023), https://www.illinoissfa.com/for-il-residents/ [https://perma.cc/B3Z6-XGBT].

285 IPA Income-Eligible, *supra* note 277.

286 *Id.*

287 *Illinois Solar for All: Residential Solar*, ILL. POWER AGENCY https://www.illinoissfa.com/programs/residential-solar/ [https://perma.cc/AQN3-Q64D] [hereinafter Residential Solar].

on-site flooding.[288] Also, as noted above, subscribers must demonstrate an income below the program threshold.[289]

Illinois has made a commitment to allocate 25 percent of the Solar for All funding toward "Environmental Justice Communities."[290] These are communities which have a demonstrated high risk of environmental and health hazards due to environmental and socioeconomic factors, such as identified pollutants and toxins, a high percentage of pollution-sensitive residents, and a lack of affordable housing.[291] In addition to program-identified Environmental Justice Communities, there is a process by which a community may request designation as an Environmental Justice Community.[292]

Solar venders are a critical part of the Solar for All success. State incentives flow directly to the venders and most of the stringent program requirements to ensure quality workmanship, competitive pricing, and fair trade fall squarely on the venders. Incentives to the venders are paid through Renewable Energy Credits ("RECs") which "represent the environmental value of the electricity generated from solar panels, but not the electricity itself."[293] Solar for All vendors are able to sell these RECs to Illinois utilities for cash, which allows vendors to reduce installation prices to program subscribers.[294] There is a wide range of financial renumeration available to solar venders. In 2023, payments ranged from $180 per REC for small residential systems generating than 10 kW, down to $56 per REC for a large residential system generating 2,000–5,000 kW.[295] To encourage vendors to participate in projects which lead to system ownership by the subscriber, the REC amount is increased for projects which lead to ownership by the subscriber.[296]

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[288] *Id.*

[289] *For Homeowners and Building Owners*, *supra* note 276.

[290] *Environmental Justice Communities*, ILL. POWER AGENCY, https://www.illinoissfa.com/environmental-justice-communities/ [https://perma.cc/428F-KYAA] [hereinafter EJ Communities].

[291] *Id.* Illinois relies in part upon the federal EPA "EJScreen" mapping tool which identifies environmental justice communities across the country. *EJSCreen: EPA's Environmental Justice Screening and Mapping Tool (Version 2.2)*, ENV'T PROTECTION AGENCY, https://ejscreen.epa.gov/mapper/ [https://perma.cc/TPQ9-KMVH].

[292] ILL. POWER AGENCY, ENVIRONMENTAL JUSTICE COMMUNITY SELF-DESIGNATION PROCESS 2 (2019). An appointed "Environmental Justice Community Self-Designation Committee" reviews applications and renders a final determination as to whether a community should be designated as an Environmental Justice Community based upon use of a point-based rubric of the various environmental and socioeconomic factors. *Id.*; EJ Communities, *supra* note 290.

[293] Residential Solar, *supra* note 287.

[294] *See Renewable Energy Credit Prices for the Illinois Solar for All Program*, ILL. POWER AGENCY, https://www.illinoissfa.com/renewable-energy-credit-prices/ [https://perma.cc/NG5P-WYV3].

[295] *Id.*

[296] *Id.*

The state determines approved venders based upon their quality of workmanship, the savings they provide to subscribers, and their adherence to the Solar for All program's extensive consumer protection guidelines.[297] The consumer protection guidelines are intended to prevent unsafe or unfair business practices by the vendors.[298] Such protections include a requirement that specified disclosure forms be provided to the customer, including a description of the system equipment and components, specified warranties, clear financial terms (including the total fees and costs of the installation), and projected energy savings.[299] Upfront fees and costs are generally prohibited and ongoing costs may not exceed 50 percent of the value of the electricity generated by the system.[300] Consumer protections also require the vendor to base financing terms upon the specific consumer's ability to repay the debt, prohibit the vender from requiring the consumer post their home or home equity as security for financing, require the vender to provide both a forbearance option and ability to pre-pay the loan without penalty, and limits vender marketing to only state-approved standardized informational brochures.[301] The program also requires venders to allow a period of at least fourteen days for subscribers to cancel without penalty.[302] Clearly, the program places a stringent burden upon the vender to ensure fair dealing, transparency, and feasible financing for subscribers, while rendering investment in PV systems low-risk for subscribers.

For those low-income residents interested in participating in distributed solar who do not have property upon which a solar system can be installed, the Solar for All program includes a Community Solar element, allowing property owners and tenants to reduce their electricity bills without the obligation to place a solar system on their property.[303] Community solar participants can subscribe to large solar arrays by leasing certain panels in the array and receiving a credit for the solar electricity generated by these panels.[304] Alternatively, subscribers can enter into a Power Purchase Agreement whereby they pay a set rate for electricity generated by an off-site solar array and that solar electricity is credited to their power bill—a savings to the

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297 ILL. POWER AGENCY, CONSUMER PROTECTION HANDBOOK FOR ILLINOIS SHINES (ADJUSTABLE BLOCK PROGRAM) & ILLINOIS SOLAR FOR ALL 6 (2023) [hereinafter CONSUMER PROTECTION HANDBOOK]; *Consumer Protections*, ILL. POWER AGENCY (2023), https://www.illinoissfa.com/renewable-energy-credit-prices [https://perma.cc/NG5P-WYV3] [hereinafter Ill. Consumer Protections].

298 CONSUMER PROTECTION HANDBOOK, *supra* note 297, at 6.

299 *Id.* at 37.

300 *Id.*

301 *Id.* at 20, 38.

302 ILL. POWER AGENCY, EXPLORING ILLINOIS SHINES & ILLINOIS SOLAR FOR ALL (June 2023), https://ipa.illinois.gov/content/dam/soi/en/web/ipa/documents/ipa-il-shines-ilsfa-101-factsheet-web-post_6-23-23.pdf [https://perma.cc/CBL2-7SQ7].

303 CONSUMER PROTECTION HANDBOOK, *supra* note 297, at 3.

304 IPA Community Solar, *supra* note 276.

subscriber as long as the retail rate for electricity is higher than the rate they pay to participate in the community solar array.[305] In the Community Solar program, unused credits can be rolled over to the following month.[306]

Like other options under the Solar for All umbrella, there is no up-front cost to the subscriber to join a Community Solar array and the solar venders are vetted through the program to ensure workmanship, safety, and transparency.[307] These subscriptions are funded in part by the program so that participants pay either low or no cost.[308] This program is particularly valuable for properties which lack minimum safety requirements, such as a modern electrical system; sufficient space or light; or a correct orientation to successfully support an on-site solar system, as well as for tenants who rent from owners who do not want to install the solar infrastructure. The program also allows non-profits and public facilities located within Environmental Justice Communities and/or an income eligible community to stand in the role of an "anchor subscriber" wherein they can establish a community solar array and utilize up to 40 percent of the solar electricity generated by the array.[309]

Illinois' well-designed Solar for All program provides numerous benefits for lower income communities: reduced or no cost solar installation, guaranteed ongoing savings on electricity, and assurances of quality workmanship. The program is inclusive, allowing participation by homeowners, tenants, and non-profits on residential properties of any size, and allowing benefits to flow to solar contractors. There has been demonstrable success in providing solar generated electricity options for low-income households. Between 2018 and 2021, the Solar for All program selected 116 projects with an anticipated total solar generation of 53,627 MWh per year.[310] Of these new solar installations, nearly 70 percent were placed in Environment Justice communities.[311]

V. BEST PRACTICES FOR SUCCESSFUL EXPANSION OF ON-SITE PV SYSTEMS

As described in the state case studies above, incentives to encourage distributed solar can be offered by the state legislature or its agencies, as well as

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[305] *Id.* Like direct solar installations, under the Community Solar program, the subscriber is guaranteed electricity credit savings on their power bill of at least 50 percent of the cost of their community solar subscription. *Id.* For example, a subscriber with a $80 monthly electricity bill and a $30 monthly community solar subscription is guaranteed to see at least a $60 solar credit on each month's bill (in this example, reducing the electricity cost from $80 to $50 per month). *Id.*

[306] *Id.*

[307] *Id.*

[308] *See id.*

[309] *Id.*; *Illinois Solar for All: Non-Profit and Public Facilities*, ILL. POWER AGENCY, https://www.illinoissfa.com/programs/non-profit-and-public-facilities/ [https://perma.cc/MV4F-G4UN].

[310] APPRISE, *supra* note 275, at 6–7.

[311] *Id.* at 8.

by collaborative-minded utilities. Incentives can be directed toward property owners, non-property owners, and contractors, and tailored to target certain income-based or geographic communities. Successful solar expansion policies often layer incentives, allowing the federal Solar Tax Credit to be subsidized by state or local incentives.

As distributed solar facilities grow, it is important that government work with the affected utilities be prepared for substantial increases of backfed electricity generation and potential pressure on the grid. As demonstrated in the case studies, smart inverters and grid improvements are very important to ensure that an incentive program can stimulate growth of on-site solar without adverse effects on the safety and reliability of the central grid. Further, once distributed solar generation has reached a designated threshold, incentives may be scaled-back and tailored toward more efficient use and storage of solar electricity.

A. Incentives for Property Owners

To encourage property owners to consider installation of a PV system, governments should allow property owners the ability to both use their own self-generated electricity and sell their surplus electricity. Governments should refrain from imposition of fees or extensive permitting requirements which render use of self-generated solar electricity difficult or more expensive than utility-generated electricity.

Governments should also provide financial aid to offset the cost of installation of a PV system. Installation assistance may be in the form of direct payment to the property owner to cover a portion of the cost of the installation or as a rebate or tax credit after installation is complete. If a government does not have the means for such direct funding, offering low-interest loans can also stimulate interest from property owners. Reduced or eliminated permitting fees can serve as a relatively low-cost form of financial assistance. The government should also remove potential financial barriers to property owner's interest in an on-site PV system, such as waiver of any increased property taxes resulting from value created by the system.

Another enticing incentive states can offer is a tariff requiring utilities to pay for surplus electricity generated by the PV system. For optimal incentivization, the rates utilities purchase the surplus electricity at should be set at retail rates, or at least at wholesale electricity rates. When utilities only pay for distributed solar electricity at their avoided cost, it provides far less incentive to property owners. A net metering program should also allow the system owner to roll-over their utility credits from month-to-month. Such rollover allows the property owner to generate and sell substantial amounts of surplus electricity during summer months with long periods of sunlight and then cash-in stored credits during the winter months when shorter days may require the property owner to use more utility generated power. An additional

option is to allow the property owner to true-up their stored utility credits on an annual basis for a cash payment.

As demonstrated by both Hawaii and California, the amount of the payment for electricity output can be reduced or tailored once the state's solar policy goals have been met. Such a reduction from retail rates to wholesale or avoided rates can be made to limit the amount new solar installations if the amount of backfed electricity becomes a risk to the utility grid safety or reliability. A reduction just to the rates of payment for daytime-generated solar power can also protect grid safety and reliability while also encouraging system owners to install batteries.

Governments and utilities may also take non-financial steps to make PV installation easier for property owners. Assistance in the planning and permitting process can be very helpful to property owners who are not likely to have much experience with PV system installation procedures. Such government assistance can take many forms, including provision of guidance in determining the financial feasibility and practical requirements of a new system, provision of a list of recommended and vetted contractors with superior workmanship and prices, and serving in the role of ombudsman.

B. Incentives for Non-Property Owners

For consumers who do not own property but wish to take advantage of the many benefits of distributed solar, governments can encourage solar consortiums or community solar projects. Such programs require coordination with state utilities to establish a credit and billing process for the consortium or community solar. This also requires a determination of what rates will be credited to subscribers for electricity generated by the solar array, which may depend on the size of the array, the time of day when the electricity is transmitted to the utility, and the community served by the solar array. Rates should also be established for the on-front and ongoing costs of subscriber participation in the community solar or consortium, as well as commitments for a minimum amount of electricity credit which the subscriber will receive from the solar array to ensure there is a financial benefit for subscriber participation. To encourage participation, utilities should establish programs by which membership in a solar community or consortium results in lower electricity rates, or a lower total electricity bill, than the standard rates for utility-generated electricity.

C. Incentives for Solar Installation Contractors

Solar contractors are of vital importance in any state seeking to expand installation of on-site solar. Therefore, efforts should be made to create a solar market hospitable and lucrative to these businesses. There are many steps a government can take to do so. From a financial perspective, assistance in reducing the price of equipment such as rebates and tax breaks is helpful to a

corporate bottom line. Similarly, reduced permitting fees and expedited permitting processes can make a jurisdiction more attractive to contractors.

Creation of an energy trading market, like the Renewable Energy Credits program used in Illinois, can create a win-win-win for contractors, consumers, and governments. Contractors gain multiple benefits under such a program. They receive assurance of supplemental profits at pre-set and transparent rates. Government incentive programs which require the property owner to hire a government-approved contractor also create a dedicated customer stream for the approved contractors. Customers benefit through assurances that the contractors in the program have been vetted for quality workmanship, fair prices, longevity in the community, and demonstrated reliability, as well as assurances that the system will be installed with high quality materials and warranties. Governments benefit by being able to tailor the value of tradable credits to match policy goals, such as larger credits for installations in lower-income communities or areas threatened with weather-based grid disruptions. These programs also enable to the government to retain greater oversight over contractors operating within the state.

D. Incentives for Specific Communities

Certain communities have a greater need for the benefits of on-site solar generation, such as lower income communities which greatly benefit from reduced electricity bills, and geographic areas subject to disruptive weather events which benefit from greater energy reliability. Targeting incentives to such communities is an important element to rapid expansion of self-generation of solar electricity.

It is important to consider the unique needs of the targeted community. For example, low-income households may have particular challenges with regard to gaining initial financing, property-ownership, and safe property conditions.[312] These hurdles can be addressed by offering direct financial assistance for installation, such as the Solar for All program used in Illinois. Low-interest loans, particularly loans which do not require a minimum credit score or security, can also be beneficial. For communities with low owner-occupied housing and/or housing which is not safe for an on-site solar installation, it is necessary to provide alternative solar options. These may include programs to encourage solar communities and solar consortiums, with guaranteed electricity credits for the subscribers. It may also include incentives for multifamily landlords to install on-site solar in which electricity savings are passed directly to the tenants.

A weather-threatened community may have challenges with regard to obtaining insurance for the system and a special need to have microgrid

[312] Hangen et al., *supra* note 74.

connections.[313] The government can step into the role of insurer for systems in weather-threatened communities. The government can also work with local utilities to establish local connections to a microgrid and ensure that such microgrid is designed to be safely disconnected from the central grid in the event of a central grid disruption.

CONCLUSION

There are extensive benefits to communities which expand their use of distributed solar electricity generation, including reduced costs for electricity, greater energy security and resiliency, and improvements to local environmental quality. When states opt to prioritize small-scale on-site solar as a core component their electricity generation framework, there are many examples of successful incentives programs to follow. The foregoing research and recommendations may serve as a blueprint for development of laws and policies leading to rapid expansion of small-scale solar generated electricity.

[313] Singh et al., *supra* note 105, at 3; FLA. DEPT. AGRIC. AND CONSUMER SERV., *supra* note 105.

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