**Institute for
Policy Studies**

HOW STATES CAN BOOST RENEWABLES, WITH
BENEFITS FOR ALL

RENEWABLE PORTFOLIO STANDARDS AND DISTRIBUTED
SOLAR ACCESS FOR LOW-INCOME HOUSEHOLDS

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The Institute for Policy Studies (www.IPS-dc.org) is the oldest multi-issue progressive think tank in Washington, D.C. Since its founding in 1963, IPS has been at the forefront of research and action for the civil rights, anti-war, feminist, environmental and global justice movements in the United States and around the globe. IPS is dedicated to turning ideas into action, based on the belief that dynamic social movements drive social change.

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EXECUTIVE SUMMARY

Given the current assault on responsible climate policy at the federal level, innovative state and local actions will be critical if we are to achieve a just transition to a sustainable economy. IPS is surveying the array of measures that can accelerate the rapid transition from fossil fuels to clean and efficient alternatives in an equitable fashion, and in this study, we focus in on one strategy: Renewable Portfolio Standards (RPS). RPS require utilities to provide a growing share of electricity from solar and wind energy, and are a particularly promising policy option — especially if they increase the benefits of a clean energy transition for low-income families.

Twenty-nine states and the District of Columbia already have RPS requirements, and eight other states have voluntary renewable energy goals. Building on this progress — by enacting RPS in additional states, tightening current standards, and making voluntary programs binding — would have significant environmental, economic, and social benefits:

- ***Reducing greenhouse gas (GHG) emissions.*** Expanding RPS would greatly reduce climate pollution, given that the electric power generation sector accounts for nearly 30% of total U.S. GHG emissions. Since residential electricity usage currently makes up more than 37% of national utilities sales, RPS success will depend on dramatically expanding home-based solar energy options. But the upfront costs of solar panel installation are a high barrier for millions of American families. Of all U.S. households, 42% have annual incomes of less than $40,000, and half of families in this income group are renters. State and local governments should offset the cost of solar panel installation for low-income homeowners and set up programs to enable renters to participate in distributed solar energy. Currently, 14 states and the District of Columbia have such "shared solar" programs.

- ***Advancing justice and equity.*** Much of the growth in residential solar energy in recent decades has largely benefited white, middle class families. Increasing solar access for low-income households is an equity issue because it removes barriers to participation for populations who have not benefited much from renewable energy but have often borne the brunt of fossil fuel extraction and pollution. Low-income households spend an average of 8.8% of their income on electricity, while the average for all Americans is only 2.9%. A 2015 study estimates that a typical set of residential solar panels would meet more than half of an average low-income household's electricity needs. Low-income households are disproportionally African-American and Latino, and hence advancing income- and race-conscious policies for renewables will also advance racial justice.

- ***Creating good jobs.*** Solar energy accounted for 43% of U.S. employment in electric power generation in 2015, even though it

represented only 2.2% of generation capacity. Similarly, wind energy represented 11.8% of power generation jobs but only 6.8% of generating capacity. These figures suggest that solar and wind energy growth through expanded RPS and increased low-income solar access would create many more jobs than a business-as-usual energy model. Renewable energy jobs are also comparable in wages to fossil fuel jobs. A typical wind turbine technician, for example, earns $25.50 per hour, significantly more than several categories of fossil fuel occupations.

- ***Building a sustainable, inclusive economy.*** By increasing distributed generation capacity, these policies would reduce our economy's dependence on centralized power generation and distribution by large corporate utilities. The total U.S. electricity market was worth $391 billion in 2015. By giving families and small businesses a stake in an expanded renewable energy market, these policies would keep more of this money in communities.

Successful policy models in various states are highlighted throughout this report, such as Hawaii's ambitious RPS target, California's low-income solar access programs with targeted hiring and training provisions for historically excluded populations, and Colorado's shared solar program. A case study is presented on how a broad coalition in Oregon successfully advocated for legislation to expand RPS, phase out coal from the electricity supply, create a shared solar program with the provision that 10% of the shared solar capacity be set aside for low-income families, and accelerate the rollout of electric vehicle charging infrastructure. Drawing from these and other successful examples, the report identifies the following key "best practice" elements of RPS and low-income solar access policies:

1. A sufficiently ambitious timetable.

2. No non-renewable or dirty power (nuclear energy, trash incineration, or biofuels) included in "renewables" definition.

3. A system of tradable renewable energy credits (RECs) to facilitate tracking.

4. Meaningful penalties for noncompliance.

5. Requirement to fund solar access for low-income households.

6. Incorporating a "green jobs" component into the low-income solar program.

7. Legislative provision for shared solar, which also incorporates funding for solar access for low-income communities (#5) and its related targeted hiring and training component (#6).

INTRODUCTION

In the current environment of federal inaction and worse on climate, state and local governments, which tend to be more responsible to popular pressure, offers an opportunity for advancing an ambitious people's climate agenda. In fact, if we are to have any hope of reducing U.S. greenhouse gas emissions over the next few years, and of ensuring that the transition from fossil fuels to clean energy accounts for the rights of low-income communities, communities of color, and displaced former fossil fuel workers, we have no choice but to pressure our states, cities, and counties to act on climate.

Fortunately, many state and local governments have already taken actions to advance a just climate agenda that can be improved upon and replicated across the country. This report is the first of an Institute for Policy Studies series highlighting some of the most promising of these actions, identifying best practices for policy design, and sharing lessons for movement building and advocacy. The series will focus on policies that:

1. Have the potential for significant climate impacts.

2. Directly address racial, economic, and gender equity.

3. Advance the notion of "economic democracy," or a decentralized production and distribution system for goods and services with greater public control and accountability than today's corporate-controlled economy.

4. Offer existing models that can be improved and replicated.

5. Promote positive solutions (e.g., renewable energy, energy conservation, green jobs, public transit) as well as policies that roll back climate destruction (such as ending state fossil fuel subsidies).

6. Include examples of effective grassroots campaigns driven by diverse cross-sectoral coalitions.

Our hope is that this report series will both inspire and inform readers to start grassroots organizing to win policy changes at the state and local level to advance a People and Planet First climate agenda.

HOW STATES CAN BOOST RENEWABLES, WITH BENEFITS FOR ALL

Renewable Portfolio Standards Enactment/Expansion:

Renewable Portfolio Standards (RPS) are binding requirements set by states for electric utilities to provide a growing share of electricity from renewable sources on a specified timeline. Currently, 29 states, along with the District of Columbia and Puerto Rico, have RPS requirements. California, for example, requires utilities to obtain 33% of the electricity they supply from renewables by 2020, going up in steps to 50% by 2030.[1] Another eight states have voluntary renewable energy goals. This leaves 13 states with neither a state-mandated RPS nor a voluntary renewable energy goal.[2] (See Figure 1)

A push to enact or expand RPS in the states could therefore take three different forms:

1. ***Enact RPS in the 13 states that do not currently have either RPS or a voluntary goal.*** In practice this may be an uphill battle in some states, such as West Virginia, which had RPS in place, but repealed it in 2015 in the face of strong pressure from the coal industry.[3]

2. ***In the eight states that have a voluntary renewable energy goal, pass legislation to enact a binding standard.*** As with enacting a new standard, this may be difficult in some states, such as Kansas, which repealed its binding RPS in 2015. In this case, some renewable advocates reportedly accepted this shift to merely voluntary goals in exchange for the scrapping of a proposed wind energy excise tax.[4]

3. ***In the 29 states (plus DC and Puerto Rico) that have a binding RPS, there may be potential to set a faster timetable.*** As with enacting a new standard or turning a voluntary goal into a standard, there are caveats. In a state with an aggressive goal (for example, Hawaii, which has a goal of 100% renewable electricity by 2045), it is unlikely that the standard can be made stronger in the near future. Even in a state with a relatively weak standard, it may not be possible to strengthen it if it was enacted or revised relatively recently (for example, Michigan revised its RPS in 2016, but the timetable of 15% electricity from renewables by 2021 remains in place, with an additional voluntary goal of 35% by 2025[5]). However, that leaves a number of states where the potential exists to set higher targets and/or a faster timetable. For example, New Mexico has a target of 20% renewables by 2020 for investor-owned utilities (the industry term for for-profit private utilities), enacted in 2002, with no next stage.[6]

Figure 1. Renewable Portfolio Standards (RPS) Policies by State

Legend:
- RPS with percentage target
- RPS with fixed generation target
- Voluntary Goal
- No RPS
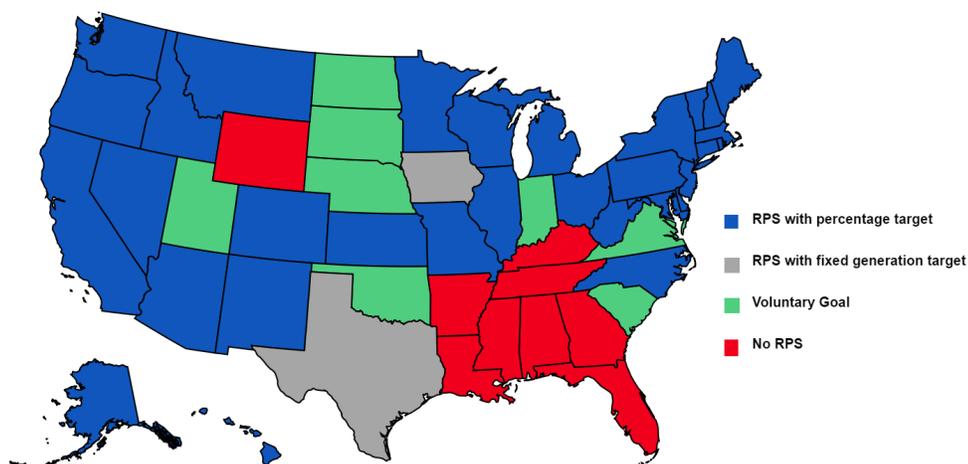
Removing Barriers to Solar Energy for Low-Income Households

There are two different models in place for expanding solar access for low-income households. They can be enacted (or strengthened) in conjunction with enactment or expansion of RPS, or as standalone legislation. Importantly, these two models for low-income solar access are not mutually exclusive. Both can be implemented at the same time, and can complement each other. The two models are:

1. ***Financial incentives for solar adoption by low-income households.*** This could take the form of direct state funding to offset the initial cost of solar photovoltaic (PV) system installation for low-income households (and in some cases, other target utility ratepayers such as seniors, small businesses, and non-profits). An example is the District of Columbia's Solar for All program, enacted as part of the expansion of RPS in 2016. It provides a dedicated stream of District funding to install solar PV systems on the homes of 100,000 low-income households, plus an unspecified number of senior households, and an unspecified number of small businesses and non-profits.[7] Note, however, that only a family that owns their home (and therefore has the ability to install solar panels on their roof), or a small business or nonprofit that owns their space, can take advantage of this opportunity unless the second model, shared solar (described below), is in place. (In the particular example of the District of Columbia, the second model is in fact operational.) Another form of financial assistance that can help lower the barrier to entry for low-income ratepayers to install solar panels is a low-interest rate loan repayable through an additional payment on utility bills, known as on-bill financing. The loan repayment is offset by the savings from solar power. An example is the On-Bill Recovery Loan option offered by New York's NY-SUN Incentive Program.[8]

2. ***Shared solar.*** This is a policy that allows tenants (residential or business), apartment dwellers, low-income households that cannot pay the upfront costs of solar installation, and homeowners with a shaded roof on which solar panels are uneconomical, to share in

the benefits of solar energy. In the shared solar model, utility ratepayers can own part of a solar array (a collection of several solar panels) not on their property, and receive credit on their bill in proportion to the share of the array they own.[9] The solar array could be on a public building such as a school, an apartment building, or any building with a large roof. Note that shared solar can work in conjunction with the financialincentives for low-income people discussed earlier, if there are funds set aside to pay all or part of upfront costs for low-income households to buy into a shared solar array. Another (not mutually exclusive) way to increase participation of low-income people in shared solar is to set aside a proportion of the output of shared arrays for low-income people, In Colorado, for example, 5% of the output of all "solar gardens" (as shared arrays are called in Colorado) is set aside for low-income ratepayers.[10]

Figure 2. Shared Solar Policies by State

Financial incentives for low-income solar access vary considerably between states. Examples include:

- State-funded rebates for solar installation for low-income homeowners, such as the District of Columbia's Solar for All program referred to above, and California's Single Family Affordable Solar Homes (SASH) program.[11]
- Loan financing with on-bill payment, such as the NY SUN program referred to above.
- A similar loan-financing model, but with additional features, such as the Massachusetts Solar Loan program, which provides the following additional benefits[12]:
  - Caps the interest rate on the loans at 5.25%
  - Provides lenders a state-funded interest rate buydown of up to 1.5% (so that lenders can effectively charge interest rates of up to 6.75% and have more incentive to participate in the program, while borrowers do not pay more than 5.25% interest).
  - Provides lenders a principal buydown for loans to qualifying low-income borrowers, to reduce the borrowers' payments.

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o   Provides lenders a loan loss reserve fund to incentivize them to lend to borrowers who otherwise may not meet income or asset based eligibility criteria.

Enabling legislation for shared solar programs is in place in 14 states and the District of Columbia. There are shared solar programs created on a voluntary basis in other states as well.[13] (See Figure 2)

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Pending state legislation on renewable standards

In the first few months of 2017, lawmakers introduced a flurry of bills addressing climate and energy issues.[14] Some of these bills include:

- **New York**: (A 5105) expands RPS target to 100% by 2032.
- **Massachusetts**: (SB 1849) expands RPS target to 100% by 2035, as well as other competing bills with less ambitious targets.
- **California**: (SB 584) expands RPS target to 100% by 2045.
- **Nevada**: (AB 206) expands RPS target to 80% by 2040.
- **Connecticut, Minnesota, Pennsylvania, Vermont**: bills to expand RPS target.
- **South Carolina**: (S 44) exempts homeowners with solar panels from paying property taxes for their solar panels and associated hardware. Passed the Senate and is awaiting a House vote.

Activists planning to push for RPS expansion and low-income solar legislation in their states should first check to see if such bills are already moving through their state legislatures. In some cases there may be the opportunity to strengthen existing proposals through amendments to increase provisions for low-income access.

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Community solar array, Tri-County Electric Cooperative, Minnesota. (Image source: Clean Energy Resource Team, http://www.cleanenergyresourceteams.org/.) Image is under Creative Commons license for non-commercial purposes.

ENVIRONMENTAL, ECONOMIC AND SOCIAL BENEFITS

Reducing greenhouse gas emissions

Of all economic sectors, electrical power generation is the largest single contributor to greenhouse gas (GHG) emissions in the United States, accounting for 29.5% of U.S. GHG emissions in 2015.[15] If we are to reduce GHG emissions in the United States, it is clearly essential to reduce emissions in the electricity sector, and enacting and strengthening RPS at the state level is key to being able to cut GHG emissions from the electric power sector.

In addition to the binding requirements of an RPS, the transition to electricity from renewables can be accelerated by individual ratepayer households (or businesses) installing solar panels, a model known as "distributed solar."[16] As seen in Figure 3 below, the residential and commercial sectors are the two largest end-users of electricity sales by utilities, accounting for 37.4% and 36.2%, respectively, of retail electricity sales by utilities in 2015.

Figure 3. Utility Electricity Sales by End Use, 2015[17]
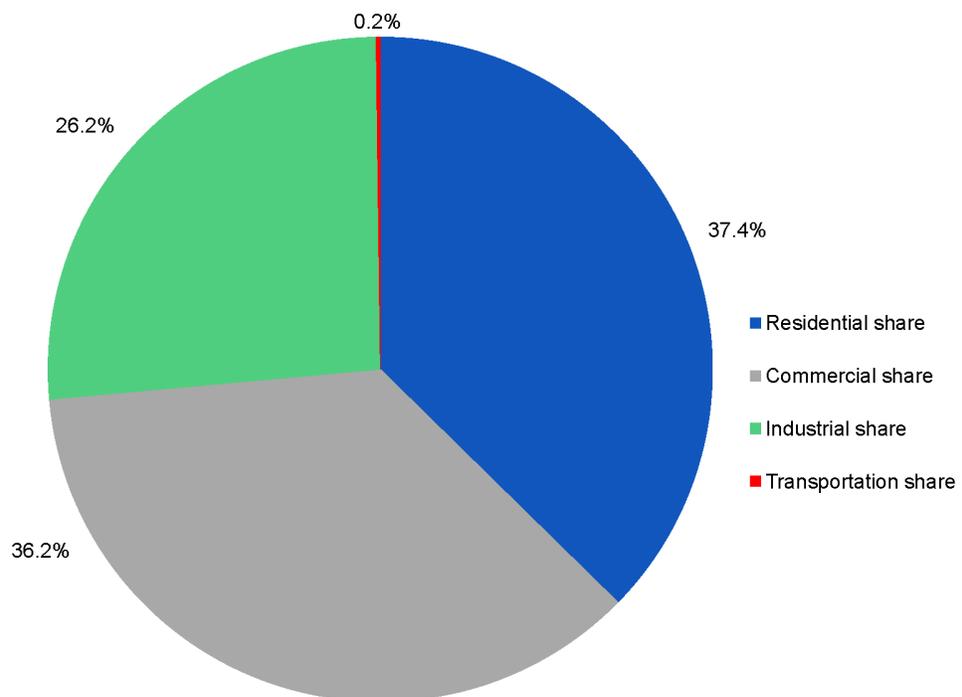
Residential and commercial electricity consumption have grown by 10.1% and 13.5%, respectively, between 2003 and 2015, outpacing the 7.6% growth in overall retail sales of electricity over the same period, as shown in Figure 4. Increasing solar penetration in the residential and commercial sectors is therefore key to reducing fossil fuel reliance in the electricity sector.

Figure 4. Growth Rate of Retail Electricity Sales End Uses, 2003 – 2015[18]
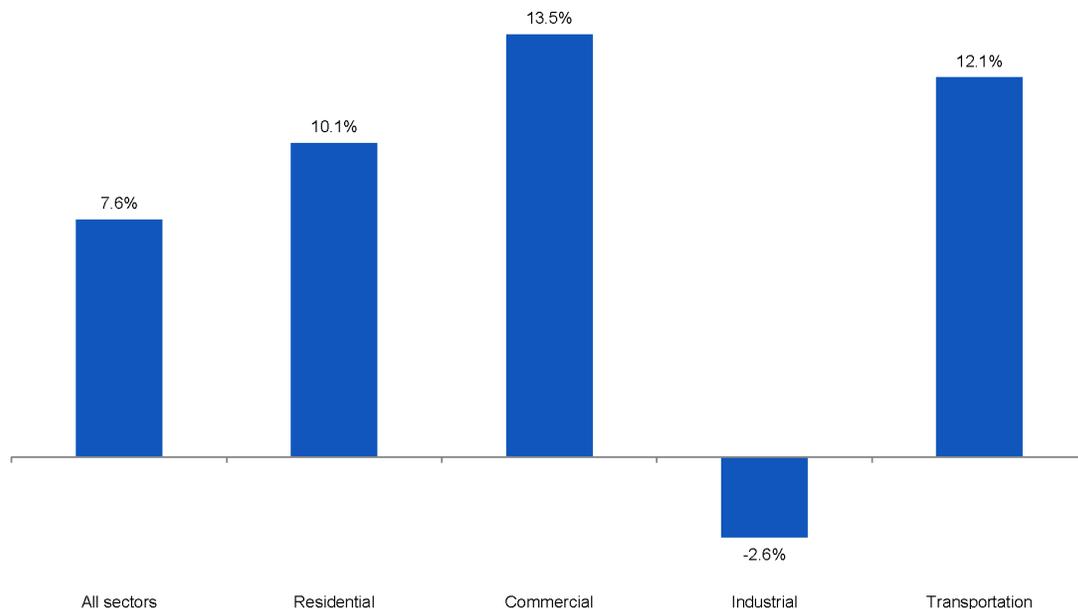
Low-income households have been slow to take advantage of solar energy. According to the Census Bureau, 49.1 million households (42% of all U.S. households) have an annual income of less than $40,000.[19] However, analysis by the Center for American Progress in 2014 found that only 3.5% of solar installations in the state of New York are for households with annual income of below $40,000, and the corresponding numbers for Massachusetts and Maryland are 2.2% and 1.1%, respectively.[20] The nationwide average of solar penetration for low-income households is likely even lower, since all three of these states have shared solar programs and the vast majority of states do not.

One might expect that families with very little money would make up a small share of national energy consumption. And yet in 2009 (the most recent year for which data are available), the 42 percent of households with annual income of below $40,000 accounted for 37.4% of all U.S. residential energy consumption.[21] On a per capita basis, residential energy consumption by persons in households with annual income of below $20,000 was only 4% lower than the nationwide average, and residential energy consumption by persons in households with annual income of between $20,000 and $39,999 was 7.7% below the average (Figure 5). Per capita energy consumption is not significantly lower in low-income households at least in part because low-income households are on average likelier to live in poorly insulated homes with higher heating and air-conditioning costs. A 2004 study found that 28% of households below the poverty level found their homes to be poorly insulated, compared to 17% of all households.[22] In addition, some home energy usage is non-discretionary. Energy Information Administration (EIA) analysis of 2001 survey data showed that 99.9% of households had at least one refrigerator, 99.7% of households had at least one cooking appliance, and 98.9% of households had at least one television.[23] Therefore, if a large share of low-income households had the opportunity to adopt rooftop solar, it would have a significant impact on GHG emissions.

Figure 5. Percentage by Which 2009 Per Capita Household Energy Consumption Varied From the National Average, by Income Group[24]

| <$20,000 | $20,000-$39,999 | $40,000-$59,999 | $60,000-$79,999 | $80,000-$99,999 | $100,000 -$119,999 | >$120,000 |

-4.0%, -7.7%, -6.0%, -0.9%, -0.3%, 8.3%, 24.1%
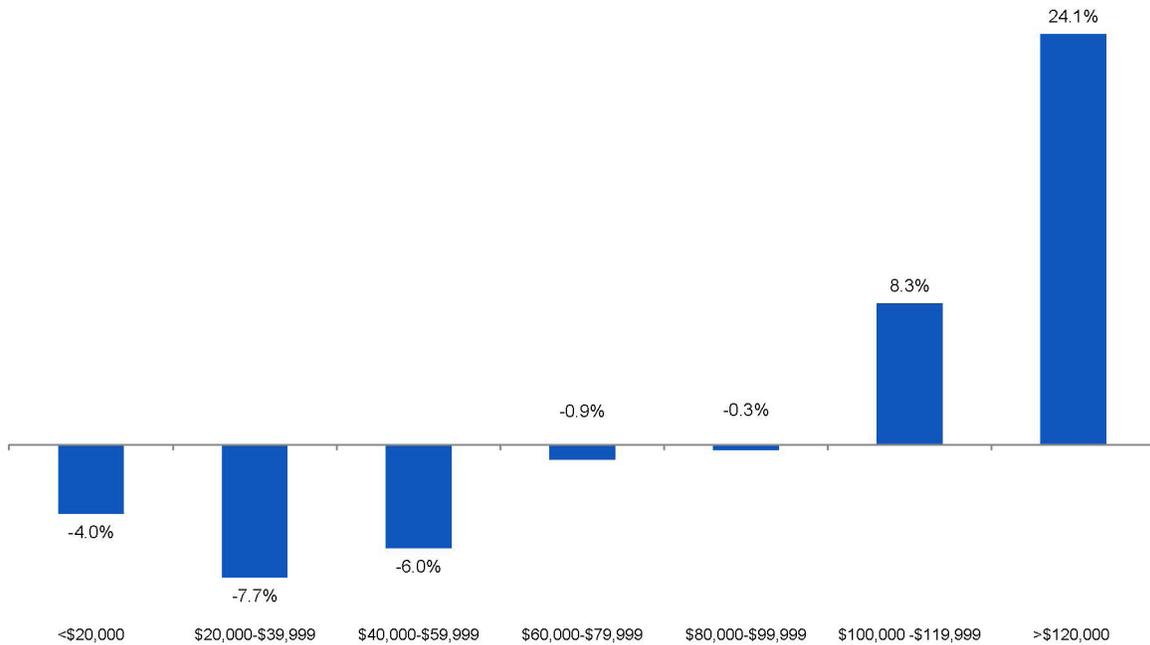
Advancing justice and equity

Increasing solar access for low-income households is an equity and justice issue because it would remove barriers to participation for populations who have so far not benefited significantly from the growing renewable energy sector but have often borne the brunt of the damage from our fossil-fuel driven economy.[25] Households with income below $40,000 accounted for 37% of residential energy expenditure in 2009, only a marginally smaller share than their corresponding share of residential energy consumption (37.4%).[26] Low-income households spend an average of 8.8% of their annual household income on electricity, while the average for all income groups is 2.9% (Figure 6).

Figure 6. Residential Electricity Expenses as a Share of Household Income, By Income Group[27]

Low-Income — 8.8%
Non-Low Income — 2.3%
Average — 2.9%
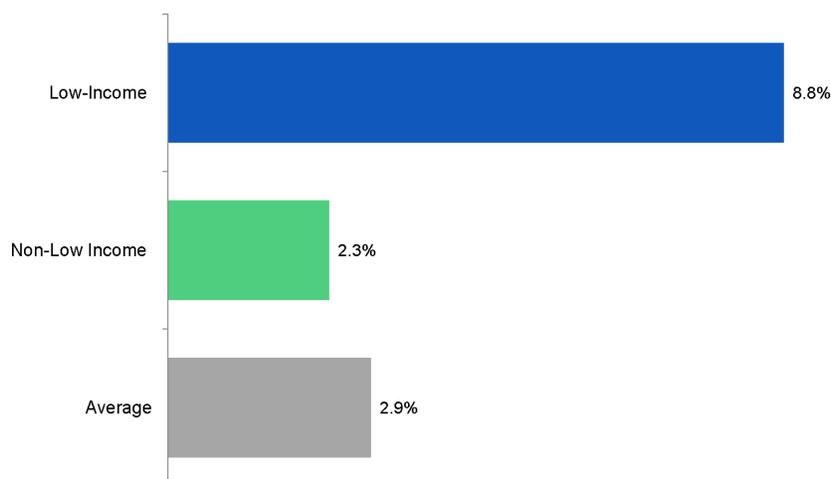
Increasing low-income households' access to distributed solar energy also advances racial justice. As noted earlier, 42% of all households have household income of below $40,000. The corresponding numbers for Black and Latino households are 59% and 52.2%.[28] Thus, Black and Latino families are disproportionately impacted by poverty and will be key beneficiaries of policies that increase their access to distributed solar energy.

Figure 7. Percentage of Households with Income Below $40,000, by Race[29]
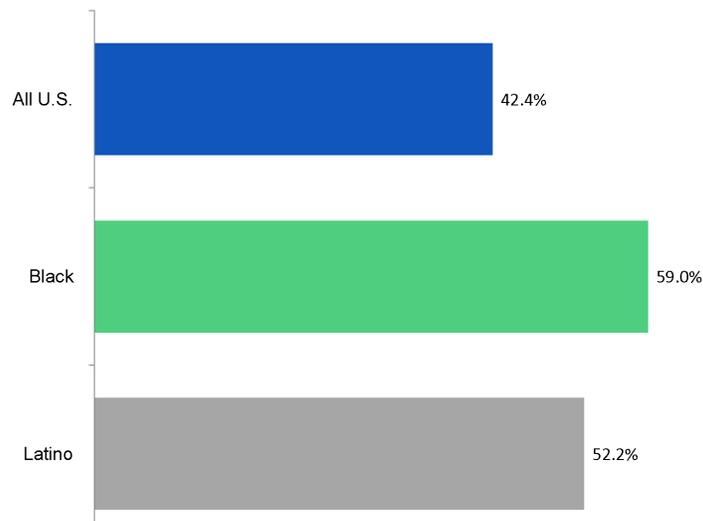
Another way in which low-income households pay the price for the disproportionate financial burden they pay for utility bills is that they are more likely to have their service disconnected for failure to pay. A recent report by the NAACP documents the tragic human cost of utility shutoffs, and the racial and income disparities that leave people of color and low-income people more vulnerable to shut-offs.[30]

While the burden of energy costs disproportionately affects low-income people, the benefits they stand to get from increased access to renewable energy are sizable. A 2015 study estimates that a typical 4 kilowatt residential solar array, which generates between 5,000 and 6,500 kilowatt-hours of electricity annually, would be able to meet more than half of a typical low-income household's electricity needs.[31]

The shared solar element of this policy package is key to expanding low-income families' access to distributed solar generation, since renter households cannot take advantage of the opportunities of distributed solar generation without a shared solar program. While 34.7% of all U.S. households rent their homes, 49.3% of households with annual income less than $40,000, and as many as 59.5% of households with income less than $10,000, are renters.[32] Expectedly, the pattern of home ownership also shows racial disparities, with a 2015 study documenting that only 54% of people of color in the tate of Maryland owned their homes, as against 77% of whites.[33] Based on racial disparities in income nationwide, we expect similar patterns elsewhere as well. A shared solar program will thus address racial as well as income inequities.

Creating good jobs

The most recent U.S. Department of Energy data on employment in the energy sector show that solar energy employment is proportionally much larger than the solar industry share of generating capacity.[34] While solar energy (utility-scale PV, utility-scale solar thermal, and distributed PV combined) represented only 2.2% of generating capacity in the United States in 2015,[35] the Department of Energy reports that it accounted for 43% of the electric power generation workforce in the first quarter of 2016.[36] Likewise, wind energy represents 6.8% of generating capacity and 11.8% of power generation jobs. By way of comparison, natural gas constitutes 40.9% of capacity but only 6.1% of generation jobs.

These figures count only jobs related to energy generation, and yet even when extraction jobs (e.g., oil and gas drilling and coal mining) are included in the total energy sector job count, solar energy is the second-largest employer, with 18.2% of total U.S. energy sector employment, after oil with 25.2%, and ahead of natural gas with 17.7%.[37] (See Table 1 in the Appendix for further detail)

These figures reinforce the findings of a 2014 University of Massachusetts-Amherst and Center for American Progress study on the job creation potential of renewable energy growth.[38] The study showed that every $1 million invested in capital expenditures in solar photovoltaic energy and in wind energy creates 13.4 jobs and 12.7 jobs, respectively. By way of comparison, the researchers found that every $1 million invested in capital expenditures for oil and natural gas, coal, and nuclear power creates just 10.5, 10.6, and 11.1 jobs, respectively. Non-renewable (fossil fuel and nuclear) power create about the same number of ongoing operations and maintenance jobs per dollar spent (5.3 jobs for oil, and 5.5 each for coal, natural gas, and nuclear) as solar PV and wind (5.5 jobs each). Therefore, investing in solar and wind energy creates more jobs than investing in fossil or nuclear energy. (Tables 2 and 3 in the Appendix summarize the data)

The conclusion from this study is that an energy policy mix of expanded RPS with increased distributed solar access for low-income people is going to expand overall employment by shifting investment from non-renewable energy to renewable energy, which produces more "bang for the buck" in terms of jobs created per unit of investment.

The Bureau of Labor Statistics reports data for mean, median, and selected percentile wage levels by occupation from the Occupational Employment Statistics (OES) survey. Figure 8 below shows the mean, median, and 10th percentile[39] wages for the only two direct renewable energy occupations found in the OES data, along with the data for all U.S. workers, and for oil and gas occupations in the OES.[40] The 10th percentile wages can be thought of as a close proxy for starting wages.

Figure 8. Mean, Median, and 10th Percentile Hourly Wages: Energy Occupations[41]
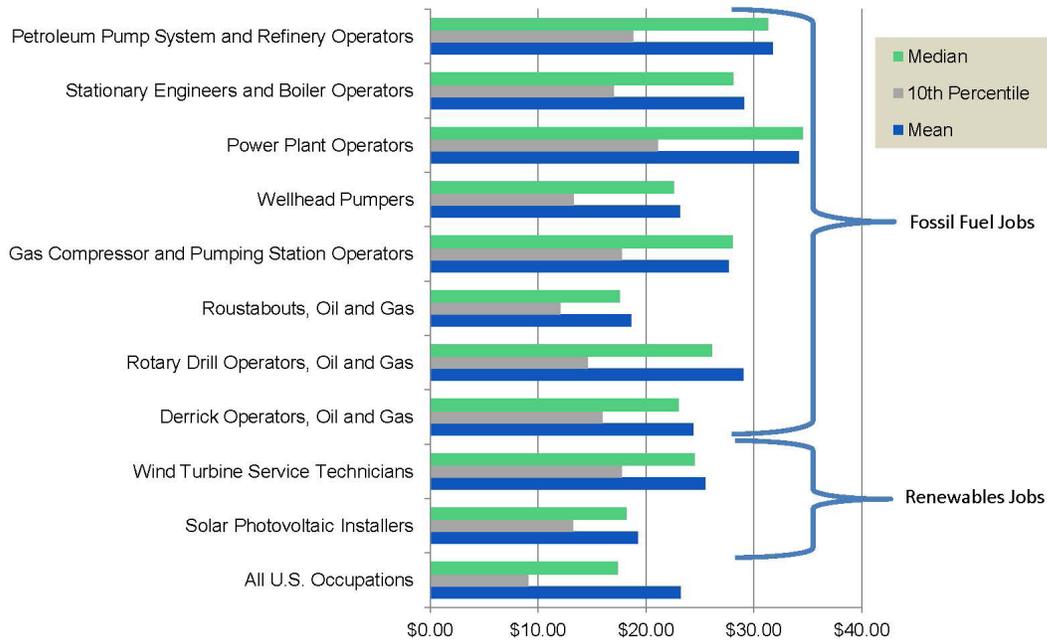
As seen from Figure 8, the wages for solar energy installers and wind turbine technicians are broadly comparable to wages for oil and gas occupations. For example, a typical wind turbine technician earns $25.50 per hour, significantly more than oil and gas derrick operators, roustabouts, and wellhead pumpers. The 10th percentile wage for those technicians is the third-highest of all the 10 listed occupations.

In conclusion, shifting energy investment from fossil fuels and nuclear energy to renewables through RPS expansion, combined with increased low-income access to distributed solar energy will result in greater job creation, at comparable wages, and will therefore be good for workers overall. (This does not minimize the need to retrain and re-employ current fossil fuel and nuclear energy workers who stand to lose their jobs as the industry sectors they work in inevitably shrink. The issue of jobs and "just transition" will be discussed in depth in a future report in this series.)

Building a sustainable, inclusive economy

The combination of RPS and of policies to increase low-income solar access both mandates increasing use of renewables and creates a larger market for solar energy (along with solar installation jobs), thus growing the clean energy sector of the economy. By increasing distributed generation capacity, these policies also serve to reduce our economy's dependence on centralized power generation and distribution by corporate utilities that are often fixated on short-term gains for their top executives and investors. The total electricity market in the United States in 2015 (the most recent year for which data are available) was $391.3 billion.[42] According to the Institute for Local Self-Reliance (ILSR), growth of distributed generation creates "an unprecedented opportunity to keep that money within communities."[43]

7 out of 10 Oregonians support transition from coal to **clean energy**

How the Renew Oregon Coalition Won RPS Expansion with a New Shared Solar Program

A noteworthy recent example of expanding renewable energy with an emphasis on equity is Oregon's Elimination of Coal from Electricity Supply Act of 2016.[44] Key components:

- Phase-out of coal from the electricity supply by 2030;
- Expansion of the RPS target from the original 25% by 2025 to 50% by 2040;
- Creation of shared solar, with requirements that provide for stable monetary benefits for subscribers and increased participation by low-income people, including:
  o Utilities must enter into 20-year contracts to purchase power from qualifying shared solar projects;
  o The Renewable Energy Certificates (RECs) issued for the power generated by a shared solar project are allocated to its subscribers in proportion to their shares in the project;
  o 10% of the installed capacity of shared solar arrays must be owned by low-income residential consumers.
- Creation of electric vehicle charging infrastructure.

The legislation passed the House by a bipartisan 38-20 vote, passed the Senate by a 17-12 vote, and was signed into law by the governor in March 2016.[45]

The Renew Oregon coalition that drove passage of the bill is very diverse and multisectoral.[46] It includes environmental organizations (both national and local), racial and economic justice organizations, labor, and faith groups, and a sizable number of small businesses and business associations. Some coalition members include:

- Portland Jobs With Justice;
- American Federation of State, County, and Municipal Workers (AFSCME) Council 75;
- Oregon Nurses Association;
- United Food and Commercial Workers (UFCW) Local 555;
- Unite Oregon (formerly the Center for Intercultural Organizing);
- Coalition of Communities of Color;
- Wisdom of the Elders;
- Asian Pacific American Network of Oregon;
- Sierra Club, Oregon Chapter;
- Southern Oregon Climate Action Now;
- Oregon Interfaith Power and Light;
- Oregon Center for Christian Voices;
- Oregon Solar Energy Industries Association;
- Main Street Alliance;
- Dozens of small businesses.

The coalition first proposed a clean energy ballot initiative for the November 2016 election, which prompted big utilities to approach them and say they would back a compromise bill.[47] There are two lessons here: one is that if energy justice advocates build sufficient people power through a very broad coalition (as the Renew Oregon coalition did), traditional adversaries may abandon their typical divide and conquer playbook and agree to offer concessions. The second lesson is that a settlement with too many compromises is not a win. Clearly, the Renew Oregon coalition had the power to get a settlement that accomplished many of their goals.[48]

One reason that the Renew Oregon coalition is so broad, and particularly, that sections of organized labor have signed on, is that the coalition has a very explicit jobs and just transition framework. The coalition's mission is to "create good-paying jobs for all Oregonians, protect air and water from pollution, and help families stay healthy." The coalition describes the jobs component of its mission as, "create good-paying jobs that can support a working family and can't be shipped overseas."[49]

A cautionary note, however, is that every campaign and every state's and city's political environment is different. Some elements of what worked in Oregon may be harder to replicate in some other places, because there may be a history of mistrust between different constituencies that needs to be overcome to build a broad coalition, and because adversaries may have more political power and therefore less inclination to settle, necessitating a longer, harder public campaign.

BEST PRACTICE ELEMENTS OF JUST RENEWABLE PORTFOLIO STANDARDS WITH LOW-INCOME ACCESS

The following are some best practice elements of Renewable Portfolio Standards (RPS) legislation with dedicated funding for increased distributed solar access for low-income households, including through a shared solar program. They have been compiled from policies already enacted in different states across the country. The policy elements are selected to maximize the overarching goal of "greenhouse gas reduction with equity and democracy." These do not cover the universe of how to strengthen RPS and design them to achieve greater equity (see endnotes for more information sources). In addition, not every one of these elements belong in every bill. For example, if a state has a strong RPS in place but lacks low-income access and shared solar provisions, only the elements having to do with low-income access and shared solar are relevant.

1. ***A sufficiently ambitious timetable.*** The legislation needs to specify a timetable for target percentages of renewable power, with a target timetable. The timetable must be achievable. For example, a goal of 100% renewable power by 2020 is not practical because renewable generation capacity cannot be expanded in a timely fashion to meet that target. At the same time, the timetable must be sufficiently ambitious. For example, a goal of 20% renewable power by 2050 sets too low of a bar. National Renewable Energy Laboratory (NREL) forecasts renewable penetration of between 33% and 59% by 2050 under a range of scenarios.[50] Significantly, enacting policies such as RPS and expanded low-income solar access will themselves affect where in this range the eventual 2050 renewable penetration will fall; according to NREL, "demand growth...can be just as significant for renewable energy deployment as improved technology costs."[51] Expanded RPS will drive demand growth by mandating that utilities have to meet escalating renewable energy targets, and expanded low-income solar access will increase demand for distributed solar generation. (Note that the NREL forecast is for the United States as a whole. Different states may have higher or lower renewable penetration potential because of resource variability.)

2. ***No non-renewable or dirty power included in "renewables" definition.*** For RPS to be just and effective, it must include only truly renewable sources that do not have serious adverse environmental impacts. Specifically, the following energy sources, sometimes referred to as carbon-free, renewable, or "alternative," do not belong in a RPS.

   a. Nuclear energy is carbon-neutral, but is by definition not renewable since it is based on mining uranium, a finite resource. It is also one of the most expensive sources of electricity. A nuclear plant entering service in 2022 is

expected to generate power at a lifetime-averaged cost of $102.80 per megawatt-hours (MWh), as compared to pre-tax credit cost of power from wind ($64.50/MWh) and solar photovoltaic ($84.70/MWh).[52] There is also significant environmental controversy regarding nuclear power, a discussion of which is outside the scope of this report.

b. Incineration of municipal and industrial process waste produces more pollutants such as methane and nitrous oxide (N_2O) per megawatt-hour (MWh) of electricity output than coal,[53] as well as other toxic byproducts such as dioxins, furans, and mercury.[54] Also, waste incineration is not climate-neutral. A life cycle analysis study showed that the energy recovered from incinerating waste is less than the energy saved by recycling or reusing the waste instead.[55] Critically, the environmental impacts of incinerators are disproportionately borne by low-income people and people of color.[56]

c. Biofuels, which are carbon-based fuels derived from plant matter, are often promoted as climate-neutral renewable energy. (Biofuels have been used more as a substitute for diesel and gasoline in transportation, but are also used to some extent in electric power generation. Wood and wood-derived fuels and "other biomass" constituted 0.9% and 0.3%, respectively, of U.S. electric power generation capacity in 2015.[57]) However, studies show that the production of biofuels uses more fossil energy over its life cycle (including energy and fossil fuel-based fertilizer use for growing the crops from which the biofuels are derived and process energy use for converting the harvested plant matter into biofuels) than the recoverable energy content of the biofuels. This results in a net negative energy return, meaning that crop-based biofuels are not in fact carbon-neutral.[58] There are environmental concerns regarding the production of biofuels as well, including concerns with regard to large-scale agricultural practices in general (but that apply to biofuels because the crops used as biofuels feedstock are grown using the same industrial agriculture methods), such as excessive water use, topsoil erosion, fertilizer and pesticide use and their impact on runoff and water quality, and genetically modified organisms (GMOs) in biofuel feedstock.[59] Other concerns are particular to biofuels, such as the large quantity of polluting wastewater produced (131 liters of wastewater per liter of corn-based ethanol, for example).[60] There are serious economic and human rights concerns about the impact of large-scale biofuels production on food supply and food prices, because of the diversion of food crops (such as corn) into biofuels production, as well as the diversion of arable land from food crop production to fuel crop production. Related to these are concerns about the impact of profitable biofuels production growth on land rights for peasant communities (including indigenous peoples) in Africa, Asia, and Latin America.[61]

3. ***A system of tradable renewable energy credits (RECs) to facilitate tracking.*** Renewable energy credits, also called certificates, are tradable credits representing renewable attributes of electricity.[62] For every megawatt-hour (MWh) of electricity generated, the producer is issued a REC, which they can sell. Sale of the REC provides more income to the renewable electricity producer, and purchasers of RECs can count their purchases towards meeting their renewable energy goals. Since there is no way to segregate electricity in the grid by its origin, RECs serve as a tracking and tracing mechanism to ensure that distribution utilities are meeting their renewables purchase requirements. Care must be taken to ensure that RECs are not double-counted, and are retired after being used to comply with an RPS so they are not used again to comply with that state's (or another state's) RPS.[63]

4. ***Meaningful penalties for noncompliance.*** Penalties for noncompliance can make utilities meet their targets if and only if they are at least equal to the cost of complying with the policy, so it does not become cheaper for utilities to pay fines rather than comply with RPS.[64] Effective penalty amounts vary depending on the utility regulations in the state (including the provisions for cost recovery through rate increases). Some states (such as Hawaii) have left the process of setting the penalty amounts entirely up to the Public Utilities Commission (PUC).[65] Others (such as Minnesota) specify that the penalties must not exceed the cost of compliance, defined as the lesser of the cost of building new generation capacity to meet the standard, or the cost of purchasing the equivalent amount of RECs, while leaving the exact penalty amounts to be determined by the PUC.[66] In such cases, intervention in the PUC regulatory process is required to ensure that the penalty amount is effective. (Note that the Minnesota approach sets a maximum penalty, and a corporate-friendly PUC can set penalties well below this maximum.) It is desirable to segregate the revenues from the noncompliance penalties from the state's general revenues and use them for renewable energy development, including for programs targeting low-income people, as the District of Columbia has done in its 2016 amendment to its RPS.[67]

5. ***Requirement to fund solar access for low-income households.*** State-funded low-income solar access, in the form of grants or very low-interest financing to fund some or all of the upfront costs for solar installation for low-income households, work best as statutory requirements rather than discretionary programs. The District of Columbia program referred to in (4) above, which provides dedicated Renewable Energy Development Fund (REDF) funding to install solar arrays on at least 100,000 low-income households' homes by 2032, is a good example. Grants are preferable to loans as a means of expanding access to low-income households, but if political or fiscal constraints make it impossible to implement a grant program, then a loan program can be used instead, with an interest rate cap and some form of principal repayment assistance for low-income families, as in the Massachusetts Solar Loan program[68], and on-bill financing, as in New York's NY-SUN Incentive Program.[69]

6.   ***Incorporating a "green jobs" component into the low-income solar program.*** A program of solar installation with state incentives on low-income ratepayer's homes provides an opening to require targeted hiring and training of persons from historically excluded communities (people of color, low-income people) for the installation jobs. The California Single-family Affordable Solar Homes (SASH) program is required by the authorizing legislation to provide "job training and employment opportunities in the solar energy and energy efficiency sectors of the economy," and accomplishes this by partnering with GRID Alternatives[70], a non-profit organization.[71] GRID makes solar energy more affordable by providing volunteer labor for solar installation on low-income homes, while also providing hands-on solar installation experience to people from underserved communities.[72]

7.   ***Legislative provision for shared solar.*** This would require utilities to treat shared solar arrays as distributed generation on par with solar arrays on ratepayers' own property, and commit to purchasing their output as well as any RECs they generate, as Colorado has done in the legislation setting up its "shared solar garden" program.[73] The Colorado Public Utilities Commission (PUC) issued regulations requiring utilities to set aside 5% or more of the output they purchase from shared solar arrays to be from low-income subscribers, as determined by whether a household is a beneficiary of the Colorado Low-Income Energy Assistance Program (LEAP).[74] Other provisions for effective shared solar include:

   a)   "virtual net metering," in which multiple ratepayers can get on-bill benefits from the distributed generation from a single solar array that may not be on the property of any of the ratepayers, but instead on some third party's property, in a prorated share corresponding to their share of the array;

   b)   specifications of maximum share of a shared solar array that one ratepayer may own;

   c)   provisions regarding portability (for example, if a ratepayer owns a share in a shared solar array, and moves to a different address, do they take the share with them?);

   d)   provisions regarding tradability whether or not it is possible for a part-owner of a shared solar array to sell their share to another ratepayer, and if so, how the share will be valued);

   e)   provisions for the structure of the entity that would own the shared solar array (a cooperative, or some other structure);

   f)   provisions governing the contractual relationship between the shared solar array owner and the "host" (the entity on whose property the system is located);

   g)   structuring the ownership and tradability of shares in a shared solar array such that Securities and Exchange Commission (SEC) reporting requirements are not triggered.[75]

8.   ***Combining funding for solar access for low-income communities (#5) and its related targeted hiring and training component (#6) with shared solar (#7).*** California's Multifamily Affordable Solar Homes (MASH) program, which is a shared-solar-like program targeting multifamily low-income housing (though it is not true shared

solar), has state funding and has the same requirements of targeted hiring and training of people from underserved communities as in the SASH program (see #6).[76] The enabling legislation for a shared solar program could specify that the dedicated funding for solar access for low-income households (such as in the District of Columbia's "Solar for All" program referred to in #5) can also be used to fund low-income ratepayer's shares in a shared solar array, and that state-funded solar installation jobs targeting low-income people, whether for on-site or for shared solar programs, are subject to requirements to hire and train workers from historically excluded communities.

APPENDIX: TABLES

Table 1. Selected Energy Jobs (Q1 2016)[77] Compared to Generating Capacity in MW (2015).[78]

Energy Source (a)	Power Generation Jobs (b)	Fuel Production Jobs (c)	Total Jobs	Generation Capacity (d)	Capacity Growth 2014-15, %
Solar	373,807		373,807	23,441.8	32.4%
Wind	101,738		101,738	72,573.4	13.0%
Geothermal	5,768		5,768	2,541.5	1.1%
Wood and Wood-based Biofuels		30,458	30,458	8,968.9	7.2%
Nuclear	68,176	8,595	76,771	98,672.0	0.1%
Coal	86,035	74,084	160,119	279,719.9	-6.5%
Natural Gas	52,125	309,993	362,118	439,425.4	1.7%
Oil/Petroleum	12,840	502,678	515,518	36,830.3	-10.5%

Notes

(a) Not all energy sources listed in the Department of Energy jobs report or the Energy Information Administration capacity data are listed. Only sources which can be directly compared are listed. For example, the jobs report classifies hydropower into traditional vs. low-impact, while the capacity data classifies hydropower into conventional vs. pumped storage. The categories are overlapping and cannot be compared directly. Similarly, the jobs data classifies biomass power into corn ethanol, other ethanol, wood-based biomass, and other, while the capacity data classifies biomass power into wood-based and other.

(b) Power generation jobs include all jobs attributable to power generation excluding fuel production jobs (see (c) below). This includes jobs related to the ongoing operation of power generating plants, construction of power generating capacity, manufacturing of power generation equipment, distribution and wholesale of power generating equipment, etc.

(c) Fuel jobs include all jobs related to production of the fuel, including oil and gas drilling, coal mining, oil refining, nuclear fuel refining, mine site preparation, mining and drilling equipment manufacturing, etc.

(d) For solar energy, the generation capacity shown is the sum of utility-scale solar and distributed solar. Distributed solar generation capacity could not be determined for 2014. The growth of solar generation capacity may therefore be overstated or understated.

Table 2. Estimates of Construction and Installation and Related Jobs Created Through Every $1 Million in Capital Expenditure for Added Generation Capacity, by Energy Source.[79]

Energy Source	Direct Jobs (a)	Indirect Jobs (b)	Induced Jobs (c)	Total Jobs
Hydro	5.2	4.2	3.8	13.2
Wind onshore	4.7	4.4	3.6	12.7
Solar photovoltaic	5.5	4.1	3.8	13.4
Solar thermal	5.0	4.3	3.7	13.0
Geothermal	3.0	4.4	3.0	10.3
Oil and natural gas	3.2	4.3	3.0	10.5
Coal	3.2	4.4	3.0	10.6
Nuclear	3.8	4.1	3.2	11.1

Notes

(a) Direct jobs are self-explanatory (for example, solar installation jobs, gas-fired power plant construction jobs, etc.).

(b) Indirect jobs are jobs at suppliers of materials to the respective industries (for example, wind turbine manufacturing jobs, oil and gas pipeline manufacturing jobs, etc.).

(c) Induced jobs are jobs created through a "multiplier effect" through demand resulting from purchase of goods and services by workers in the direct and indirect jobs.

One of the renewable sectors that this report considered in their job estimates was bioenergy; however, we regard it as controversial (see Section C.2) and have omitted it from the comparison.

Table 3. Estimates of Generating Capacity Operations and Maintenance and Related Jobs Sustained By Every $1 Million in Operations and Maintenance Expenditure, by Energy Source.[80]

Energy Source	Direct Jobs	Indirect Jobs	Induced Jobs	Total Jobs
Hydro	1.5	2.4	1.6	5.5
Wind	1.5	2.4	1.6	5.5
Solar photovoltaic	1.5	2.4	1.6	5.5
Solar thermal	1.5	2.4	1.6	5.5
Geothermal	1.5	2.4	1.6	5.5
Oil	0.8	3	1.5	5.3
Coal	1.5	2.4	1.7	5.5
Natural gas	1.5	2.4	1.57	5.5
Nuclear	1.5	2.4	1.57	5.5

See notes to Table 2 for explanation of direct, indirect, and induced jobs.

ENDNOTES

[1] National Council of State Legislatures (NCSL), STATE RENEWABLE PORTFOLIO STANDARDS AND GOALS, updated 12/28/2016, available at: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

[2] Ibid.

[3] Dickerson, Chris, "UPDATE: Lawmakers pass repeal of energy law," West Virginia Record, 1/27/2015, available at: http://wvrecord.com/stories/510588339-update-lawmakers-pass-repeal-of-energy-law.

[4] Lowry, Bryan, "Kansas House swaps renewable energy mandate for non-binding goal," Wichita Eagle, 5/7/2015, available at: http://www.kansas.com/news/politics-government/article20465616.html.

[5] Michigan Senate Bill 438, signed into law by the Governor on 12/21/2016; http://www.legislature.mi.gov/documents/2015-2016/publicact/htm/2016-PA-0342.htm.

[6] National Council of State Legislatures (NCSL), STATE RENEWABLE PORTFOLIO STANDARDS AND GOALS, updated 12/28/2016, available at: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

[7] District of Columbia Act 21-466, 2016, Section 3 (http://lims.dccouncil.us/Download/35409/B21-0650-SignedAct.pdf).

[8] New York State Energy Research and Development Authority (NYSERDA), "Customer Guide to Solar in New York: NY-Sun Incentive Program," available at: https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Customers/Available-Incentives/Affordable-Solar.

[9] National Renewable Energy Laboratory (NREL), U.S. Department of Energy, Shared solar Fact Sheet, available at: http://www.nrel.gov/tech_deployment/state_local_governments/communitysolar.html.

[10] U.S. Department of Energy, Community Shared Solar Frequently Asked Questions (FAQs), available at: http://apps3.eere.energy.gov/greenpower/community_development/community_solar_faq.html.

[11] Single-Family Affordable Solar Homes (SASH) 2.0 PROGRAM HANDBOOK, downloadable at: http://www.gosolarcalifornia.ca.gov/affordable/sash.php

[12] http://www.masssolarloan.com/ (with more details under tabs titled "For Consumers and Residents" and "For Banks and Credit Unions").

[13] Interstate Renewable Energy Council (IREC), State Shared Renewable Energy Program Catalog, last updated 12/1/2016, downloadable in Excel spreadsheet form at: http://www.irecusa.org/regulatory-reform/shared-renewables/state-shared-renewable-energy-program-catalog/.

[14] Hirji, Zahara, "Hundreds of Clean Energy Bills Have Been Introduced in States Nationwide This Year," Inside Climate News, 3/27/2017.

[15] U.S. Environmental Protection Agency (EPA), "Inventory of U.S. Greenhouse Gas: Emissions and Sinks:1990-2015," draft report for public comment, Table 2-10, pp. 2-23 – 2-25, available at https://www.epa.gov/sites/production/files/2017-02/documents/2017_complete_report.pdf.

[16] Distributed solar is different from "utility scale solar," which consists of large solar power generation plants, and which can include both solar photovoltaic or PV technology, and, more rarely, solar thermal technology, in which steam formed from solar heat drives a turbine-generator set.

[17] Our calculation based on U.S. Energy Information Administration (EIA), Retail Sales of Electricity data series, downloadable in Excel spreadsheet format from interactive search on http://www.eia.gov/electricity/data/browser/#/topic/5?agg=2,0,1&geo=g&freq=M&start=200101&end=201611&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=. (Time series and output options can be customized.)

[18] Ibid.

[19] Our calculation based on U.S. Bureau of the Census, American Housing Survey 2013 National Summary Tables, Table C-09-AO, Income Characteristics—All Occupied Units, downloadable in Excel spreadsheet format at: http://www.census.gov/programs-surveys/ahs/data/2013/ahs-2013-summary-tables/national-summary-report-and-tables---ahs-2013.html.

[20] Mari Hernandez, "Rooftop Solar Adoption in Emerging Residential Markets," Center for American Progress, May 2014, available at: https://www.americanprogress.org/issues/green/reports/2014/05/29/90551/rooftop-solar-adoption-in-emerging-residential-markets/.

[21] Our calculation based on U.S. Energy Information Administration (EIA), Residential Energy Consumption Survey (RECS) 2009, Table CE1.1 Summary Household Site Consumption and Expenditures in the U.S. - Totals and Intensities, downloadable in Excel spreadsheet format from http://www.eia.gov/consumption/residential/data/2009/index.php?view=consumption#summary.

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[23] Energy Information Administration (EIA), "The Effect of Income on Appliances in U.S. Households," available at: https://

www.eia.gov/consumption/residential/data/2001/appliances/appliances.php.

[24] Our calculation based on U.S. Energy Information Administration (EIA), Residential Energy Consumption Survey (RECS) 2009, Table CE1.1 Summary Household Site Consumption and Expenditures in the U.S. - Totals and Intensities, downloadable in Excel spreadsheet format from http://www.eia.gov/consumption/residential/data/2009/index.php?view=consumption#summary.

[25] An in-depth examination of the disparate harm to low-income communities and communities of color from fossil fuel extraction and use is outside the scope of this report. For two specific examples of studies documenting this disparate impact, see: Miranda, Marie Lynn, Sharon E. Edwards, Martha H. Keating, and Christopher J. Paul, "Making the Environmental Justice Grade: The Relative Burden of Air Pollution Exposure in the United States," International Journal of Environmental Research and Public Health, 2011, pp. 1755 – 1771; and Clark, Lara P., Dylan B. Millet, and Julian D. Marshall, "National Patterns in Environmental Injustice and Inequality: Outdoor NO2 Air Pollution in the United States," PLOS One, Volume 9 Issue 4, April 2014.

[26] Our calculation based on U.S. Energy Information Administration (EIA), Residential Energy Consumption Survey (RECS) 2009, Table CE1.1 Summary Household Site Consumption and Expenditures in the U.S. - Totals and Intensities, downloadable in Excel spreadsheet format from http://www.eia.gov/consumption/residential/data/2009/index.php?view=consumption#summary.

[27] U.S. Department of Health and Human Services (HHS), Low Income Home Energy Assistance Program (LIHEAP), "LIHEAP Home Energy Notebook for FY 2011," Tables 2-1a through 2-1c, p. 4, available at: https://www.acf.hhs.gov/sites/default/files/ocs/fy2011_hen_final.pdf In this study, a low-income household is defined as a household with annual income less than the greater of 150% of HHS Poverty Guidelines and 60% of State median income.

[28] Our calculation based on U.S. Bureau of the Census, American Housing Survey 2013 National Summary Tables, Table C-09-AO, Income Characteristics—All Occupied Units, downloadable in Excel spreadsheet format at: http://www.census.gov/programs-surveys/ahs/data/2013/ahs-2013-summary-tables/national-summary-report-and-tables---ahs-2013.html.

[29] Ibid.

[30] NAACP Environmental and Climate Justice Program, "LIGHTS OUT IN THE COLD: Reforming Utility Shut-Off Policies as If Human Rights Matter," March 2017, available at: http://www.naacp.org/wp-content/uploads/2017/03/Lights-Out-in-the-Cold.pdf

[31] Mueller, James A., and Amit Ronen, "Bridging the Solar Income Gap," GW Solar Institute, George Washington University, January 2015.

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[33] SKEO Solutions, "Planning for Climate and Energy Equity in Maryland," prepared for the Town Creek Foundation, December 2015, available at: http://mdehn.org/wp-content/uploads/2016/03/Planning-for-Climate-and-Energy-Equity-in-Maryland-Final-12-30-2015-3.pdf.

[34] Methodological note: the generation jobs count from the Department of Energy includes all jobs attributable to power generation, including jobs related to the ongoing operation of power generating plants, construction of power generating capacity, manufacturing of power generation equipment, distribution and wholesale of power generating equipment, etc. The generation jobs count does not, however, include "fuel jobs" related to oil and gas drilling, coal mining, mine site preparation, mining and drilling equipment manufacturing, etc.

[35] U.S. Energy Information Administration (EIA), Electric Power Annual Capacity by Energy Source, downloadable in Excel format at https://www.eia.gov/electricity/data.cfm#gencapacity.

[36] U.S. Department of Energy, U.S. Energy and Employment Report 2017, Table 1, p. 29, available at: https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf.

[37] Our calculation based on Ibid.

[38] Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Bracken Hendricks, "Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities," Political Economy Research Institute (PERI), University of Massachusetts Amherst, and Center for American Progress, September 2014, Chapter 6, Employment effects of the clean energy investment framework, available at: https://cdn.americanprogress.org/wp-content/uploads/2014/09/PERI.pdf. The count of jobs includes direct , indirect, and induced jobs. Direct jobs are self-explanatory (for example, solar installation jobs). Indirect jobs are jobs at suppliers of materials to the respective industries (solar installation, wind turbine installation, coal mining, etc.). Induced jobs are jobs created through a "multiplier effect" through demand resulting from purchase of goods and services by workers in the direct and indirect jobs. One of the renewable sectors that this report considered in their job estimates was bioenergy; however, we regard it as controversial (see Section C.2) and have omitted it from the comparison.

[39] The 10th percentile wage for an occupation is the wage level such that just 10% of workers in the occupation earn lower wages.

[40] Only distinct occupations that are not professional, technical, or supervisory are included in the comparison. For example, mining occupations which combine coal and metals mining are not distinct energy occupations and are therefore excluded. Likewise, nuclear engineers (who typically have advanced degrees) are excluded. Some occupational titles are condensed in Figure 7 for ease of presentation.

[41] Bureau of Labor Statistics (BLS), Occupational Employment Statistics (OES) data, May 2015, available (in Zip file format expandable to Excel) at: https://www.bls.gov/oes/#data.

[42] U.S. Energy Information Administration (EIA), Table 2.3,. Revenue from Sales of Electricity to Ultimate Customers, available at: http://www.eia.gov/electricity/annual/html/epa_02_03.html.

[43] Farrell, John "Beyond Utility 2.0 to Energy Democracy," Institute for Local Self Reliance (ILSR), December 2014.

[44] Oregon Senate Bill 1547 and House Bill 4036, 2016.

[45] From search by bill number and session year on: https://www.oregonlegislature.gov/

[46] "Health Advocates Favor The Coal Transition," Renew Oregon press release, 2/9/2016.

[47] "Clean Energy Advocates Announce A Huge Deal," Renew Oregon press release, 1/6/2016.

[48] Shilpa Joshi, Organizing Director, Renew Oregon, personal communication, 3/9/2017.

[49] http://www.reneworegon.org/the_campaign

[50] National Renewable Energy Laboratory, U.S. Department of Energy, "2016 Standard Scenarios Report: A U.S. Electricity Sector Outlook," Figure 14, p. 14, November 2016, available at: http://www.nrel.gov/docs/fy17osti/66939.pdf.

[51] Ibid., p.,12.

[52] U.S. Energy Information Administration (EIA), "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2016," downloadable at: http://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.

[53] Our calculation based on U.S. Environmental Protection Agency (EPA), eGrid 2014 data set, 2/27/2017, plant-level data, downloadable in Excel format at: https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid, supplemented with the corresponding technical documentation, downloadable at: https://www.epa.gov/sites/production/files/2017-02/documents/egrid2014_technicalsupportdocument_v2.pdf. Solid wood waste has the highest methane and nitrous oxide emissions per MWh of any energy source, and municipal solid waste has the second highest.

[54] "Incinerators Trash Community Health," Global Alliance for Incinerator Alternatives (GAIA), June 2008, available at: http://www.no-burn.org/wp-content/uploads/Incinerators-Trash-Community-Health.pdf.

[55] Morris, Jeffrey, "Comparative LCAs for Curbside Recycling Versus Either Landfilling or Incineration with Energy Recovery," The International Journal of Life Cycle Assessment, Vol. 10 Issue 4, 2005; abstract available at: https://link.springer.com/article/10.1065%2Flca2004.09.180.10. (The complete paper is paywalled.)

[56] See, for example, documentation of the disproportionately large African-American population in Georgia counties with "waste-to-energy" incinerators in Bullard, Robert D., "Dismantling Energy Apartheid in the United States: A Black History Month Special Report," Dissident Voice, 2/9/2011.

[57] U.S. Energy Information Administration (EIA), Electric Power Annual Capacity by Energy Source, downloadable in Excel format at https://www.eia.gov/electricity/data.cfm#gencapacity.

[58] Pimentel, David, and Tad W. Patzek, "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower," Natural Resources Research, Vol. 14, No. 1, March 2005; Pimentel, David, "Ethanol Fuels: Energy Balance, Economics, and Environmental Impacts are Negative," Natural Resources Research, Vol. 12, No. 2, June 2003.

[59] Ibid; see also "FUELING DISASTER: A COMMUNITY FOOD SECURITY PERSPECTIVE ON AGROFUELS," Community Food Security Coalition, December 2007, available at http://alivebynature.com/Fueling_Disaster.pdf; and, "The Real Cost of Agrofuels: Impacts on food, forests, peoples and the climate," Global Justice Ecology Project, 2008, available at http://globaljusticeecology.org/files/Truecostagrofuels.pdf.

[60] Pimentel, David, and Tad W. Patzek, "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower," Natural Resources Research, Vol. 14, No. 1, March 2005; Pimentel, David, "Ethanol Fuels: Energy Balance, Economics, and Environmental Impacts are Negative," Natural Resources Research, Vol. 12, No. 2, June 2003.

[61] "Biofueling Hunger: How US Corn Ethanol Policy Drives up Food Prices in Mexico," ActionAid USA, May 2012, available at http://actionaid.org/sites/files/actionaid/biofueling_hunger_aausa.pdf; "The European Commission 2015 Renewable Energy Progress report overlooks adverse impacts of the EU biofuels policy in developing countries," Action Aid International, March 2016, available at http://actionaid.org/sites/files/actionaid/expose_progressreportec_final_inclus_0.pdf; "FUELING DISASTER: A COMMUNITY FOOD SECURITY PERSPECTIVE ON AGROFUELS," Community Food Security Coalition, December 2007, available at http://alivebynature.com/Fueling_Disaster.pdf; and, "The Real Cost of Agrofuels: Impacts on food, forests, peoples and the climate," Global Justice Ecology Project, 2008, available at http://globaljusticeecology.org/files/Truecostagrofuels.pdf.

[62] For a detailed explanation, see https://www.epa.gov/greenpower/renewable-energy-certificates-recs.

[63] "RECOMMENDED PRINCIPLES AND BEST PRACTICES FOR STATE RENEWABLE PORTFOLIO STANDARDS," State-Federal RPS Collaborative, January 2009.

[64] Ibid.

[65] Hawaii Revised Statutes (HRS) §269-92 (c).

[66] Minnesota Statutes, 216B.1691, Subdivision 7.

[67] See for example District of Columbia Code § 34-1436.

[68] http://www.masssolarloan.com/ (with more details under tabs titled "For Consumers and Residents" and "For Banks and Credit Unions").

[69] New York State Energy Research and Development Authority (NYSERDA), "Customer Guide to Solar in New York: NY-Sun Incentive Program," available at: https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Customers/Available-Incentives/Affordable-Solar.

[70] CA Assembly Bill 217, 2013.

[71] Single-Family Affordable Solar Homes (SASH) 2.0 PROGRAM HANDBOOK, downloadable at: http://www.gosolarcalifornia.ca.gov/affordable/sash.php

[72] http://www.gridalternatives.org/what-we-do

[73] Colorado House Bill 10-1342, 2010.

[74] Colorado Public Utilities Commission (PUC), Code of Colorado Regulations (CCR) 723-3, RULES REGULATING ELECTRIC UTILITIES, Section 3665. The 5% share may be met by one or both of set-asides for power purchase from arrays owned entirely by low-income subscribers, or a prorated share of power purchases from arrays corresponding to their ownership by low-income subscribers.

[75] For a detailed discussion of policy elements to consider for enabling legislation for shared solar, see: National Renewable Energy Laboratory (NREL), U.S. Department of Energy, "Community Shared Solar: Policy and Regulatory Considerations," September 2014, available at http://www.nrel.gov/docs/fy14osti/62367.pdf; Interstate Renewable Energy Council (IREC), "Model Rules For Shared Renewable Energy Programs," February 2017, available (with free registration) at http://www.irecusa.org/wp-content/uploads/2017/02/FINAL_17_02_02_irec_guiding_principles_feb_2017-1.pdf.

[76] The California MASH program provides targeted state funding for installing solar arrays on multifamily low-income housing (such as apartment buildings), and provides for virtual net metering benefits for the residents. Like shared solar, the MASH program allows for multiple beneficiaries of the same solar array, who are tenants rather than owners of the property where the array is located. Unlike true shared solar, the MASH program does not allow for the solar array to be located off-site. See California Public Utilities Commission Multifamily Affordable Solar Housing Program Handbook, downloadable at: http://www.gosolarcalifornia.ca.gov/documents/MASH_Handbook.pdf

[77] U.S. Department of Energy, U.S. Energy and Employment Report 2017, Table 1, p. 29, available at: https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf.

[78] All data except distributed solar generation capacity from U.S. Energy Information Administration (EIA), Electric Power Annual Capacity by Energy Source, downloadable in Excel format at https://www.eia.gov/electricity/data.cfm#gencapacity; distributed solar generation capacity from EIA, Electric Power Annual Capacity, Table EPA-04-03, downloadable in Excel format at https://www.eia.gov/electricity/data.cfm#gencapacity.

[79] Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Bracken Hendricks, "Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities," Political Economy Research Institute (PERI), University of Massachusetts Amherst, and Center for American Progress, September 2014, Chapter 6, Employment effects of the clean energy investment framework, Tables 6.3 and 6.8, available at: https://cdn.americanprogress.org/wp-content/uploads/2014/09/PERI.pdf. The count of jobs includes direct, indirect, and induced jobs. Direct jobs are self-explanatory (for example, solar installation jobs). Indirect jobs are jobs at suppliers of materials to the respective industries (solar installation, wind turbine installation, coal mining, etc.). induced jobs are jobs created through a "multiplier effect" through demand resulting from purchase of goods and services by workers in the direct and indirect jobs. One of the renewable sectors that this report considered in their job estimates was bioenergy; however, we regard it as controversial (see Section C.2) and have omitted it from the comparison.

[80] Ibid., Tables 6.4 and 6.8.