Crafting Community Solar Programs to Alleviate Energy Burdens and Empower Communities in Virginia

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This Master's Project

Crafting Community Solar Programs to Alleviate Energy Burdens and Empower Communities in Virginia

by

Ellie Sekelsky

is submitted in partial fulfillment of the requirements for the degree of:

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at the

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Ellie Sekelsky
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[MP Instructor]  
[Date]
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List of Abbreviations:

LMI – Low-middle Income groups
PV – Photovoltaic solar cells
CSP – Concentrated Solar Power
WAP – Weatherization Assistance Program
LIHEAP – Low-Income Housing Energy Assistance Program
LIHTC – Low-Income Housing Tax Credit
SCC – State Corporation Commission
CSF – Community Solar Facility
RAC – Rate Adjustment clauses
VPLC – Virginia Poverty Law Center
DHCD – Department of Housing and Community Development
WDR – Weatherization Deferral
SSI – supplemental security income
TANF – temporary assistance to needy families
WDR – Weatherization Deferral Repair Program
HIEE – Housing Innovations of Energy Efficiency
RGGI – Regional Greenhouse Gas Initiative
EIA – Energy Information Association
Abstract:

Low to moderate-income (LMI) groups usually suffer from high energy burdens and community solar is a renewable energy strategy that can save LMI groups on their monthly electricity bills. This research explores the intersection of renewable energy and energy justice, specifically the potential for community solar, energy efficiency, and home weatherization to alleviate Virginia's energy burdens. Included is an analysis of incentives, programs, and Greenhouse gas emission goals for the state, investigations on how low-income groups are receiving aid and what is available to them from programs and utilities, suitable sites for solar based on groups in need, and comparisons are made between active community solar programs in other states to what Virginia offers. These analyses reveal that Virginia has solar incentives and programs however not enough for LMI groups to benefit. This confirms that there is not enough funding to tackle the everyday needs of all burdened people to benefit from renewably sourced electricity. Recommendations for the state to improve Community Solar for disadvantaged groups include 1) empowering and providing funding for smaller communities to facilitate community solar, electric bill assistance, and weatherization relief, 2) Optimizing the location of community solar and new infrastructure with low-income communities in mind, 3) improving education towards the availability of energy assistance and the benefits renewable energy provides for smaller communities, 4) emphasize the importance of collaboration between utilities, governments, non-profits, and communities to create a cohesive and well run community solar program. These recommendations stress that small LMI communities need to gain more support and financial benefits to be included in the renewable energy revolution.

Acknowledgements:

I would like to give a big thank you to my master’s project advisor, Stephanie Siehr, for her active guidance, support, and feedback throughout this project’s entirety. I would also like to thank my family and friends as well for encouraging me throughout my time at USF to put my best foot forward. Specifically, I would like to thank my parents for their never-ending support for my interests and pursuit of a master’s degree.
Chapter 1:  
1.1 Introduction  

Investments in energy efficiency and renewable energy at the state and local levels can yield benefits, such as reduced fuel and electricity expenses, enhanced grid reliability, improved air quality and public health, and create more job opportunities (Mulholland et al. 2018). Generating electricity from renewable resources is a challenge that the United States has been implementing at different rates. Making the switch from fossil fuel energy production to green energy production (such as wind or solar generation) is met with a lot of challenges, but many policies and programs are being adopted across the nation at the state level working for this production. Significant changes to the grid are occurring everywhere. With these changes, new technologies for our country's energy systems require innovation as new requirements for energy storage, renewable resource abundance, and energy transmission emerge. There are currently 23 US states and 2 territories have implemented electricity production goals for zero greenhouse gas emissions (Xu 2022). For every state, these goals differ and each one runs into different challenges that can prevent affordable clean energy. With the cooperation of state governments, state electricity providers, and low-income assistance programs, renewable energy goals can be attainable and affordable for all residents of these territories. Renewable energy goals and improvements are the future however, some sociodemographic groups can get left behind. Specifically, lower-income groups can struggle to keep up with these goals as programs can lead to unaffordable costs and lack a focus on developing the energy infrastructure of lower-income areas. As our nation moves forward to create an environmentally sound landscape it is important to understand that all residents must be included in these technological advances, or those goals will not be achievable.

Energy Burdens occur when a household spends a disproportionate and large portion of their income on their monthly energy bills (Kontokosta 2020). Most often this is due to low-income housing having inefficient building techniques or older appliances causing people in LMI groups to use more electricity and have higher costs. In VA some populations are paying more than 8% of their income on energy bills monthly (Drehobl 2020), this is a large and often unaffordable portion of an individual’s salary. The problem is that low-income groups often occupy the lowest-quality housing (Kontokosta 2020). Lower-income housing frequently has inefficient and old appliances. They also do not utilize good weatherization techniques, requiring people to use more
electricity to heat or power their homes causing higher utility bills including gas and electric. Weatherization refers to the ability for one’s home to lose very little, if any, energy. This can include sealing places where air can get in, improving ventilation to improve air quality, or adding insulation. If the building of a person’s home is improved to prevent loss of energy, then they can ultimately save on energy bills due to less demand for things such as heating and cooling (Bechler 2021). Improving the energy efficiency of homes can also work alongside weatherization in lowering energy bills. Energy-efficient appliances do the same job as the more energy-intensive ones, but with less energy (Yeganeh 2020). Everyday items such as lightbulbs or kitchen appliances can be replaced to reduce electricity bills. If communities of all demographics and incomes are expected to participate in the renewable energy movement the abolishment of energy burdens needs to be a priority.

Community solar defined by the United States Department of Energy refers to “any solar project or purchasing program, within a geographic area, in which the benefits of a solar project flow to multiple customers such as individuals, businesses, nonprofits, and other groups” (2024). It is a renewable energy strategy that does not require an individual to install solar onto their property. The Energy Policy Act a federal act put into action in 2005 established the roots for community solar to become an accessible, widespread, and successful energy option for consumers (Energy Policy Act 2005). This act officially defined net metering, allowing several states to adopt the idea. As seen in this act net metering was defined as:

“…service to an electric consumer under which electric energy generated by that electric consumer from an eligible on-site generating facility and delivered to the local distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period” (Energy Policy Act 2005)

This concept made it more accessible to use solar and receive benefits from providing solar-produced electricity to the grid. Net-metering was created for photovoltaic cells (PV) either installed on an individual’s home or any individual who owns a solar system. The term has given more incentive for individuals to install solar, but not all groups have the opportunity to install their own PV panels. Net-metering has also allowed community solar projects to grow in the last few years. Incentivizing not only individuals but solar installers as well. This technique has gained
a lot of popularity because community solar has the power to be a more accessible form of renewable electricity. This technology allows customers to power their homes using solar without the commitment to the more permanent photovoltaic rooftop solar. It also allows customers who lack the resources to host cells on their property, such as people residing in apartment buildings, or rentals, or lack access to adequate sunlight to produce electricity through solar (Coughlin et al. 2011). Community Solar cuts out the commitment of panels and adds the comfort of accessible green electricity.

1.2 Virginia’s Electrical Makeup

Virginia state government has written a few renewable energy goals. The state wants to be 30% electrified by 2030 and 100% green by 2050 (U.S. Energy Information Administration 2024a). Three main investor-owned electric utility companies provide electricity for different populations of the state, Dominion Energy has a goal of being green by 2045, and Appalachian Power and Kentucky Utilities both have a goal of being green by 2050 (State Corporation Commission 2020). 13 member-owned electric cooperatives exist in the state. Each one provides its own renewable energy options for its customers (State Corporation Commission 2020). Six of the co-ops provide a direct community solar electricity service to their customers. This is done by outsourcing from local shared solar sites. The others all provide a solar incentive program such as net metering (State Corporation Commission 2020). This can encourage the use of individuals sharing their solar power and gaining a benefit from doing so. Dominion Power is the only investor-owned utility that offers a community solar pilot program. The other two major utilities, Appalachian Power and Kentucky Utilities have yet to roll out their pilot programs. They do however encourage the use of solar and offer other green options. Figure 1 demonstrates the localities that all the utilities provide including some non-jurisdictional utilities. Having a plethora of member-controlled and shareholder-controlled utilities presents challenges in launching programs. They all have different follow-throughs and strategies that prevent cohesion in the state. If these utilities want to support the state’s goals all the programs must align.

Virginia electricity is generated in many ways including coal, natural gas, petroleum, renewable energy, and nuclear. Nuclear is the state’s largest source of electricity. However not all the nuclear they use is supplied from in-state plants. Natural gas from in-state supplies is responsible for about 54% of the state’s electricity making it the largest contributor to electricity
production in Virginia. Nuclear supplies from in-state plants provide about 31%, renewable energy 11%, and coal accounts for 4%. Up until 2009 coal was the main electricity generation technique but has since been declining in use. Renewables are slowly taking its place. The state has large offshore wind potential which has led to projects dedicated to harnessing wind power (U.S. Energy Information Administration 2024a).

Figure 1: Electric utility service areas in Virginia (State Corporation Commission 2020).

One main issue is finding suitable sites to locate local community solar locations to source from. Some things to consider when placing a shared solar site include the amount of solar potential the area of land gets, what communities should be a priority, if development will impact the ecosystems surrounding it, and more (Katkar et al. 2021). Factors that should be investigated include poverty level, Energy Burden, land type, existing solar farm sites, and solar irradiance.

With state policies promoting community solar and aiding with weatherization and energy-efficient housing these two can work together to ensure no resident of Virginia gets left behind and the state’s green energy goals can be achieved. The goal of this project is to identify program recommendations for ensuring Community Solar’s success in the state as a renewable energy source and an affordable option for aiding energy-burdened households.
1.3 Research Questions

Community solar is not a new concept in the state, but many of the programs that state utilities provide are new. To successfully implement a program, I wanted to explore what the state is doing to aid low-income customers as the state and utilities are encouraging and rolling out their Community Solar programs and provide recommendations for improvements on the program. I have several sub-questions that I will center my research around. Each question has different methods associated.

1) What is required to impart a successful community solar program in Virginia that can effectively reduce energy burdens for low-income groups in the state?
   a. Policy/Program analysis: What policies/programs or incentives already exist for implementing solar and aiding lower-income groups?
   b. Environmental Justice Analysis: What is the state doing to reduce energy burdens and increase energy justice?
   c. Geospatial analysis: Where are suitable sites for community solar in Virginia?
   d. Comparative Case Study: What needs to change for a program like this to be successful for all residents of VA?

1.4 Methods

This research reviews the current programs in Virginia for community solar through analysis of state programs and utility offerings. I expect that improved state government programs that aid in decreasing high electricity costs and implementing community solar can improve environmental justice surrounding renewable energy deployment in Virginia and encourage a smoother transition to renewable energy. I will compare these programs to ones found in other states in the US that have successfully implemented community solar programs and aid low-income groups. These will include comparisons to states such as New York, Massachusetts, and California which have implemented permanent community solar programs. Based on these I will provide recommendations from my findings. I will perform a geospatial analysis to provide further recommendations on adequate locations for shared solar facilities that utilities can outsource. Allowing for local source generation and decreasing the chance of energy loss through lengthy transmission. This can also allow me to target communities in need of assistance. I will perform an environmental justice analysis where communities that are struggling more in the state will be
analyzed. The problem is largely stemming from low-income housing and lack of energy efficiency and weatherization quality. Programs related to offering these services are going to be investigated. These analyses combined will bring me to conclusions about gaps in programs and bring to light improvements that are necessary to see a successful movement toward renewable energy and lower energy burdens.

Chapter 2: Overview of Community Solar Programs and Incentives

This chapter goes over why and how community solar compares to other renewable energy options. Existing government incentives and programs are assessed. By the end of this chapter, it will be understood what community solar is and why it is a good option for LMI groups. The programs analyzed included national and state solar programs focused on LMI groups and community solar programs run by the electric utilities in Virginia. This is done through a program analysis of what requirements exist through the federal and state governments.

2.1 Utility Renewable Energy, Community Choice Aggregation, and Community Solar

Renewable energy refers to any sort of energy production that results in producing zero greenhouse gas emissions, this includes solar, wind, hydroelectric, biomass, and other sources that produce electricity for the grid. Customers of a utility can gain their electricity from sources like this if their utility provides this option to them or if they have photovoltaic cells (PV) attached to their homes. If neither of these are true, their home is not running on renewable energy sources. Having customers receive a specific type of renewable energy, provided by a renewable energy provider, to power their homes is impossible because the grid cannot separate the individual electrons coming from different sources of electricity (US Department of Energy 2024). Because of this a lot of electric utilities offer renewable electricity but as a subscription for their customers to pay to allow a portion of the grid to be electrified from renewables. For these programs a customer pays to add a renewable run source and the source is added to the grid for all customers (Thoubboron 2022). Encouraging utilities to continue programs like this or include more renewables to their portfolio is the best option to ensure that customers can receive the benefits.

Community Choice Aggregation (CCA) is a strategy that allows municipalities (cities or counties) to contract for electricity generation from an external alternative supplier (Thoubboron 2022). If residents or businesses move into an area that has municipal aggregation of their
electricity they automatically opt into that program, but they can opt-out to join another utility at any point in time. Because the aggregate is providing electricity for the people living in that community, the city or county can choose what sources to buy their electricity from. This can be in the form of renewable power, natural gas, or any other source they can get supplies from and provide it to their customers at competitive prices. This is an easy option because the people within the community are automatically part of it and given the best prices that their municipal, city, or group aggregate has produced for them (Thoubboron 2022). Virginia is one of eight states in the US that has passed legislation to allow municipalities and the state to take part in aggregation. This was passed in 1999, however, there are currently no plans for aggregation for businesses or individual residents (Thoubboron 2022).

Community solar or Shared solar, is a program run by a community, utility, non-profit, or government where interested participants can opt-in to participate (Thoubboron 2022). Some utilities also offer community solar opportunities, but rather than through the community it is run through the utility. If a utility provides a program, then for a premium price customers pay a subscription to have a portion of the utility’s electricity be generated via solar. Usually, a utility will have its own solar farm that it owns and operates within the service area and saves a percentage of those farms for subscribers to utilize. Community-driven community solar is far more beneficial and relies solely on a community to participate and cooperate for a program to succeed (Environmental Law and Policy Center 2022). Community-run community solar can utilize more competitive prices when choosing a solar provider. This can result in lower costs per kWh for customers ultimately leading to lower electricity bills.

All these programs have pros and cons, but while community solar is a lot of work if your utility provides it for you, it can be more convenient and provide more financial benefits. With CCAs, a city decides to generate electricity for its residents by choosing what energy generation strategy it wants to use, so not much work is involved for the consumer. This strategy does not always lead to financial benefits, but it can (Thoubboron 2022). Choosing the way to be a part of renewable energy generation depends on what is offered to your community.

2.2 The Electrical Grid

To understand community solar technologies completely it is important to understand how the electrical grid works. The generation of electricity can occur from many resources. Resources
that are being weaned out include coal, natural gas, and petroleum liquids. More renewable energy sources include wind, water, and solar. Most of these work by creating some sort of heat to create steam or movement to move a turbine that then creates electricity within the plant’s generator. Solar photovoltaics collect the energy from the sun in the form of photons and converts the radiant energy into energy (Office of Electricity Delivery and Energy Reliability 2015).

There are 3 important steps to the grid. This includes generation, transmission/distribution, and end use. Once electricity is generated from a solar facility it needs to travel. First the electricity travels to a substation and which turns it into high voltages. It is transmitted and distributed using different levels of lines with different capacities (high-capacity transmission lines may be about 500kW and low distribution lines may be <34 kW) until it reaches your home. The end use of electricity is used to power homes and businesses for everyday tasks (Office of Electricity Delivery and Energy Reliability 2015).

The Regional Transmission Organization (RTO) is responsible for controlling and monitoring electric power system operations. The RTO for Virginia is called PJM (Pennsylvania-New-Jersey-Maryland) Interconnection. The unit of measurement for electricity use is in kilowatt hours (kWh). Most often community solar customers subscribe to blocks of solar. Blocks refer to units that community solar is sold in, as an example a utility may sell a subscriber community solar in blocks of 500 kWh a month. The average home in the US uses about 900 kWh per month. A large-scale solar farm is usually measured in MW. The conversions for these units are as follows: 1 kW = 1,000 W, 1 MW = 1,000 kW, 1 GW = 1,000 MW (Office of Electricity Delivery and Energy Reliability 2015). To connect solar to the grid solar must connect to at least a three-phase transmission line (requiring 3 wires) or a substation and usually is at a maximum distance of 4 miles away from that line (Katkar et al. 2021).

With the rise in renewables used today there are innovations being incorporated into our grid including increased energy storage techniques and smart meters. The current grid is antiquated and requires an overhaul. Designs for a more sustainable grid are important the resiliency of the grid for the future will depend on it. Creating new forms of interconnection and storage utilizing existing infrastructure is a must. This includes smart metering so that utilities become more aware of outages or peak use times. Priorities for new distribution techniques should be around low to moderate income groups to increase inclusivity in the electricity distribution (Office of Electricity
Delivery and Energy Reliability 2015). Figure 2 demonstrates a look into a more modernized grid that includes renewable energy production.

![GRID MODERNIZATION](image)

*Figure 2: Example of Grid Modernization. (Puget Sound Energy 2024).*

### 2.3 How Community Solar Works

A popular Solar strategy has been personal Photovoltaic (PV) systems. In this technology, customers have solar cells on their properties or rooftops and generate electricity for their homes using the generated output. Customers of a utility who own and operate PV cells can gain credits on their electricity bills and not have to pay the offset amount on their bill. This is known as net-metering and most utilities offer the program to their customers. This is a great incentive to get people involved with renewable energy systems and gain rewards from being involved, however, about 50% of American households cannot harbor solar cells in their homes nor can they afford it (Devar 2020). Luckily for a lot of people, there is a solution!

The Department of Energy defines Community Solar or shared solar as “any solar project or purchasing program, within a geographic area, in which the benefits of a solar project flow to multiple customers such as individuals, businesses, nonprofits, and other groups.” It has been known to increase access for Low to Moderate-income groups, increase community resilience and health, and create jobs and opportunities within those communities (US Department of Energy 2024). Community solar and shared solar are the same thing, but shared solar refers more so to utility programs while community solar refers to another entity or cooperative that runs a solar program. Community solar projects are often solar farms owned and operated by a government, electric utility, non-profit, or community aggregate. They generate electricity from a large portion of photovoltaic (PV) cells on a large plot of land that are interconnected to the grid and give energy
back to a utility. Subscribers to the electric utility can volunteer to subscribe for their energy to be generated via solar. Having this generation in the customer portfolio allows them to generate credits (Coughlin et al. 2011). Credits are provided by the electric utilities for customers and are then taken off their monthly electricity bills. This gives a good incentive for customers to subscribe to the programs that they offer. Most often subscribing adds to their monthly bill, but it will pay off in the number of credits they receive allowing for discounts on their bill. Figure 3 provides a more visual representation of this process.

![Diagram of the process of utility scale community solar](source author)

**Figure 3:** The Process of Utility Scale Community Solar (source author).

There are two main technologies that communities can utilize:

1. Photovoltaic cells (PV) – cells directly rely on sunlight to generate electricity. Can be used in areas with a low amount of direct radiation as long as there is sunlight. Often can be used for smaller projects and are more affordable (Desideri et al. 2012)

2. Concentrated Solar Power (CSP) – Thermal technology focused on using the sun’s energy into heat. This energy generation is easier to distribute on the grid and can be used in areas where sunlight is unreliable. More expensive to build and cannot operate on a small scale (Desideri et al. 2012).
Both options offer their own pros and cons and choosing the right one for a solar project is based on what the investor wants out of the project and the characteristics of the land for development. PV cells are the most common and affordable route for community solar projects.

Net metering allowed individuals who owned a solar system to gain a profit from their system’s solar output. This also opened the door to community solar programs. Community solar became a possibility for people who may not have the right variables for solar to be successful on their property. Community solar has 3 key models:

- **Utility-Sponsored Model**: utilities control the project, meaning they are responsible for operating and developing it and the customers have the option to partake (Coughlin et al. 2011).

- **Special Purpose Entity (SPE) Model**: a community solar project started when individual investors join a business enterprise (Coughlin et al 2011).

- **Non-Profit “Buy a Brick” Model**: community solar is owned and run by a non-profit and donors can contribute (Coughlin et al 2011).

Figure 4 shows how there are different benefits towards community solar strategies. If the project is community owned, then users will see the most benefits. Table 1 demonstrates how these different models work, their individual goals, and user goals. When installing a shared solar site, it is necessary to consider exactly what is important to your goals to select the right strategy. The most benefits are seen from the community-owned strategy. In this approach, the only stakeholder is the community. This allows the community to receive all the benefits.

![Image](image_url)

*Figure 4: Different Community Solar investors and their benefits. (Environmental Law and Policy Center 2022)*
If an individual is a renter who cannot modify their home, live in an apartment complex, don’t get adequate sunlight, or rooftop solar is too expensive, then community solar is the right option for them (Xu 2022). This renewable energy strategy allows customers easy access to solar that benefits them and the planet. Customers are lending a hand in creating cleaner towns. Using community solar has allowed people to receive Renewable Energy Credits (RECs) if they subscribe to their utility’s program (Coughlin et al. 2011). Giving LMI customers the opportunity to be a part of community solar can greatly improve their health. Making the switch to solar can mean other sources of pollution within their area of residence will be eliminated (Devar 2020). More specifically it is known to include economic benefits, health benefits, resilience benefits, and electrical grid benefits.

Table 1: Comparison of Types of Community Solar. (Coughlin et al, 2011)

<table>
<thead>
<tr>
<th>Administered by</th>
<th>Utility</th>
<th>Special Purpose Entity</th>
<th>Non-profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owned by</td>
<td>Utility or 3rd party</td>
<td>SPE members</td>
<td>Non-profit</td>
</tr>
<tr>
<td>Financed by</td>
<td>Utility, grants, ratepayer subscriptions</td>
<td>Member investments, grants, incentives</td>
<td>Donor contributions, grants</td>
</tr>
<tr>
<td>Hosted by</td>
<td>Utility or 3rd party</td>
<td>3rd party</td>
<td>Non-profit</td>
</tr>
<tr>
<td>Subscriber Profile</td>
<td>Electric rate payers of the utility</td>
<td>Community investors</td>
<td>Donors</td>
</tr>
<tr>
<td>Subscriber Motive</td>
<td>Offset personal electricity use</td>
<td>Return on investment; Offset personal electricity use</td>
<td>Philanthropy</td>
</tr>
<tr>
<td>Long-term Strategy of Sponsor</td>
<td>Offer solar options</td>
<td>Sell system to host</td>
<td>Retain for electricity production for life of system</td>
</tr>
<tr>
<td>Add solar generation (possibly for Renewable Portfolio Standard)</td>
<td>Retain for electricity production for life of system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>Sacramento Municipal Utility District – Solar-Shares Program</td>
<td>University Park Community Solar, LLC</td>
<td>Solar for Sakai</td>
</tr>
<tr>
<td></td>
<td>United Power Sol Partners</td>
<td>Clean Energy Collective, LLC</td>
<td></td>
</tr>
</tbody>
</table>

2.4 Community Solar Programs by the Federal Government

For community solar to take off as a more accessible form of renewable energy in the US the motivation and funding must be available for smaller co-ops and towns to have access to
electricity produced from community solar. The federal government offers incentives and opportunities for community solar projects across the entire United States. These incentives are presented by the Department of Energy as an encouragement to reach 100% renewable energy production by the year 2050 (U.S. Global Change Research Program 2023). Others are specifically made for individual consumers, businesses, or industries such as agriculture. One of these specifically made for community solar is called the Sunny Awards for Equitable Community Solar, a prize for community solar projects across the United States (U.S Department of Energy 2022a). A lot of these programs focus on projects working to include LMI customers and ensure jobs and electricity reliability for users.

This program awards community solar projects every year. The grand prize winners receive $10,000 in prizes and up to $100,000 awarded to community solar projects (U.S Department of Energy, 2022a). These awards do not cover a large amount of the costs associated with deploying and upkeeping a community solar project, but it is a significant amount for non-profits that are working on their own to deploy a project. Table 2 identifies the solar incentives and programs offered by the Federal government focused on aiding LMI or disadvantaged groups (Full table in Appendix 1). A lot of the programs and incentives revolve around tax breaks for solar or renewable projects. The Inflation Reduction Act of 2022 has created room for a $369 billion tax credit on solar and wind projects to boost the development of projects in the US (Daniels 2022). The federal funding here should greatly provide more opportunities for expanding nationwide renewable energy.

Table 2: Federal incentives and programs that aid disadvantaged groups. (Author, compiled from DSIRE 2023).

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>What is it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Energy Conservation Subsidy Exclusion - 2002</td>
<td>Financial incentive</td>
<td>Last updated 2022. Energy conservation funding provided to individual customers by utilities is not taxable.</td>
</tr>
<tr>
<td>Energy-efficient mortgages - 2002</td>
<td>Financial incentive</td>
<td>Last updated 2020. Can finance EE homes. Home loans are financed by FHA or VA programs for people who may not be eligible for loans.</td>
</tr>
</tbody>
</table>
2.5 Solar Programs by the Virginia State Government

Virginia state government has developed a portfolio of renewable or solar-specific energy policies and incentives over the years, some of which have been around for a while. Table 3 demonstrates the policies and incentives by the Virginia state government that can aid in encouraging renewable electricity for LMI or disadvantaged groups (See Appendix 2 for the full table). These can appeal to all parties important to the development of community solar including the utilities, investors, developers, and even the customers can all benefit from what the state provides.

Table 3: VA solar incentives and programs that aid disadvantaged groups. (Author, compiled from DSIRE 2023)

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>What is it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-family shared solar - 2021</td>
<td>Policy</td>
<td>Allow up to 3 MW of solar energy production for multi-family dwelling units such as apartment buildings. This is for multi-family units that use Dominion Energy and Old Dominion Power.</td>
</tr>
<tr>
<td>Mandatory Utility Green Power Option - 2007</td>
<td>Policy leads to programs</td>
<td>Utility must provide an option for customers to supply their homes with 100% green energy. If they cannot the customer is allowed to purchase it from any supplier that is not their utility.</td>
</tr>
<tr>
<td>Green Job Creation Tax Credit - 2010</td>
<td>Incentive</td>
<td>Tax credit of $500 for every new green job created where the person can make over $50,000. Green job must be related to renewable or alternative energy production.</td>
</tr>
<tr>
<td>VirginiaSAVES Green Community Loan Program - 2015</td>
<td>Incentive</td>
<td>Financing for projects dedicated to energy efficiency and renewable energy. Money is provided to non-profits and local governments dedicated to such projects.</td>
</tr>
<tr>
<td>Small business and Non-Profit Loan Program - 2014</td>
<td>Incentive</td>
<td>Small-businesses and non-profits can receive funding for solar or wind additions.</td>
</tr>
</tbody>
</table>

The Virginia Clean Economy Act (VCEA) has also set Virginia on a path toward 100% renewable energy for Dominion Energy by 2045 and 2050 for Appalachian Power. It requires that at least 25% of renewables be dedicated to low-income projects for large utilities (Pitt et al. 2023). These programs are ones offered by state governments. In a study done by Michaud et al. it was found that some people argue that the best way to regulate community solar programs is through the government while others debate that this is something that needs to be controlled by the utilities (2020). However, for programs to be successful it usually involves the cohesive thoughts of multiple media. In this case, a well-rounded program will receive input from the state government while working with utilities (Michaud, 2020). With state policies and incentives, it is also important to look at how the utilities are handling community solar, Table 4 outlines the many utilities that provide electricity throughout the state and what they offer as far as community solar or renewable energy (Appendix 2). Figure 6 demonstrates the process for creating financial incentives for solar by both local governments and utilities and federal government entities.
Figure 6: Federal and local incentive strategies used to encourage solar. (Blommestein et al. 2017)

Table 4: Electric utilities in VA with community solar. (Author, compiled from sources)

<table>
<thead>
<tr>
<th>Utility Name</th>
<th>Solar Program</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>BARC Electric Cooperative</td>
<td>SolarizeBARC</td>
<td>BARC Electric Cooperative 2020</td>
</tr>
<tr>
<td>Central Virginia Electric</td>
<td>Solar Share</td>
<td>Central Virginia Electric Cooperative 2024</td>
</tr>
<tr>
<td>Mecklenburg Electric Cooperative</td>
<td>Cooperative Sunshare</td>
<td>Mecklenburg Electric Cooperative 2024</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Northern Neck Electric Cooperative</td>
<td>Cooperative Sunshare</td>
<td>Northern Neck Electric Cooperative 2024</td>
</tr>
<tr>
<td>Shenandoah Valley Electric Cooperative</td>
<td>Cooperative Sunshare</td>
<td>Shenandoah Valley Electric Cooperative 2024</td>
</tr>
<tr>
<td>Rappahannock Electric Cooperative</td>
<td>Cooperative Sunshare</td>
<td>Rappahannock Electric Cooperative 2024</td>
</tr>
<tr>
<td>Southside Electric Cooperative</td>
<td>Cooperative Sunshare</td>
<td>Southside Electric Cooperative 2024</td>
</tr>
<tr>
<td>Town of Bedford</td>
<td>Bedford Solar</td>
<td>Town of Bedford VA 2023</td>
</tr>
<tr>
<td>Harrisonburg Electric Commission</td>
<td>Friendly City Solar</td>
<td>Harrisonburg Electric 2024</td>
</tr>
</tbody>
</table>

Out of the 32 utilities within Virginia, 22 do not have community solar programs, and 1 utility has a solar program in the works. This does not mean they do not utilize or support solar at all. Most utilities encourage solar cell installation and offer tips for installing solar and interconnections. Also encouraging net metering to their customers. In addition, many of the utilities are smaller and buy their electricity wholesale from larger companies. Sometimes these companies generate a portion of their electricity from renewable sources. While there may not be a subscription option for customers a portion of their electricity still may have been renewably produced (Table 4). Some of the utilities have a very small customer base (Appendix 3). This could mean they don’t have enough funding or interest to incorporate renewable electricity projects. It is Virginia law to allow customers of a utility company to purchase renewable power from anyone who is licensed to provide it, this is if their utility does not provide the customers with an option that is 100% renewable (U.S. Energy Information Administration 2024a). While we have seen several steps that the US, Virginia, and Virginia’s electric utilities have taken where might there still be room for improvement?
Chapter 3: Virginia Policies, Green Electricity Goals, and Strategies

To acquire the interest of populations in Community Solar as a renewable energy option ensuring a thorough understanding of national and statewide goals for carbon emissions is important. This chapter overviews the goals for carbon emissions in the US and VA as well as the current makeup of electricity production. The results from the analysis in this chapter will give insight into renewable energy currently being used in the VA and the US and highlight the need for increasing use of renewable technologies including the use of community solar.

3.1 Goals for GHG in the US and VA

3.1.1 United States

The United States has started to follow many countries’ examples by creating a plan for cutting back emissions and creating energy goals. This plan serves as a guide to the states residing within the US. The Federal goals as formed under the Biden Administration outline several milestones in the coming years.

The first milestone is incorporating emissions-free electrical systems by 2030 for industry and business. With this goal, strategies have been outlined for promoting an emissions-free industry (The White House, 2021). The second goal highlights electric vehicle acquisition by the country, the US anticipates having 100% EV sales by 2035. EV sales in the entire country should meet this goal by that year, ways for this to be achieved include providing accessible infrastructure change such as charging stations and education to influence a cultural change for people in the country. The third one is building emissions reaching net zero by 2045. Achieving this goal can be completed by promoting energy efficiency and weatherization by retrofitting old buildings. The next goal is to have zero emission supplies by 2050 (not including products flown in). This will be achieved by holding industries accountable for reporting their emissions plus increasing the use of sustainable goods within the industry. Another goal is encouraging federal operations to be at zero emissions by 2050. This will be achieved by a combination of goals such as reaching net-zero building emissions and net-zero goods and services. Finally, there is a goal to be operating and prepared for climate resiliency. This can be achieved by encouraging federal, private, and non-profit agencies to assess and arrange plans for resiliency in climate-caused risks (The White House, 2021). Holding the industry accountable for procuring plans that combat climate change and adapt towards it can ensure our country's achievements in the future.
These goals mostly pertain to federal goods and industry, along with these goals there have also been outlined steps to ensure citizens will benefit. These include promoting climate concern and attentive individuals to be a part of the workforce. They are also promoting an increase in actions focused on environmental justice and equity within the government. All these goals can be achieved and increased by working together and creating partnerships with organizations focused on sustainability and climate resilience (The White House, 2021). These goals are achieved within the country but also will require the additional help of international governments.

3.1.2 Virginia

Virginia is trying to implement these federal guidelines and goals to help the country achieve net zero. Deploying technologies such as community solar is directly correlated with reaching these goals. VA state government approach centers around 5 key ideas: reliability, affordability, innovation, competition, and environmental stewardship. In the coming years, electricity production will be powered primarily using renewable resources. Virginia kept their goals like what the federal government had set its standards towards. They are working towards 100% renewable energy production by 2050 (Virginia Department of Energy, 2022). A goal like this is a lot of work to implement and leaves minimal room for error. As we have seen in the previous section some of the state’s electric utilities don’t yet offer many of their customers a renewable electricity option.

As far as electricity production each utility has its own goals based on the state’s goals outlined above. Phase II utilities (these are smaller utilities) are supposed to be renewably run by 2045 while phase I utilities (investor-owned utilities) must be renewable by the year 2050 (Virginia Department of Energy, 2022). Investor-owned utilities in VA are the larger ones such as Dominion Energy and Appalachian Power, so they have more customers to supply. Therefore, they have a later deadline to reach 100% renewable energy (DSIRE 2023). Virginia is the leader within its region with the most ambitious renewable energy plan out of all states in the PJM region. The Pennsylvania-New Jersey-Massachusetts (PJM) interconnection is the electric transmission system Virginia is included in (Virginia Department of Energy, 2022). Figure 7 shows a timeline of Virginia’s goals vs the states within the region.
Figure 7: Pennsylvania-New Jersey-Massachusetts Interconnection state renewable electricity timelines compared to VA. (Virginia Department of Energy 2022).

Getting customers involved with green electricity is another big struggle faced by utilities. A case study done in Silicon Valley for a community choice aggregate revealed that customers already participating in renewable practices are more likely to be aware of and subscribe to green energy program options offered by their utility (Fikru and Canfield, 2024). This demonstrates how important incentives, aid, and education are for promoting green energy towards the involvement of LMI communities.

3.2 Status of Renewable Electricity Production in the United States

In the United States, about 3.9% of electricity is produced from solar (U.S. Energy Information Association 2024b). Utility-scale and commercial PV are leading this number. Community solar is a very small contributor to this percentage. 10% is generated from wind and 8% from other renewables such as hydroelectric. The rest of the production comes from natural gas, nuclear, and coal. The amount of electricity produced by nonrenewable sources is slowly dwindling every year and with it an increase in access to clean electricity. The major challenge with the movement to green sources of electricity is the idea that the electricity demand in the county is increasing as the population increases. As some industries, such as fossil fuels, resist renewable energy, they must consider the pros when repelling the switch to green production.
One benefit of increased clean electricity production is job creation. This is especially true in smaller rural towns that may be struggling economically and have plenty of wind or solar resources (Nilson & Stedman 2023). While LMI households may have some increased opportunities from renewable energy production such as jobs, it is important to keep in mind that they may not have affordable access. This is why it is important to include LMI groups in the discussion for renewable electricity installations and utility plans when making new investment decisions.

3.3 Virginia Electricity Portfolio

As the market share of renewable technologies is growing the transition to renewable electricity has become less expensive for utility-scale projects. Wind and solar technologies have dropped 70% to 90% in the last 10 years due to the cost of economies of scale, along with more funding and incentives to encourage development and installation of these technologies (Xu et al., 2023). This has allowed the potential for renewables to increase considerably. In the US most of the electricity produced is still sourced from natural gas (43%), nuclear (18%), and coal (16%), to increase renewables considerably by the year 2050 more accessible forms of renewables must be formed (U.S. Global Change Research Program, 2023).

How is Virginia’s renewable electricity generation in comparison to the US? Most of the state’s electricity is produced in the state. As of 2020 most of Virginia’s electricity was produced from natural gas consumption. The second most used resource is nuclear power. Solar accounts for about 4% of the state’s electricity production, most of which is coming from large-scale utility operations. There are 7 large-scale community solar projects in the state that each produce over 100 MW a year. The solar capacity is now 2,482 MW, including individuals who own solar PV or utility-owned solar projects. Virginia’s yearly electricity consumption is 107.8 TWh, a significant amount compared to solar production in operation (1 TWh = 1,000,000 MWh). This is a meaningful finding towards the encouragement of expanding community solar initiatives. Non-solar-based electricity production also includes 2 hydroelectric plants responsible for creating about 4% of the electricity produced for the state (U.S. Energy Information Administration 2024a). VA has not yet taken full advantage of the potential for offshore wind, but projects by larger utilities are underway.
Dominion Energy has an offshore wind project in the works just offshore from Virginia Beach. This will be the first offshore wind project taken on by an electric utility (Dominion Energy, 2024). There is further wind opportunities within the Shenandoah Mountains. However, due to the region being protected National Park Service land, there is little to no potential for development there. The state does not generate all its used power, as a result, it is up to the surrounding states within the PJM interconnection to adopt renewable electricity strategies (U.S. Energy Information Administration 2024a). Supplying renewable electricity to all Virginia residents is not something that can occur if surrounding states do not also participate in contributing renewable electricity. A cohesive environment of states dedicated to increasing renewable use is important to allow for the success of a net-zero United States. To reach these goals there will also need to be a mixed portfolio of renewable technologies such as wind, solar, or hydroelectric. Community Solar is a good path to reaching Greenhouse gas emission goals because it can also be used to support communities in need.

Chapter 4: Combating Energy Burdens in Virginia

Energy burdens affect a large population of VA and the need for assistance is ever-growing as the cost of living increases for residents. This chapter is an environmental justice analysis. The state of energy burdens is analyzed including existing programs for aid provided from federal, state, and local sources. There is also a program analysis on recommendations for instituting an effective energy assistance program. The results from this analysis will conclude the need for further aid programs for LMI groups to end energy burdens.

4.1 Environmental Justice Literature Review

In energy efficiency, according to ACEEE, Virginia falls at number 20 out of the 50 states (2022). This ranking was given out based on legislation passed in the last year and budget allowances to help low-income groups with things such as energy efficiency and weatherization of their homes.

Environmental justice has been a recognized topic within environmental protection since the 1980’s. It refers to the just treatment and involvement of people from all societal backgrounds and groups involving federal decisions that may affect human health and the environment (Si & Stephens 2021). Environmental justice communities are often found to be people who qualify as
low-income, minorities, or the elderly. They tend to be exposed to more environmental toxins such as pollution from nearby streets or factories or victims of toxic waste dumping near their neighborhoods (Behles 2013). In today’s world, it is becoming more apparent that energy justice and unaffordable utility services fall under this category. Many people in Virginia struggle to pay their bills for things such as heat or electricity, something needs to be addressed. There have been case studies over the years that have encouraged local, state, and federal governments to create programs to alleviate energy burdens. There has also been known to be disproportionate access based not only on income but also on housing type (Emmel et al., 2010). Energy Burdens are described as the percentage of a resident’s income that is spent on their monthly electricity bills (Shen et al. 2023). Some people pay over 6% of their income on electricity, making them fall under the category energy burdened (Drehobl 2020). Figure 8 shows how different factors such as income, race, age, tenure, or housing type can affect what kind of energy burden different groups face. Elderly low-income individuals are the ones on average found with the highest energy burdens. Low-income groups in general tend to be victims of high electricity bill costs. This disparity is due to many factors including high household energy loss or cases of health issues or disability causing the inability for some people to make a higher income (Shen et al. 2023).

Figure 8: Comparison of Energy Burdens by subgroups. (Drehobl 2020).
According to the Virginia Poverty Law Center (2017) Virginia has the 10th highest electricity bills in the country. This conclusion was based on statistics from the area and frequent comments about electricity bill affordability from low-income families. This begs the question, are high electricity bills the utility's fault or is it a matter of energy efficiency in these low-income homes? Perhaps it is both. Virginia instilled that the two biggest utilities, Dominion and Appalachian Power, must terminate rising base rates on electricity. This was arranged in 2015 to prevent the minimum rate price from being inaccessible for people to afford (VPLC, 2017). This process is not sustainable for the business model, so it should be based on income or poverty status. With efficient housing, it has been found that customers in VA can save up to $54/month when compared to inefficient low-income housing (VPLC, 2017). For a low-income customer, these savings can be large and significant for a family in need. Appropriate efficient housing strategies for LMI groups should be a top priority for housing organizations.

When assessing a utility's commitment to its customers it is important to consider the affordability, reliability, and environmental responsibility of those utilities. They are responsible for upholding their values of service to their community (Citizens Utility Board 2021). While Virginia’s utilities do not fall at the worst rankings in the US the values for those three variables are rather low. The Citizens Utility Board analyzed all the 50 states utilities. What they bring to light is the disparities between each state in terms of utility performance. The performance of utilities in the state based on those three variables falls at 41 out of the 50 states. It falls 38th in affordability rankings based on the cost of household electricity expenditures, total electricity costs as a percent of income, cost per kWh, cost per kWh for residents, and annual expenditures. The average annual expense for electricity is $1,626 per customer, this is the 6th highest average in the US, however, customers pay about $0.12 per kWh which is 24th in the US. It begs the question why are the averages so high if the cost of electricity is not that great? It could be down to excessive electricity use or a lack of energy-saving homes. For reliability, Virginia falls at 43 out of the 50 states. This was measured by looking at the average duration of power outages, the average time to restore power to customers, and the average frequency of power outages. For Environmental responsibility, Virginia ranks 28th. This variable was based on variables such as CO₂ emissions per GWh, renewable electricity generation, clean electricity generation, etc (Citizens Utility Board 2021). Virginia still has a long way to go as far as getting the utilities to be successful for the customers
Being able to afford your household’s electricity is very important to the health and well-being of individuals. In the US, low-income housing has been known to be susceptible to poor indoor air conditions due to living in more polluted neighborhoods and usage of old building materials such as lead. A more affordable neighborhood may have a more polluted atmosphere (Yeganeh 2020). This can be because of proximity to traffic or factory pollution. LMI customers have often been the victims of higher electricity bills, not just from high costs but also from homes that lack energy efficiency and good weatherization techniques. In present times this has been addressed by states and is being worked towards. In the last several years low-income housing development has included a larger focus on energy efficiency making indoor conditions more beneficial for overall health (Yeganeh 2020).

Solar as a renewable technology has been known to increase job opportunities, improve health, and offer more reliable electricity during outages (Devar, 2020). Solar along with a lot of other green technologies, such as wind, have also been responsible for these same benefits. Creating equitable community solar requires allowing the benefits from solar to reach all demographics. Encouraging solar organizers to intentionally focus on serving those LMI communities is a great first step (Devar, 2020). There is not just one simple solution to forming an equitable option there are many and it can change in a state from case to case. Si and Stephens (2021) emphasize the disproportionate access of sociodemographic groups to solar opportunities. In the last several years more and more states have implemented community solar programs most of which have been catered toward higher-income customers. With proper community engagement and political support this statistic can change and is changing.

The Virginia Clean Economy Act has been estimated to increase electricity costs in the future (U.S. Energy Information Administration 2024a), so what is being done for LMI customers as costs are getting out of hand?

4.2 Federal Assistance and Organizations

While federal government departments have different assistance programs there are two main ones pertaining to combating energy burdens. The U.S. Department of Energy has the Weatherization Assistance Program (WAP) and the Department of Health and Human Services Low-Income Home Energy Assistance Program (LIHEAP) (Behles 2013). Both services exist to provide funding to organizations such as non-profits, utilities, state governments, or individuals in
need of financial assistance. They often work hand in hand (Behles 2013). There is another federal program called the Low-Income Housing Tax Credit (LIHTC) that is not specifically meant to alleviate energy burdens, but it works towards rehabilitating low-income housing such as making the buildings more energy efficient (Yeganeh 2020). Although these governmental programs are here to help, they can still be difficult to access due to issues such as a lack of internet connectivity or knowledge of how the programs work. Table 5 goes over these programs briefly along with the budgets they received for 2024.

*Table 5: Energy bill assistance, home weatherization, and energy efficiency programs (Author, compiled from source).*

<table>
<thead>
<tr>
<th>Name</th>
<th>2024 Budget</th>
<th>What it does</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weatherization Assistance Program (WAP)</td>
<td>$700 million annually</td>
<td>Aids low-income groups in weatherizing their homes. Budget includes home weatherization assistance as well as the training and employment of people to weatherize structures.</td>
</tr>
<tr>
<td>Low-Income Home Energy Assistance Program (LIHEAP)</td>
<td>$3.6 billion</td>
<td>Provides low-income communities with heating and cooling, crisis assistance, and home weatherization. LIHEAP and WAP go hand in hand.</td>
</tr>
<tr>
<td>Low-Income Housing Tax Credit (LIHTC)</td>
<td>$10 billion annually</td>
<td>A tax credit for investors for building, acquiring, and rehabilitating low-income housing. Emphasis on green housing is encouraged.</td>
</tr>
</tbody>
</table>

The WAP is a program made specifically for individuals who do not exceed 150% of the federal poverty rate based on the area, this parameter relies heavily on the state and region and differs significantly across the US (Behles 2013). It was established in 1976 and made to serve low-income renters and people residing in multifamily housing. This program works by providing funding for dwellings to be assessed and their energy efficiency increased to reduce electricity bills and increase health and wellness. States receive funding from the DOE once it is received it is then distributed to organizations, communities, or individuals within the state (Martin 2023). Programs
like this are often paired with other state or federally funded programs to determine the best course of action for assisting LMI customers in the most cost-effective way.

The LIHEAP works to assist low-income groups in paying their electricity bills. This program was established in 1981 (Behles 2013). It was specifically established to help families dealing with energy burdens. The program’s purpose is to assist families who pay a large amount of their monthly income on electricity bills. This program is not entirely focused on fixing energy inefficient housing types as it provides bill assistance in an emergency. Even so, a component of the LIHEAP program is set aside to ensure assistance for weatherizing homes (Bechler 2021). Federal funding is provided to the state, and it is allocated to organizations that can help households in need. Depending on the state there are different criteria for being an eligible participant. The federal government states that an eligible household will be at or below 150% poverty level or 60% of the state income. These are the criteria for states to allot the funding. Some states can make it so that you can be eligible for one thing but ineligible for another and change the requirements between heating and cooling assistance and weatherization.

Figure 9 shows the yearly budgets for WAP and LIHEAP from when they both began. WAP funding has not increased significantly and the data for 2018 and 2020 are missing as funding was going towards other projects such as LIHEAP. LIHEAP funding did increase around 2008-2009 but has since dropped and been around the same. In 2022 $3.5 billion was allocated to WAP for the next five years making its budget $700 million a year. However, only 0.2 % of homes that require assistance are receiving it. This is because a lot of low-income homes need significant fixes necessary to allow for weatherization, but government funding will not cover those significant repairs. More LMI families are getting turned away than they are getting help from this program (Pontecorvo 2022). These budgets should be increasing as inflation and utility electricity costs are rising and homes need further repairs.
The LIHTC program is allocated about $10 billion annually for rehabilitating or constructing new rental properties for low-income housing (Yeganeh 2020). The program was established in 1981 to create affordable housing for low-income groups. While this is not directly correlated to renewable electricity use or reducing energy burdens it is another helpful factor in reducing issues with bill payment. Weatherization and green building techniques were not at the forefront of the program. In recent years the focus on energy efficiency in new low-income housing complexes has been growing in the program (Yeganeh 2020). If energy efficiency is a focus when low-income housing is built, then it is likely that high electricity bills can be avoided from the get-go.

Ensuring these programs are available for LMI groups is extremely important in the long run. Often if a group is receiving monthly bill assistance that is acting as a temporary solution and is not fixing the root of the problem. The root of the problem is centered around housing type or the cost of electricity from the utility that lies within their region (Bechler 2021). When participants are eligible to receive aid from these programs other environmental burdens are not considered.
when deciding to grant assistance. These can include adverse effects on health from pollution or the effects of climate change. Groups facing multiple environmental burdens are often in need of the most help, but those impacts are not usually considered. Another thing is that within states only about a third of populations falling below the criteria for poverty gain assistance. This is quite a large group that is losing out on aid, so an increase in funding is necessary to provide support for more people. It is important that these programs stay intact and receive additional funding because emissions are continuing to increase, and the application of renewable energy is becoming more mainstream (Behles 2021).

4.3 State Government Programs

In 2024 the funding VA received from LIHEAP was $93,123,844, this funding also included an additional $2,344,728 from the Infrastructure Investment and Jobs Act (IIJA) (LIHEAP 2024). The IIJA was established in 2021 and was built to support more projects dedicated to national infrastructure including electric vehicle charging, roads and bridges, public transit, power grid resiliency, etc. (Library of Congress 2024). Extra funding was provided specifically for weatherization in conjunction with LIHEAP. To be eligible for heating assistance, cooling assistance, and crisis in VA the household must be at or below 150% of the federal poverty level and be at or below 60% of the median state income to be qualified for weatherization (Bechler 2021). Automatic eligibility into the program includes households taking part in the Supplemental Nutrition Assistance Program (SNAP), Supplemental Security Income, and Temporary Assistance for Needy Families (TANF). For families, there are maximums and minimum amounts allocated for aid including a $185 minimum and $600 maximum for heating assistance a year, a $50 minimum and $700 maximum for cooling, and a $4,200 maximum for crisis support. This allows yearly (2020 information) for over 100,000 households to be served for heating purposes, about 66,000 to be served for cooling purposes, about 15,000 to be served for crisis support, and about 511 to receive weatherization assistance (LIHEAP 2024). These numbers likely only cover a small percentage of households in need as it is believed that about 10% of residents in the state fall under the federal poverty level (American Community Survey 2021). There are about 121 Social Service agencies in the state that can distribute this project’s funding to individuals in need.

To be eligible for WAP in VA, you must be 60 years of age and older, be part of a family where one or more members have a disability, or be in a family with children and fall under 60%
of the state’s median income. Households are also eligible if they receive supplemental security income (SSI) or temporary assistance to needy families (TANF) (LIHEAP 2024). This is administered by the Virginia Department of Housing and Community Development (DHCD) and received by other agencies around the state there are about 133 agencies that provide WAP assistance. Another program administered by the state in conjunction with WAP is called the Weatherization Deferral Repair Program (WDR). This program is made specifically to fix the problems with homes that were deferred weatherization from WAP due to things such as leaky roofs, minor structural issues, contaminants, etc. basically things that must be fixed before the house can be weatherized. This is provided by funding from the Housing Innovations of Energy Efficiency (HIEE) and these funds are received from DHCD’s participation in the Regional Greenhouse Gas Initiative (RGGI) (Virginia Department of Housing and Community Development 2023). One main issue is that people residing somewhere as renters don’t have access to weatherization if they don’t own the property. If they are renting it is up to the building stakeholders to get it weatherized.

While these are state government agencies that assist with bills and weatherization there are a few that also run as nonprofits or separate entities.

4.4 Utility Programs

A Lot of the state’s utilities offer bill assistance programs and free programs. These can include weatherization to a customer’s home, energy efficiency assessments, and energy. Saving techniques. Within the 32 electric utilities, they all offer opportunities for the customer to gain assistance with their bill (Appendix 1). If the customer cannot gain assistance for their bill there are government programs offered as outlined above. Often larger utilities provide free programs if you qualify such as weatherization or energy-efficient housing tips and assessments where they have employees come over to assess the home for free. The Percentage of Income Payment Program (PIPP) is offered by Dominion Energy only and it is for low-income customers where they can receive more affordable monthly bills year-round. To qualify you must be an active Dominion Energy customer and be at or below 150% of the federal poverty level. Some utilities (but not all) waive the security deposits of their customers who are eligible for LIHEAP (LIHEAP 2024).
There are a few utility-run charitable assistance options available as well. Appalachian Power has a Dollar Energy Fund through its Neighbor-to-Neighbor Program that can aid in energy bill payments. Atmos Energy provides bill assistance based on customer donations. Columbia Gas of Virginia has a program called Heatshare also aiding in energy bill assistance. Dominion Energy, Virginia Natural Gas, and The Harrisonburg Electric Commission all utilize a Virginia program called EnergyShare that aids in heating and cooling bill assistance (LIHEAP 2024). The funding from this program is provided by donations from utility stockholders, customers, employees, local businesses, churches, and other civic groups. The Northern Virginia Electric Cooperative has electricity bill assistance as well. Washington Gas has the Washington Area Fuel Fund where heating payment assistance is administered to customers who have exhausted gov. assistance. The City of Charlottesville has a Gas Assistance Program that supplies bill assistance to families struggling to pay gas bills (LIHEAP 2024). Outside of government entities, there are still several assistance opportunities available, however, being donation-based the reliability of the amount they can assist is at a disadvantage.

4.5 Energy Burden Framework

What is a good energy assistance program? Many variables must be taken into consideration including what the money is helping with, who needs the help, and what categories the people in need fall under. According to Shaban and Stockton (2020), the assessment of a good energy assistance program centers around the data available to create a perfect assistance program based on the facts. Their white paper discusses the steps for a successful assistance program and identifies a few metrics that must be measured before a program is formed. These metrics include energy assistance need, energy assistance funding, avoided burden, and avoided need. Understanding these metrics before the beginning of a project is necessary for ensuring the right groups gain assistance. Further to avoid having gaps in who receives energy assistance there are several ratios responsible for figuring that out. These ratios are made up of the four metrics responsible for making any assistance program successful. These ratios and their calculations can be found in Figure 10. There is the funding, operational effectiveness, and targeting effectiveness ratios. Once calculated these all can lead to the effectiveness of the program in total. Figure 11 shows the assistance path patterns that a program can take with their overall effectiveness.
Failing assistance programs often get abandoned or more money gets put into them. Often putting more money into them isn’t the solution if it’s not done the right way. If the program is reassessed and the cause of the failure is identified, then there may not even be a need to increase the budget. Basing a program on more demographic and geographic characteristics of the area will lead to better success as you assess the individuals who are suffering from high energy burdens (Shaban and Stockton, 2020).
The effectiveness of a program requires the understanding of several calculations. Energy burden is found by dividing the electricity bill cost by the average income, this will result in a percentage that describes the amount of income per month spent on electricity bills. The affordability threshold is the threshold for a community electricity bill affordability, every region has a different threshold due to average income differences. The Low-income threshold also depends on the area’s average income. This can be found by comparing the population that makes a certain amount below the average income, it creates the foundations for who is considered LMI. Energy assistance needs to describe how much assistance LMI customers may be required to make their bills affordable. Energy assistance funding the money offered for use in discounts, donations, etc. for customer assistance. Where this money goes is important to assess before deploying it for use in a program. Avoided Burden is the amount of money people have gained assistance from that has helped to release the stress of paying a large amount of their monthly income on electricity bills. Avoided need calculates the amount customers have saved on electricity bills due to program assistance (Shaban and Stockton, 2020). All these calculations provide aid in the assessment of assistance programs.

This white paper also expresses different ways to model for measuring how effective a program will be. They provide three examples: Econometric Modeling of Sampled Data, Bottom-up aggregation of Customer Data, and a hybrid approach. The Econometric modeling of the Sampled Data technique involves using existing data such as census data from the American Community Survey (ACS). ACS data is collected country-wide, so it makes it easy data to access. However, this data can be outdated and often inaccurate due to being self-reported and possible outliers skewing the data. The second option is the Bottom-up Aggregation of Customer Data involves gaining data right from the source. This includes reaching out to utilities themselves for customer income and bill payment data. This is a very accurate method that allows for more control and accuracy of the data, but often it is time-consuming. The third option presented is a hybrid approach that combines the first two. It can utilize ACS data (which is easier to obtain) and then combine that with some direct information from the utilities. It is another pretty accurate one that requires more work than the first one but less work than the second one. If using one of these methods to assess the effectiveness of a program, then it should yield good results to see how helpful your program has been. Some additional pieces of data that should be considered within these methods of analysis should be the burden index which is the percentage of burdened
households in an area, the program equity index which is the percent energy assistance received within a population, the energy cost index is the percentage more an area is paying on energy compared to the outside areas, and the late payment index which describes the percent of late bill payments in one region compared to another (Shaban and Stockton, 2020). This white paper expresses a lot of good thoughts to consider when implementing a program.

4.6 Environmental Justice Analysis

After the environmental justice analysis in this chapter, it can be concluded that further support is necessary so that low-income groups have a chance at more affordable monthly electricity bills. This includes an increase in weatherization, energy efficiency, and energy bill assistance. An increase in WAP funding to reflect LIHEAP funding allowances should be focused on because weatherization is a more permanent solution to bill affordability in the long term. This increase in assistance along with the appropriate deployment of an assistance program will make it possible to see increased involvement in renewable energies from a larger group of demographics and income levels. Focusing on these communities will also require an analysis of where community solar should be deployed in VA based on the location of low-income groups and good locations for solar sites. In the next chapter, this analysis will be conducted.

Chapter 5: Site Suitability Analysis

Deploying equitable community solar in VA requires identification of suitable sites. This chapter is a geospatial analysis to find suitable sites for community solar in Virginia using criteria centered around low-income groups. I chose data layers focused on five criteria: (1) percentage of the population living in poverty, (2) the percentage of energy burden per zip code, (3) solar irradiance across the state, (4) existing solar sites, and (5) land type (i.e. conservation and easement-controlled land). The results introduced areas of suitability within the state that were analyzed at the end of the chapter.

5.1 Site Suitability Literature Review

One of the most important aspects of beginning new projects is ensuring the site that is selected is feasible to use. A study done by NREL investigated solar site requirements and determined the average acreage needed to produce at least 1 MW of electricity (Ong et al. 2013).
As seen in Table 6 the requirements for CSP (Concentrated Solar Power) and PV solar systems vary. They compared the total and direct land use of solar projects. Direct land use refers to the land directly occupied by the solar technology infrastructure such as solar arrays, substations, etc. The land area that is occupied by the site boundaries is the total land area. The direct area lies within the bounds of the total area, and the total area is normally something you would see on site blueprints (Ong et al. 2013). The land use estimates consider both area capacity to place 1 MW of electricity and production (area to produce 1 GW/yr). Differences in land use size could depend on the technology type used in this case PV vs. CSP.

Table 6: Total acreage requirements for different solar project systems and sizes. (Ong et al. 2013).

<table>
<thead>
<tr>
<th></th>
<th>Small PV systems (&lt;20 MW)</th>
<th>Large PV systems (&gt;20 MW)</th>
<th>CSP systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct per 1 MW</td>
<td>~ 5.9 acres</td>
<td>~ 7.2 acres</td>
<td>~ 7.7 acres</td>
</tr>
<tr>
<td>Direct per GWh/yr</td>
<td>~ 3.1 acres</td>
<td>~ 3.1 acres</td>
<td>~ 2.7 acres</td>
</tr>
<tr>
<td>Total per 1 MW</td>
<td>~ 8.3 acres</td>
<td>~ 7.9 acres</td>
<td>~ 10 acres</td>
</tr>
<tr>
<td>Total per GWh/yr</td>
<td>~ 4.1 acres</td>
<td>~ 3.4 acres</td>
<td>~ 3.5 acres</td>
</tr>
</tbody>
</table>

One assessment to make before placing solar locations is to assess possible damage that can occur to the surrounding environments. Considering the fragility of an ecological environment when placing a renewable site needs to be one top priority. In most cases, once the project is installed the surrounding environment can flourish around it. Solar sites can also be combined with open agricultural land, this strategy is called agrivoltaics. The farmland can be grazing areas, cropland, or empty grassland. In the case of crop growth, it is recommended that solar be paired with shade-tolerant crops. Many experts have speculated the possible interruption in crop production due to this strategy (Daniels 2022). The direct effects of this are not yet known completely, but it is something to consider when placing solar installations. For the most part, agrivoltaics can continue to promote the growth of grasslands and native habitats while also generating electricity from the sun (Daniels 2022). The idea of agrivoltaics is still met with a lot of uncertainty as things such as crop loss, increase in land taxes, and aesthetic problems are met with a lot of resistance.

Utility-scale solar projects are on the rise and they are thought to comprise about 80-90% of the solar production in the US in the near future (Michaud 2020). As solar generation increases,
the demand for transmission also rises. As a result the proximity to transmission lines or substations is another important criteria in siting solar. For a farm to connect to the grid, it must be in proximity to transmission lines. One study done by Katkar et al. (2021) found that a majority of utility-scale solar were located between 1.5 – 4 mile range from a transmission line. It would be ideal to locate large solar installations within 1 mile of a transmission line (Daniels 2022). Because of this need for close proximity to transmission lines, there will likely be a significant increase in transmission lines in the coming years to deal with growing electricity demands and increasing amounts and sizes of projects.

New York state is one of the leaders in the US for solar. About 92% of the land in the state is either agriculture or forests, so there are lots of good spots. However, figuring out where to locate them has been a large challenge for the state. In a site-suitability analysis, Katkar et al. (2021) decided that the most important variables for a solar location include distance from transmission lines, slope of the land, distance to other infrastructure such as substations, land cover, and land quality. Using the National Land Cover Database, they deemed land cover falling under the categories barren land, herbaceous hay/pasture, and cultivated crops as good land cover types. Another type of land to consider is brownfields which are found in urban areas. Brownfields are areas of land contaminated with hazardous substances, but otherwise are desirable for redevelopment (Daniels 2022). These are usually vacant areas where contaminants may lie in the soils from the land’s previous uses and require substantial cleanup. Depending on the need for solar and the utility project budget, brownfields could be feasible and are something to consider.

5.2 Model Builder and Methods

How exactly are ideal Community Solar sites located? There are several factors to consider, and utilities often take different routes based on their priorities and land availability based on their service territories. In my site suitability analysis I wanted to take into consideration energy burdens along with the usual guidelines for community solar farm locations. There are several factors that I considered in my site suitability, with using available data I found for the state of Virginia. The data layers are as follows:

1) Land designation:
For this layer I used Virginia Conservation land (i.e. national parks and state parks) and lands with easements. I designated conservation land as a 1 due to their protection from development. I labeled lands with easements as a 2 due to development constraints. Solar farms on easement land are complicated. The rest of the state I labeled as a 3 with possibly no constraints on development (Department of Conservation and Recreation 2022).

2) Poverty status
From the American Community Survey, I used poverty status data by census tract. For census tracts, I collected the percentage of the population living below the federal poverty level. For this data, I designated 3 categories for my site suitability analysis. I designated poverty percentages from 0-10% as a 1 being low priority, 10-20% as a 2 with moderate priority, and 20-100% poverty as a 3 with high priority for community solar to serve poor communities (United States Census Bureau 2021).

3) Energy Burdens
With data from the Virginia Poverty Law Center, I was able to create a layer with energy burdens per ZIP code in Virginia. Energy burdens are represented in average percentage of income spent on energy bills. These were split into three categories and weighted with 0-3% being a 1 as least suitable (because 3% is around the state average), 3-5% as 2 or medium, and 5-15% as 3 for most suitable sites. To be considered Energy burdened is at 6%, but if the average for the zip code is 5% it is likely there are still a lot of people that have an energy burden over 6% (Virginia Poverty Law Center 2017).

4) Solar irradiance
For the solar irradiance layer, I gathered data from the Global Solar Atlas, which shows the specific PVOUT (Photovoltaic Power Output) for every part of the world. I clipped this layer to Virginia and changed the colors for 3 categories for kWh production. The recommended production for an area to be good for a solar project is one that produces 1,000 kWh. The state’s lowest area of production is 1295 kWh, so theoretically the whole state gets adequate sunlight. I wanted to ensure the best solar areas were chosen, so I split the values as follows 1295-1450 kWh got a value of 1
as least suitable, 1451-1500 got a medium value of 2, and 1501-1580 kWh got a value of 3 as most suitable. (Solargis 2024).

5) Operating solar projects

For this site suitability analysis, I wanted to investigate existing solar projects in the state currently in operation. The Solar Energy Industries Association (SEIA) has a map of in-operation solar projects as well as ones currently being developed (Solar Energy Industries Association 2024). I was able to make a point feature class of active projects in VA. Because of the land acreage need associated with projects I decided to create 1 and 2-mile buffers around these projects to ensure those spaces aren’t included in my analysis and new sites aren’t interfering with an existing site. 1 mile buffers were assigned a value of 1, 2 mile buffers were assigned a value of 2, and the rest of the area of the state was given a 3.

Once all the layers were collected I processed the data to perform the weighed suitability analysis. This tool works by overlaying all the data layers and determining where each assigned value overlaps. First, all the vectors (polygons) were converted into raster data (pixels). I used the “feature to raster” tool from the ArcGIS Pro analysis toolbox. I classified the layers by assigning values to data ranges. Table 7 summarizes all the data value assignments made when reclassifying the layers.

Table 7: Site suitability classifications for the weighted site suitability analysis (Author)

<table>
<thead>
<tr>
<th>reclassifications</th>
<th>1 = not suitable</th>
<th>2 = medium suitable</th>
<th>3 = most suitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty (% of population)</td>
<td>0 – 10 %</td>
<td>10.1 – 19.9 %</td>
<td>20 – 100 %</td>
</tr>
<tr>
<td>Energy Burdens (% of income used)</td>
<td>0 – 3 %</td>
<td>3.1 – 4.9 %</td>
<td>5 – 15 %</td>
</tr>
<tr>
<td>Solar Irradiance (kWh/kWp)</td>
<td>1295-1450 kWh/kWp</td>
<td>1451-1500 kWh/kWp</td>
<td>1501-1580 kWh/kWp</td>
</tr>
<tr>
<td>Land Type</td>
<td>Conservation land</td>
<td>Easements</td>
<td>Open land</td>
</tr>
<tr>
<td>Distance to existing projects</td>
<td>1 mile away</td>
<td>2 miles away</td>
<td>No projects nearby</td>
</tr>
</tbody>
</table>
After layers were reclassified, using the specifications above, I used the weighted overlay tool from the analysis toolbox was used. Figures 12 and 13 show the workflow made in Modelbuilder in ArcGIS Pro.

*Figure 12: ModelBuilder workflow for site suitability analysis (Author).*

*Figure 13: ModelBuilder of the Weighted Overlay. (Author)*
5.3 Maps

Figure 14: Weighted Overlay Variable Layers

Virginia Demographics and Land assessment layers used in the weighted suitability analysis. The layers represent the percent of the population living in poverty by census tract, the percentage of population with energy burdens by ZIP code, existing solar projects in operation, conservation and easement land, and solar irradiance (Author).
5.4 Results

While there are a lot of assumptions that went into this site suitably, the most important aspects of this project were focused on for this site’s suitability including a focus on LMI groups. Again, the layers included the percentage of the population below the poverty level, the percentage of energy burdens, land easements and conservation land, existing sites, and solar potential.

Based on the results of my suitable site analysis a lot of the suitable areas for community solar sites are in the Southern region of the state these range from far West to far East. This makes sense because a lot of existing solar sites are not in the southwest region and high burdens, poverty, and solar potential are all located more so in the Southern parts of VA. Locations in the Northern part of the state are non-suitable likely due to the presence of low poverty and energy burdens. This can be a result of the higher incomes of people who work and live in the DC area. This can also be due to the high amount of development where not a lot of open land is available. Community Solar projects can be found also on developed land if places want to offer their rooftops as an option for solar development to be provided for LMI groups. This suitability claims that about 5% of the state could be suitable for community solar sites focused on aiding LMI communities. Of course, there is the possibility that these lands are occupied by residents or
farmland that does not grow shade-tolerant crops. Figure 16 shows the site suitability for Virginia and Figure 17 demonstrates the site suitability and including points where existing solar sites are.

Figure 16: Suitable and non-suitable sites result from the weighted overlay. (Author)

Figure 17: Weighted overlay results with active solar projects presented. (Author)
Other layers that will improve my analysis if included:

1) Land cover
The National Land Cover Database (NLCD) provides a raster data set of all land coverage types for North America. They provide 20 different classifications and Katkar et al. (2022) used the NLCD for their land coverage types and determined that the best land coverage for solar sites was barren land, pasture/hay, and cultivated crops. For a site suitability, including grasslands/herbaceous as well as shrub scrub in the land cover would work as well. The criteria for land types is land where shade is not an issue (i.e. forests were not suitable) and where there is not a lot of development (i.e. developed areas are not included). (United States Geological Survey 2021)

2) Transmission line proximity
Community Solar farms can be at most 4 miles from a transmission line or a substation to connect to the grid successfully. Ideally, this distance should be about a mile (Katkar et al. 2021).

3) Average cloud cover could change the appropriate solar strategy between either Photovoltaic (PV) or Concentrated Solar Power (CSP)
Because solar energy output is based on the sun’s PVOUT, recognizing an area’s average cloud cover every year is important and could change the potential for output or strategy for solar technology (CSP or PV systems).

Some assumptions that go into weighted suitability assessments for this topic include transmission lines having the capacity for connectivity, transmission line locations, all agricultural land being available for solar projects, the funding and interest enough for low-income areas and utility providers to support community solar projects. This site suitability is a good indication of where communities are that should be focused on. Further analysis should be pursued regarding the solar siting availability such as rooftop community solar or agrivoltaics.
Chapter 6: Case Studies

At least one Community solar site exists in 42 states. While this is great only 22 states have enabling legislation for community solar projects. Virginia is one of these states. This chapter focuses on monitoring VA and comparing its programs to other programs that exist in other states. They all have their strategies and incentives that focus on LMI groups. An investigation into community-owned and run community solar programs is performed. I focused on states that have had the longest-running programs and legislation as well as LMI-focused projects. States that were analyzed include California, Massachusetts, New York, and New Jersey and compared to the state of Virginia’s program.

6.1 Keys to Success

Community solar is one of the most accessible forms of renewable energy and gives the most attention to energy justice struggles. It is more accessible for groups that normally would not have opportunities for involvement, such as renters and other disadvantaged groups. While not an exhaustive list, Devar (2020) offers three main principles for guiding Community Solar Programs. The first principle is to ensure the feasibility of the project. This is where stakeholders, communities, or organizations must consider funding, customer participation, or project and site development. These considerations are the first step to ensuring that the project is achievable and that people will receive the benefits. The second is to ensure that marginalized communities benefit. To do this policies within the program must highlight if they want to target groups based on income or based on geographic areas. Targeting a group based on income means setting aside a percentage of the customer capacity to be groups from lower income backgrounds, so setting aside 30% of your customer capacity specifically for LMI groups. The other strategy focuses on a specific area where the solar sites can deliver that may have a large concentration of marginalized groups. The third has to do with prioritizing community governance. This refers to encouraging the community groups to work together to solve problems within the community. These groups can include governmental, nonprofit, or individuals.

For these programs to be successful and gain interested customers adding financial or compensation incentives is important. For a program directly adding incentives for marginalized groups such as extra bill savings or credits can attract people to participate. Other incentives can include encouraging developers towards certain types of land for solar use such as brownfields or
developing the workforce. To also promote community engagement, it is important to ensure their involvement with the projects by taking part in community outreach and education on the project and ensuring the project’s simplicity for the benefit of community understanding (Devar 2020). Virginia offers a good amount of incentives for utilities, landowners, or developers to receive tax breaks or funding on projects like this. For a state to successfully launch a Community Solar Program, these are some of the most important aspects to increasing the use and access of renewable energy and reducing electricity bill burdens that customers may be facing.

6.2 States with Community Solar Programs

As of 2021, there are 23 states and districts in the US that have regulations on community solar. There are a few states such as Florida and Texas that do not have formal state-mandated community solar programs, but they have many solar sites that do provide electricity for other states and independent customers. States such as California and New York have substantial community solar programs. The National Community Solar Partnership (NCSP) has a goal of creating enough community solar programs to power 5 million homes and save $1 billion on energy (U.S. Department of Energy, 2022a). Every year starting in 2022, the Department of Energy offers awards to organizations with outstanding Community Solar projects. In 2022 there were a couple of big winners the two top projects I will highlight below.

Community Power: Jobs and Savings for LMI Households (Brooklyn, NY)

Within Brooklyn and Manhattan, there is a 1.2 MW solar project that has been working to provide electricity for LMI customers. This program came to fruition from multiple partnerships each enacting a different level of support. A couple of non-profits such as WE ACT for Environmental Justice and the Brooklyn Movement Center were able to gain participants by being actively engaging within their communities. Through educational efforts and partnering with other organizations such as the NYC Community Energy Co-op, Sunwealth, Accord Power, Green City Force, Con Edison, and the New York City Housing Authority this project was able to garner attention and be successful thus far. They offer solar-powered electricity to about 500 LMI households with a 20% discount on their monthly electricity bills. Not only did this project allow customers to save on their bill it also was completely community driven. Within the installation of
the panels residents of the communities were offered apprenticeship opportunities to learn and a few later gained full-time positions (U.S. Department of Energy, 2022a).

District of Columbia’s Solar for All (Washington, DC)

This project led by the District of Columbia Sustainable Energy Utility and Groundswell is a 30 MW project started in 2016. It serves about 6,000 LMI households and allows customers to save 50% on electricity bills. To become a part of this program your income must fall below 80% of the median income of the area. This allows customers to save up to $520 a year on their electricity bills. This project also focuses on engaging the community. The not-for-profit organization Groundswell that aided in this project provides community events based around informing about renewable energy opportunities. This project also provides engaging opportunities for the public and offers job skills and certifications that members can carry into a job (U.S. Department of Energy 2022b).

These are two independent cases of Community Solar built specifically for low-income communities. Their success seems to be centered around truly getting the community involved including education and training programs as well as job opportunities for communities in need. From the three principles outlined in section 6.1 these programs seem to have captured all of them as far as being successful. These projects were found to be feasible by recognizing available rooftop space as an opportunity for solar placement near groups of lower income and disadvantaged populations. These projects are specifically focused on increasing accessibility for marginalized communities, and they increase community governance by not only getting many community organizations involved, but also providing opportunities for the community afterward such as education, training, certifications, and jobs. These two Sunny Award winners fall under the category of equitable community solar.

The two projects above demonstrate a true community solar project run by the communities. Other states with Community Solar Programs include similar components for equitable design but also have large-scale and statewide projects. New Jersey has been running a successful program since 2019 and just recently made it permanent in 2023. Table 8 compares five different states including VA with CSS programs and what their state requirements are. Programs that have been around for longer and that have had greater success tend to focus a large amount of
effort on LMI or disadvantaged communities and have a larger room for development since project caps are larger. A state will usually put a cap on their projects to ensure that the program will be developed using best practices and to incentivize developers. California’s program focuses on LMI groups but also Disadvantaged Communities (DAC). The DAC designation includes other factors such as health and pollution. Considering multiple aspects of community well-being, not only income, is crucial for program success.

*Table 8: Comparison of 5 State Community Solar Programs.* (Author, compiled from sources)

<table>
<thead>
<tr>
<th>State</th>
<th>LMI Participation</th>
<th>State Target</th>
<th>Subscriber Costs/Benefits</th>
<th>source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virginia</td>
<td>30%</td>
<td>150 MWs to possible expansion of 200 MWs</td>
<td>Minimum bill requirement. Subscribers get bill credits.</td>
<td>Pitt et al. 2023</td>
</tr>
<tr>
<td>California</td>
<td>51% per project</td>
<td>430 MW and continuing to grow</td>
<td>LMI groups can receive 20% off of electricity bill</td>
<td>State of California 2024</td>
</tr>
<tr>
<td>New York</td>
<td>No LMI target, but several LMI specific programs</td>
<td>10 GW (currently provides 2 GW of community solar)</td>
<td>Bill credits and solar for all. Free Community Solar program for LMI groups, get discounted bills.</td>
<td>New York State Energy Research and Development Authority 2024</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>40%</td>
<td>3,200 MW</td>
<td>Rate per kWh is fixed and significantly less for solar than traditional energy.</td>
<td>Massachusetts Department of Energy Resource. 2024</td>
</tr>
<tr>
<td>New Jersey</td>
<td>51% per project</td>
<td>225 MW for 2023 with chance to expand another 225 MW in 2025</td>
<td>Electricity bill discount minimum of 15%.</td>
<td>Peretzman 2023</td>
</tr>
</tbody>
</table>

Virginia specifically has five central utility-owned and run community solar programs and two third-party community solar programs (Pitt et al. 2023):

1) BARC Community Solar Program (BARC Electric Cooperative 2020)
This program is capped at providing only 25% of a household’s supply to service as many customers as possible. Offer blocks to customers which are 50 kWh for $4.95 each. There are 2 community solar locations for this utility. No mentioned LMI component.

2) Dominion Community Solar Pilot Program (Dominion Energy 2024)
Required by law in 2017 to launch a community solar program. Offered blocks of 100 kWh for an additional $2.013 each. However, the block fees are added to your monthly electricity bill. Customers can also participate in a shared solar program where they can subscribe to a solar facility outside of Dominion Energy to receive credits for their monthly electricity bill. Most participating shared solar facilities have about 30%-100% of electricity production set aside for LMI customers.

3) Cooperative Sunshare CSS program (A & N Electric Cooperative 2024b)
Offered by 6 of the co-op utilities in the state. A 50 kWh block will cost $5.28 extra per month. This program has 2 solar facilities to provide for customers.

4) Solar Share (Central Virginia Electric Cooperative 2024)
Owns and operates 2 community solar sites that total 10 MW of electricity production. 60% of energy generated goes directly to the utility customers. The remaining 40% can be used by customers who subscribe to their program.

5) Bedford Solar (Town of Bedford VA 2023)
3 MW facility where subscribers can contribute 50-100% of their monthly energy use. Solar project makes 11% of their electricity from renewable sources.

6) Friendly City Solar (Harrisonburg Electric 2024)
1.5 MW facility owned and operated by Dominion Energy. The Harrisonburg Electric Commission pays Dominion for it and offers customers subscription of 25% of their energy use. This program has not generated enough customer interest likely due to the number of students in the area.

7) Dominion Third-Party Shared Solar Program (Dominion Energy 2024)
Cap of 150 MW capacity for the facility. If 30% of subscribers are LMI then permission is received for an additional 50 MW. So far have 60.5 MWs developed and in use.

8) Multi-Family Shared Solar program (Dominion Energy 2024)
Focused on providing solar for multi-family housing units such as apartments. Projects are capped at 3 MWs or up to 5 MW if the multi-family unit is in a co-location to solar facility.

The utility programs in VA are focused on supporting the development of solar in VA and have not focused enough on LMI communities. While a customer can receive bill credits, expenditures as a voluntary participant often add on to monthly expenditures. The third-party CSS programs are more focused on LMI assistance including multi-family homes where often low-income or renters are located. Dominion Energy is the largest utility provider in the state and the only ones promoting community solar for LMI groups. There are not a lot of developed projects built for assisting low-income groups or getting low-income communities involved especially small-scale community projects. For the future of CSS programs, more growth needs to happen at the community level. This is where the most benefits are seen for LMI customers. After Virginia created legislation permitting community solar in the state there has been more effort to grow solar and include more disadvantaged groups, but to know if these programs are successful more time needs to move forward, and projects need to grow.

6.3 Challenges
As mentioned in previous sections there are several challenges associated with community solar projects. One problem is the appropriate funding. How can Virginia implement further projects if so much needs to change? Having local utilities be more involved in communities and reaching out to organizations for assistance is a lot of work and upkeep for small communities, but benefits such as cleaner environments, employment opportunities, a more reliable electric system, and monthly bill savings can outweigh those challenges. Keeping LMI customers at the forefront of our thoughts as well as creating appropriate spaces for projects to emerge is one of the most important things to remember (Devar 2020). To combat challenges like this educating and empowering smaller communities to be involved in renewable energy is something to be considered. Lack of opportunities can be due to small funding and lack of knowledge on the
benefits that a community-owned and operated community solar facility has over a utility-owned project. Another associated challenge is land use or finding appropriate locations for projects. For example, NYS has struggled with USSE (Utility-Scale Solar Energy) due to conflicts with the use of agricultural land although forests and agriculture occupy 92% of the state there is a constant challenge to take part in agrivoltaics (Katkar 2021).

6.4 How can we ensure a successful program?

If Virginia follows the key guidelines described in section 6.1 for policy and community projects, it will ensure equity and benefits for the communities in need. Well-thought-out plans not only for community solar but also for weatherization and energy assistance are also intertwined with the overall prospects of the involvement of LMI customers in the movement toward renewable energy. Ensuring that all residents using electricity in Virginia have access to some sort of renewable energy program from their utility is the first step. The second is the affordability of the programs and ensuring that portions of the programs are set aside for LMI customers. Considering LMI groups within the discussion of community solar is a must. Taking ideas from existing projects and states that have many projects can be a great way to gain ideas on project functions.

Chapter 7: Conclusions

7.1 Recommendations

In a lot of the states with successful community solar programs, they have larger capacities for community solar as a state mandate as well as larger goals for including more LMI groups. Another setback in VA lies in the aesthetic and historical importance that residents value in the land. Due to the state’s historical nature as one of the oldest states, there are a lot of limits on land development as well as historical building retrofitting which can lead to less energy-efficient homes. There are also 32 electric utilities within the state, some of which share programs such as the Cooperative Sunshare program that many cooperatives subscribe to. Most utilities do their own thing. This strategy does not make it easy for all state residents to gain access to Community Solar opportunities if utilities don’t offer assistance or tips for starting an equitable program. Below are my main takeaways and recommendations organized into four categories based on my analysis.
Funding:
Advocating for increased federal and state funding to support a broader range of low-income customers, particularly focusing on weatherization and energy efficiency, offers a more sustainable solution to battling high electricity bills. Prioritizing energy efficiency and weatherization efforts not only reduces bills but also overall energy consumption for customers in the long term. Thus, leading to lower electricity bills and therefore less bill assistance will be necessary. Additionally, expanding incentives in utility Community Solar Programs to include disadvantaged communities alongside low-income groups can enhance representation and engagement, ensuring more inclusive participation.

Location:
Innovative technologies and strategies in solar development should be prioritized to mitigate unnecessary costs. A particular emphasis should be placed on enhancing the grid and electrical infrastructure, especially within disadvantaged communities. As the grid evolves and expands including disadvantaged areas in infrastructure planning, such as transmission line placement, will ensure the future of the state’s goals for renewable energy. Initiating techniques, particularly on agricultural land or impervious surfaces, is essential due to the abundance of farmland in the state. Utilizing these placement strategies can present an ideal opportunity for optimizing land use for solar energy production as well as propelling the state toward its goals.

Education:
Empowering LMI communities through education and accessible programs is crucial for their involvement in community solar initiatives. State and community governments and non-profits could provide education and funding for community projects that can encourage the growth of community solar. Virginia should prioritize the establishment of more community-led shared solar programs, as community-run initiatives offer smaller communities the opportunity to gain full benefits from such programs. The benefits can include lower electricity bills, job training and opportunities, and a more secure electrical grid for the community as a whole.

Collaboration:
It's crucial to foster cohesion among utilities by partnering with local and state agencies and nonprofits to facilitate the adoption of community solar programs. This is especially important given Virginia's historical significance and as a result the presence of its numerous small private utilities. Some cooperatives utilize the same community solar programs, I believe more utilities should work together to encourage the use of more renewable energy options. Embracing solar integration within small communities rather than resisting it is essential. Communities may resist due to the replacement of job opportunities or the interference with the aesthetic of the land. When solar for a community would instead create job opportunities, making renewable energy more accessible for communities in need.

Some areas in Southwest Virginia have high poverty and high energy burdens and no programs yet for renewable energy access. The state has far to go in ensuring all residents get fair bill assistance and equitable involvement in the green energy movement. From my analysis, I have concluded that energy burdens are higher due to poor energy efficiency in low-income housing, not necessarily due to high electricity prices. In most cases, Community Solar saves customers as much as 10% on their monthly electricity bill. However, savings could be greater if there were more community-led Community Solar and not utility-led programs that cost extra for regular customers. Energy burdens could be reduced. If there is higher funding for empowering smaller more disadvantaged communities, then the benefits can be large.

If this work is to be continued in the future, there are a few recommendations for directions this research could go into. One recommendation would be to add to the suitable site analysis. Including layers such as land cover or transmission lines can make the results more accurate for the needs of establishing solar. I would also emphasize agricultural land to encourage the use strategy of agrivoltaics. Also looking into states bordering Virginia and seeing how they are doing with community solar and renewable energy could give an interesting comparison for that region of the US. I would also continue to monitor funding for renewable energy installations and projects across the state and monitor participation and interest in these projects as well. Continuing an investigation into WAP and LIHEAP funding can bring more conclusions on why WAP has not grown significantly to reflect LIHEAP funding or rising inflation rates. The inflation rate would impact the cost of building materials, labor, and electricity bills. All this further research can lead to more in-depth answers on how to end energy burdens.
7.2 Conclusions

Community Solar is just starting its journey in Virginia with involvement from utilities across the state. While renewable energy is present it is not yet offered for all, or affordable for all, groups. Additionally, low-income groups have been suffering from high energy burdens for decades, nowadays as we are seeing the grid begin to change people are falling deeper into unaffordable living situations. Focusing on areas of the state with low-income or disadvantaged communities makes it possible to involve these groups in renewable energy. Empowering small communities should be at the forefront of the discussion for implementing equitable community solar. The combination of energy-saving techniques and access to a community solar program can be a beneficial combination for LMI groups. Continuing the growth of programs that can help people while also getting them involved in renewable energy advancements can ensure a smoother green energy transition and end energy burdens.

References:


Appendices


<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>What is it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Energy Investment Tax Credit (ITC) – 2002</td>
<td>Financial incentive</td>
<td>Last updated 2023. Under 1 MW projects receive 30% tax credit. Over 1 MW receive 6% base tax credit but can be eligible for 30% tax credit.</td>
</tr>
<tr>
<td>Residential Energy Conservation Subsidy Exclusion -2002</td>
<td>Financial incentive</td>
<td>Last updated 2022. Energy conservation funding provided to individual customers by utilities is not taxable.</td>
</tr>
<tr>
<td>Program Name</td>
<td>Type</td>
<td>Last Updated</td>
</tr>
<tr>
<td>-------------</td>
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</tr>
<tr>
<td>Modified Accelerated Cost-Recovery System - 2002</td>
<td>Financial incentive</td>
<td>2023</td>
</tr>
<tr>
<td>Residential Energy Conservation Subsidy Exclusion - 2002</td>
<td>Financial incentive</td>
<td>2023</td>
</tr>
<tr>
<td>Renewable Electricity Production Tax Credit (PTC) - 2002</td>
<td>Financial incentive</td>
<td>2023</td>
</tr>
<tr>
<td>Energy-efficient mortgages - 2002</td>
<td>Financial incentive</td>
<td>2020</td>
</tr>
<tr>
<td>USDA- Rural Energy for America Program Grants - 2003</td>
<td>Financial incentive</td>
<td>2018</td>
</tr>
<tr>
<td>Office of Indian Energy Policy and Programs - 2003</td>
<td>Financial incentive</td>
<td>2020</td>
</tr>
<tr>
<td>Residential Renewable Energy Tax Credit – 2005</td>
<td>Financial incentive</td>
<td>2022</td>
</tr>
<tr>
<td>Name</td>
<td>Type</td>
<td>Explanation</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Clean Renewable Energy Bonds - 2006</td>
<td>Financial Incentive</td>
<td>Last updated 2018. Bonds can be used primarily by the public sector. Can be used for renewable energy technologies by cooperatives, government, or other certain lenders.</td>
</tr>
<tr>
<td>Qualified Energy Conservation Bonds - 2008</td>
<td>Financial Incentive</td>
<td>Last updated 2018. Can be used for energy projects from state, federal, or tribal governments.</td>
</tr>
<tr>
<td>High Energy Cost Grant Program - 2010</td>
<td>Financial Incentive</td>
<td>Last updated 2022. Program that grants financial assistance for improving the generation of energy, transmission, or distribution in rural areas.</td>
</tr>
<tr>
<td>Policy Title</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shared Solar Program - 2021</td>
<td>Policy</td>
<td>SCC licensed utilities can offer shared solar subscriptions to their customers. Cap of 150 MW of solar power and 45 MW must be given to low-income subscribers.</td>
</tr>
<tr>
<td>Multi-family shared solar - 2021</td>
<td>Policy</td>
<td>Allow up to 3 MW of solar energy production for multi-family dwelling units such as apartment buildings. This is for multi-family units that use Dominion Energy and Old Dominion Power.</td>
</tr>
<tr>
<td>Commercial Solar Property Tax Exemption - 2014</td>
<td>Incentive</td>
<td>If a project produces 20 MW or less and serve a public or private institution of higher education or produces less than 5 MW is exempt from 100% of property tax. Projects over 5 MW and below 150 MW get an 80% property tax exemption.</td>
</tr>
<tr>
<td>Solar rights - 2008</td>
<td>Policy</td>
<td>A person cannot be restricted from installing solar onto their property unless there is a size, place, or solar placement strategy restriction from the community.</td>
</tr>
<tr>
<td>Solar Easements - 1978</td>
<td>Policy</td>
<td>Persons owning land can create solar easements on their property where they protect sunlight access.</td>
</tr>
<tr>
<td>Renewable Electricity Production Tax Credit - 2002</td>
<td>Incentive</td>
<td>A tax credit is given to an individual based on inflation and kWh generated. Last renewed in 2022.</td>
</tr>
<tr>
<td>Renewable Portfolio Standard - 2021</td>
<td>Policy</td>
<td>Regulation for utilities’ renewable energy portfolios. Timeline of renewable expectations is outlined.</td>
</tr>
<tr>
<td>Residential Property Tax Exemption for Solar - 2022</td>
<td>Incentive</td>
<td>Solar equipment is exempt or partially exempt from property tax.</td>
</tr>
<tr>
<td>Mandatory Utility Green Power Option - 2007</td>
<td>Policy</td>
<td>Utility must provide an option for customers to supply their homes with 100% green energy. If they cannot the customer is allowed to purchase it from any supplier that is not their utility.</td>
</tr>
<tr>
<td>Program</td>
<td>Incentive</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Green Job Creation Tax Credit - 2010</td>
<td>Incentive</td>
<td>Tax credit of $500 for every new green job created where the person can make over $50,000. Green job must be related to renewable or alternative energy production.</td>
</tr>
<tr>
<td>VirginiaSAVES Green Community Loan Program - 2015</td>
<td>Incentive</td>
<td>Financing for projects dedicated to energy efficiency and renewable energy. Money is provided to non-profits and local governments dedicated to such projects.</td>
</tr>
<tr>
<td>Energy Project and Equipment Financing - 2011</td>
<td>Incentive</td>
<td>The Virginia Resources Authority could provide financial assistance towards renewable energy projects for local governments.</td>
</tr>
<tr>
<td>Small business and Non-Profit Loan Program - 2014</td>
<td>Incentive</td>
<td>Small-businesses and non-profits can receive funding for solar or wind additions.</td>
</tr>
<tr>
<td>Renewable Energy Machinery and Tools Property Tax Exemption - 2015</td>
<td>Incentive</td>
<td>City, county, and town in the state can decide their own property taxes on machinery and tools for RE (cannot exceed taxes on the general class of energy tools; must be lower).</td>
</tr>
<tr>
<td>Interconnection Standards - 2015</td>
<td>Policy</td>
<td>Enforces the regulation of interconnection standards specifically outlining 2 types, one for systems that are net-metered and one for systems that are not.</td>
</tr>
</tbody>
</table>

Appendix 3: Virginia Utilities their customers and whether or not they provide community solar

(Author compiled from sources).

<table>
<thead>
<tr>
<th>Utility name</th>
<th>Region/# of customers</th>
<th>Comm. Solar?</th>
<th>Assistance Programs</th>
<th>Source (citations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian Power (APCo)</td>
<td>~1 million people or 34 counties; SW VA</td>
<td>No</td>
<td>N/A for solar; home performance program; smart thermostat program; Low-income weatherization; Low-income multifamily; Free or</td>
<td>Appalachian Power 2024</td>
</tr>
<tr>
<td>Utility</td>
<td>Count (VA)</td>
<td>Do Solarize</td>
<td>Offer Programs</td>
<td>Details</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Kentucky Utilities</td>
<td>5 counties in VA; SW VA</td>
<td>No</td>
<td>Offer a plethora of opportunities and suggestions for savings; provide links to support programs for bill payments on their website</td>
<td>Kentucky Utilities 2024</td>
</tr>
<tr>
<td>Dominion Energy (VA)</td>
<td>~2.6 million people; 2/3 of the state (all around)</td>
<td>yes</td>
<td>Solar projects in operation and working in 37 counties; Offer about 40 different energy saving and money saving programs; Have designated amount of community solar program for LMI customers.</td>
<td>Dominion Energy 2024</td>
</tr>
<tr>
<td>A&amp;N Electric Cooperative</td>
<td>35,000 homes; entire peninsula in the Bay</td>
<td>yes</td>
<td>Cooperative Sunshare offers customers all or a portion of their energy to be solar sourced from two solar farms in the state; Have net-metering for connecting personal PV’s to the grid</td>
<td>A &amp; N Electric Cooperative 2024</td>
</tr>
<tr>
<td>BARC Electric Cooperative</td>
<td>~13,000 people; Western VA</td>
<td>yes</td>
<td>SolarizeBARC program is a combo of utility scale, rooftop, battery storage, and community solar programs; have 2 community solar locations</td>
<td>BARC Electric Cooperative 2020</td>
</tr>
<tr>
<td>Craig-Botetourt Electric Cooperative</td>
<td>7,361 customers; SW VA</td>
<td>no</td>
<td>Offer net-metering for customers with rooftop solar</td>
<td>Craig-Botetourt Electric Cooperative 2022</td>
</tr>
<tr>
<td>Cooperative</td>
<td>Customers</td>
<td>Programs</td>
<td>Notes</td>
<td></td>
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<tr>
<td>-------------</td>
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</tr>
<tr>
<td>Community Electric Cooperative</td>
<td>11,000 customers; SE VA</td>
<td>no</td>
<td>Offers net-metering for customers and rooftop solar guides and programs</td>
<td></td>
</tr>
<tr>
<td>Central Virginia Electric Cooperative (CVEC)</td>
<td>~36,000 people; central VA</td>
<td>yes</td>
<td>2 solar generation farms that produce 10 MW of energy (largest solar project from an electric cooperative in VA)</td>
<td></td>
</tr>
<tr>
<td>Mecklenburg Electric Cooperative</td>
<td>31,000 customers; South VA</td>
<td>yes</td>
<td>Part of the Cooperative Sunshare program Does offer customers to voluntarily receive 100% renewable energy from wind power</td>
<td></td>
</tr>
<tr>
<td>Northern Neck Electric Cooperative</td>
<td>~19,964 People; NE peninsula</td>
<td>yes</td>
<td>Cooperative Sunshare program from 2 solar farms in the state; $5.46 for 50 kWh from Oct-May and $5.95 per 50 kWh from Jun-Sep</td>
<td></td>
</tr>
<tr>
<td>Northern Virginia Electric Cooperative (NOVEC)</td>
<td>175,000 homes and businesses; Northern VA</td>
<td>no</td>
<td>Net-metering program for individual solar PV cells energy production to be put back into the system. Offer programs for energy saving.</td>
<td></td>
</tr>
<tr>
<td>Powell Valley Electric Cooperative</td>
<td>33,000 people in VA and TN; SW VA</td>
<td>no</td>
<td>Offers a program called green switch where customers can choose to pay $2 extra a month to power their home using renewables.</td>
<td></td>
</tr>
<tr>
<td>Prince George Electric</td>
<td>12,206 members</td>
<td>no</td>
<td>No renewable energy option for customers, but net metering is an option.</td>
<td></td>
</tr>
<tr>
<td>Cooperative (PGEC)</td>
<td>and 6 counties; SE VA</td>
<td>option for individuals with PV cells.</td>
<td>Cooperative 2023</td>
<td></td>
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</tr>
<tr>
<td><strong>Rappahannock Electric Cooperative</strong></td>
<td>~ 176,000 customers and portions of 22 counties; Central N VA</td>
<td>yes</td>
<td>5.8% of energy provided to customers is renewable. Utilizes Cooperative Sunshare</td>
<td>Rappahannock Electric Cooperative 2024</td>
</tr>
<tr>
<td><strong>Southside Electric Cooperative</strong></td>
<td>53,372 homes and businesses 18 counties; Central S VA</td>
<td>yes</td>
<td>Offers tips and services for installing solar on their homes. Also utilizes Cooperative Sunshare</td>
<td>Southside Electric Cooperative 2024</td>
</tr>
<tr>
<td><strong>Shenandoah Valley Electric Cooperative</strong></td>
<td>99,400 customers; NW VA</td>
<td>yes</td>
<td>Have a community solar facility that customers can subscribe to. $5.38 per 50 kWh block</td>
<td>Shenandoah Valley Electric Cooperative 2024</td>
</tr>
<tr>
<td><strong>Bristol Power Board</strong></td>
<td>16,000 homes</td>
<td>no</td>
<td>No community solar program but offers opportunities and tips for interconnecting personal PV cells to the grid</td>
<td>Bristol Power Board 2024</td>
</tr>
<tr>
<td><strong>City of Bedford</strong></td>
<td>5,609 people, 883 commercial/industrial</td>
<td>yes</td>
<td>Community solar project where customers can participate 50% or 100% of renewable energy; costs $0.008/kWh</td>
<td>Town of Bedford VA 2023</td>
</tr>
<tr>
<td><strong>City of Danville</strong></td>
<td>42,000 customers</td>
<td>no</td>
<td>Don’t appear to have a renewable energy program, but offers assistance with bills</td>
<td>Danville Virginia 2020</td>
</tr>
<tr>
<td>City of Manassas</td>
<td>16,209 customers</td>
<td>no</td>
<td>Offers net metering to customers with their own renewable energy technology.</td>
<td>Manassas Virginia 2020</td>
</tr>
<tr>
<td>City of Martinsville</td>
<td>7,705 customers</td>
<td>no</td>
<td>No program, but offers a portion of energy from hydroelectric power (2% of energy production)</td>
<td>Martinsville Virginia 2024</td>
</tr>
<tr>
<td>City of Radford</td>
<td>7,493 customers</td>
<td>no</td>
<td>No community solar or any renewable option for residents</td>
<td>Radford Virginia 2023</td>
</tr>
<tr>
<td>City of Salem</td>
<td>~13,300 customers</td>
<td>no</td>
<td>No community solar program, but portion of energy generated from hydroelectric. The rest is wholesale from American Electric Power.</td>
<td>City of Salem 2023</td>
</tr>
<tr>
<td>Franklin</td>
<td>5,636 customers</td>
<td>Not yet</td>
<td>Community solar project in the works called Southampton Solar Panel Project.</td>
<td>City of Franklin VA 2024</td>
</tr>
<tr>
<td>Harrisonburg Elec Com.</td>
<td>20,000 customers (residential, commercial)</td>
<td>yes</td>
<td>Friendly City Solar program; customers can subscribe 50% or 100% solar energy; $0.115/kWh</td>
<td>Harrisonburg Electric 2024</td>
</tr>
<tr>
<td>Richlands</td>
<td>2,500 customers</td>
<td>no</td>
<td>Town energy bought wholesale from American Municipal Power</td>
<td>Town of Richlands, Virginia 2023</td>
</tr>
<tr>
<td>Town of Blackstone</td>
<td>2,015 customers</td>
<td>no</td>
<td>No information online, but no option for customers.</td>
<td>Town of Blackstone Virginia 2024</td>
</tr>
<tr>
<td>Town of Culpeper</td>
<td>5,775 customers</td>
<td>no</td>
<td>Power is wholesale from Virginia Municipal Electric Association and offer net-metering program.</td>
<td>Town of Culpeper, Virginia 2024</td>
</tr>
<tr>
<td>Town of</td>
<td>Customers</td>
<td>Renewable Energy Option</td>
<td>Reason</td>
<td>Energy Provider</td>
</tr>
<tr>
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<td>----------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Elkton</td>
<td>1,110</td>
<td>no</td>
<td>No renewable energy option for customers.</td>
<td>Find Energy 2022</td>
</tr>
<tr>
<td>Front Royal</td>
<td>~8,000</td>
<td>no</td>
<td>Gets energy from NEER/AMP solar fields, not an option for customers just incorporated into their overall energy generation</td>
<td>Front Royal Virginia 2024</td>
</tr>
<tr>
<td>Wakefield</td>
<td>535</td>
<td>no</td>
<td>Two powerplants generate for them, there is no renewable energy generation</td>
<td>Town of Wakefield, VA 2024</td>
</tr>
<tr>
<td>VPI &amp; SU</td>
<td>6,000</td>
<td>no</td>
<td>Provides energy for large college town; No renewable energy option for customers (mostly because a majority are students)</td>
<td>Virginia Tech 2024</td>
</tr>
</tbody>
</table>