SOLAR SOLUTIONS

Policy Analysis for Small-Scale Solar Growth in West Virginia

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Prepared for: Solar United Neighbors, West Virginia

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SOLAR UNITED NEIGHBORS

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Disclaimer

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University Virginia. This paper is submitted in partial fulfillment of the course. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, Solar United Neighbors, or by any other agency.

Honor Pledge

On my honor as a student, I have neither given nor received unauthorized aid on this assignment.

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Executive Summary

West Virginia, the twelfth-highest polluting state in the U.S. as of 2023, still generates nearly 90% of its electricity using carbon-packed coal (U.S. Energy Information Administration, 2024a). Comparatively, the United States produces roughly 10% of its electricity using coal U.S. Energy Information Administration, 2023). West Virginia's (WV) reliance on fossil fuels is unsustainable, but there is insufficient market competition to provide meaningful clean alternatives because three entities in WV actively stifle small-scale solar access and policy adoption—utility (monopoly electric utilities), regulatory (Public Service Commission), and legislative.

States with a historic reliance on fossil fuels for their economies and cultural heritage have a harder time passing clean energy legislation than others. The current legislature in West Virginia favors coal, and few solar energy-supportive bills exist in the state today (Adams, 2024). Research shows that states like West Virginia are unwilling to adopt policies, such as solar energy policies, that challenge their current market systems (Vasseur, 2016). The United States is moving away from coal to produce electricity, seeking out cheaper and cleaner energy technologies. However, West Virginia has resisted these national trends and doubled down on coal, passing coal supportive legislation and constructing more coal-fired power plants (Ramie, Wason, and Nostrand, 2023). This economic reliance on comparatively expensive coal has resulted in not only a lack of viable energy alternatives, but harmfully high electricity costs for consumers. (Ramie, Wason, and Nostrand, 2023; Coyne, 2024).

The client, West Virginia Solar United Neighbors (WV SUN), seeks to pass legislation that increases access to small-scale solar energy across West Virginia. WV SUN is the West Virginia-specific branch of the national 501(c)(3) non-profit organization Solar United Neighbors. WV SUN actively lobbies the West Virginia State Legislature to support policies that enhance and broaden community access to rooftop and distributed generation solar energy. This document outlines potential alternatives for WV SUN to consider and provides a final recommendation to guide their advocacy efforts.

This document outlines four potential alternatives for WV SUN to consider and provides a final recommendation to guide their advocacy efforts.

The suggested alternatives include the following:

1. Status Quo
2. Renewable Portfolio Standard Policy
3. Cash-Rebate Incentive Policy
4. and Community Solar Policy

Each of these suggested alternatives are rigorously evaluated by a series of evaluative criteria in order to determine how well each alternative addresses the problem. The criteria use both point and panel data in its evaluation.

The evaluative criteria include the following:

1. Political Feasibility (High, Medium, or Low)
2. Cost to West Virginia households (USD)
3. Effectiveness (MW of Solar Installed)
4. and Affordability of Solar for Residents (Reduce, Increase, or Maintain)

Ultimately, this report recommends that WV SUN continue pursuing a community solar policy. Based on the weighting of criteria, community solar outperforms the other alternatives in terms of effectiveness and political feasibility. The document ends by recommending action items and a timeline WV SUN can use to implement the recommendations of this report, including identifying a policy window of opportunity (Kingdon, 2002) and using research-proven framing strategies to successfully market a community solar policy.

Introduction

Despite significant national efforts to decarbonize the U.S. power grid and transition to more affordable energy sources, West Virginia still generates about 90% of its electricity from highly polluting and costly coal (U.S. Energy Information Administration, 2024a). Renewable energy options, like small-scale solar, struggle to gain a foothold in the state due to its long-standing structural and cultural dependence on fossil fuels for its economy. Solar United Neighbors' West Virginia branch, a non-profit organization, is dedicated to promoting small-scale rooftop solar and expanding solar energy access for residents. However, the industry faces substantial challenges because enacting solar-friendly policies in West Virginia is particularly difficult. This report presents four evidence-based alternatives for Solar United Neighbors to consider in addressing this policy issue and offers a final recommendation to guide their advocacy efforts.

Problem Statement

West Virginia, the twelfth-highest polluting state in the U.S. as of 2023, still generates nearly 90% of its electricity using carbon-packed coal (U.S. Energy Information Administration, 2024a). West Virginia's (WV) reliance on fossil fuels is unsustainable, but there is insufficient market competition to provide meaningful clean alternatives because three entities in WV actively stifle small-scale solar access and policy adoption—utility (monopoly electric utilities), regulatory (Public Service Commission), and legislative.

Solar United Neighbors, West Virginia

West Virginia Solar United Neighbors (WV SUN) is the West Virginia-specific branch of the national 501(c)(3) non-profit organization Solar United Neighbors. WV SUN's mission is to expand rooftop solar energy access in West Virginia. Rooftop solar energy refers to electricity generated by solar panels mounted on the roof of a building. WV SUN hopes to advocate for a fair energy system that benefits local communities through job growth, energy democracy, utility cost reduction, pollution reduction, and by making solar energy generation more affordable. At the community level, WV SUN partners with local solar installers to provide one-on-one resources for businesses, individuals, and other organizations seeking to implement rooftop solar energy. It also generates community support for clean energy policies through advocacy, community education, and community events. At the state level, the organization lobbies the West Virginia State Legislature to advocate for policies that would benefit and expand community access to rooftop solar energy.

Solar United Neighbors Advocacy (Solar United Neighbors, n.d.)

In West Virginia, solar energy is largely inaccessible to the community. First, solar panels are expensive with and especially without government incentives. The average solar panel system in West Virginia costs $44,128, and $30,890 after consumers receive a 30% cost reduction via federal income tax credits (ITC) (Walker, 2024). With West Virginia's current poverty rate of approximately 17%, many homeowners still cannot afford solar panels even with current federal incentive policies (U.S. Census Bureau, 2024).

WV SUN works closely with solar installers and local communities to install solar energy on the ground, which is made logistically difficult to implement due to the unsupportive policy environment in West Virginia. To navigate this, WV SUN lobbies the state legislature to advocate for bills that make small-scale solar systems accessible to local communities, such as the Community Solar bills that were proposed in the 2023 and 2024 legislative sessions. Community solar allows multiple consumers to benefit from a small, shared system of solar panels, making it easier to afford and reduces overall electricity costs, among countless other benefits (U.S. Department of Energy, n.d.). However, both bills died in committee (Barkus, 2024). Much of the state's existing legislation is supportive of the fossil fuel industry due to its historic economic reliance on fossil fuels. Very few renewable energy bills can pass through the state legislature, and very few are active today. Research suggests that this is a trend. One study indicates that fossil fuel states are very unlikely to pass policies that challenge their current economic system and are largely opposed to market intervention from renewable energy policy (Vasseur, 2016).

The policy issue, where the electricity monopoly, state legislature, and regulatory bodies in West Virginia actively hinder small-scale solar access and policy adoption, is significant to the client because these institutional barriers prevent them from effectively advocating for policies that would make rooftop solar accessible to West Virginians. WV SUN is looking for solutions to improve solar access in West Virginia and address this barrier, such as advocating for alternative solar energy policies or using more successful lobbying strategies.

Background

West Virginia's History with Fossil Fuels

West Virginia has a wealth of coal deposits spanning across sixty-two seams of mineable coal. Mining began in the early 1800s, and throughout the century became a booming and profitable economic industry for the state (WV Office of Miners' Health Safety and Training, n.d.). The Appalachian region is commonly known as the formerly dominant energy sector of the United States, having fueled the nation's electricity needs for over a century due to its wealth in fossil fuels. West Virginia became a key coal producer, and the industry became its dominant economic sector. At its peak in 1997, West Virginia produced 181.9 million tons, or approximately 22%, of coal for the United States (Beaulieu, 2021; U.S. Energy Information Administration, 2016).

As of 2022, West Virginia ranks fifth in the United States for total energy generation (U.S. Energy Information Administration, 2025b). For a long time, coal was the predominant source of energy for the United States. However, coal has been on a steady decline since 2007 because utilities nationwide have transitioned to cleaner, low-cost alternatives due to technological advances (Ramie, Wason, and Nostrand, 2023). National coal use for energy production declined from 52% to 19% between the years 2001 and 2020 (Beaulieu, 2021). Despite the dip in national coal use and the transfer of many utilities to low-cost alternatives, West Virginia has not strayed from coal. The state has only decreased its coal electricity production from 98% to 86% since 2001 (Beaulieu, 2021; U.S. Energy Information Administration, 2025b). Former director of the Center for Energy and Sustainable Development at West Virginia University, James Van Nostrand, explained in an interview that, not only has West Virginia resisted the nation's energy transition accompanying technological advancement, but the state adopted three new coal plants and the policymakers have "doubled down" on coal (Ramie, Wason, and Nostrand, 2023).

Appalachian communities in the U.S., such as West Virginia, often falsely view mining or extractive energy industries as their only prospect for economic development because of their history, leading them to negatively view efforts to regulate fossil fuels or transition to renewable energy sources (Poudyal et al., 2019). Although many individuals in these communities dislike coal due to its environmental and health effects, they are loyal to the industry because of their historical dependence on extractive mining for economic prosperity. Many communities support and promote extractive industries because they view fossil fuel industries as long-term facilitators of their economic mobility. As a result, they think that the fate of their economy is "linked" to their extractive energy industries (Feng, 2020). The fossil fuel industry has dominated West Virginia's economy for a long time, leading it to shape a proud heritage and culture around mining. Proud heritages built around fossil fuels lead individuals to view environmental activists and regulation as threats (Lewin, 2019). The added element of cultural and economic reliance on extractive industries makes their energy transitions, and passing clean energy policies, harder to achieve than those in other communities throughout the United States.

Fossil Fuel Companies and State Legislation

West Virginia's electricity provision is dominated by a small group of powerful fossil fuel companies, including Appalachian Power Company and First Energy Corporation (Barkus, 2024). Although there is still some competition in the energy industry, these companies wield considerable market power and influence legislative and regulatory bodies, crowding out competition, especially from the clean energy sector. These energy companies represent one of the largest lobbying forces in the state, shaping energy legislation. During the 2023 legislative session, three natural gas and coal representatives were in the top 10 highest lobbying spenders, and coincidentally, three pro-coal bills were passed during the session (Adams, 2024). This regulatory capture from electric companies means that fossil fuel legislation passes and clean energy bills struggle to make it through.

A community solar bill was proposed in both the 2023 and 2024 legislative sessions (bills lobbied for by the client, WV SUN) and never made it out of committee (Barkus, 2024). Similarly, in 2024, the state's legislature passed a bill that would have doubled the total production cap of utility-scale solar systems in the state, but it was vetoed by the Governor who expressed concerns about the bill's potential harm to the coal industry (West Virginia Legislature, n.d.). The state also issued a Renewable Energy Portfolio Standard (RPS) alongside 30 other states in 2005 and became the first to ever repeal an RPS in 2015 (Barkus, 2024). The state's dependence on fossil fuels fortifies the lobbying influence of fossil fuel companies, making it challenging for alternative energy solutions to gain traction in the legislature. This also makes it difficult for the client, WV SUN, to encourage rooftop solar policies in the state legislature and increase solar energy access in the state.

The primary policies that influence solar energy in WV are the Inflation Reduction Act, the EPA's Solar For All Program, WV House Bill (HB) 3310, and WV Senate Bill (SB) 583. The 117th U.S. Congress passed the Inflation Reduction Act of 2022, which encourages investment into clean energy initiatives, including solar energy. This bill provides financial incentives for clean energy development, such as tax credits for rooftop solar, and funding opportunities for renewable energy projects at the statewide and local level, such as grants for low-income communities (The White House, 2023). As a result of the IRA, the EPA has created the Solar For All Program, which allocates billions of dollars in federal funding to support solar projects in low-income communities across the country. Recently, the Solar For All Program provided the WV Office of Energy with $106 million to install residential rooftop solar systems and reduce the costs of electricity for homeowners in WV (West Virginia Office of Energy, n.d.). This project is called the WV Real Resilient Roofs Program.

In terms of the state legislature, clean energy policy has been scarce. HB 3310 legalized Power Purchase Agreements in West Virginia, allowing residents to finance rooftop solar systems with little to no upfront cost (West Virginia Legislature, 2021). WV Code §24-2F-8 and amending HB 2201 created a set of regulations for net metering in the state (West Virginia Legislature, 2015). Finally, SB 583 clarified solar regulatory frameworks to reduce barriers to solar energy, created provisions for the development of utility-scale renewable energy facilities, and overall, promoted the development of renewable energy (West Virginia Legislature, 2020). Each of these recent policies has shaped the incentive structures, legality, and statewide implementation of solar energy.

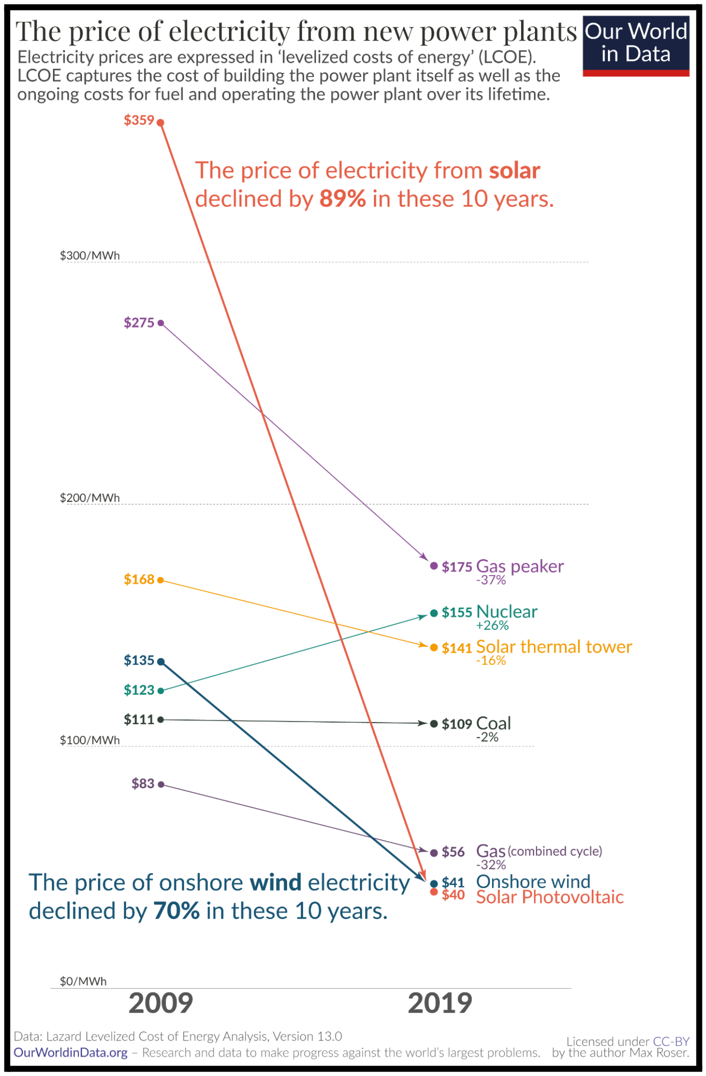
Important Legislation

2000 — 2009 — 2015 — 2020 — 2023 — 2025

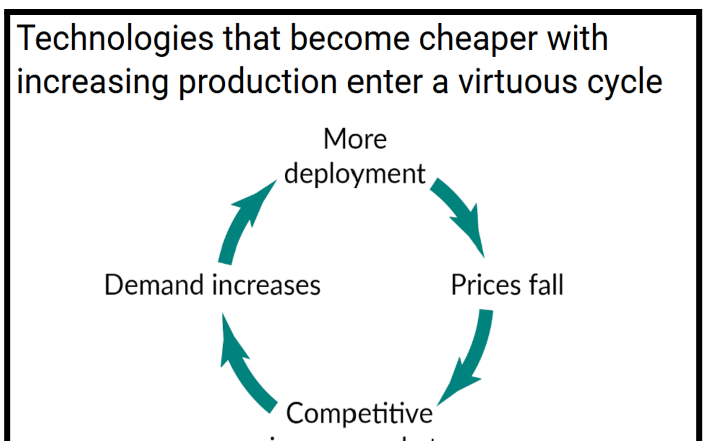
- **HB 103 (2009):** Adopted a renewable portfolio standard (West Virginia Legislature, 2009)
- **West Virginia Code §24-2F-8 & HB 2201 (2015):** Established and defined the rules for net metering (West Virginia Code §24-2F-8; West Virginia Legislature, 2015)
- **HB 2001 (2015):** West Virginia became the first state in the U.S. to repeal its renewable portfolio standard (West Virginia Legislature, 2015)
- **HB 583 (2020)**: Clarified solar regulatory frameworks to reduce solar energy barriers and diversify the state's energy portfolio (West Virginia Legislature, 2020)
- **HB 3310 (2023):** Legalized power purchase agreements (West Virginia Legislature, 2021)

Rate Hikes: Fossil Fuel Companies and The Public Service Commission

Energy companies not only influence the state legislature with their lobbying power, but they also influence regulatory measures and electricity prices through the Public Service Commission. The West Virginia Public Service Commission (PSC) regulates electricity companies and sets the prices that they are allowed to charge. Prices are typically determined using base rates that cover the companies' operating costs and riders, which are additional fees that the companies request to recover costs from other programs. A significant portion of these Riders are Expanded Net Energy Costs (ENECs), which cover increases in the price of the fuels used to produce electricity and account for as much as 32% of consumers' electric bills. ENECs have been increasing over time, paralleling the rising costs of fossil fuels, predominantly coal (Omole & Curchin, 2024). The state's reliance on coal-fired power plants leads to volatile and expensive utility bills for homeowners, yet the PSC often allows companies to set their utility prices with significant leeway.



In recent years, electricity prices have risen and are only projected to increase under the status quo. Between 2017 and 2023, Appalachian Power convinced the PSC to increase utility rates 14 times. Since 2019, homeowners have seen a 32.6% increase in utility rates–figures expected to rise further with the price of fossil fuels (Coyne, 2024). Most



Source: Roser, 2020

recently, in July 2024, Appalachian Power requested a 1.61% increase in rates, which the PSC approved. The following month, the company requested an additional 18% increase, which the PSC postponed for further investigation due to public backlash (Coyne, 2024). West Virginia is dominated by a few energy companies that collaborate with the PSC to set utility prices, which are steeply on the rise due to the volatile price of fossil fuels. The aforementioned interview with Jamie Van Nostrand explains that, because West Virginia doubled down on coal and expanded its industry unlike the rest of the United States, the mean electricity price increased five times the U.S. average between 2008 and 2020. These giant rate hikes were higher than any other state in the U.S. (Ramie, Wason, and Nostrand, 2023). With West Virginia's poverty rate at 17.9% in 2022, the third highest in the nation (O'Leary, 2023), these rising utility costs hit many residents especially hard.

Rising utility rates are a negative consequence of West Virginia's unsustainable reliance on fossil fuels. A few small electric companies in West Virginia wield significant influence over state legislation and utility regulation, perpetuating the industry's monopoly and obstructing the development of policies and fair market competition for alternative energy solutions. This dominance hinders the state's ability to pass solar policies, enhance solar access, and reduce rising utility rates. The continued investment in costly coal, despite the availability of cheaper renewable energy options, exacerbates this issue.

Benefits of WV SUN's Goal: More Rooftop Solar

Rooftop solar energy has many advantages including energy security and resilience, energy production cost reductions, utility cost savings, carbon emission reductions, local job creation, and more (U.S. Department of Energy, n.d.).

Solar panels offer the potential for greater energy independence, which can lead to lower electricity costs for consumers. In West Virginia, the electricity market is currently dominated by a small monopoly of powerful fossil fuel companies that rely heavily on fossil fuels for power generation. Since 2019, utility rates have risen by 32.6%, with further increases expected as fossil fuel prices continue to climb (Coyne, 2024). Utility bills tend to be regressive, meaning they disproportionately affect low-income households, which spend a larger share of their income on electricity (Dauwalter & Harris, 2023). For instance, low-income families in the U.S. allocate 7.2% of their income to utilities—three times more than higher-income households (Shahyd, 2016). With West Virginia's poverty rate at 17.9% in 2022, the third highest in the nation (O'Leary, 2023), these rising utility costs hit many residents especially hard. Implementing small-scale solar systems can significantly reduce this financial burden. Solar systems offer greater savings for regions with higher local utility rates and have the potential to save West Virginians up to $120,000 in energy costs over the lifespan of the system (Walker & Langone, 2024). Research shows that households can save about $250 annually on electric utility costs per 1 KW of rooftop solar installation (Lane, 2025). Rooftop solar panels also substantially increase home value for residents (U.S. Department of Energy, 2015).

Perhaps the most apparent advantage of solar energy generation is its environmental benefits. Solar panels replace higher-polluting energy sources, such as fossil fuels, to reduce greenhouse gas emissions and improve air quality. The Intergovernmental Panel on Climate Change explains that the lifetime carbon emissions of electricity produced by solar panels is 12 times less than gas and 20 times less than coal (Schlömer et al., 2014). In 2022, a staggering 89% of the electricity generated in West Virginia came from coal, with only about 7% from renewable sources such as solar energy (U.S. Energy Information Administration, 2024a). Comparatively, the United States produced roughly 10% of its electricity using coal and 14% using renewable energy in 2022 (U.S. Energy Information Administration, 2023; U.S. Energy Information Administration, 2025a).

Coal is the most carbon-intensive and highly polluting energy source, thus, transitioning some of its energy production to small-scale solar energy could create a cleaner environment for West Virginia residents. One study finds that existing solar infrastructure in the U.S. is lacking, forgoing 2 billion dollars' worth of environmental benefits (Dauwalter & Harris, 2023). The vast majority of counties in West Virginia are forgoing all environmental benefits from solar panel installs due to the absence of in-county rooftop solar installations. Only a handful of counties are obtaining any, albeit minimal, environmental benefit (Dauwalter & Harris, 2023). Installing solar panels on West Virginia rooftops will help the state recover some of these otherwise lost environmental benefits. In addition, West Virginia had the twelfth highest emissions of carbon in the nation in 2023, therefore cleaning up the state's electricity generation sector can also help the U.S. move closer to achieving national carbon reduction goals (Environmental Protection Agency, 2024).

Benefits of Rooftop Solar (Tata Power-DDL, n.d.)

Solar energy can also promote energy security and reduce a local community's reliance on central utility companies that use fossil fuels. Energy security and energy independence refer to the capacity to maintain a consistent and cost-effective energy supply while owning and protecting the producing infrastructure. Solar panels can create resilient, energy-secure homes and businesses by ensuring that consumers maintain consistent power during blackouts and extreme weather events such as earthquakes (Patel et al., 2021; U.S. Department of Energy, n.d.). Despite the numerous benefits of small-scale solar energy, there are significant barriers to solar panel access in West Virginia, leading to low levels of implementation.

Public Opinion Data

Evidence indicates that many West Virginians already have favorable views on small-scale solar energy. A poll conducted in three counties in West Virginia reveals that 91% of voters generally support rooftop solar panel electricity generation, with 65% expressing strong support (Conservation West Virginia, 2024). Additionally, the same source reports that 82% of voters believe renewable energy will create more quality jobs, 92% consider the rising cost of electricity a serious concern, 82% are worried about the reliability of the state's energy system, and 91% would support candidates advocating for more renewable energy (Conservation West Virginia, 2024). Another study shows that 69% of West Virginians already support solar energy policies (Barkus, 2024-b; Solar United Neighbors, n.d.). These findings suggest that public opinion in West Virginia may already align with the goals of WV SUN. Despite a supportive legislative constituency, significant barriers to pro-solar energy policy remain.

Evidence on Potential Solutions

This section outlines four potential alternatives for WV SUN to consider to improve the adoption of small-scale solar energy in the state.

The suggested alternatives include the following:

1. Status Quo
2. Renewable Portfolio Standard Policy
3. Cash-Rebate Incentive Policy
4. and Community Solar Policy

Status Quo

The Status Quo reflects a timeline of inaction should the client West Virginia Solar United Neighbors (WV SUN) take no further action to address the problem statement. This alternative is used to project the outcomes of the problem under the current policy landscape and act as a baseline with which to compare the outcomes of other alternatives.

Renewable Portfolio Standard

One alternative solution to the problem is that WV SUN can use its advocacy and lobbying influence to encourage the West Virginia State Legislature to adopt a Renewable Portfolio Standard policy. A Renewable Portfolio Standard (RPS) is a type of mandate policy that requires utility companies to generate a certain percentage of electricity from renewable energy sources (SolSmart, 2017). Depending on the RPS policy, utility companies have several different options to meet the renewable energy requirements, including buying renewable energy from a third party producer or building their own renewable energy projects. However, some RPS policies may have more specific requirements called “set-asides” or “carve-outs” that require a certain amount of electricity to come from specific types of renewable energy, such as small-scale sources like rooftop solar panels on homes in order to encourage the growth of smaller renewable energy projects (SolSmart, 2017). Thirty five percent (35%) of all growth in U.S. renewable energy between 2000 and 2023 is associated with state RPS requirements (Barbose, 2024).

The theory of change for this alternative is that encouraging an RPS policy with set-asides for rooftop solar energy can affect how the state’s utility companies currently generate their electricity, directly altering the state’s energy portfolio to include more rooftop solar development. Currently, 30 U.S. States and Washington D.C. have RPS policies in place (NCSL, 2021). Five Appalachian states with similar historical relationships with fossil fuels and energy production as West Virginia have RPS policies: Pennsylvania, Ohio, North Carolina, Maryland, and Virginia. North Carolina’s RPS, which has carve outs for solar energy, has encouraged more homeowners and businesses to install rooftop solar panels, contributing to North Carolina's ranking as one of the top states for solar energy capacity with 14,837 solar energy systems (Orentas & Allen, 2024).

Cash-Rebate Incentive

One potential solution is for WV SUN to leverage its advocacy and lobbying efforts to persuade the West Virginia State Legislature to implement a cash rebate incentive policy for rooftop solar development. Incentive policies are a governmental strategy to encourage individual actions that collectively drive broader change and align with public policy goals (Vasseur, 2016). Research indicates that states producing fossil fuels are less likely to adopt incentive-based policies, but Republican-leaning states like West Virginia are more inclined to adopt incentives over mandates, regardless of their fossil fuel production (Vasseur, 2016).

A cash rebate policy is a type of incentive that can subsidize the purchase of rooftop solar systems. Under this policy, consumers who purchase a solar system can submit proof of installation to the government and receive a refund, typically as a check or direct deposit. This rebate directly reduces the upfront cost of the solar system, making it more affordable. The theory behind this approach is that a cash-incentive policy can lower financial barriers to small-scale solar energy systems, making them more accessible to residents and businesses, thereby increasing the number of installations.

Studies have shown that cash incentives are associated with an increase in rooftop solar installations (Sarzynski et al., 2012; Hughes and Podolefsky, 2015). One significant study found that cash incentives outperform other incentive policies because the immediate financial support reduces the upfront cost of solar systems, unlike time-delayed policies such as tax credits (Matisoff and Johnson, 2017). This study used a fixed effects model to analyze new rooftop PV installations based on policy and incentive value, controlling for time-invariant factors and unobservable characteristics. It concluded that financial incentive policies are not effective without the presence of another financial mechanism, such as net metering or government-subsidized financing. These mechanisms enable the effectiveness of other financial incentives (Matisoff and Johnson, 2017). Since West Virginia already has a net metering system, cash-rebate incentive policies could be effective in this context.

Eight different states have adopted state-level cash rebate programs for solar energy (Parkman, 2024). The Appalachian state of Maryland, sharing a historical relationship with fossil fuels and energy production similar to West Virginia, offers the Residential Clean Energy Grant Program. This program provides grant funding to reduce the cost burden for residents and businesses, incentivizing clean energy investments. The program offers a $1000/system cash rebate for solar photovoltaic systems between 1 and 20 kW (residential, rooftop size solar systems) and has been a huge contributor to the state's recent growth in solar energy (Maryland Energy Administration, 2022).

Community Solar Bill

One potential solution is for WV SUN to leverage its advocacy and lobbying efforts to persuade the West Virginia State Legislature to adopt a community solar policy for rooftop solar development. A community solar bill enables multiple individuals to benefit from a single distributed generation solar energy project. Instead of installing solar panels on their own roofs, participants can purchase or lease a portion of a larger solar project located within their community. By paying a subscription fee, they receive credits on their electricity bills for the energy generated by their share of the project. This arrangement is especially advantageous for those who cannot install solar panels at home, such as renters or individuals with unsuitable roofs (U.S. Department of Energy, n.d.).

The theory of change for this alternative suggests that promoting a community solar bill can make solar installations more accessible by lowering initial costs and removing adoption barriers for middle and low-income families, renters, and occupants of multifamily buildings (O'Shaughnessy, Barbose, Kannan, & Sumner, 2024). This can generate a positive feedback loop, boosting overall interest and investment in solar energy, including rooftop installations.

Currently, 23 states and Washington D.C. have legislation enabling community solar, and at least one community solar project exists in 44 states (NREL, n.d.). A research article examining 11 states with community solar found that such legislation has expanded solar adoption to communities that would have otherwise faced challenges in adopting rooftop solar (O'Shaughnessy, Barbose, Kannan, & Sumner, 2024). Another study used a model to project the impact of a community solar policy allowing installations within a 100-meter radius of buildings. The findings indicate that this policy would increase PV adoption by 21% by 2035 compared to scenarios without community solar (Nunez-Jimenez, Mehta, Griego, 2023).

Evaluative Criteria

Each of the suggested alternatives are rigorously evaluated by a series of evaluative criteria in order to determine how well each alternative addresses the problem. The criteria use both point and panel data in its evaluation.

The evaluative criteria include the following:

1. Political Feasibility (High, Medium, or Low)
2. Cost to West Virginia households (USD)
3. Effectiveness (MW of Solar Installed)
4. and Affordability of Solar for Residents (Reduce, Increase, or Maintain)

The first criteria is political feasibility. This represents how feasible it is to implement the alternative in West Virginia's unique political context. Weighing factors such as partisan opinion based on voting records on similar pieces of legislation, whether the suggested alternative is an incentive or mandate (Vasseur, 2016), and the administrative and accounting costs on the State Legislature and utility companies to implement the policy, I assign the alternative with a ranking of high, medium, or low representing its feasibility. Costs on the State Legislature and utilities are included in political feasibility because a high implementation cost can negatively impact an alternative's political feasibility. Additionally, research shows that, while states that produce fossil fuels are generally less likely to adopt incentive-based policies than other states, Republican-leaning states such as West Virginia are more likely to adopt incentives than mandates, regardless of their fossil fuel production (Vasseur, 2016). This criteria has a weight of 40%.

The second criteria is cost to West Virginia households. This evaluates accounting costs and considers opportunity costs and administrative costs associated with each policy. These costs include changes in tax spending, electricity cost savings, and home equity value. After determining the costs, I convert the figures to reflect the net present value over the initial ten years of the policy intervention, and take a sum. I make sure to separately calculate the costs to households pursuing solar installations and those not. This criteria has a weight of 15%. To evaluate costs, I pull data from the U.S. Energy Information Administration, EnergySage solar company, and research publications. Visit the "Calculating the Cost Criteria" section of this report for more information (See Appendix, Calculating the Cost Criteria).

The third criteria is effectiveness. Effectiveness is estimated in terms of the additional megawatts (MW) of rooftop solar capacity that will be installed as a result of the policy intervention in the first ten years, in addition to what is estimated in the status quo. This criteria has a weight of 30%. To evaluate effectiveness, I pull data from the U.S. Energy Information Administration and point-source data in research publications.

The final criteria is affordability of solar for residents. The high cost of solar panels leads to regressive benefits to rooftop solar energy, with the highest earners benefiting most from solar panels, and the lowest earners benefiting the least (Dauwalter & Harris, 2023). There are significant cost barriers to solar for households in West Virginia. Ideal policy solutions will make small-scale solar more accessible and affordable for West Virginians. I analyze if each alternative reduces, increases, or maintains the cost burden of rooftop solar systems. This criteria has a weight of 15%. To evaluate this criteria, I pull data from the U.S. Department of Energy, EnergySage solar company, and several research publications.

Evaluating the alternatives results in a 4x4 outcomes matrix highlighting how well each alternative meets the criteria. From this matrix, I provide a justification for a final recommendation.

Evaluating Alternatives

Status Quo

The status quo represents a scenario where no further action is taken by the state legislature or regulatory bodies to solve the problem. This alternative serves to project the potential outcomes under the current policy landscape and provides a baseline for comparing the results of other proposed alternatives. This section evaluates the status quo using the four criteria.

1. Political Feasibility

   The status quo is politically feasible because it requires no additional action or changes to existing policies. This means there are no new legislative efforts, budget allocations, or regulatory adjustments needed, which can often be contentious and time-consuming. By maintaining the current state, policymakers avoid the potential conflicts that come with implementing new measures. Additionally, the status quo cost to the government is $0, because there are no administrative or accounting costs. Therefore, the political feasibility of the status quo is **high**.

2. Cost to Households

   The status quo cost to households ranges from **$35,267 to $50,330**, depending on the size of the solar system. For more detailed information on calculations, see “Calculating the Cost Criteria” (See Appendix, Calculating the Cost Criteria).

3. Effectiveness

   Based on annual residential solar capacity data (U.S. Energy Information Administration n.d.-2), estimates show that residential solar capacity in West Virginia increases by about 6 MW annually. Its electricity generation capacity increases by 540 MWh annually. Over a ten year period, the status quo is projected to increase solar capacity by **60 MW**. To estimate effectiveness, I recorded residential solar capacity in West Virginia from 2020 to 2024, calculated the year-to-year differences, and averaged them to estimate future growth without policy intervention.

4. Affordability of Solar

   The status quo **maintains** current cost-burden because it doesn't implement policy changes to alter the cost of rooftop solar panels. The current cost of rooftop solar systems in West Virginia varies depending on the size of the solar system and whether or not federal Investment Tax Credits (ITC) are applied. Figure 1 details the variation in costs, with a 3 KW system costing a minimum of $6,501 and a 10 KW system costing a maximum of $30,957 (See Appendix, Figure 1; EnergySage, 2025). Without additional statewide financial assistance or targeted interventions, these communities continue to face existing financial barriers to accessing solar energy.

Renewable Portfolio Standard

One possible alternative is for WV SUN to leverage its advocacy and lobbying efforts to persuade the West Virginia State Legislature to implement a Renewable Portfolio Standard (RPS) policy with a 5% set-aside for distributed generation solar. An RPS mandates that utility companies produce a certain percentage of their electricity from renewable energy sources (SolSmart, 2017). Set-asides are particular requirements that ensure a portion of this electricity comes from specific types of renewable energy, such as small-scale sources like rooftop solar panels on homes, to promote the development of smaller renewable energy projects (SolSmart, 2017).

1. Political Feasibility

   The political feasibility of adopting a Renewable Portfolio Standard (RPS) policy in West Virginia is **low** due to historical resistance and the strong influence of the coal industry. In 2009, the state adopted an RPS requiring utility companies to produce 15% of their electricity from renewable sources by 2021 (West Virginia Legislature, 2009). However, the policy was significantly weakened by coal-supportive legislators who included "clean coal" as a renewable energy source, undermining its effectiveness.

   In 2015, West Virginia became the first state to repeal its RPS with the passage of HB 2001, despite the original policy being largely ineffective (West Virginia Legislature, 2015; Barkus, 2024). This repeal suggests that a new RPS policy would likely face substantial opposition and struggle to gain the necessary support. Additionally, an RPS policy would increase costs for utilities by 34%, making it largely infeasible given West Virginia utility's regulatory capture (Novacheck and Johnson, 2015).

Finally, research shows that Republican states like West Virginia are less likely to adopt mandate policies compared to incentive policies (Vasseur, 2016).

2. Cost to Households

The cost to households under an RPS policy ranges from **$40,032 to $57,782**, depending on the size of the solar system. For more detailed information on calculations, see "Calculating the Cost Criteria" (See Appendix, Calculating the Cost Criteria).

3. Effectiveness

RPS policies are likely to have a small impact on solar capacity. Research shows that standard RPS policies encourage investment into low-cost renewable energy generation, and typically results in wind energy investment instead of solar (Matisoff and Johnson, 2017; Deschenes, Malloy, and McDonald, 2023; Lemay, Wagner, and Rand, 2023). However, RPS policies with a carve out for DG solar have a slight positive effect on small-scale solar installation (Novacheck & Johnson, 2015). Estimates suggest implementing an RPS policy with a 5% set-aside for distributed generation solar projected to increase solar capacity by approximately **64 MW** over ten years, 4 MW more than the status quo projections.

4. Affordability of Solar

RPS are designed to increase the use of renewable energy sources by requiring utilities to produce a certain percentage of their electricity from renewable sources. However, RPS do not directly reduce the costs of solar panels for homeowners because they do not provide direct financial incentives or subsidies for individual solar panel installations. As a result, an RPS policy would **maintain** the current affordability for residents because it doesn't implement policy changes that would alter the cost of rooftop solar panels.

Cash-Rebate Incentive Policy

WV SUN can use its advocacy to push for a $1 per watt cash-rebate incentive policy for rooftop solar in West Virginia. This policy would allow consumers to get a refund from the government after purchasing and installing a solar system, making it more affordable by lowering the upfront cost. This specific policy would offer reimbursement of $1 per watt of solar capacity installed. Incentive policies like this encourage individual actions that contribute to broader public policy goals (Vasseur, 2016).

1. Political Feasibility

   A cash-rebate policy would have **low** political feasibility. Research shows that Republican states like West Virginia prefer incentive-based policies over mandates, making a cash-rebate more politically feasible than other options (Vasseur, 2016). However, no other Appalachian states with similar historical and socio-political backgrounds have adopted statewide cash-rebate policies (Just Energy, n.d.). Additionally, West Virginia has struggled to pass several solar-related bills in recent sessions, such as the Renewable Energy Facilities Program, which sought to double the generation capacity of solar facilities, and Community Solar Bills, further diminishing its political feasibility (Conservation West Virginia, n.d.). This policy would also impose costs on the state legislature. West Virginia would need to spend approximately $28.6 million to encourage additional solar installations beyond the current status quo, and if previously projected rooftop solar installations take advantage of the cash-rebates, the expenditure could rise to $89 million.

2. Cost to Households

   The cost to households under a cash-rebate policy ranges from **$34,228 to $56,070** depending on the size of the solar system. For more detailed information on calculations, see "Calculating the Cost Criteria" (See Appendix, Calculating the Cost Criteria).

3. Effectiveness

   Cash-rebate incentive policies are proven by a variety of research studies to have a large influence on rooftop solar development in states. A study examining the impact of various policy incentives on residential solar adoption in the Northeast U.S., including West Virginia, found that increasing the rebate amount by $1/W is expected to boost annual PV capacity additions by approximately 47%, with a growing marginal effect (Crago and Chernyakhovskiy, 2017). Estimates show that with a $1/W cash rebate policy, West Virginia could achieve **89 MW** of solar capacity over ten years, 29 MW more than the status quo.

4. Affordability of Solar

   Rebate programs are designed to make solar power cheaper for consumers, **increasing** the affordability of solar for residents. Research in Massachusetts shows that rebates can cut the cost of installing solar panels by up to 50% (Crago & Chernyakhovskiy, 2017). Cash rebates are especially helpful because they provide immediate financial assistance in the form of payment upon purchase, directly lowering the up-front costs that consumers have to pay to install solar systems (Matisoff and Johnson, 2017; Garcia, 2024).

Community Solar Policy

One possible alternative is for WV SUN to leverage its advocate for a community solar policy that allows the development of 1-5 MW DG community solar projects within a 100-meter radius in West Virginia. This policy allows multiple people to benefit from a single solar project by purchasing or leasing a portion of it. Participants pay a subscription fee and receive credits on their electricity bills for the energy generated. This is ideal for those who can't install solar panels at home, like renters or those with unsuitable roofs (U.S. Department of Energy, n.d.).

1. Political Feasibility

   Passing a community solar policy mainly involves legislative action to legalize and regulate community solar projects, with no additional accounting costs to the State Legislature beyond the usual administrative expenses associated with passing legislation. This benefits its political feasibility. However, based on community solar's prior performance in the West Virginia Legislature, the political feasibility of a community solar policy in West Virginia is **medium**. The state saw its first proposed community solar bill in 2022, and since then, a new bill has been proposed annually, including in the 2025 legislative session. Despite these efforts, the proposed community solar bills for 2022, 2023, and 2024 all failed to advance beyond the Committee stage (West Virginia Legislature, n.d.). However, compared to the RPS and cash-rebate policies, a community solar bill is more politically feasible due to its low costs to both government and utilities.

2. Cost to Households

   The cost to households under a community solar policy ranges from **$27,345 to $50,308** depending on the size of the solar system. For more detailed information on calculations, see "Calculating the Cost Criteria" (See Appendix, Calculating the Cost Criteria)

3. Effectiveness

   Estimates show that under the status quo, residential solar capacity in West Virginia is projected to increase by approximately 60 MW. Research shows that policies allowing community solar development on buildings within a 100-meter radius increases the adoption rate of residential solar by up to 21% by 2035 compared to scenarios without community solar (Nuñez-Jimenez, Mehta, & Griego, 2023). Using this data, estimates show that this alternative can alter status quo projections to approximately **73 MW** over ten years, becoming most effective in West Virginia's urban regions due to higher density of housing. This estimate implies that a community solar policy could lead to 13 MW more residential solar capacity than the status quo projections.

4. Affordability of Solar

In 2023, data from 11 states revealed that individuals who adopted community solar were approximately 6.1 times more likely to reside in multifamily buildings compared to those who chose rooftop solar. They were also 4.4 times more likely to be renters and had an annual income that was 23% lower (O'Shaughnessy et al., 2024). These findings indicate that community solar has successfully broadened solar adoption to include communities that might have faced financial or logistical challenges in adopting rooftop solar.

Community solar systems reduce the cost-burden of solar for consumers as it allows them to benefit from solar energy without the need to install their own panels. Instead, they subscribe to a shared solar project and receive credits on their electricity bills for the energy produced by their share of the project (U.S. Department of Energy, n.d.). This model eliminates the high upfront costs of purchasing and installing solar panels, making solar energy more accessible for a wider range of people. Due to these findings, community solar has the potential to **increase** affordability for residents.

Recommendation

	Political Feasibility (Low, Medium, or High) Weight: 40%	**Cost to Households** (USD; 3 KW system – 10 KW system) Weight: 15%	**Effectivenes s** (MW of Solar Installed) Weight: 30%	**Affordability for Residents** (Reduce, Increase, or Maintain) Weight: 15%
Status Quo	High	\$35,267 – \$50,330	60 MW	Maintain
RPS	Low	\$40,032 – \$57,782	64 MW	Maintain
Cash Rebate	Low	\$34,228 – \$56,070	89 MW	Increase
Community Solar	Medium	\$27,345 – \$50,308	73 MW	Increase

I recommend that Solar United Neighbors continue advocating for a community solar policy. Based on the evaluative criteria, community solar is a highly effective and politically feasible option. Community solar ranks second in efficacy, providing an additional 13 MW beyond current capacity projections, nearly a 22% increase. This policy is also the most politically feasible of the alternatives, as legislators supporting community solar are simply legalizing the use of distributed generation (DG) solar in West Virginia, without committing to increased spending or mandating higher solar adoption. In this way, legislators can also avoid the potential backlash associated with higher spending or regulatory requirements, while still supporting the growth of solar energy in a more passive manner. A final benefit of this policy is that it makes solar energy more accessible and affordable for low-income residents and those with unsuitable roofs.

Implementation

This section outlines a plan for implementing community solar in West Virginia. It includes a discussion of key stakeholders, strategies to get legislation passed in a partisan context, and potential challenges to implementation.

Challenges to Implementation

Implementing solar energy policies in states that have historically relied on fossil fuels is challenging. Much of the current legislation favors the fossil fuel industry because of its historic economic significance. As a result, renewable energy bills rarely make it through the state legislature, and only a few are active today. Research shows that states dependent on fossil fuels are unlikely to pass policies that disrupt their economic systems and generally resist market interventions from renewable energy policies (Vasseur, 2016). Although coal has been on the decline as a primary energy source in the U.S. since 2007 due to technological advances and a shift to cleaner alternatives (Ramie, Wason, and Nostrand, 2023), West Virginia has resisted this transition. Instead, they've added new coal plants and doubled down on coal (Ramie, Wason, and Nostrand, 2023). Additionally, energy companies, which are among the largest lobbying forces in these states, heavily influence energy legislation. For example, during the 2023 legislative session, three natural gas and coal representatives were among the top lobbying spenders, coinciding with the passage of three pro-coal bills (Adams, 2024). As a result, fossil fuel legislation advances while clean energy bills, such as community solar, struggle to gain traction.

Key Stakeholders

It is important for WV SUN to acknowledge stakeholders of a community solar policy. Affected groups include homeowners, businesses, rooftop solar developers, and solar advocacy groups such as Solar Holler, West Virginians for Energy Freedom, and the WV Environmental Council. Additionally, the WV Department of Environmental Protection (WVDEP), WV Office of Energy, WV General Assembly, WV Governor, Public Service Commission (PSC), and utility companies like First Energy and Appalachian Power. Homeowners and businesses likely have mixed views; some benefit from more accessible solar energy, while others display NIMBY attitudes. Solar advocacy groups are supportive and can aid in WV SUN's advocacy efforts. The

WV General Assembly and Governor have mixed perspectives, with some supporting clean energy, and others opposing, as a result of fossil fuel interests and regulatory capture. Utility companies generally oppose the policy due to conflicts with their fossil fuel interests, while regulatory bodies like the PSC, WVDEP, and WV Office of Energy are likely ambivalent.

Moving forward, partnering with developers, advocacy groups, and legislators will be valuable for coalition building and political influence. Generating public support from homeowners and businesses is crucial, as it can influence the decisions of state legislators. It is also important to engage with opponents of a community solar policy to address their key concerns, identify mutually beneficial solutions, and boost overall support for the policy.

Framing Solar Policy

Framing refers to the ways in which issues and policies are presented and described by policymakers and advocates (Wolsink, 2020). The way an activist or policymaker frames a solar energy policy is crucial for its success, particularly in fossil fuel-dependent communities with lower levels of support for renewable energy. The choice of words and highlighted incentives can persuade a community favoring fossil fuels to consider alternative energy sources. However, some framing methods are more effective than others, and some can even be counterproductive. It's essential to use language that resonates with the target audience. Understanding how to frame solar energy when engaging with a community can help increase support for projects and policies.

One study examines public opinion on renewable energy in the Western United States to identify the most effective framing strategies. It finds that fossil fuel-dependent states often respond best to frames emphasizing economic development and air pollution reduction (Olson-Hazboun et al., 2019). Another study finds similar results, noting that economic prosperity and job protection are key motivators for those who support fossil fuels (Miniard & Attari, 2021). Therefore, communities may be more inclined to support renewable energy projects that promise to clean up air pollution, grow their economies, and create lasting jobs. A third study expands on these findings, explaining that framing solar energy policies using economic benefits increases the number of individuals who want to live in a house with solar panels. Using a combination of both economic and environmental incentives generates more support for solar than either method alone (Crowe, 2021). This suggests that employing multiple thoughtful framing methods can generate more support for solar energy policies than any single frame alone.

Partisan ideology influences people's renewable energy preferences, making it important to consider when framing changes to energy production. A conservative ideology is often associated with support for fossil fuels (Hawes and Nowlin, 2022). One study shows that framing energy development in terms of economic benefits is useful for gaining support among ideologically moderate people and conservatives. Another study shows that Republicans are far more likely to support air pollution or energy security frames than others (Wiener and Koontz, 2010; Feldman & Hart, 2018). It is also important to note that Republicans believe in climate change significantly less than Democrats, making them far less likely to support climate change framing (Feldman & Hart, 2018; Miniard & Attari, 2021; Olson-Hazboun, 2019).

The most effective framing strategies for advocating rooftop solar policies in conservative, fossil-fuel states like West Virginia are economic benefits and job creation, air pollution reduction, and energy security. The least effective is climate change framing. When WV SUN advocates for a community solar bill, it may be beneficial to utilize these frames. Additionally, understanding the specific goals of West Virginia can help ensure the use of frames that best align with the target community's interests.

Implementation Plan

Identifying and seizing a "window of opportunity" can place community solar on the WV State Legislature's agenda. This window opens when a relevant problem gains attention (problem stream), a viable policy solution exists (policy stream), and the political climate is favorable (political stream) (Kingdon, 2002). This is the time to market community solar policies to legislators and the public as a solution to a salient issue. These windows are rare but crucial for major policy changes.

The following are three examples of signs to watch for:

- **Shifts in Political Office**: New officials focused on energy democracy, climate change, or utility costs may seek policy suggestions.
- **Media Focus on Crises**: Environmental disasters or electricity cost spikes can create a "focusing event," drawing media and public attention to a problem and leaving policymakers seeking solutions.
- **Federal or International Climate Action**: Global and national actions can provide financial incentives and political support for community solar policies. These often generate media attention, aligning the public's interest with solving the problem.

Figure 2 includes actionable steps that WV SUN should undertake immediately and further develop annually when the State Legislature is not in session to prepare for the next policy window (see Appendix, Figure 2). Once a window of opportunity arises, WV SUN should pursue the following action items to encourage policy success in the next legislative session.

- **Mobilize Allies**: Contact coalition partners to generate momentum and support.
- **Advocate for Policy**: Promote your policy to legislators through calls, emails, and meetings. Use your lobbying team to engage supporters and opponents.

- **Generate Media Attention**: Capture public attention through interviews, articles, rallies, and other media engagements.
- **Sticky Messaging**: Use simple, concrete messaging and emotional storytelling to make community solar memorable and keep it on the public and policymakers' minds and agenda (Heath and Heath, 2007).

Even after policy implementation, it is wise for WV SUN to continue to monitor the policy's effectiveness and equity outcomes. For at least ten years after passing a policy, WV SUN should reference the U.S. Energy Information Administration's annual reports on West Virginia's rooftop solar capacity (U.S. Energy Information Administration, n.d.b) and utilize existing co-op partnerships with solar developers to track changes in rooftop solar installations to ensure that the policy is increasing rooftop solar implementation as the policy matures. WV SUN should also engage the community and relevant stakeholders for feedback using its advocacy arm to qualitatively assess the policy's distribution of costs and benefits across parties.

Appendix

System Size (KW)	2025 System Cost (USD)	2025 System Cost with ITC (USD)
3 KW	$9,287	$6,501
4 KW	$12,383	$8,668
5 KW	$15,479	$10,835
6 KW	$18,574	$13,002
7 KW	$21,670	$15,169
8 KW	$24,766	$17,336
9 KW	$27,862	$19,503
10 KW	$30,957	$21,670

Figure 1 - Average solar cost by system size in West Virginia (EnergySage, 2025)

Action Item	Description
Coalition Building	Create partnerships with organizations, legislators, and stakeholders who support community solar policies to bolster political influence and credibility.
Engage Stakeholders	Identify key supporters and opposers of community solar policy such as legislators and private company representatives. Engage with these stakeholders to address their key concerns and garner mass support for community solar policy.
Draft a Policy	Draft a community solar policy for the window of opportunity. As the window passes quickly, it is important to have a policy written and ready to implement as a solution.
Stay Vigilant	Pay attention to current events for political shifts or focusing events that may signal an upcoming window and be prepared to seize the opportunity.
Develop Framing Strategies	Use identified linguistic strategies to garner the most support for community solar policies. Proper policy framing can help persuade a larger audience to support your policy.
Capacity Building	Work to improve WV SUN's organizational structure, employee & volunteer training, lobbying team, and resources. An organization's capacity affects its ability to mobilize quickly and advocate effectively.
Raise Awareness	Use media, interviews, and other forms of messaging to raise awareness of community solar policies and explain its mission and purpose. Raising awareness about the policy can help increase its support.

Figure 2 - Steps to Prepare for a Window of Opportunity

Calculating the Cost Criteria

This section briefly describes the methods used to calculate the estimated cost to households for each alternative. Costs are projected over ten years, from 2026 to 2036, and every figure is converted from present value to net present value (NPV) using a 5% discount rate before doing calculations. Pulling data from sources such as the U.S. Energy Information Administration, EnergySage solar company, and research publications, I estimate the various accounting, administrative, and opportunity costs facing households in West Virginia.

As cost varies depending on whether or not a household chooses to adopt solar, and the size of the solar system the household installs, I start by estimating two ranges of data. The typical rooftop solar installation ranges from 3 KW to 10 KW in (EnergySage, 2025). First, I use cost estimates for 3 KW and 10 KW systems to calculate the lower and upper bounds of potential costs to households, respectively. Then, I estimate the costs for households that adopt solar panels, and for households that do not, as their respective costs would vary. After determining the cost values for each of these ranges, I estimate the share of the population that would adopt solar panels versus the share that would not adopt solar in order to approximate a singular range using the following formula:

$$Lower\ Bound = \left(Cost_{Adopting\ 3KW} \times Share_{Adopting}\right) + \left(Cost_{Non-Adopting\ 3KW} \times Share_{Non-Adopting}\right)$$

$$Upper\ Bound = \left(Cost_{Adopting\ 10KW} \times Share_{Adopting}\right) + \left(Cost_{Non-Adopting\ 10KW} \times Share_{Non-Adopting}\right)$$

The specific costs I use to obtain my final estimate vary depending on the alternative. The following breaks down my cost estimates for each alternative.

Status Quo

To estimate the cost to households under the status quo, I consider the following costs:

- **Electricity Rates**: Electricity rates represent the amount homeowners are projected to spend on electric utilities over the next ten years in net present value. First, I recorded the average retail price per MWh of electricity in West Virginia from 2020-2024 (U.S. Energy Information Administration, 2024b) and calculated the average annual price change to project future price changes. Energy consumption data shows that West Virginia households consume approximately 0.98 MW per month (U.S. Energy Information Administration, n.d.a). Using electricity cost changes and energy consumption data, the NPV ten-year electricity cost estimates for each household are approximately $22,403.
- **Electricity Cost Savings**: Electricity cost savings represents the amount homeowners are projected to save on electricity bills after installing solar panels. The amount of savings varies depending on the size of the system. Households can save about $250 annually on electric utility costs per 1 KW of solar installation (Lane, 2025). With typical rooftop

solar installations ranging from 3 KW to 10 KW (EnergySage, 2025), the savings over ten years in NPV are estimated to be between $6,761 and $22,537, depending on the solar capacity installed. For non-adopting households, this is an opportunity cost, not a savings, and is instead added to the overall cost.

- **Home Value**: Home value represents the increases in home value equity from solar panel installations. Home value has been shown to increase by approximately $4 per watt of rooftop solar, or $4,000 per KW (Hoen, 2015). Over ten years, household value would increase by $7,405 with a 3 KW system and $24,686 with a 10 KW system in NPV.

- **Solar System Costs**: Solar system costs represent the amount homeowners have to pay to install solar systems. Figure 1 details the cost of solar installation in West Virginia, depending on the size of the system and the availability of federal tax credits (See Appendix Figure 1; EnergySage, 2025). The ten-year net present value of solar panel costs for homeowners ranges from $3,991 to $19,004, depending on the size of the system.

Status Quo Cost (Adopting) =
Electricity Rates – Electricity Cost Savings – Added Home Value + Solar System Costs

Status Quo Cost (Non-Adopting) =
Electricity Rates + Foregone Electricity Cost Savings + Foregone Home Value – Savings on Solar System Costs

Currently, 2,827 West Virginia Households employ rooftop solar, and the residential solar capacity in the state is 31 MW (Agopian, 2024; U.S. Energy Information Administration, n.d.b). Under the status quo, 60 MW of solar are projected to be installed over the next 10 years, a 193.55% increase in solar generation capacity. Using these figures, approximately 5,471 additional West Virginia households are projected to adopt rooftop solar panels, which is 0.76% of households (U.S. Census Bureau, 2024).

$$Lower\ Bound = \$35,267.35 = (-\ \$5,548.20 \times 0.0076) + (\$35,579.92 \times 0.9924)$$

$$Upper\ Bound = \$50,330.66 = (\$12,227.96 \times 0.0076) + (\$50,622.46 \times 0.9924)$$

Renewable Portfolio Standard

- **Electricity Rates Under RPS**: Electricity rates under an RPS represents the amount homeowners are projected to spend on electric utilities over the next ten years with an RPS policy. West Virginia uses a cost-of-service model to determine electricity rates for residents. This is overseen by the Public Service Commission, and sets rates at a price that allows companies to recoup all of their expenses and a profit margin (West Virginia Code §24-2-4B, n.d.). As an RPS would increase the costs for utility companies by as much as 34%, the electricity rates would rise to reflect these changes due to the cost-of-service agreement (Novacheck and Johnson, 2015). To determine electricity costs under an RPS model, I calculate changes to electricity rates to alter status quo projections. The NPV ten-year electricity costs to homeowners changes to $30,021.

RPS Cost (Adopting) =
Electricity Rates Under RPS – Electricity Cost Savings – Added Home Value + Solar System Costs

RPS Cost (Non-Adopting) =
Electricity Rates Under RPS + Foregone Electricity Cost Savings + Foregone Home Value – Savings on Solar System Costs

Sixty-four (64) MW of solar are projected to be installed over the next 10 years under an RPS, which is a 206.45% increase in solar generation capacity. Approximately 5,836 additional West Virginia households are projected to adopt rooftop solar panels, which is 0.81% of households (U.S. Census Bureau, 2024).

$$Lower\ Bound\ = \$40,032.40\ = (\$19,845.29\ \times\ 0.0081) + (\$40,197.25\ \times\ 0.9919)$$

$$Upper\ Bound\ = \$57,782.66\ = (\$1,802.75\ \times\ 0.0081) + (\$58,239.80\ \times\ 0.9919)$$

Cash-Rebate Incentive Policy

- **Cash-Rebate Savings on Solar Systems**: Cash-rebate savings on solar systems represents the amount homeowners would save on solar panel purchases. The expenses associated with a cash-rebate incentive policy for households differ based on the size of the installed solar system. As the alternative suggests a $1/W cash rebate on solar system purchases, homeowners would save $1,841 on a 3 KW system while a 10 KW system would save $6,139. Note that these figures are converted into NPV over a ten-year time period.

- **Additional Tax Burden**: Additional tax burden represents the additional taxes that households could bear due to the increased state government spending associated with a cash-rebate policy. This calculation assumes that all of the tax burden falls onto households evenly (opposed taxes levied on businesses, variation based on income tax, variations in sales tax, etc.). This potentially over- or under- estimates each respective household's tax burden. This calculation also assumes that the increase in tax burden is proportional to the spending increase, and is not offset by alternative legislative spending cuts. The estimated ten-year NPV increases in budget spending equate to approximately $54,742,694, if all 89 MW of encouraged solar (including 60 MW from status quo) receive a cash rebate. With 721,448 tax paying households in West Virginia (U.S. Census Bureau, 2024), the tax burden per household equates to approximately $75.88.

Cash-Rebate Cost (Adopting) =
Electricity Rates − Electricity Cost Savings − Added Home Value + Solar System Costs − Cash-Rebate Savings + Additional Taxes

Cash-Rebate Cost (Non-Adopting) =
Electricity Rates + Foregone Electricity Cost Savings + Foregone Home Value + Additional Taxes − Savings on Solar System Costs + Foregone Cash-Rebate Savings

Eighty-nine (89) MW of solar are projected to be installed over the next 10 years under an RPS, which is a 287.10% increase in solar generation capacity. Approximately 8,116 additional West Virginia households are projected to adopt rooftop solar panels, which is 1.12% of households (U.S. Census Bureau, 2024).

$$Lower\ Bound\ = \$34,228.33\ = (\$10,462.09\ \times\ 0.0112) + (\$34,497.53\ \times\ 0.9888)$$

$$Upper\ Bound\ = \$56,070.84\ = (-\ \$11,611.46\ \times\ 0.0112) + (\$56,837.47\ \times\ 0.9888)$$

Community Solar Policy

Costs to households using community solar can vary depending on whether the individual project uses a subscription or ownership model. A subscription model allows homeowners to pay a monthly rate to a larger community solar project and receive credits on their energy bills. Alternatively, an ownership model allows households to directly purchase a share of electricity produced by solar panels. However, it is important to note that despite the adoption of a community solar policy, homeowners still have the option to purchase and install solar panels, making the lowest and highest rates those estimated under the status quo. These are the thresholds used in the outcomes matrix.

- **Fixed-Rate Electricity Savings**: Fixed-rate electricity rates refers to the energy utility costs households would pay with a subscription model. The most common community solar subscription is fixed-rate, offering 5-20% savings on monthly electric bills (Walker, 2025). A 5% fixed-rate can save a household $1,832 over ten years, while a 20% fixed-rate can save a household $7,329. The final calculation uses the lowest savings for a conservative estimate.

- **Ownership Electricity Savings**: Ownership electricity rates refers to the electricity utility costs households would pay with an ownership model. An ownership model allows households to purchase a share of electricity produced by solar panels, with savings depending on the system size (Walker, 2025). This is equivalent to "Electricity Cost Savings" under Status Quo.

Fixed-Rate Community Solar Cost (Adopting) =
Electricity Rates – Fixed-Rate Electricity Cost Savings + Foregone Home Value – Solar System Costs

Fixed-Rate Cash-Rebate Cost (Non-Adopting) =
Electricity Rates + Fixed-Rate Electricity Cost Savings + Foregone Home Value – Savings on Solar System Costs

Ownership Community Solar Cost (Adopting) =
Electricity Rates – Electricity Cost Savings + Foregone Home Value + Solar System Costs

Ownership Community Solar Cost (Non-Adopting) =
Electricity Rates + Foregone Electricity Cost Savings + Foregone Home Value – Savings on Solar System Costs

Seventy-three (73) MW of solar are projected to be installed over the next 10 years under an RPS, which is a 235.48% increase in solar generation capacity. Approximately 6,657 additional West Virginia households are projected to adopt rooftop solar panels, which is 0.92% of households (U.S. Census Bureau, 2024).

$$Lower\ Bound = \$27,345.79 = (-\ \$5,548.20 \times 0.0092) + (\$27,651.22 \times 0.9908)$$

$$Upper\ Bound = \$50,308.86 = (\$12,227.96 \times 0.0092) + (\$50,662.46 \times 0.9908)$$

Calculating the Effectiveness of the Status Quo

Year	Current Residential Solar Ca	Current Generation Capac	Source
2024	31.844	2797.015	https://www.eia.gov/e
2023	26.414	2,179.52	https://www.eia.gov/e
2022	18.77	1,553.14	https://www.eia.gov/e
2021	12.464	1,036.57	https://www.eia.gov/e
2020	7.613	638.57	https://www.eia.gov/e
2019	No data	No data	https://www.eia.gov/e

Calculating the Average Difference in MW over Time

Years	Differences in M	Average Additional M
2023-2024	5.43	6.05775 [1]
2022-2023	7.644	
2021-2022	6.306	
2020-2021	4.851	

Calculating the Average Difference in MWh over Time

Years	Differences in MWh Ge	Average Additional MWh/ye
2023-2024	617.49	539.61 [2]
2022-2023	626.38	
2021-2022	516.57	
2020-2021	398.00	

Year	Avg. Retail Price (USD) per I	Avg. Retail Price (USD) pe	Source
2024	$153.30 [3]	$131.00 [4]	https://www.eia.gov/e
2023	$140.50	$126.80	https://www.eia.gov/e
2022	$132.30	$123.60	https://www.eia.gov/e
2021	$121.50	$111.00	https://www.eia.gov/e
2020	$118.00	$105.90	https://www.eia.gov/e
2019	$112.50	$105.40	https://www.eia.gov/e

Calculating the Avg. Difference in Annual Retail Price (USD) per MWh of Electricity, WV

Years	Differences in An	Average Additional P
2023-2024	$12.80	$8.83 [5]
2022-2023	$8.20	
2021-2022	$10.80	
2020-2021	$3.50	
[9]		

Calculating the Avg. Difference in Annual Retail Price (USD) per MWh of Electricity, U.S.

Years	Differences in Annual P	Average Additional Price pe
2023-2024	$4.20	$6.28 [6]
2022-2023	$3.20	
2021-2022	$12.60	
2020-2021	$5.10	
[10]		

Calculating the % Difference in Annual Retail Price (USD) per KWh of Electricity from 2019 to 2024

Percent change between 20	Percent change between 20
36.267 [7]	24.288 [8]

Calculating Costs Under the Status Quo

Annual Electricity Rates in WV ($/MWh * Consumption) [11]

Year	Monthly Electricity Rate in W	Annual Electricity Rate in U	Calculating NPV [12]	Net Present Valu
2024	$153.30	$1,802.81		$22,403.94 [13]
2025	$162.13	$1,906.59		
2026 [17]	$170.95	$2,010.37	$2,010.37	
2027	$179.78	$2,114.15	$2,013.48	
2028	$188.60	$2,217.94	$2,011.73	
2029	$197.43	$2,321.72	$2,005.59	
2030	$206.25	$2,425.50	$2,200.00	
2031	$215.08	$2,529.28	$2,080.85	
2032	$223.90	$2,633.06	$2,063.07	
2033	$232.73	$2,736.85	$2,042.28	
2034	$241.55	$2,840.63	$2,018.78	
2035	$250.38	$2,944.41	$1,992.89	
2036	$259.20	$3,048.19	$1,964.89	

Foregone Cost Savings per KW

Approximate ann	Size of Solar System ir	Annual electricity
$250.00 [14]	1	$250.00
	2	$500.00
	3	$750.00
	4	$1,000.00
	5	$1,250.00
	6	$1,500.00
	7	$1,750.00
	8	$2,000.00
	9	$2,250.00
	10	$2,500.00

Net Present Value of Annual Savings Forgone in USD with a 3 KW Solar System (Lower Bound)

Year	Calculating NPV Savings of a	Ten Year Saving
2026 [15]	$750.00	$6,761.14 [16]
2027	$714.29	
2028	$680.27	
2029	$647.88	
2030	$680.27	
2031	$617.03	
2032	$587.64	
2033	$559.66	
2034	$533.01	
2035	$507.63	
2036	$483.46	

Calculating Costs Under the Status Quo (Continued)

Net Present Value of Annual Savings Forgone in USD with a 10 KW Solar System (Upper Bound)

Year	Calculating NPV Savings of	Ten Year Savings NPV (1
2026 [19]	$2,500.00	$22,537.13 [20]
2027	$2,380.95	
2028	$2,267.57	
2029	$2,159.59	
2030	$2,267.57	
2031	$2,056.76	
2032	$1,958.82	
2033	$1,865.54	
2034	$1,776.70	
2035	$1,692.10	
2036	$1,611.52	

Net Present Value of Foregone Home Value from Solar Installations

Percentage Price	Size of Solar Sys	Home Value incr	Calculating NPV Hom
0.3403797468 [2	1	$4,021.14	$7,405.89
	2	$8,042.28	
Home Value incr	**3**	**$12,063.42**	Calculating NPV Hom
$4.02	4	$16,084.56	$24,686.31
	5	$20,105.70	
Home Value incr	6	$24,126.84	
$4,021.14	7	$28,147.97	
	8	$32,169.11	
	9	$36,190.25	
	10	**$40,211.39**	

NPV of Solar System Costs in USD

Cost of a 3 KW Syst	Calculating NPV of a 3
$9,287.00	$5,701.41
Cost of a 3 KW Syst	Calculating NPV of a 3
$6,501.00	$3,991.05
Cost of a 10 KW Sys	Calculating NPV of a 1
$30,957.00	$19,004.91
Cost of a 10 KW Sys	Calculating NPV of a 1
$21,670.00	$13,303.50

Summing Costs to Households

NPV Cost to Households With Solar

Cost of a 3 KW S	Cost of a 10 KW System
$12,227.96 [24]	-$5,548.20 [25]

NPV Costs to Households Not Pursuing Solar

Costs to household (	Cost to househol
$32,579.92 [26]	$50,622.46 [27]

View full spreadsheet here:
https://docs.google.com/spreadsheets/d/1ullW2dH1CHoWVO-tHsFnpq9yfg9GVgWdQh3hJZE5ZlI/edit?gid=0#gid=0

Effectiveness of Renewable Portfolio Standard	
Average Additional MW/year under Status Quo	**Calculating Solar Capacity (in MW) in Ten Years with an RPS**
6.05775 [1]	63.606375 [2]
Average Additional Solar MW in 10 Years	
60.5775	

Costs to Consumers with a Renewable Portfolio Standard							
Calculating Changes to Electricity Rates			Summing Costs to Households				
Net Present Value Ten-Year Cost of Electricity in USD	New NPV Cost to Consumers		**NPV Cost to Households With Solar**			**NPV Costs to Households Not Pursuing Solar**	
$22,403.94	$30,021.27 [3]		Cost of a 3 KW System	Cost of a 10 KW System		Costs to household (lower bound)	Cost to household (upper bound)
			$19,845.29 [4]	$1,802.75 [5]		$40,197.25 [6]	$58,239.80 [7]
Utility Company Cost Increase							
34.00%							

View full spreadsheet here:
https://docs.google.com/spreadsheets/d/1ullW2dH1CHoWVO-tHsFnpq9yfg9GVgWdQh3hJZE5ZIl/edit?gid=0#gid=0

Effectiveness of Cash Rebate

Average Additional MW/year under Status Quo	**Calculating Solar Capacity (in MW) in Ten Years with a Community Solar Policy**
6.05775 [1]	89.17008 [2]
Average Additional Solar MW in 10 Years	
60.5775	

Costs to the State Legislature of Cash Rebate

MW of Solar Encouraged	Cost Expended on Solar Incentives in USD ($1/W)	Cost Expended if Status Quo Projected Solar Capacity AND Additional Capacity Use Cash-Rebates	NPV Costs to state legislature
28.59258	$28,592,580.00	$89,170,080.00	
			$17,553,363.81 [3]
KW of Solar Encouraged			
28592.58			$54,742,693.93 [4]
W of Solar Encouraged			
28592580			

Costs to Consumers Under a Cash Rebate Policy

NPV of Solar System Costs in USD

Cost of a 3 KW System in USD	Calculating NPV of a 3 KW System in a Decade, USD
$9,287.00	$5,701.41
Cost of a 3 KW System with ITC, in USD	Calculating NPV of a 3 KW System with ITC in a Decade, in USD
$6,501.00	$3,991.05
Cost of a 10 KW System in USD	Calculating NPV of a 10 KW System in a Decade, USD
$30,957.00	$19,004.91
Cost of a 10 KW System with ITC in USD	Calculating NPV of a 10 KW System with ITC in a Decade, in USD
$21,670.00	$13,303.50

Cost Savings for Homeowners on Solar Panels

3 KW in Watts	Savings on a 3 KW Solar System	NPV Savings of a 3 KW Solar System (10 years)
3000	$3,000.00	$1,841.74
10 KW in Watts	Savings on a 10 KW Solar System	NPV Savings of a 10 KW Solar System (10 years)
10000	$10,000.00	$6,139.13

ADDITIONAL Taxes for Households Due to Increased Government Spending [5]

Number of Households in WV	Cost Per HH	Cost Per HH
721,448	$39.63	$75.88
Cost Expended on Solar Incentives in USD ($1/W)		
$28,592,580.00		
Cost Expended if Status Quo Projected Solar Capacity AND Additional Capacity Use Cash-Rebates		
$54,742,693.93		

Costs to Consumers Under a Cash Rebate Policy (Continued)

Foregone Cost Savings per KW

Approximate annual electricity cost savings per kilowatt in USD (assuming [$1500 in annual savings per 6 KW system](#))	Size of Solar System in KW	Annual electricity cost savings in USD
$250.00 [6]	1	$250.00
	2	$500.00
	3	$750.00
	4	$1,000.00
	5	$1,250.00
	6	$1,500.00
	7	$1,750.00
	8	$2,000.00
	9	$2,250.00
	10	$2,500.00

Net Present Value of Annual Savings Forgone in USD with a 3 KW Solar System (Lower Bound)

Year	Calculating NPV Savings of a 3 KW System	**Ten Year Savings NPV (3 KW)**
2026 [7]	$750.00	$6,761.14 [8]
2027	$714.29	
2028	$680.27	
2029	$647.88	
2030	$680.27	
2031	$617.03	
2032	$587.64	
2033	$559.66	
2034	$533.01	
2035	$507.63	
2036	$483.46	

Net Present Value of Annual Savings Forgone in USD with a 10 KW Solar System (Upper Bound)

Year	Calculating NPV Savings of a 10 KW System	**Ten Year Savings NPV (10 KW)**
2026 [9]	$2,500.00	$22,537.13 [10]
2027	$2,380.95	
2028	$2,267.57	
2029	$2,159.59	
2030	$2,267.57	
2031	$2,056.76	
2032	$1,958.82	
2033	$1,865.54	
2034	$1,776.70	
2035	$1,692.10	
2036	$1,611.52	

Summing Costs to Households

NPV Cost to Households With Solar		**NPV Costs to Households Not Pursuing Solar**	
Cost of a 3 KW System	Cost of a 10 KW System	Costs to household (lower bound)	Cost to household (upper bound)
$10,462.09 [11]	-$11,611.46 [12]	$34,497.53 [13]	$56,837.47 [14]

View full spreadsheet here:
https://docs.google.com/spreadsheets/d/1ullW2dH1CHoWVO-tHsFnpq9yfg9GVgWdQh3hJZE5ZlI/edit?gid=0#gid=0

Effectiveness of Community Solar	
Average Additional MW/year under Status Quo	**Calculating Solar Capacity (in MW) in Ten Years with a Community Solar Policy**
6.05775 [1]	73.298775 [2]
Average Additional Solar MW in 10 Years	
60.5775	

Calculating the Cost With Community Solar for Households

Annual Energy Utility Costs Under a Fixed-Rate Subscription Model (5-20% Monthly Savings on Utilities) [3]

Year	Annual Price of Energy in WV in USD, 2024 (Cost in $/MWh * Monthly Consumption)	Average Monthly Price of Energy in WV in USD, 2024 (WV Avg Monthly Utility Cost in $/MWh * Avg Monthly Household Consumption)	Annual Savings on Utility Bills under a 5% Fixed Rate Subscription (Lower Bound)	Annual Savings on Utility Bills under a 20% Fixed Rate Subscription (Upper Bound)	Calculating NPV Annual Savings Under a 5% Fixed Rate Subscription	Calculating NPV Annual Savings Under a 20% Fixed Rate Subscription	NPV Annual Savings Under a 5% Fixed Rate Subscription
2024	$1,802.81	$150.23	$90.14	$360.56			$1,832.44
2025	$1,906.59	$158.88	$95.33	$381.32			
2026 [4]	$2,010.37	$167.53	$100.52	$402.07	$100.52	$402.07	NPV Annual Savings Under a 20% Fixed Rate Subscription
2027	$2,114.15	$176.18	$105.71	$422.83	$110.99	$443.97	$7,329.78
2028	$2,217.94	$184.83	$110.90	$443.59	$122.26	$489.05	
2029	$2,321.72	$193.48	$116.09	$464.34	$134.38	$537.54	**NPV Annual Costs with Community Solar (Under a 5% Fixed Rate Subscription)**
2030	$2,425.50	$202.13	$121.28	$485.10	$147.41	$589.64	$20,571.49 [5]
2031	$2,529.28	$210.77	$126.46	$505.86	$161.40	$645.62	
2032	$2,633.06	$219.42	$131.65	$526.61	$176.43	$705.71	**NPV Annual Costs with Community Solar (Under a 20% Fixed Rate Subscription)**
2033	$2,736.85	$228.07	$136.84	$547.37	$192.55	$770.20	$15,074.16 [6]
2034	$2,840.63	$236.72	$142.03	$568.13	$209.85	$839.38	
2035	$2,944.41	$245.37	$147.22	$588.88	$228.39	$913.55	
2036	$3,048.19	$254.02	$152.41	$609.64	$248.26	$993.04	

Calculating the Cost With Community Solar for Households (Continued)

Annual Energy Utility Costs Under an Ownership Model [7]			**Adding Up Costs to Households (Fixed-Rate Subscription Model)**			**Adding Up Costs to Households (Ownership Model)**	
Ten-Year NPV Annual Savings in USD with a 3 KW Solar System	**NPV Annual Costs with Community Solar, Owning a 3 KW system**		**Lower bound**	**Upper bound**		**Lower bound**	**Upper bound**
$6,761.14 [8]	$15,642.80 [9]		$22,480.05	$45,257.80		$11,396.94	$59,334.02
Ten-Year NPV Annual Savings in USD with a 10 KW Solar System	**NPV Annual Costs with Community Solar, Owning a 10 KW system**						
$22,537.13 [10]	-$133.19 [11]						

Summing Costs to Households

NPV Cost to Households With Solar					**NPV Costs to Households Not Pursuing Solar [12]**	
Cost with 5% Fixed Rate Subscription	Cost with 20% Fixed Rate Subscription	Cost with 3 KW System (ownership model)	Cost with 10 KW System (ownership model)		Costs to household (lower bound)	Cost to household (upper bound)
$23,986.33 [13]	$18,489.00 [14]	$27,039.74 [15]	$43,824.41 [16]		$27,651.22	$50,622.46 [17]

The lowest possible cost for any household remains -$5,548, because nothing changes from the status quo

View full spreadsheet here:
https://docs.google.com/spreadsheets/d/1ullW2dH1CHoWVO-tHsFnpq9yfg9GVgWdQh3hJZE5ZIl/edit?gid=0#gid=0

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