Solar Microgrid Implementation in Prince George's County, Maryland

Analyzing Solar Microgrid Projects in Low-Income Communities

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Abstract

This paper discusses the benefits associated with developing a solar microgrid in a low-income community in Prince George's County, Maryland.

The benefits include reduced air pollution in the community, reduced adverse health impacts from air pollution, reduced spending on utility bills, as well as increased energy security and a more equitable distribution of renewable energy.

Using various sources including reports, academic articles, and case studies, this study proves installation of a microgrid in the County would benefit the community and the surrounding area. An in-depth cost-benefit analysis proves the economic feasibility of a microgrid, and the social benefits provide a sound argument for the benefits of installation.

Barriers to implementation are also discussed, focusing on problems related to the source of initial funding.

The study concludes with two recommendations for implementing resilient solar photovoltaic systems in Prince George's County. First, finding alternative funding for a microgrid such as federal grants, public partnership, private sector involvement, and community-based funding. Second, the County should consider using community solar rather than a microgrid based on case studies that indicate the cost-effectiveness and increased feasibility of community solar compared to a solar microgrid.

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Introduction

The emergence of solar energy has revolutionized the way society produces electricity, especially in an era of fluctuating energy prices and climate change. Solar panels allow companies and homeowners to provide themselves with cleaner, more sustainable energy sources to complement existing power grids. However, this technology is largely limited to those who can afford the upfront costs of installing solar panels. This cost barrier means many lower income communities can't benefit from the use of solar energy, putting them at a disadvantage with reduced energy security and a higher risk from the effects of pollution and climate change.

To address this inequity, Prince George's County is developing a plan for installing solar-powered microgrids in low-income communities. These microgrids would target community centers whose tenants cannot individually afford or approve their construction.

This research assesses the benefits, costs, and potential challenges of installing solar microgrids, and how the county can overcome this problem of inequity.

One of the greatest implications of energy inequity is adverse health impacts due to air pollution and climate change. Studies have found a significant link between income and rates of respiratory issues such as asthma. Ambient air pollution accounted for 4.2 million deaths in 2015 worldwide. Seventy percent of all air pollution-related deaths were the result of non-communicable diseases, as were 19 percent of cardiovascular deaths, 21 percent of stroke deaths, and 23 percent of lung cancer deaths (Landrigan, 2017). Ambient air pollution, largely caused by burning fossil fuels, disproportionately affects low-income areas and urban centers where carbon and greenhouse gas emissions are high. This contributes to economic damage due to lost productivity and high medical expenses (Landrigan, 2017).

Climate change also affects low-income areas more severely. In rural areas, agricultural yields are becoming less fruitful, leading to rising food prices everywhere, and subsequently higher rates of malnutrition. Climate change has also increased both droughts and floods in several parts of the world, including the United States (Balasubramanian, 2018).

One barrier to implementing solar microgrids is funding. Most communities, especially those in marginalized communities, have limited local government budgets with more immediate demands to fund services such as trash pickup and landscaping. For example, in Prince George's County, College Park has roughly $30 million in total revenue and is relatively large, wealthy city has a public university and other sources of revenue. Nevertheless, there are issues with community buy-in; increasing costs will inevitably strain small budgets. Installing solar panels on a single home for instance, can cost $20,000. Solar energy is one of the most cost-effective types of energy production, but it still comes at a price that many property owners and communities can't afford.

Off-the-grid energy improvements are expensive and would have to go through the Interior Department among other agencies. For example, the state of Texas runs its own power grid—Texas Interconnection—which is one of three grids that make up the US power grid. Most states can rely on a backup energy supply from connections grids in other states. But in Texas, during the winter of 2021 and since, extreme weather made the grid fail. Texas is on its own, people lost power and suffered health and property damage due to a lack of heat. This suggests the need for a backup to any local power supply, especially if that supply is off-the-grid.

A microgrid offers security risks and rewards. These systems can generate more power than needed and that can be sold to benefit the local community. There is also less chance of cyber-attacks; a community microgrid is a less appealing target and can act independently. Their security can be supported by solar farms that often generate excess power and can be used to charge backup batteries when the local energy grid is experiencing an outage due to storms and other natural disasters. Community owned and operated solar farms secure clean energy as either a primary or backup source that also benefits the community financially as well as environmentally.

Solar energy microgrids and solar farms, give local communities more control and benefits of energy production, particularly valuable for those hit hardest by climate change. Communities can also lessen their reliance on traditional energy production that have harmed marginalized communities for decades.

Many communities understand and appreciate the transition to renewable energy however, some hesitate to move away from traditional energy sources. In her 2020 study, Hannah Wiseman found that community members often object to the process of creating energy generators such as a solar farm. These projects take time and introduce industrial development into communities that are otherwise relatively quiet, something that community members value. Their construction brings in workers and large equipment that would disrupt day-to-day life, making community members hesitant to have these generators installed.

Regarding solar installation specifically, some communities object to clearing trees or altering community space to accommodate solar grids (Wiseman, 2020). The general sentiment about construction is hesitancy, even in communities that understand the benefits of a transition to renewable energy.

Providing renewable energy sources to low-income communities within Prince George's County requires collective action to overcome various barriers. This report discusses the barriers to entry, including funding, political feasibility, community hesitancy, among others. Using examples from successful community microgrids across the country, the report outlines best practices for successful implementation of a microgrid and its sustained benefits. A cost-benefit analysis compares the costs of implementing the microgrid to the resulting benefits—financial and social.

The report also addresses the solutions a microgrid can provide for

- limiting adverse health effects of climate change on low-income communities
- providing energy security in low-income communities
- creating equitable access to renewable energy.

This report aims to answer the following questions:

- How can a microgrid effectively provide solar energy to low-income communities in Prince George's County?
- What actors should be involved to make implementation feasible?
- Which other communities have successfully implemented a microgrid?
- What are the long-term benefits provided by a microgrid?

Literature Review

Distributing renewable energy in underserved and underrepresented communities continues to be a struggle. Community members often believe that these new technologies are questionable and that those proposing them are privileged and untrustworthy.

This a long-standing issue for the equitable distribution of renewables and their benefits to those hit hardest by climate change. Informing these communities in a respectful way from trusted sources is paramount to successfully transitioning to renewable energy. This challenge is aggravated by the lack of readily available information about underserved communities. It requires work to find the issues facing these communities, including land use problems, economic issues, concerns about new technologies, and the community leaders best positioned to work in these communities.

To address the issue of inequitable access to renewable energy, the Partnership for Action Learning in Sustainability (PALS) is currently undertaking a project to install solar-powered microgrids in underserved communities in Prince George's County. The project's goal is to provide mid- and low-income apartment buildings with access to solar power, usually limited to single households or large grid systems. The project will also attempt to ensure equitable access at a lower long-term cost, provide greater energy resilience and security, and reduce the environmental and health effects of fossil fuel pollution. The project also seeks to challenge skepticism about renewable energy among local leaders.

Many low-income areas lack energy resilience and rely on diesel powered microgrids. These microgrids produce high levels of greenhouse gasses that contribute to climate change and that can have catastrophic effects on the local environment, agriculture, health. Low-income communities have higher rates of respiratory disease such as asthma, especially among young children, as a direct result of air pollution. Researchers found that air pollution is a direct cause of 42,000 premature deaths in Nepal every year, and 6.68 million worldwide. They also found significant improvements in air quality after the introduction of solar-powered microgrids. (Shakya, et al., 2022

Renewable energy, particularly solar, is less accessible due to high implementation and maintenance costs throughout its lifespan. While long-term benefits outweigh short-term costs, many low-income households and communities lack the necessary capital (NREL, 2022).

Other barriers to solar include not owning a home or not qualifying for the tax benefits of implementing solar technologies (NREL). Many low-income households rent or lease, requiring approval from a landlord or other ownership entities. Tax credits can be an incentive, but in some cases, users must be in a certain tax bracket to receive the benefits. Many low-income households will not qualify.

These barriers in low-income communities reduce the likelihood of their embracing solar energy and increase the transactional costs of installation.

Assuming these barriers are overcome, the long-term benefits of solar implementation can reimburse the homeowner's effort and investment. The Washington, D.C. Department of Energy and Environment finds that community solar saves users between 5 and 15 percent annually on their energy bills (2022). Over time, a community's savings via electrical bills will pay for solar implementation in full, and eventually reduce overall energy costs for as long as the solar grid is intact. The apartment community itself is also able to reinvest the energy savings into projects that it might otherwise have not been able to undertake.

For example, a D.C. community microgrid was able to reinvest almost $500,000 into a community greenspace that wasn't feasible until the transition to solar energy (Surampudy, 2017). The solar savings solar provides gives communities more flexibility in projects that can benefit the wider community. Solar provides positive externalities beyond financial benefits; savings can be reinvested, ensuring that low-income communities can continue to grow into smarter and more effective spaces.

These financial benefits are just one reason solar is beneficial in low-income communities. The positive climate implications are an even more compelling reason to install microgrids. Community solar company, Solstice notes a household that transitions to solar energy saves approximately 5,335 pounds of coal annually (2022). Applying the same metric community-wide would reduce coal use exponentially, which can reduce CO_2 emissions and create a less polluted community and planet. Negative health impacts such as lung disease, respiratory

infections, and heart disease increase in areas where pollution is prevalent (World Health Organization, 2019). Low-income areas are likely to be more adversely impacted by these negative health effects, making it imperative to reduce emissions as much as possible. Community solar company, EnergySage, claims widespread solar adoption reduces harmful air pollutants such as nitrous dioxide, sulfur dioxide, and others (2022). Reduction of these pollutants is concurrent with a reduction in respiratory and cardiovascular diseases (EnergySage, 2022). A transition to solar energy lessens environmental impacts on communities, supporting positive health impacts that can keep neighborhoods safe.

Another benefit of solar energy is security. Energy insecurity occurs when natural disasters, fuel price fluctuations, geopolitical struggles, or other events impact access to energy. Resource group, Resilient Energy Platform, states power is such a significant force, that energy insecurity can create continuous negative impacts and slow recovery processes after a negative event (2019). Communities reliant on fossil fuel energy generation are subject to outside influences that can harm their ability to maintain affordable and consistent energy.

Solar energy supports energy security because it's not reliant on external sources such as foreign fuel sources or other factors that can limit accessibility. At a household level, low-income communities are more likely to be energy insecure due to poor housing conditions and a lack of maintenance (Sonal Jessel, 2019). Compounding these negative effects with a reliance on fossil fuels leaves low-income communities at the highest risk for an energy crisis and make it imperative to transition to energy sources that can increase their security.

Solar energy increases energy security for low-income communities by not relying on outside actors, and therefore being less susceptible to price and availability shifts in fossil fuel markets. Increasing energy security will make low-income communities more resilient and better equipped to face unfavorable events that might arise.

The hesitancy in accepting solar power comes from different aspects of community life. A main point of contention is when outside groups tell various communities about renewable energy; they are often dismissed as privileged and unaware of the challenges of daily life in these communities. Likewise, misinformation or a lack information in low-income and communities, in older households, and a general aversion to change can slow transitions. These complex social and economic issues can't be
fixed overnight but must be addressed to achieve combat climate change. These issues require nuance, setting aside egos to talk to people where they are and not where someone thinks they should be.

Technical progress has made solar energy an inexpensive form of energy production (along with wind power generation). The development and advancement of technology has proceeded at such a rapid pace that it is difficult to keep up and stay informed about the operations and benefits. But technology requires a social component; speaking respectfully to people where they are and connecting with local leaders to bring everyone along can show the benefits of solar technology for everyday life in underserved communities.

The literature review citations in this chapter are listed in detail in the in Work Cited section at end of the report. An annotated bibliography of additional sources is in separate report.

Methodologies

This report uses research from various academic journals, case studies, local reports, interviews, and site visits. Academic journals and case studies make up most of the background information on the benefits of solar microgrid implementation.

Additionally, the report discusses instances of community hesitancy in the adoption of solar energy. Local reports and academic journals show that while many community members understand the benefits of solar energy, they remain hesitant to fully embrace it.

The cost-benefit analysis used data from various sources to create an average cost metric to show typical financial benefits for microgrid participants. The Prince George's County case study at the end of the report uses county hearing documents and correspondence between stakeholders when the microgrid was proposed. Another case study examines the Maycroft Apartment complex in Washington, D.C. The Maycroft study offers an alternative approach to a microgrid can provide energy resilience.

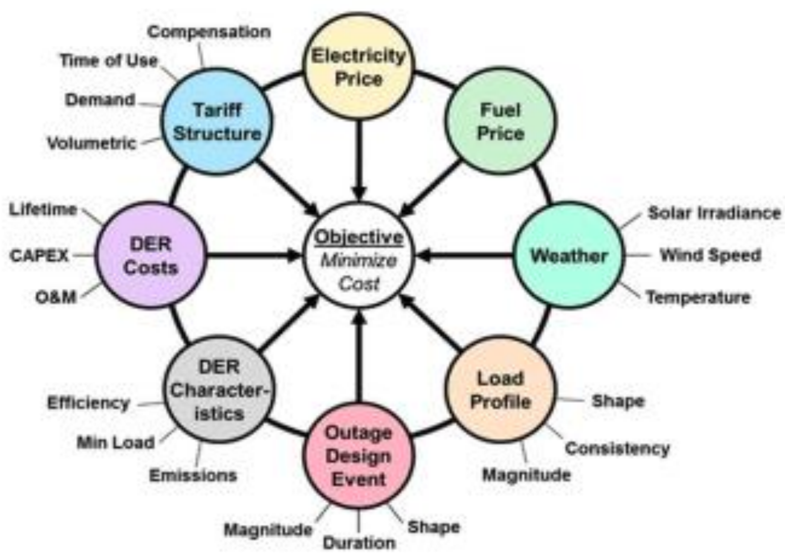
Finally, the recommendations summarize the benefits of a microgrid and applies them to the Prince George's County case study. The recommendations use data from the Pepco utility company and show that techniques from the Maycroft case study can solve the various problems that arose during the initial proposal.

Findings

Preliminary Findings

Cost-Benefit Analysis

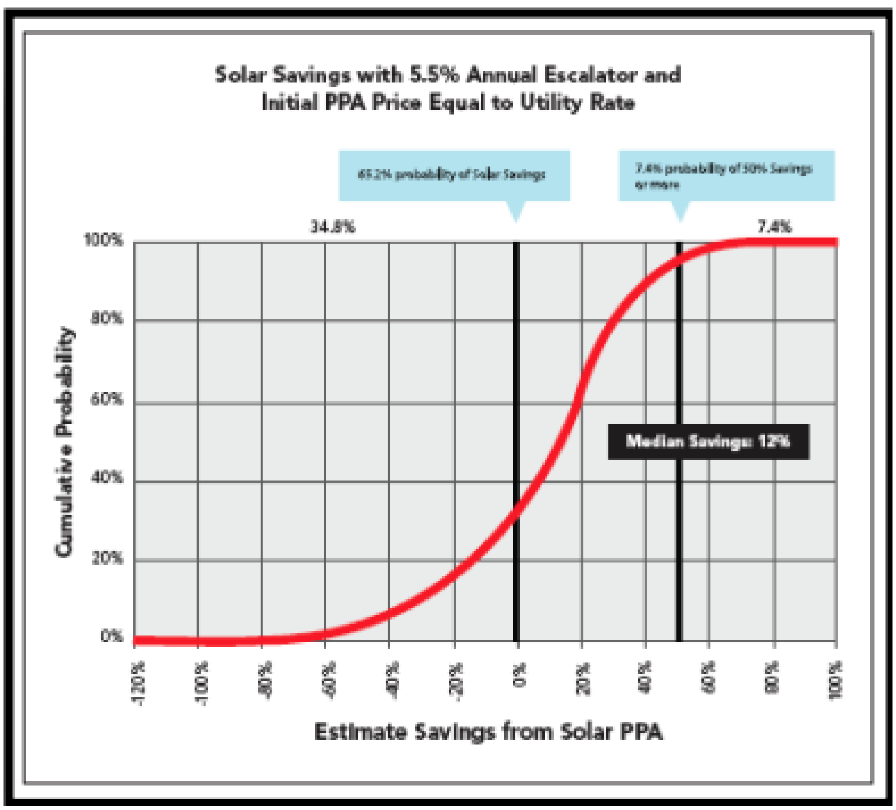
The feasibility of a community solar microgrid relies on several factors, but the costs incurred, and benefits received are among the most important aspects to consider before implementation. Construction of a microgrid varies from case to case, but they all have similar features for a cost analysis. There are three categories of costs: resource selection, involving energy generation; resource sizing and the capacity for energy storage capacity; and resource dispatch, how energy will be priced (Weng, Maitra, Roark, 2018). These three inputs need to be considered prior to implementation. The illustration below shows other considerations, which are impacted by location and other variables.



The cost depends on a variety of factors, but typical community microgrids cost between $2-$4 million per megawatt (Giraldez, 2018). A megawatt can power 400-900 households, so depending on the grid's size, initial costs generally increase for larger communities (Giraldez, 2018). In Prince George's County, the typical community falls within the 400-900 home range.

Initial costs are high, but various financial incentives can reduce these costs. For example, many state and local governments have policies that reward renewable energy projects, such as renewable portfolio standards, renewable energy certificates, and other policies that make a microgrid financially feasible (U.S. Department of Energy, 2020). Investment tax credits are another form of capital cost recovery that can be used to implement technologies such as a microgrid (U.S. Department of Energy, 2020). Tax credits and other deductions reduce the cost of implementation and provide financial assistance that encourage the creation of renewable energy storage systems.

The goal of building a microgrid in a low-income community is to create social and financial benefits for residents. Financial benefits are one of the most motivating factors to consider. A clear benefit is the decrease in monthly energy bils for consumers. Ben Kaldunski’s case study in Wisconsin estimates the probability of net savings after creating a microgrid (see below).



The figure is based on data from four microgrids established in the Madison area and depicts the various levels of saving for consumers. The median savings were estimated at 12 percent, while there was at least a 66 percent chance of any savings at all. Furthermore, there are scenarios with a lower probability but higher savings. For example, savings over 50 percent have an 8 percent probability of occurring. Kaldunski's predictions show that savings on monthly utility bills are highly likely and are a solid indicator of the financial benefits associated with a microgrid.

The social benefits of implementing a community microgrid are another important factor. In a case study of a community microgrid in Korea, researchers found a 39.5 percent decrease in CO2 emissions compared to the prior energy system (Lee, Kim, 2021). Researchers also determined that each household reduced its carbon emissions by 2,968 tons per year (Lee, Kim, 2021).

The social benefits of reduced carbon emissions include cleaner air and water and improved overall health. Megan Avakian discusses the negative health impacts that can be avoided by reducing greenhouse gas emissions. Avakian claims that if no progress is made in reducing emissions, there will be over 500,000 premature deaths due to air pollution (Avakian, 2022). The estimated cost from these negative health impacts is estimated between $50 and $380 for every ton of carbon dioxide cut (Avakian, 2022). She estimates this cost outweighs the cost of transitioning to renewable energy (2022).

The social benefits of a solar microgrid are more difficult to quantify than the financial benefits. However, the financial gains from reduced utility bills and reduced negative health impacts from air pollution both provide incentive to pursue the construction of a solar microgrid in a Prince George's County community.

Environmental and Public Health Impacts

The US ranks second globally behind China in annual CO2 emissions at 5.28 billion tons, and 12th globally in per capita CO2 emissions at 16.6 tons per person. Most of the US CO2 emissions come from burning fossil fuels such as oil, coal, and natural gas for energy production in buildings, homes, and cars. CO2 emissions have declined since 2000, due in large part to the phasing out of coal-based power plants, however, the US remains among the world leaders in carbon emissions, and more can and should be done to improve this downward trend (Vartan, 2022).

Climate change and air pollution have severe environmental and public health effects. According to the National Institute of Environmental Health Sciences (NIEHS), air pollution leads to approximately 6.5 million deaths globally every year, a number that has risen steadily over the last 20 years.

In 1970, the federal government established the National Ambient Air Quality Standards, and NIEHS researchers conducted the "Six Cities Study," which discovered the link between fine particulate matter and mortality. Particulate matter (PM) is pollutants like carbon, sulfate, mineral and nitrate gasses emitted from fossil fuels, vehicle engines, and cigarette smoke along with organic material such as wildfires. Fine particulate matter (PM 2.5) is a subset of PM that is so thin (30 times thinner than a human hair) that it can be absorbed by human cells, leading to negative health effects, including increased risks of cancer, respiratory disease, and cardiovascular disease.

One study found a connection between lung cancer rates and reliance on coal for electricity while another study of over 57,000 women living on or near major roadways found that living in these areas may increase the risk of breast cancer. Other studies show that exposure to PM 2.5 can impair blood vessel function, increase the risk of strokes, and in the case of pregnant women, cause hypertension (heightened or irregular blood pressure) which can lead to prematurity and birth defects.

PM exposure is found to increase the risk of respiratory diseases such as asthma, emphysema, chronic obstructive pulmonary disease (COPD), and chronic bronchitis. About 9 in 10 of people living in urban areas worldwide are affected by air pollution. Children, especially those living in urban areas, risk developing short-term respiratory infections, leading to school absences and chronic diseases such as asthma and bronchitis. There is also evidence to suggest that PM exposure can impair children's brain development, leading to cognitive and emotional issues later in life. According to the World Health Organization (WHO), up to 14 percent of children ages 5-18 worldwide have asthma related to air pollution. Studies in older Americans have found connections between pollution and neurological disorders such as dementia, Alzheimer's, short-term memory loss, and Parkinson's disease (NIEHS, 2022).

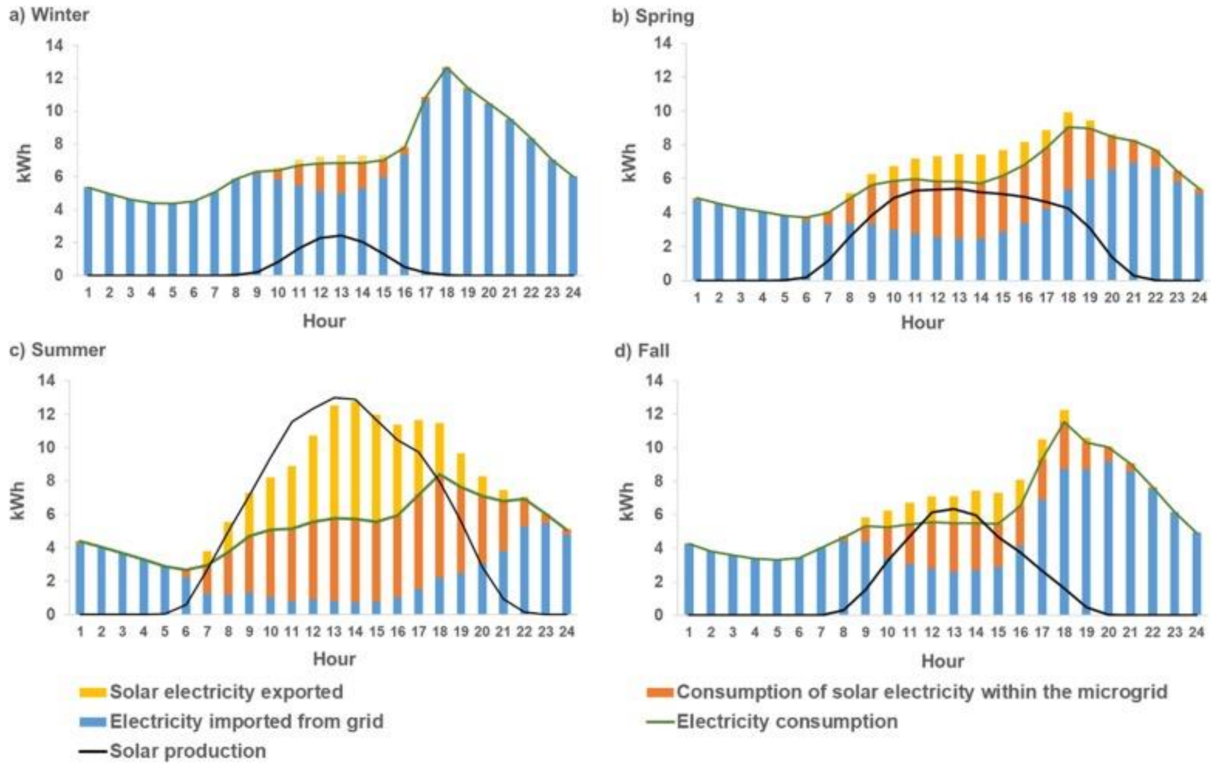
The public health effects of air pollution also extend to economic damage. It is estimated that in the 15 countries that produce the most greenhouse gases, public health damage caused by air pollution costs up to 4 percent of annual GDP (WHO, 2018).

Researchers tested integrating microgrids into Sweden’s overall electrical grid can reduce greenhouse gas emissions and improve the rate of climate change. They used a grid-connected microgrid in an urban setting, and a semi-autonomous microgrid in a rural community as their case studies. Sweden has adopted ambitious climate change policies and is already heavily reliant on hydroelectric and nuclear power, so it already has a low carbon footprint compared to other nations. This may not make it the best comparison for the US, but it still yields interesting results.

The researchers note that Sweden’s low carbon footprint does make it difficult to truly assess the long-term impact of microgrids on GHG emissions, especially as Sweden begins to phase out nuclear power. They found that in the short to medium term, solar microgrids can reduce GHG emissions, but they can also contribute to climate change depending on the context.

The graph below shows the energy profile of the urban microgrid over its first year. In months of high solar radiation, the microgrid can export surplus power to the grid or store it in batteries, but even with a surplus, the microgrid still receives some power from the grid. They found that with a low-pollution energy grid in place, the microgrid displaces electricity from the grid, leading to higher GHG emissions. They also found that microgrids without batteries weren’t as impactful.

It should be noted that these studies are new and ongoing, and microgrids still have many potential benefits such as the electrification of cars and providing stronger energy resilience to remote areas. These studies also indicate what sort of returns (or lack thereof) might be yielded by a power grid that is already carbon neutral, something to consider even if it does not currently apply to the US (Papageorgiou, et al., 2020).



Energy Resilience and Equity

In a Forbes article Desmond Wheatly, CEO of Beam Global, an electric vehicle charging technology company, details how the US suffers from frozen natural gas lines in extreme cold, blackouts when users turn up air conditioning during heatwaves, and bad actors who've targeted and shut down entire sections of the energy grid.

The US has failed to invest in its most vital infrastructure, which is leading to inefficiency and, at times, complete failure. Wheatly proposes that decentralized microgrids are efficient alternatives and supplements to existing power grids. The US will need to double its electricity output by 2050 to keep up with demand trends for electric vehicles; microgrids can be used as charging stations. They can be sources of environmentally safe power for hospitals and emergency services, especially in the event of a blackout and can improve national security by eliminating the weaknesses of centralized grids, making it harder to compromise US power supplies.

Wheatly notes that there are only 200 microgrids in existence in the US, and as with any new technology, there will be a period of cultural adjustment as well as investment in upgrading centralized grids to fully capitalize on the benefits of microgrids (Wheatly, 2021).

Karissa Garcia of the World Business Academy traces the use of solar-powered microgrids in California, a state experiencing some of the worst heatwaves and resulting wildfires in its history. The microgrids' main mission is to provide residents with renewable and sustainable energy, especially when the power grid fails.

She writes, the primary mission of the microgrids is to provide "sustainability, resilience, and equity." Importantly, these programs must be supported at the local level as it is difficult to get support from state or federal governments. The microgrids have displayed their effectiveness in maintaining power for residents after wildfires caused blackouts for the first time in 20 years (Garcia, 2020).

In a 2019 study, researchers used a three-step analysis to assess the effectiveness of microgrids as a solution to power disruption. The first step assessed the historical resilience of existing power grids. The second step analyzed the use of microgrids as a resilience resource, particularly how they were created and networked, and the third step analyzed the strategies used by microgrids to maintain resilience in the event of a power outage, or natural disaster.

Strategies include proactive scheduling so microgrids are prepared to deal with any contingency, outage management so microgrids can handle the load management of switching from connected to island mode and continue to provide emergency power, and advanced operation strategies where microgrids utilize other technologies such as Artificial Intelligence, multi-agent systems, energy storage systems, and demand response programs to boost their resilience (Hussain, et al., 2019).

Hesitancy to Accept Assistance

Points of contention develop when outside groups proposed renewable energy to a community. Outsiders are dismissed as privileged, not understanding daily life in these communities. Challenges include an aversion to change, the need to focus time and energy on living day to day, providing for basic needs, and a lack of trust that outside groups have community interests at heart. The issues for underserved communities to access and benefit from renewable energy sources are complex. They require nuance and setting egos aside to talk to people where they are.

Progress in the field of solar energy has made it one of the least expensive forms of energy production (along with wind power). The rapid development and advancement of technology makes it difficult to keep up with the benefits of new and advancing technologies. As with any community project, speaking respectfully to people where they are and connecting with local leaders can bring everyone along to reap the benefits of solar technology in underserved communities.

Analysis of Findings

Environment and Public Health

The environmental and public health effects of air pollution caused by fossil fuels are noted above. The US ranks second globally in total CO2 emissions, and 12th in CO2 emissions per capita (Vartan, 2022). The reduction of greenhouse gas emissions is one of the central aims of PALS. An estimated 6.5 million people die every year from causes directly related to all forms of air pollution (this includes greenhouse gasses caused by power plants along with other causes such as secondhand cigarette smoke and vehicle engine exhaust).

Studies have linked exposure to air pollution, especially in urban areas, to increased cases of asthma and other forms of respiratory disease, cancer, strokes, and cardiovascular disease. One study conducted on 57,000 women living near major roadways found a significantly higher rate of breast cancer compared to the national average. Air pollution exposure can also have detrimental impacts to the brain health of people, especially children and the elderly. Exposure to particulate matter has been directly linked with inhibited cognitive and emotional development in children and increased rates of Alzheimer's and Parkinson's in seniors (NIEHS, 2022).

Equity and Resilience

The demand for energy, especially with electric vehicles means the US will need to double its electricity output by 2050; an impossible goal using current energy infrastructure. Microgrids can bridge that gap. There are currently only about 200 microgrids in the US, but they have the potential to provide renewable energy to residents who can't afford solar panels.

The PALS project is seeking to provide alternative energy access to lower and middle-income apartment residents. Microgrids can provide a host of energy resilience perks to the most vulnerable residents. The ability to capture and store power in batteries for later use provides security in the event of a blackout and an extra layer of cybersecurity thanks to their autonomy from the centralized grid (Wheatly, 2021).

While there are different models, all require multilevel approval from the state, county, residents (tenants and landlords), and utilities. Maryland requires utilities approve microgrid projects, but PALS wants to ensure that residents are the primary beneficiaries of a new system. A subscription-based model wherein the utilities pay for and maintain the microgrid and allow residents access based on a monthly fee is one option. Another option is a publicly owned microgrid, financed and leased by the government for use by residents. The result should ensure inexpensive and equitable access to this technology that is normally only available to wealthier parties (Anderson, et al., 2022).

Hesitancy

One of the biggest issues in setting up community microgrids is the hesitancy among lower-income and minority residents to adopt renewable energy. Renewable energy is seen as a talking point for politicians and as a “white people issue.”Community members described a public climate meeting as a bunch of old white male politicians (both Democrat and Republican, interestingly enough) getting on the podium to compete for who had the most pro-environment record.

It seems that the people who propose these policies are out of touch with average Americans, and especially with communities of color. What’s more, there are legitimate barriers to adopting renewable energy, including the time and money needed to overhaul energy infrastructure geared toward fossil fuels. That isn’t necessarily an issue for a local microgrid, but it is clear that investors lack incentive to invest in new and unproven technology, and while costs are going down, they are still considerable (Gitman, 2019).

A major theme of our final report will be to make a direct appeal to the residents who will benefit from this microgrid, by showing those benefits. Educating residents on this rapidly growing technology from a place of respect is paramount to our pitch.

Prince George’s County Case Study

In 2018, Pepco tried to establish two solar microgrids in Maryland—one in Largo, in Prince George’s County and the other in Rockville, in Montgomery County. Pepco’s request to the Public Service Commission of Maryland was eventually denied, and the benefits of a solar microgrid in Prince George’s County were lost.

The following report discusses the benefits of a microgrid in Prince George's County, the costs associated with implementation, the stakeholders, justification for the project's denial, and policy recommendations for future approval of a similar microgrid.

Benefits

A microgrid is a system of interconnected energy loads that can disconnect from a centralized grid and operate independently (Maryland Microgrid Task Force). They offer several benefits, both quantifiable and unquantifiable, that would have been received by County residents had the proposal passed.

The Prince George's County microgrid would have been connected to the County administrative building, two medical facilities, a pharmacy, a gas station, and a grocery store (Order No. 88836). In the event of power loss, the microgrid could have powered these essential businesses and protect community members from adverse effects. Pepco estimated the value of outage avoidance to be $7.2 million for microgrid participants (Order No. 88836).

Aside from the financial benefits, a microgrid would have offered other unquantifiable benefits. Pepco stated those benefits include "clean energy procurement, improvements to [Pepco's] distribution system, and valuable insights into best practices for future microgrid development" (Order No. 88836).

Clean energy procurement is essential for the future of Prince George's County; the transition from fossil fuels benefits all community members, even those unconnected to the microgrid. Pepco's improvements to its distribution system would be financially benefit customers in the future. Finally, Pepco argues that microgrid implementation now would set a standard for future microgrids to be developed around the state. The proposed microgrid would initially help area residents, but the information learned would allow for more microgrids like it to be installed efficiently.

Costs

The initial proposal estimated installation costs at $45 million for the two microgrids—Largo and Rockville (Order No. 88896). The proposal estimated an additional $18.4 million contingency cost, bringing the total cost to $63.4 million for both microgrids to be created (Order No. 88836). The Largo microgrid would have cost $18.7 million, which includes capital costs, operation and management costs, and net of market revenues (Order No. 88836). Since the proposal was for two microgrids, costs are discussed with respect to both projects. Pepco determined that the total cost to their Maryland customer base would be a $0.36 increase in their utility bill over the 20-year lifespan of the microgrid.

A key cost issue was Pepco's proposed funding method. Pepco proposed that the entire $63.4 million to be paid by all their Maryland customers. The Largo microgrid would only have served 220,000 residents but would be paid for by customers who wouldn't directly benefit. This payment structure violates the cost-causation principle used in public utility provision, where service costs should be paid by those using the service (Order No. 88836). This cost structure was a primary reason for denying Pepco's proposal.

Stakeholders

There are stakeholders who support microgrid implementation, and others who are opposed. Several private companies—Shoppers Food Warehouse and University of Maryland Medical System in Largo—supported a local microgrid because they would have directly benefited from its resiliency benefits. Another proponent was the County government noting that it would have provided residents with access to necessary goods and services in the event of an outage (Order No. 88836). A County administration building would have been connected to the microgrid so they would have also benefited directly.

Opposing stakeholders included various for-profit and government entities. The Apartment and Office Building Association (AOBA) pointed out the negative effects of the Pepco's proposed funding mechanism, relying on all Maryland residents to pay for a microgrid that wouldn't benefit them. The AOBA recommended instead a public-private partnership (Order No. 88836). The National Electrical Manufacturers Association had a different concern—that Pepco's ownership of the battery energy storage system (BESS), the microgrid controllers, and the distributed energy assets, they would control energy production and supply, which is against state policy and would decrease fairness in energy markets.

Justification for Denial

The Commission dismissed Pepco's proposal stating it was "not in the public interest with regard to cost recovery and ratepayer impacts, cost-effectiveness, and our pilot study guidelines" (Order No. 88836). Of these three reasons, the main factor was the funding method. The Commission could not approve a project as something in the public interest if costs would be incurred by those who were not directly benefiting from the project.

The Commission also concluded that the lack of risk-sharing by Pepco, the developer, the participants, or the counties involved was unacceptable given they were the subjects who stood to directly benefit from the microgrid. Pepco claimed that a microgrid would avoid an outage cost of $7.2 million, which would only benefit those involved (Order No. 88836). None of the participants would pay directly for that benefit, reaping all the savings with little to none of the cost.

The Commission additionally found that Pepco could have more actively pursued outside funding such as government grants, private organizations, microgrid participants, or incurring some of the costs itself. Various grants would have been relevant—the Commercial Clean Energy Grant Program, the Solar Canopy Grant Program, and others.

The cost-benefit analysis of the microgrids proved to be the ultimate point of rejection for Pepco's proposal. Pepco claimed that the microgrid's total benefits would amount to approximately $21 million, while the final cost would be $63.4 million (Order No. 88836). This 3:1 cost-benefit ratio showed the project wasn't worth pursuing from a financial standpoint. The microgrid's other benefits—including increasing access to emergency services in an outage—aren't included in the benefit estimates, but they are unquantifiable and were not considered when the proposal was made.

Recommendations

Status Quo

The County could continue to fight for a Largo microgrid, and the financial and social benefits might outweigh the estimated cost of s $18.7 million (not including contingency costs).

The microgrid would serve 220,000 people and using community-based funding, each user would owe $85. However, using the same estimates as Pepco, this cost would be distributed over the microgrid's 20-year lifespan, costing $4.25/resident/year. There are other variable costs not included in that estimate, but this approach satisfies the cost-causation principle, which would justify Commission approval.

The County might also consider partnering with private organizations and using various federal organizations to help reduce costs associated with a microgrid. The Commission originally denied Pepco's proposal because they "could have gone further to pursue potential funding sources" (Order No. 88836). In response, the County could pursue other funding sources to reduce the overall implementation cost. There are countless organizations that undertake microgrid projects, along with several federal grants and tax credits that can make a microgrid more economically feasible.

Alternative

The County can achieve results comparable to a microgrid by pursuing a solar photovoltaic (PV) system paired with battery storage. In a Maycroft case study, a low-income apartment complex installed a solar panel system on the roof connected to a battery storage system in the basement. The captured energy was stored in the batteries; in an outage, the community center could sustain power for up to three days (Maycroft, 2019). This "Resiliency Center Powered by Pepco" included appliances such as a refrigerator for temperature-sensitive medication and power outlets for emergency medical devices, charging, or fans to keep temperatures reasonable in the summer (Maycroft, 2019). The system used at Maycroft provides the same levels of resiliency as the proposed Largo microgrid, just on a smaller scale.

Maycroft connected their system with a New Partners Community Solar system, increasing their resiliency and connecting them to a network of clean energy. Also, by connecting to a community solar system, the 64 apartment residents and 36 other local homes could receive financial benefits from the system's energy production. By connecting to a community solar portfolio, complexes like Maycroft can "sell back" their energy to utility companies. This financial credit is taken off the monthly utility bill. It's estimated that over the next 15 years, the 100 homes connected to the community solar portfolio will see a $40-$50 decrease in monthly utility bills, over $750,000 in savings through the solar panel's lifespan (Maycroft, 2019). The total cost of Maycroft's resiliency center was $327,000, which included the community solar array, batteries, design, installation, inverter, and other necessary equipment.

The County could use the Maycroft model and create a similar solar energy portfolio in Largo. The original microgrid would have benefited six participants: the County's administrative building, two medical facilities, a pharmacy, a gas station, and a grocery store. Instead of using a microgrid to power all six in case of an outage, each individual entity would have its own system connected to the others. The costs will be higher than Maycroft due to higher energy reliance but will be lower than the Pepco estimate of $18.7 million to develop a full-scale microgrid. The benefits will be the same as a microgrid for a lower price, justifying further research to identify if a community solar approach would be a more effective way to keep essential businesses energy resilient.

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