Undergraduate Thesis Prospectus

Empowering Sustainability: Assessing Solar Power Implementation

(technical research project in Systems and Civil Engineering)

Driving Sustainable Power Adoption: US Policy and Promotion

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem

How can the adoption of renewable energy systems in the United States be accelerated?

The United States plays a pivotal role in mitigating climate change globally as one of the world's major greenhouse gas emitters. The US accounts for 14 percent of the record high global carbon dioxide emissions of 37.1 billion metric tons in 2021 (EPA, 2023). The shift to renewable energy in the US is urgent to address environmental concerns, such as decreasing air pollution and dependence on fossil fuels. The adoption of renewable energy enhances economic opportunities through technological innovation and job creation. If the adoption of renewable energy systems in the US is accelerated, it would set a global example to encourage sustainable practices for emissions to meet the United Nation's net zero goal by 2050 (UN, n.d.).

Empowering Sustainability: Assessing Solar Power Implementation

How will implementing solar energy panels at the Brooks Family YMCA in Charlottesville, Virginia, impact the local community taking into account technical, economic, and social considerations?

The Brooks Family YMCA leadership team wants to assess the technical and economic viability of installing and operating solar panels to offset the annual electric utility expense. The YMCA wants to become a beacon for clean, green energy in the Charlottesville community. This technical research problem is spearheaded by a capstone advisor in the Systems Engineering department, Reid Bailey. The project consists of three Systems Engineers, me, Jack Dreeson-Higginbotham, and Liam Shields, along with three Civil Engineers, Julia Lombardi, Hannah Billing, and Morgan Griffin. The primary goal of this project is to provide the YMCA Board and Leadership with a comprehensive report to inform their decision-making on how to proceed with

vendor proposals.

It has been previously estimated that a roof-top solar system at the Brooks Family YMCA could offset 22 percent of the two million kilowatt-hours of electricity used annually (Convert Solar, 2021). Installing a solar energy panel system will provide the YMCA with potential grants that will allow for prioritization of other programs, providing educational opportunities for solar and sustainable energy.

A recommendation will be developed regarding the potential installation of solar panels on the Brooks Family YMCA. These recommendations will be based on the assessment of the technical and economic viability of the panels. To further comprehend the functional and economic viability of solar panels, the requested documents include electrical plans, architectural plans, structural plans, and an electricity bill from the previous year. The electricity bill allows for comparisons when calculating the amount of energy savings. The solar energy produced could potentially fund new or improve existing programs at the YMCA.

The recommendation will be detailed to an actionable state that can be directly implemented. It will focus on the economic feasibility of the panels, the potential electric offset, and the effect of the panels on the wider community surrounding the YMCA. The visibility of the panels and the potential educational benefits will also be considered. The client will receive a detailed report outlining the recommendation along with how to implement solar panels if they choose to move forward with the project.

Requests for Proposals (RFP) will be sent out to solar companies to attain and analyze quotes and present the best option to the board of directors. The permitting/installation process will then start after selecting the solar company. A visual representation system of the energy saved with the solar panels will be displayed inside the YMCA to educate the community about

solar power and its benefits. Providing the YMCA with the knowledge and tools to install solar panels will benefit them economically and socially to increase sustainability awareness within the Charlottesville community.

Driving Sustainable Power Adoption: US Policy and Promotion

In the US, how have proponents of more sustainable residential power systems promoted public policies to subsidize and accelerate their adoption?

Discovering how proponents of sustainable residential power systems promote policies for subsidizing and accelerating adoption in the US is crucial for advancing energy sustainability and reducing carbon emissions. New multinational, national, and regional legislations have been created that mandate transitions to clean energy sources (Ufer, 2023).

Participants include four proponents of sustainable, energy efficient power systems: community and national advocacies, resident organizations, engineers, and policymakers. The American Council on Renewable Energy (ACORE) is a national nonprofit organization that focuses on collaborative advocacy across the renewable energy sector. Their goal is to unite policy, technology, and finance to accelerate the transition to a renewable energy economy (ACORE, 2023). Advocacy groups and industry associations like the American Clean Power Association (ACP) lobby for policies that support sustainable residential power systems (Oquist, 2023). Resident organizations like Solar United Neighbors, present their community with a solar co-op that offers support and guidance to amplify the positive impact of going solar (Schalk, 2023). Improvements in technology that make it more efficient to acquire, store, and distribute renewable energy at a lower cost has led to an increased adoption in the US. Mechanical engineers have found that a demand for their expertise in renewable energy has grown, as the

number of job postings for these positions increased 7.15 percent between 2018 and 2019 (Ufer, 2023). Policymakers include at least two classes, those who favor the expansion and increased adoption of sustainable residential power systems (UN, n.d.), and others who favor fuel-burning power plants and the restriction of renewable energy development (Despart et al., 2023). 67 percent of Americans say the US should prioritize developing alternative energy sources, such as wind, solar and hydrogen technology, while 32 percent say the priority should be expanding the exploration and production of oil, coal, and natural gas (Kennedy et al., 2023).

Researchers are continuing to investigate the economic benefits of renewable energy, which help to support policies that accelerate renewable energy development (Ufer, 2023). Public policy plays a large role in leading the United States' efforts to achieve net-zero emissions by 2050 and net-zero power sector by 2035. Proponents of more sustainable residential power systems in the US use many different approaches to promote public policies, as the energy sector accounts for approximately 75 percent of global greenhouse gas emissions (Department of State, n.d.). Federal tax credits offer financial incentives to homeowners who install sustainable energy systems. The Residential Clean Energy Credit equals 30 percent of the costs of new, qualified clean energy property for your home installed anytime from 2022 through 2032 (IRS, 2023). In some states, there are net metering policies where residential and commercial customers who generate their own electricity with solar power can sell their remaining electricity back to the grid. This allows customers to reduce their future electric bills (SEIA, 2023).

In some states, lawmakers have worked on passing "solar access laws." Local ordinances or homeowner's association (HOA) rules can create uniformity among a community, but may prohibit the installation of solar electric, heating, or cooling technologies (SEIA, 2023). These solar access laws can protect property-owner's solar access rights.

Advocates have supported the adoption of green building standards that contain model codes or rating systems so communities can develop green building programs or revise building ordinances (EPA, 2023). Besides solar installations, existing buildings can reduce carbon emissions by switching oil and combustion appliances to low-carbon fuels like renewable biomass, low carbon district heating/cooling systems, and high efficiency electricity-based heat pump systems (Chisholm et.al, 2019).

Through various strategies, proponents of more sustainable residential power systems have influenced public policies to subsidize and accelerate their adoption in the United States, making them more accessible for homeowners.

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