

Brooks Family YMCA Solar Energy Project

Renewable Energy & Battery Storage: Their Importance for the Energy Transition to
Combat Climate Change and its Effect on People and Communities

A Thesis Prospectus
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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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Introduction

Climate change is a contentious phrase that has been used to describe what scientists conclude to be anthropogenic influence on the earth's ecosystem. But one does not need to be a scientist to see and understand the affects climate change has caused so far. Just in recent years, there have been heat waves, storms, wildfires, flooding, and many more with increased severity and frequency (EPA, 2022). This climate change is caused mostly by the burning of fossil fuels releasing greenhouse gases, which is the traditional way of producing electricity (Energy System, 2023). Energy production is important for a society to thrive; there are general correlations that can be drawn between the energy that is consumed and the prosperity of a country (Cleveland, 2022). So, if reducing energy consumption is not an option, or at least cannot make a significant enough change to dramatically improve conditions, then the answer must be to produce this energy without the release of greenhouse gases.

Luckily, there have been many innovations in renewable energy technologies in recent years, though their implementation has been slow in some cases, especially on a large scale (Energy System, 2023). There are many reasons for this delay, but one is trying to solve the issue of the gap between when renewable energy is produced, such as when wind blows or sun shines, and when that power is demanded, a demand which tends to be much more consistent than the changing weather patterns. To fill this gap, battery storage will be important so that excess power produced at peak times can be used later when less energy is being produced than what is demanded (Energy Storage, 2023).

The STS research thesis looks at this problem, specifically at what renewable energy and battery systems are available. More than just what technologies are available, I will also look at how the implementation of these technologies positively or negatively impact several systems. These include the US power grid, the local and national ecosystems, and our communities. On this last topic, I will delve into environmental justice and equity issues and how the energy transition helps or hinders these.

Within the US power grid whose energy transition I will be analyzing in my STS research, my capstone will be working on one specific project in relation to renewable energy. The local Brooks Family YMCA in Charlottesville, Virginia has asked for an evaluation of the possibility of installing solar panels on their roof to help offset some of their power costs reinvest that money in programs for the people they serve. They expressed interest in being a community leader in contributing to the energy transition and educating the community on clean energy. The project will look at 3 aspects, namely the technical, structural, and economic feasibility of putting solar panels on the roof and then the opportunity to educate and include the community.

Both the capstone project and the STS thesis deal with the same problem, or rather, the solution to the same problem but on different physical and time scales.

Brooks Family YMCA Solar Energy Project

As discussed, renewable energy will help us to fight against climate change as it provides a carbon free alternative to fossil fuels. The Brooks Family YMCA in

Charlottesville, Virginia wishes to be a community leader in green energy and sustainability efforts and thus is interested in adding solar panels to their property. The goal of the capstone project is to evaluate the technical, structural, and economic feasibility of adding solar panels to the roof of the YMCA. The idea came to the YMCA when they were approached by a solar company 2 years ago with the proposal to do a PPA-style solar energy agreement. However, they wished to look further into their options and the ability of the building to withstand the extra weight before committing to solar. By installing a solar panel system, the Brooks Family YMCA electric utility expense costs can be significantly offset and provide potential grant opportunities that will allow the important Charlottesville community structure to prioritize funding for other purposes, provide educational opportunities for solar, and be seen as a community leader in sustainability.

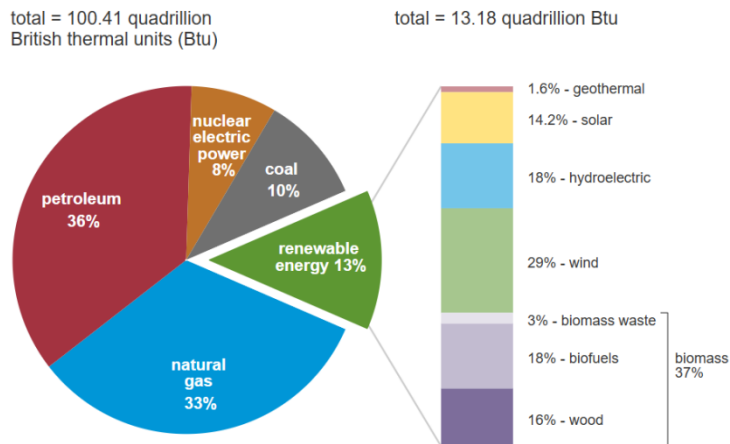
The project itself requires a significant amount of project management and consultation with many experts on the details of the building, the solar panel design, and the economics of the project. The building itself was newly built in 2017, designed by VMDO architects. The facilities use anywhere from 140,000 kWh to 230,000 kWh per month depending on the time of the year, with an electricity bill anywhere between \$10,000-\$20,000 per month. The original solar proposal that kickstarted the idea of solar energy for the building estimated that about 22% of their annual electricity could be produced by the solar panels. When talking to the structural engineer, he emphasized the importance of not adding too much weight to the building, considering the structure was not built with solar panels in mind, providing a limitation to the design. The financial aspect of the project has proven interesting, as power purchase

agreements (PPAs), buying, or leasing have all been looked at as possibilities. PPAs invite an interesting alternative to outright purchasing or financing in that the company owns the panels and takes care of maintenance and simply “uses” the roof of the building to produce power in exchange for an agreement to buy power from them for a 20–25-year period. Our team has talked with 4 solar companies and is in the process of receiving and reviewing proposals.

Renewable Energy & Battery Storage: Their Importance for the Energy Transition

My research statement is as follows: I am working on the topic of renewable energy and battery storage because I want to find out the current impact of renewables and battery storage on the US power grid, the environment, and communities. This is important because a switch to renewables will be a large part of our fight against climate change.

U.S. primary energy consumption by energy source, 2022



Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2023, preliminary data
 Note: Sum of components may not equal 100% because of independent rounding.

Figure 1: EIA U.S. Energy

Renewable energy can come in many different forms including solar, wind, geothermal, hydroelectric, and more (EIA, 2023). Batteries can also come in many types, such as more traditional lithium-ion batteries, or less traditional like pumped hydro or compressed air (Energy Storage, 2023). Renewable energy technologies rely upon battery technologies to help balance the highly variable production of energy that renewables often offer. Currently, that variability is generally offset by fossil fuels, but if the US grid wishes to reach 100% renewables, then batteries will need to fill that gap (Plumber, 2021). The National Renewable Energy Laboratory or NREL created a Storage Futures Study that looked at the future of battery technology. In their final publication that summed up their findings, they expressed the importance of batteries for a 100% renewable grid (Blair, 2022). They expect that lithium-ion batteries will be the leader in storage and that many types of storage options will likely continue to improve in efficiency and cost-effectiveness as the technologies improve (Blair, 2022). In the US, President Biden has a goal of reaching 100% carbon free electricity production by 2035, which would require the combination of renewables and batteries (Plumber, 2021).

The STS portion of the research will focus on several aspects of how energy, energy production, and climate change affect the environment and thus, communities. Those living near power plants tend to receive an unequal burden of the emissions that come from the plants, and these people tend to be people of color and/or low-income households (EPA, 2023). Climate change across the country frequently affects those of color and/or low-income households disproportionately, meaning that although climate change affects us all, for some it is much more devastating (EPA, 2021). Also, the

research will look at initiatives that are currently used or proposed to make renewable energy more accessible, including making it more affordable, and how battery storage can help make the transition more equitable (NCSL, 2022) (Tarekegne, 2021).

Furthermore, the energy transition has already created new jobs and several federal acts have assigned more money to aid in the creation of more jobs and renewable energy infrastructure (USDOE, 2023).

The topic will be analyzed in several different ways. First, I will look at the different types of renewable energy, their differences, their feasibility at a large scale, their cost, and any other important details. Secondly, I will do the same in-depth research on battery technologies. I will then look at the current implementation of renewables and batteries on the US grid and touch on the topic of where we are projected to head. The main portion of the STS topic will be looking at the impact that these technologies have on the planet and on people. I will look at how materials are sourced, the injustices that may be helped or hurt in implementing these technologies, the jobs and opportunities that have been and likely will be created. I will also look at how fighting climate change helps to protect communities, ecosystems, and even culture (think historical sights positioned near coastlines).

Conclusion

The final deliverable for the YMCA capstone project is a recommendation to the executive committee on which, if any, solar proposal they should move forward with. We will also help them to begin the process of installing solar panels, if time allows in the spring semester, and help design a display for community education and awareness.

My STS research will help to answer the question: Where are we in the US with renewable energy and battery storage and how does it affect the current system, climate change, and our communities?

Renewable energy and battery storage could be argued as two of the most important technologies moving forward in climate change mitigation. Climate change mitigation itself is so important because of the harm to the physical and mental wellbeing of all of us. Climate change, however, does not affect us all equally as some bear much more of the burden simply due to location. Combating the effects of the changing climate will help to slow down or stop the seemingly ever-increasing frequency and intensity of extreme weather events, which in turn will protect our communities. The goal of the STS research will be to further demonstrate the importance and impact that the energy transition will have on mitigating climate change and why this is important for protecting the environment and our communities.

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