Prospectus

Designing for Sustainability at Fontaine Research Park
(Technical Topic)

Actor Network Theory and the Fragile Success of the Regional Greenhouse Gas Initiative
(STS Topic)

By

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24 November 2020

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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

As the Earth's climate continues to deviate from normal weather patterns, society has become increasingly concerned with ways in which they can help to alleviate the problem. Between rising sea levels and the increase in extreme weather developments such as hurricanes and tornadoes, much of the world stands to lose a great deal if these extreme weather patterns continue. While individual action can provide some relief, it is only legislation and the work of large institutions and corporations that can truly make meaningful differences. To address this problem, I will be designing a plan for the University of Virginia (UVA) to test its ability to implement sustainable architecture in order to create a self-sufficient microgrid, thereby reducing its overall carbon footprint. Using the knowledge that this will generate about the logistics of creating and maintaining an entirely energy self-sufficient community, UVA will be better prepared to take strides towards applying these methods to the rest of their facilities.

However, although the logistics of this problem are important, it is also essential to understand the social and political forces that will influence both the adoption of this plan and the way in which it can be extrapolated to other institutions, corporations, or infrastructure. If we focus exclusively on how technical changes can solve this problem, ignoring all other socio-technical factors that contribute, we risk misunderstanding the problem and how to best address it. This is due to the fact that the problem is, at its core, socio-technical in nature. In order to portray how outside forces influence both the implementation and the adoption of sustainable practices, I will make use of Actor Network Theory (ANT), a framework designed to better understand the interplay between human and non-human factors, and how they interact to drive and form technology (Cressman, D.,2009).

In order to create a plan for UVA to take steps towards carbon neutrality, both technological and social factors must be considered. In the Technical portion of the paper, I will outline a technical process for designing a smaller-scale sustainability program for UVA to decrease their overall carbon footprint as well as build momentum towards an eventual self-sustaining energy grid. In the STS portion of the paper, I will then make use of the aforementioned STS framework, Actor Network Theory, to analyze how the success of sustainable legislature designed to push industries toward less carbon-intensive alternatives can pose a vulnerability for the future of governmentally incentivized carbon neutrality. In assessing the logistical feasibility of sustainable infrastructural transformations for the University of Virginia and creating a comprehensive view of all factors that contribute sustainable legislation's success and its vulnerabilities, a concrete understanding of how to address the issue of carbon neutrality will become much clearer.

Technical Problem

The University of Virginia (UVA) owns many parcels of land aside from the physical campuses on which they conduct their academics. Many of them have been developed into research parks and the like, while others serve less academic-centric purposes (Projects and Properties, n.d.). Adjacent to Grounds and off of Interstate 64 and Route 29, Fontaine Research Park is home to a variety of university-related research units, departments, and clinics with over 1,350 employees (Fontaine Research Park, n.d.).

As it currently stands, UVA has made a commitment to be entirely carbon neutral by 2030 (Kelly, UVA Embarks on Ambitious Sustainability Plan, 2020). As a means to make progress towards achieving this goal, the university has enacted some rooftop solar panels on its campuses, but the output from these panels is marginal compared to the amount of energy

needed to run the university. However, through a purchase agreement with Dominion Energy, UVA has acquired all the energy produced by the Puller and Hollyfield Solar facilities. These purchases are valid for the next 25 years and will replace approximately 21% of UVA's electricity demand with production from renewable resources (Climate Action and Energy, n.d.). Although the purchase of these facilities helps to reduce the on-paper calculated carbon footprint of the university itself, they do nothing to reduce the footprint of the state as a whole. UVA does not commission these construction projects, but rather purchases them after they have already been completed. Whether or not the University had chosen to purchase the plant from Dominion, the facility would still have existed, owned by either Dominion themselves or another entity. For this reason, the technicality of it being owned by UVA makes no real difference in the amount of renewable energy being produced in the state of Virginia.

In order to truly contribute towards a reduced carbon footprint, UVA must shift its focus from outsourced purchases and offsets to demand reduction and on-site renewable energy generation. Many of the buildings on central Grounds are too old to be adequately retrofitted to meet sustainability requirements, and some of the buildings, including all of the Academical Village, are designated as a World Heritage Site, and therefore have significant restrictions as to how they can be altered (Kelly, 2012). However, Fontaine Research Park poses a truly unique opportunity for the university as it is one of very few facilities that is actively constructing new buildings. At present, the university requires all new buildings to be LEED certified, a rating-based system to discern how energy efficient, and therefore green, a building is (Land and Buildings, n.d.). With the decreased demand for energy associated with LEED certified buildings, it is well within reason for UVA to develop an entirely self-sustaining energy microgrid, a subsect of the larger UVA energy grid, at Fontaine Research Park.

In order to forecast both the supply and demand of energy throughout the calendar year in a fully constructed Fontaine Research Park, I will use both linear statistical models and Bayesian decision theory. Through the extrapolation of data about advanced energy saving practices such as chilled water storage, as well as data pertaining to the effectiveness of on-site renewable energy generation, I will prove the feasibility of transforming Fontaine Research Park into an entirely energy self-sufficient network.

STS Problem

The Regional Greenhouse Gas Initiative (RGGI) is the first mandatory market-based program in the United States aimed at reducing cumulative greenhouse gases. At present, 10 states have agreed to the terms of the initiative with an 11th, Virginia, joining in 2021 (Welcome, n.d.). Through this initiative, a cap is set for the production of greenhouse gases, and later, "emission allowances" are sold via auction to companies in exchange for the right to produce the number of emissions specified by their allowance. The majority of the proceeds from the auction, roughly $3.2 billion to date, are then invested in consumer benefit programs such as energy efficiency and renewable energy. Each year from 2015-2020, the emissions cap has been lowered by 2.5% in the hopes of slowly weaning each state's respective energy grid away from the use of fossil fuels, and redirecting it towards less carbon-intensive sources (The Regional Greenhouse Gas Initiative: Background, Impacts, and Selected Issues, 2019).

The implementation of RGGI has resulted in improved air quality from 2009-2014, valued at nearly $5.7 billion (Manion, et al., 2017), as well as an increase of more than 40,000 job-years in participating states between 2009 and 2017, valued at $4.7 billion (Hibbard, Tierney, Darling, & Cullinan, 2018). For these reasons, it is heavily agreed upon that the implementation of RGGI has been immensely successful, with the majority held opinion being

that the presence of the cap itself is the reason for the policy's success. However, although this this belief is true, it is entirely too narrow and short-sighted, completely overlooking other factors that have thus far contributed to the perceived success of RGGI such as the rising price point of emission allowances and the rate of generation for revenue from the auction. If we are not fully aware of the contributions of other factors, we risk not fully understanding how the success of the initiative could be vulnerable in the future.

I argue that although the emissions cap is partially responsible for the perceived success of RGGI, the rising price point of emission allowances and the revenue generated from the auction process also contribute in comparable magnitudes. In order to corroborate this claim, I will make use of Actor Network Theory (ANT), an STS framework used to open the black box of any complex web of interactions between heterogenous components. This depiction is used to portray how both human and non-human actors contribute toward the shaping of both technology and the society that interacts with it (Cressman, D.,2009). In the context of this situation, the governors of each respective RGGI-affiliated state function as network builders, deciding exactly which actors will directly interact with one another, and the laws that govern the manner by which they can interact.

Actor Network Theory will help to build a case as to how the rising price point of emission allowances and the revenue generated from the auction process have contributed to and influenced RGGI's ability to be successful. In addition to this, ANT will help to show and explain the vulnerability created by the current refusal to acknowledge other factors that have contributed to RGGI's success outside of the presence of an emissions cap. More specifically, to support my argument, I will analyze both Paul Hibbard's and the Congressional Research Service's analyses of RGGI's overall impact, as well as Abt Associates' analysis of RGGI's

impact on public health. These primary sources provide information on how RGGI has shaped the lives of the citizens inside participating states, as well as how other actors, such as companies who purchase allowances, have shaped the way RGGI has developed into its current state.

Conclusion

In this paper, both the technical and social solutions address the redesigning of sustainable infrastructures. The technical paper will deliver a proposed design alteration for the construction of Fontaine Research Park, with the intention of creating an optimally efficient, and ideally self-sufficient, energy microgrid within the University of Virginia. The STS Research paper will seek to provide further insight into the ways in which Actor Network Theory can adequately depict the complex web of relationships that influence both the adoption of new technology, legislature in the case of this paper, as well as the manner by which it spreads. Through this, the STS Research paper will work to bridge the gap of understanding pertaining to how a multitude of other factors outside the existence of an emission cap contribute towards the success of RGGI.

The results of the technical paper will resolve the issue of how to solve this broad socio-technical issue of achieving carbon neutrality on a smaller scale. The findings from the STS Research paper will also shed light on whether the lack of understanding of the factors that contribute to the success of RGGI will pose a substantial threat to the legislation's future stability and ability to meet its goals.

Word Count: 1804

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