**Thesis Project Portfolio**

# Predicting the Future Energy Consumption of UVA Smart Buildings with Machine Learning Models

(Technical Report)

# Working From Home: How the Advent of Remote Work Impacts the Software Engineering Industry

(STS Research Paper)

An Undergraduate Thesis

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## Executive Summary

As a student of the computer science discipline, I have found that my surrounding environment, team, and accessibility to resources greatly impacts my ability to deliver high quality work. Throughout the duration of my capstone research, which was conducted during the peak of the COVID-19 pandemic, I often found myself at a loss for how to proceed; there I was, a young academic with very little experience in machine learning attempting to tackle a real-world problem with real world impacts. I knew full well that the quality of the end product was directly proportional to the effort I put in, but soon realized that the design of remote work, and the motivations of the engineers under its scheme, also had a significant impact on my capacity to learn and produce. Between the turnaround time to get questions answered, occasionally shaky communication, and distracting home environment, I found myself thinking if my quality of work would be significantly greater had I been researching in an in-person environment. This question in turn became the primary driver for my STS research; if this was something I had been experiencing as a computer scientist, in my mind there was no doubt that others have had similar experiences in a remote setting with critical work on the line. With the world being so reliant on software in this modern day and age, my STS research focused on the widespread transition to remote work, and whether this was having adverse impacts on society.

In the modern day and age, energy usage is paramount to nearly every facet of daily life. Whether it be the lights that shine in an office, or the equipment that monitors and supplies water and heat, different human needs constantly demand the use of energy. As our energy consumption grows, so do questions of sustainability. Is the extensive use of certain energy sources good for the environment? What portion of the energy we use is actually considered "clean" in an average building? The capstone project acknowledges these questions by

attempting to predict future energy usage within Rice Hall at different intervals into the future. By utilizing past available data and novel machine learning techniques, the goal of the research is to reliably predict trends in energy usage over a period of time. The focus of the research entails the use of long short-term memory (LSTM) models, which are a relatively recent innovation upon the widely known neural network. Using these computer science tools to form predictions will allow us to better gauge when we are utilizing the most energy, effectively allowing us to better deliver and prepare for these periods of time. Thus, the implications of such research are to minimize energy waste and only provide energy when it will actually be used.

Remote work is typically identified as the practice of working in any location that is offsite from a central office. Remote work, and its implications on industry, is the subject of this STS research. Particularly, the research attempts to answer the following question: how does working remotely affect the productivity and personal lives of software engineers and the success of their places of employment? To support the research question, the social construction of technology (SCOT) framework is being used. This framework aims to determine the entities associated with the functioning of remote work and to identify how the differing influence of these groups answers the research question. Additionally, SCOT is accompanied by the documentary-based method to conduct research, which is used to gather sources regarding industry trends and case studies on smaller groups of software engineers. The result of the research methods is that remote work presents a net positive for most software engineers and technology companies. Experienced developers benefit from working at their own pace and in a comfortable environment, with businesses benefitting from lower costs associated with maintaining offices. Regardless of the findings, the research is significant to engineering due to the widespread use of software and the consequent necessity to continue producing it. With large

movement towards remote work, the analysis of this trend and its relation to producing high-quality software is essential.

Though I did not work on these two projects simultaneously, I was able to attain valuable insight on how something that is seemingly secondary in the computer science world, the work environment, is absolutely influential on results. Previously, I would have thought that as long as I possessed the necessary skillset and my laptop, this would be sufficient in outputting quality work, but the real-world experience I attained from conducting critical research made me believe otherwise. For me personally, I found that I was more productive when in-person, and believed that this sentiment was universal; however, the brunt of the STS research findings demonstrated that the unique impacts I felt were often not reciprocated by more experienced engineers. In hindsight, this definitely could have been the case with the more experienced researchers, who likely preferred conducting their research within the confines of their homes. The accumulation of experiences from these two projects has shown me that the world of engineering is highly personalized. At least in the realm of computer science, remote work can absolutely still deliver results on critical projects, even if this was not my exact experience.