A GLOOMY CLOUD: A SOCIOECONOMIC ANALYSIS ON THE USE OF DATA CENTERS IN NORTHERN VIRGINIA

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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:

If you were to drive out toward the western parts of Northern Virginia and away from the commotion of DC, you'd think you'd start to leave the big, loud, busyness of the city, but you'd be wrong. Instead of rolling farm fields, open country, and lush forests, you'd be greeted by large, cold, and noisy buildings littered throughout a bustling suburbia. These sprawling facilities are data centers, which have become a staple of the Northern Virginia area over the last few years. Living in this region, more specifically at the heart of data center construction in Loudoun County, this has been my own experience for the last decade. Seeing a constant stream of construction to build these data centers within my community and hearing echoing complaints from my family and neighbors, this really got me thinking about how these data centers may be impacting its surrounding community, both in terms of their environmental effects and how they might be affecting the socioeconomics and overall culture of the region. More formally, the question at hand is how has the building of data centers for better cloud and data uses in Northern Virginia affected the surrounding community both environmentally and socioeconomically?

Data centers are defined as large facilities that use computer systems to store, process, and send data from the internet (Blodis and Opmane, 2012). These buildings have become increasingly important as the data has become the modern-day gold. For instance, it has been shown that over the last six years, there has been a 440% increase of internet traffic with a 60% increase in internet users over this same tired period (International Energy Agency, 2022). On top of this, a greater reliance on better internet speed and data sending has been stressed by the COVID-19 pandemic, locking many employees and students at home to work and learn through

internet-based approaches (Vogels, Perrin, Lee, Anderson, 2020). Because of this, an increase in the construction and development of data centers has become more apparent to support these demands and build better internet infrastructure (Schewitzer, 2021). One appealing region where this construction has been booming is in the Northern Virginia area, more specifically in Loudoun and Prince William Counties (Bast, Carr, Madron, and Syrus, 2022).

In this project, a socioeconomic analysis along with a literature review will be employed to answer how data centers are affecting the community, both environmentally and socioeconomically, as well as how to better integrate them into society. Interviews were conducted with Northern Virginia community members to understand how they are personally affected by this intrusive technology as well as their thoughts on better integration. Using Pinch and Bijker's Social Construction of Technology (SCOT) framework, I organize the meanings and viewpoints of relevant social groups of the community where the data centers are being built in order to understand what the effects are of data centers on their lives and how they can be integrated better in current and future communities. At the conclusion of this analysis, it has been found that data centers in the Northern Virginia area positively impact the community through stimulating the economy and creating jobs but are greatly negative for those that live in the area by over utilizing the surrounding natural resources, driving up living costs, and ruining the local culture and aesthetics.

Literature Review

With internet demands on the rise, due to a growing user and usage base through remote learning and work, tech companies have been looking to expand their data center operations in areas that can not only house them but have the necessary support from local governments. One

such sought after region that has been heavily supportive of these initiatives is the Northern Virginia area. For example, a 2016 economic report from the Northern Virginia Technology Council states that since the 1990s, there has been heavy investment in Northern Virginia in developing it as a growing data center and tech hub (Northern Virginia Technology Council, 2016). Furthermore, in this same report, its noted that the Virginia government gives significant tax breaks to tech companies in order to attract them to build in the area. This is a mutually beneficial situation as both county and state governments get large tax revenues from this. For instance, the report performed a cost/benefit analysis and found that for every dollar spent in investing in data centers and its technologies that there was a $9.50 and $4.50 return for Loudoun and Prince William Counties, respectively. Because of this, it's highly attractive for the Virginia government to lure tech companies to build in the state as well as lucrative for tech companies as it gives them a large discount in expanding their operations.

As for non-economic advantages that attract tech companies to the area, the Northern Virginia region boasts a myriad of natural resources that these data process and storage facilities require. The most significant resource that the area has is land. The region is home to the suburbs of the Washington, DC metro area that has ample space for development of residential, commercial, and corporate uses. Because of the aforementioned economic benefits and large area of land to build on, the Northern Virginia counties are advantageous for tech companies to push their expansion. Furthermore, data centers house not only data but also complex support systems that keep the faculties up and running. For example, a key part is its cooling operations that keep the servers from overheating, in which water is constantly needed as the main source of cooling. Because of this, there is a need for a large source water that is close to the data center operations,

and the region possess ample access the abundance of water from both the Potomac River and watersheds throughout the area (Bast, Carr, Mardon, Syrus, 2022).

In previous research, it has been found that data centers are environmentally taxing, resource intensive, and can cause increases in land and housing prices where land is scarce. For example, according to the International Energy Agency, data centers consume about 205TWh of electricity, which is 1% of the world's electrical output (Al Kez et al, 2022). Furthermore, In a 2012 report by Hewlett Packard, it was estimated that the use and disposal of information and communication technology, which includes data centers, accounts for 2% of the world's carbon emissions (Hewlett Packard, 2012). On top of this, in 2022, a report by International Energy Agency has found that data centers alone account for 0.6% of the world's CO2 emissions (International Energy Agency, 2022). Past research on the economic effects of data centers in other areas of the world has shown that data centers are detrimental to property costs for buyers. For example, in a study performed by Lam et al in Hong Kong, the use of data centers was found to raise land costs for both commercial and residential land due to the increasingly scarce land and the increase of value in the area due to a tech presence (Lam et al, 2021).

As mentioned earlier, the chosen STS framework for this project is Pinch and Bijker's SCOT framework. The main idea behind this framework is the idea that various social groups give various meanings to a specified technology in the way it should be used, and because of these differing views, there are different ways at solving current problems of the technology and innovating it for the better (Pinch and Bijker, 1984). More formally, these groups are called relevant social groups that utilize interpretive flexibility to understand what the technology is, how to use it, and how it should be developed (Pinch and Bijker, 1984). I chose this framework as the goal of the project is to understand how the community is affected by data centers and how

they can be better integrated in society. Naturally, such a contentious technology ingrained in a large community would have many different groups that view it in their own light. For example, there are the community members, which can be further separated to those that are more intimately involved with data centers such as those that work in tech, construction workers, government, and wildlife. Because of this, SCOT would be the ideal choice to analyze potential positive or negative effects while trying to piece together a solution or multiple solutions to try to better integrate data centers in the society.

Methods

In completing my project to answer the question "how has the building of data centers for better cloud and data uses in Northern Virginia affected the surrounding community both environmentally and socioeconomically", I performed a literature review of various articles, technical reports, and other official documents in conjunction with interviews from community members to understand both the real and perceived effects of data centers on the community. The interviews conducted were with 12 members from the Northern Virginia community, six of which were those that work within the tech field or with data centers and the other six were people that don't have a work relation to the technology. To further get a better sample of the population to represent the Northern Virginia area, a myriad of different people from socioeconomic groups were included. Because the project aimed to look what the community feels in terms of how data centers are affecting their daily lives, interviews with community members was the primary and most ideal method to understanding the problem and solving it.

Analysis

In answering my question through both literature reviews and community member interviews, one major effect of data centers on the Northern Virginia region that was emphasized greatly by all parties was that they bring jobs and stimulate the local economy. All relevant social groups recognized the important role that data centers play in bringing jobs to the community. Moreover, in an economic outlook report by the Northern Virginia Technology Council, it has been estimated that in 2021 alone, a total of 14,600 jobs were created directly from the building of new data centers, through jobs such as data center operation and construction, and an additional 39,280 jobs that indirectly support the data center efforts such as software engineers and other operational jobs in other regions (Northern Virginia Technology Council, 2022). This fact has been greatly echoed by the residents of Northern Virginia, as many, even those not employed directly by the tech industry, have seen a great wave of people moving to the area for jobs. Furthermore, companies like Amazon have invested heavily in the Northern Virginia area, building not only data centers but also regional offices to enforce their growing dominance in the region (Armus, 2023). And one data center manager I spoke with said these big companies have a pipeline of operational data center jobs to upper management and higher paying engineering jobs at their local offices, which just goes to show how expansive the job opportunity is for workers in the area. The combination of building data centers and tech companies expanding in Northern Virginia has positive implications for the region such as stimulating the economy with more jobs, developing an educated workforce by having highly specialized workers migrate into the area, and raising salaries for those both in and not in the tech industry with the high wages that are paid to these newcomers to the region.

Another way that the community feels positively impacted is through the enormous tax revenue that the local government receives from allowing these facilities to run and be built on their land. In 2021, it was estimated that local Northern Virginia governments made $974,100,000 in tax revenue from these data center operations (Northern Virginia Technology Council, 2022). Because of this increased and added tax revenue, this actually decreases taxes in other areas that benefits residents. For example, community members have said they have seen a decrease in their property taxes because the county has this excess of revenue that can be used to cover other areas of taxes. In this case, the groups of both local government and the Northern Virginia community sees data centers as a hugely beneficial technology that gives economic incentives to both. This, in turn, gives greater spending power to both people living in the area and the government.

Although these economic advantages affect virtually all relevant social groups surrounding data centers in a positive way, there are large concerns by community members that data centers are negatively affecting the Northern Virginia area by ruining the local ecology and taking up needed natural resources as well as destroying the aesthetics of suburban neighborhoods. One way that data centers have become detrimental to the community's environment and usurpation of resources is through their use of water for both cooling and construction. Both the Potomac River and Loudoun County watershed are large bodies of water that give access to water for these facilities. On top of this, these are the main water sources of the residential community as well. This competition, on top of potential water runoff from construction, threatens access to clean water for Northern Virginia residents as well as the survival of local parks and wildlife due to potential contaminated water runoff (Draganchuk, 2022). Furthermore, there is great community concern, primarily from those that don't work in

the technology field, that there are far too many data centers being built in their backyard. They think that the land where the data centers are built on could be used for something the benefits the community more such as more residential uses or commercial buildings. The number one negative comment I heard in my interviews was that these data centers are offensive in their architecture and that they ruin the aesthetics of an area that is supposed to be quiet and free from city-like influence. To put it simply, they are an eye sore. Furthermore, neighborhood members in Prince William County have felt too contained by these sprawling facilities that have been set up right in their backyards, as they produce high noise pollution and are just unpleasant to see to enjoy the outdoors (Olivo, 2023). One older gentleman I interviewed, who has lived in Northern Virginia his whole life, summed up his and the community's frustration with this technology with this: "Loudoun County matters to the Potomac Basin. It matters to the Chesapeake Bay. There used to be a slogan, Keep Loudoun Beautiful. You don't hear it much anymore. Our county had a rich history and it feels like the data centers are trying to help a privileged few redefine a place that they claimed as their own, but have no roots in. Those of us with roots are pretty creeped out by the whole thing. They threaten to lock my home into a the fate of a soulless commuter hub, more drywall than community. A profit center". Statements like his matter, as these are the people that give community life and make it thrive. Without people that are passionate about the culture of where they live, then places will be turned into boring, cold areas that people would not want to live in and therefore be detrimental to the region as a whole.

Another hidden cost of constructing data centers in a heavily residential area is that there is the potential to raise housing prices and general costs of living. A key part of my interview was trying to hear the thoughts of community members experiences and if they thought data centers played a role in the rising cost of living in the area. One realtor I interviewed said that

there has definitely been an increase of housing prices from just a year ago, mentioning that the increase is 10%. He says that this is mainly due to a lot of people moving in for jobs, in part created by the data center and tech boom in the region. On top of this, all the interviewees noted that the area is costly to live in, but data centers may not be all the blame. Those that have been here for more than a decade have pointed to the fact that the Beltway has always been home to federal government jobs and government contractors that naturally have high wages, and because of this, the area has always been costly to live in. Moreover, residents also realize that supply chain issues and people moving out of the cities into the suburbs due to the COVID-19 pandemic also played a role in creating a higher cost of living in the Northern Virginia area.

Conclusion

In this project, an analysis of the environmental and socioeconomic effects of data centers in the Northern Virginia region was performed. Because I have had personal experience seeing these sprawling facilities being constantly constructed in my own city of Ashburn in Loudoun County as well as hearing general negative sentiments from neighbors, I wanted to see what the true effects of this intrusive technology are and know how to better improve their integration of these technical behemoths if they are truly found to be invasive to the Northern Virginia community. Investigating past research on the topic in addition to interviewing Northern Virginia community members, SCOT framework was used to better understand what this technology means to different groups and what problems arise because of this. In this analysis, it has been found that data centers have been hugely advantageous to local communities by creating a plethora of jobs and adding significant tax revenues. However, community members have found problems in that they cause environmental damage, take up natural resources, and,

most significantly, are unappealing buildings that ruin the culture and landscape of the countryside.

Although there may seem to be a large negative connotation with data centers for those that live in the vicinity of such facilities, the future is bright in terms of better assimilating them into a residential society. For an innovative, sustainable way of integrating data centers in society, one interviewee pointed that abandoned buildings can be converted to house the data processing equipment instead of building a whole new building from the ground up. Another suggestion, provided by a data center manager, suggested that to solve the problem of ruining community aesthetics, data centers be built in more discreet buildings that could mimic designs of office buildings instead of the more typical windowless warehouse. The overarching theme for solutions from all the interviewees for better integration was to not just think about the data center needs but also the needs of the community such as how can it be better for the environment, safe for those around it, and be palatable to those that live in the community. With thoughts like these in mind, this would help foster a better culture and community between both society and technology and ensure both live sustainably together.

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