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The Economic Impacts of Nuclear Power Plant Closures on Rural Communities

By

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Science, Technology, and Public Policy

Department of Public Policy College of Liberal Arts

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The Economic Impacts of Nuclear Power Plant Closures on Rural Communities

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Abstract

The 2015 announcement to close Indian Point Energy Center (IPEC) in Buchanan, NY caused a shockwave of concerns for the local community. As a rural community, Buchanan, NY relies on major employers to provide long-lasting careers with steady incomes and steady tax revenue for the community (Mitchell, 2019). A major employer is a business that produces more goods and services than can be utilized by the local economy, and therefore it exports a significant portion of its goods and employs five hundred workers or more (Montrose EDC, 2019). The type of industries that are major employers includes manufacturing, energy plants, hospitals, schools, automobile plants, etc. As a nuclear power plant, IPEC provides various economic benefits to the local community such as; approximately half of Buchanan's operating budget (\$4 million), 5,300 local jobs from direct and indirect sources, \$25 million in annual school taxes, etc. (Moore, 2018; NEI, 2015; Pezzullo, 2020). This research attempted to gain a better understanding of how major employer closures impact the community, and how a community can battle those impacts with a specific focus on the closure of nuclear power plants in rural communities. By understanding how the closure can impact the community, policy recommendations could be formulated to lessen the negative economic impacts. Previous research has shown a nuclear power plant closure can cause short-term economic distress as a community transitions, but long-term economic distress is unlikely (Greco & Yamato, 2019; Haller, 2014; Haller, et al., 2017; Kotval & Mullin, 1997). This study used a multiple case study to gather information on previous nuclear power plant closures in other U.S. rural communities and compared the impacts with the predicted impacts from the closure of IPEC to formulate policy recommendations. It was concluded, rural communities can survive the economic impacts of a nuclear power plant closure through the use of various public programs and policies as well as the collaboration between company and government.

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1 Chapter One: Introduction

“What Happens to a Factory Town When the Factory Shuts Down?” seems to be the big question for the New York Times in May 2019 (Frazier & Kaufman, 2019). This headline addressed the public opinion on the closing of the General Motor’s plant in Lordstown, OH (Frazier & Kaufman, 2019). The article shows how the workers were shocked and attempted to prevent the closure since it employed 8,000 (1.8%) of the Mahoning Valley’s population (Frazier & Kaufman, 2019; Gabbatt, 2019). Currently, the community is attempting to find new employment for the 8,000 displaced workers, and finding this attempt to be unsuccessful (Gabbatt, 2019). Large scale unemployment is just one impact on a community that occurs when a major employer closes down. A major employer is a business that produces more goods and services than can be utilized by the local economy, and therefore it exports a significant portion of its goods and employs five hundred workers or more (Montrose EDC, 2019). The type of industries that are major employers includes manufacturing, energy plants, hospitals, schools, automobile plants, etc.

From the perspective of residents within a community, the purpose of a major employer is to provide long-lasting careers with steady incomes and steady tax revenue for the community (Mitchell, 2019). With the loss of an employer, there is a decrease in local tax revenue from property taxes and school taxes paid by the employer as well as a small decrease in income tax revenue from displaced employees (Pettinger, 2017). The increase in unemployment leads to an increase in the population using federal aid, welfare, and unemployment benefits (Pettinger, 2017). These impacts can be short-term or long-term depending on how soon the displaced employees are reemployed after the closure (Pettinger, 2017). Because the purpose of the employer is unfulfilled, the local community experiences these types of economic impacts.

Similar to Lordstown, OH, other rural communities experience economic impacts when a major employer closes down. The impacts are greater on rural communities because there are fewer opportunities for reemployment once a major employer closes down (Gabbatt, 2019). Therefore, the ability to battle the economic impacts from a closure also decreases. A community that is also experiencing a major employer closure is Buchanan, NY. Entergy Nuclear Northeast's Indian Point Nuclear Center is currently undergoing decommissioning that will begin in 2021. Much like other nuclear host communities in the United States since the 1990s, Buchanan, NY is preparing for decommissioning approximately twenty years earlier than expected (US EIA, 2017).

In this thesis, I reviewed literature that discusses the economic impacts on host communities of various business closure types and then analyzed three cases of nuclear power plant closures in rural communities. There were two goals: 1) To have an understanding of how major employer closures impact the community, and how a community can battle those impacts. 2) Use the literature review and case study analysis to recommend policies to government officials of Buchanan, NY, so that the closure of Indian Point does not cause extreme economic distress. From the analysis it was found that rural nuclear host communities will experience various economic impacts. The impacts will be battled the best through reemployment in the community and collaboration between the local government and private energy company.

1.1 Background

Indian Point Energy Center has been operating since 1962 under the ownership of ConEdison and in 2000, Entergy (ConEdison, 2000). In 2015, New York Governor Andrew Cuomo began to feel pressure from environmental groups regarding the approximately sixty-year-old nuclear power plant, Indian Point, located in Buchanan, NY (Yee & McGeehan, 2017).

Because of this pressure, Governor Cuomo called for a full investigation of the plant in compliance with NRC policies and enforcement staff (Gallay & Shank, 2016). The goal of the investigation was to determine if the plant should be permanently closed (Gallay & Shank, 2016). Unfortunately, they found that the plant was leaking radioactive isotopes such as strontium-90, cesium-137, cobalt-60, nickel-63, and tritium into the Hudson River and groundwater (Gov. Cuomo, 2016). These leakages surpassed the NRC limits of radiation exposure, causing state-wide and local concern for the surrounding ecosystem and population (Daily Freeman, 2016). Because of the outcomes of the investigation, they decided that Indian Point units two and three should close down. Unit one was shut down in the 1970s and has not been used since (NRC, 2018a). A year later in 2017, the decommissioning process began and will be completed by 2021 (Yee & McGeehan, 2017). Because of the pressure from environmental groups, the NYS government would not have conducted a full investigation to find the environmental and human health risks which violate the US NRC and the NYS Nuclear Policy.

1.1.1 Motivation

As a resident of Montgomery, NY the closure of Indian Point Energy Center is worrisome for other residents. My hometown is approximately 45 minutes from Indian Point Energy Center, and there are various residents that are currently employed by the plant as either security guards or engineers. When the closure was announced, these residents immediately began to worry what this meant for their employment. I became interested in the topic because I was hearing concerns from people I have known for many years. I started to question what would happen to those that lived closer to the plant and those who live in the community surrounding the plant. As the news spread the concern of loss of energy was also ringing

throughout the region and New York City. Indian Point has the largest capacity of New York nuclear plants of 2,057 megawatts and operates at 86.65%, causing local residents to wonder what will happen to their electric bills when so much energy is being lost from one source (NEI, 2019). Governor Cuomo assured residents early on that energy loss and major increases on electric bills would not occur (Zambito, 2018; 2019a; Zawacki, 2019). Even with reassurances from the state government, residents will not know the impacts this closure has on their communities until 2021 when Unit #3 will cease operation. With a looming closure, residents are forced to sit and wait to see what will happen. I hope through this thesis, that residents will be able to understand what can happen and what to expect.

Aside from my local area, other rural communities with major employers will be able to prepare for a closure in their community based on the information found in this thesis. This thesis focuses on examining three nuclear host communities as well as Buchanan, NY, with the goal to create generalizable recommendations for other rural communities. Since major employers in rural communities play a large role in the resident's daily lives, it is important for other community officials and residents to understand the direct and indirect economic impacts. By creating generalizable recommendations, community officials will be able to create policies that will ensure their community survives a major employer closure.

2 Chapter Two: Theory and Literature Review

The place to begin is to examine what are the economic impacts on a rural host community from a major employer closure? This question provides the overarching drive for this thesis and is important because a broad understanding helps generalize the material. If the material is generalizable, the internal and external validity of the thesis will be improved. Additionally, the material will then be more applicable to make suggestions for Buchanan, NY.

As seen in the following literature review, when a major employer is lost in a rural host community, various economic impacts can occur with short-term economic distress being the most common. Since short-term economic distress is most common, it can be assumed that the three cases and Buchanan, NY will also experience this impact. With a broad understanding, it will be easier to predict which economic impacts will influence Buchanan, NY the most.

2.1 Theory

By answering this question, I expect to find various direct and indirect economic impacts from a major employer closure. Figure 1 illustrates how direct impacts can influence the indirect impacts. Figure 1 shows the possible direct and indirect impacts with plus, minus, and plus-minus signs to indicate whether the impact increases, decreases, or fluctuates at the time surrounding a closure. I theorize the direct economic impacts will be loss of local tax revenue and an increase in unemployment percentages. The direct impacts occur from the employer no longer operating. Figure 1 exemplifies how unemployment and the decrease in tax revenue are closely related in that when the responsibilities of a major employer are no longer fulfilled the community must respond to alleviate the loss in tax revenue and employment.

In addition to these, there will also be indirect economic impacts such as; loss of local business, a flux in median household income and value, population flux, an increase in taxes such as school and/or property taxes, creation of public programs, and cuts to community services. In response to the loss of a key tax contributor, community officials may have to raise property tax rates and/or school tax rates to offset the loss from the closure (Haller, 2014; Kotval & Mullin, 1997). The change in tax rates can also influence one's decision to live in the area where the major employer once operated. Thus, causing a flux in the community's population if people choose to move in or out of the area. The use of public programs will also help alleviate

the financial burdens placed on the displaced employees. The loss of local business can be a result from a decrease in annual revenue. Especially if the business accommodated the employees of the major employer during the work week. Once the major employer closes, the median household income and value may change. If the displaced employees do not find re-employment within a year of the closure, median household income is likely to decrease. However, if employment is found for most of the displaced employees, it is likely the median household income will not change (Haller, 2014; Haller, et al., 2017; Kotval & Mullin, 1997; Leistritz, et al., 1996; Mayer, 2018). Based on the possible change in median household income, I theorize the loss of a major employer can also impact the median household value. For non-nuclear power plant communities, median household value may decrease since the community no longer has lucrative employment opportunities. The loss of employment can also lead to the migration of displaced employees and their families. Thus, causing the community's population to decline. Once the employer no longer pays taxes, the community's tax base will decrease, causing other public services to experience budget cuts such as libraries, community centers, fire departments, etc. (Abel, 2013; Harwell & Behrendt, 2013; Kayastha, et al., 2016; Pezzullo, 2020; Zambito, 2018). From budget cuts, there will be a financial burden on the employees in these public services.

I also theorize nuclear power plant host communities will have some opposing indirect impacts. In the case of nuclear power plant communities, median household value could increase after the closure because people may no longer view the area surrounding the plant as a potential health threat. Like the change in median household values in nuclear communities, I predict population in these communities may increase due to people feeling safer to live in the area. In terms of business opportunities, there might be promotions of other industries, a transition to

other types of energy plants, and repurposing of the plant site. If other business opportunities are created, than the displaced employees will be able to find employment that does not require relocation. This will be vital for the local community’s ability to battle the impacts. If the displaced employees are forced to relocate, I theorize the host community will suffer more due to the loss of market actors and tax revenue.

Figure 1 highlights these indirect changes the direct impacts can cause. With an employer to no longer fulfill its responsibilities, I believe it is crucial local community officials act in order to alleviate economic shock from these direct and indirect economic impacts. This can be done through the recommendations made in Chapter Eleven.

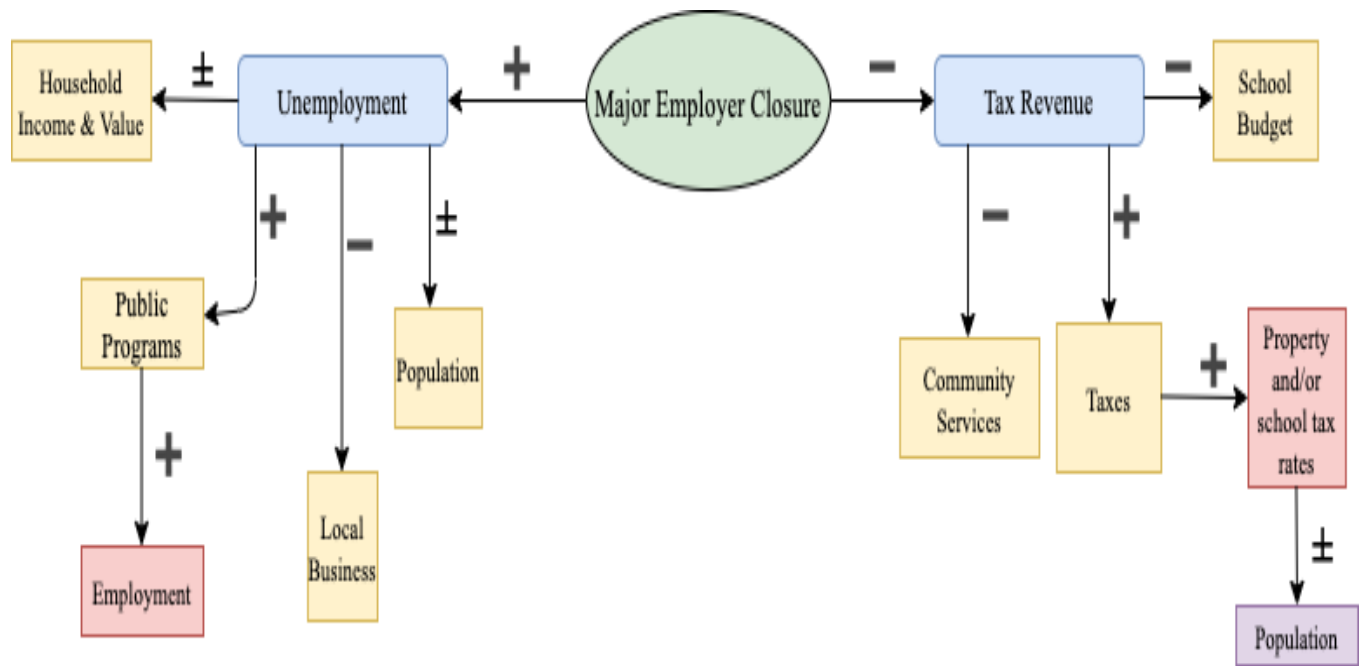


Figure 1: Direct and Indirect Impacts of a Major Employer Closure

2.2 Literature Review

When a major employer closes, a community is challenged with maintaining the current tax rates, unemployment percentages, revenue, and community lifestyle (Cole, 1987; Greco & Yamamoto, 2019; Haggerty, Haggerty, Roemer, & Rose, 2018; Haller, 2014; Kotval & Mullin,

1997; Leistritz, Knapp, Root, & Walzer, 1996; Mayer, 2018; Powers & Hegarty, 2001; Raimi, 2017; Sanzillo, 2017). In addition to theses, communities are also tasked with transforming their economy to make up for the benefits of the major employer and deterring residents from moving out of the community (Haller, 2014; Haller, Haines, & Yamamoto 2017; Kotval & Mullin, 1997; Leistritz, Knapp, Root, & Walzer, 1996; Mayer, 2018). Eleven articles were cross-examined to directly compare each case of a major employer closure. Eight articles discussed closures of energy plants such as coal, nuclear, natural gas, and renewables. Two articles focused on electrical equipment manufacturing closures, and one article reviewed closures within the agricultural industry. The categorization of these articles is found in section 2.1 Based on the challenges in these communities, five categories of economic impacts were created which are vital to analyze how a community is impacted by a major employer closure. The five categories are discussed in section 2.2. However, none of these articles discussed all five categories of economic impacts. Sections 2.1 and 2.2 allow for cross-examination that directly compares each article along with descriptions of each category.

2.2.1 Categorization of Articles

Table 1: The location, closure type, research question(s), research design, and methods					
Source (Year)	Location	Type of Closure	Research Question	Research Design	Methods
Cole (1987)	Buffalo, NY	Electrical equipment	Downstream tax & welfare costs after closure?	Single Case Study	Analysis of available data
Greco & Yamamoto (2019)	Vernon, VT & Scriba, NY	Nuclear Plant Closure	1. What leads to nuclear decommissioning? 2. What are the economic impacts and the issues?	Multiple Case Study	1. Review of literature. 2. Interviews
Haggerty, Haggerty, Roemer, & Rose (2018)	Western US	Coal Mine	What methods are being used to respond to coal plant closures?	Multiple Case Study	Coding of available data
Haller (2014)	Wiscasset, ME	Nuclear Plant Closure	How the community was affected by Yankee's decommissioning?	Single Case Study	Analysis of media coverage
Haller, Haines, Yamamoto (2017)	United States	Nuclear Plant Closure	What implications does nuclear decommissioning have for local labor forces and economic development?	Non-equivalent Comparison Group	Regression analysis
Kotval & Mullin (1997)	Rowe, MA	Nuclear Plant Closure	1. How do closings affect economies? 2. What is the role that the government?	Single Case Study	Application of theoretical framework
Leistriz, Knapp, Root, & Walzer (1996)	IL, IA, MN, MO, ND, & SD	Agricultural Industry	What factors lead to effective response to economic distress?	Multiple Case Study	Sample Survey
Mayer (2018)	CO & UT	Coal Mine	1. How is accountability associated with the policies and policy actors? 2. Who is responsible to pay for these policies?	Multiple Case Study	1. Sample Survey. 2. Statistical Analysis of Survey
Powers & Hegarty (2001)	Bloomington, IN	Electrical equipment	How can a mayor respond to a major employer closure?	Single Case Study	Analysis of available date
Raimi (2017)	United States	Wind, Coal, Solar, Petroleum, & Gas	What happens to plant sites when facilities reach the end of their lives?	Multiple Case Study & Use of Available Data	Analysis of available date
Sanzillo (2017)	AZ	Coal Mine	How to create economic growth, new jobs, and new revenues after the closure of the Navajo Generating Station and Kayenta mine?	Executive Report	N/A

The purpose of this table is to show how the articles are similar and different across the three last categories. As seen, the most common designs are single and multiple case studies, and the least used is the non-equivalent comparison group. The last article, Sanzillo (2017), shows an executive report as the design, but this report was based on a single case study, the Navajo Generating Station. The report also did not mention analytical methods as its purpose was to inform officials of the community. In order to further compare the articles, they were separated further based on the economic impacts found in each. The next section describes the economic impacts found in each article.

2.2.2 Description of Economic Impacts

Table 2 provides the findings of each article. The findings were split up into various impacts for Table 2; economic distress, tax increase, if the displaced workers were reemployed, the use of public programs, and others. Even though other impacts are possible, these were used as a comparison because these were the impacts discussed across all of the articles. In the table, a plus sign means the article did find that impact, a minus sign means they found the opposite of that impact, and a blank cell is if the article did not look into that impact.

Table 2: Economic Impacts of Closures					
Source (Year)	Economic Distress	Tax Increase	Re-employment of displaced employees	Creation of public programs	Others
Cole, Sam (1987)	+			+	
Greco & Yamamoto (2019)	+			+	
Haggerty, Haggerty, Roemer, & Rose (2018)	+			+	+
Haller, Melissa (2014)	+	+	+	+	
Haller, Haines, & Yamamoto (2017)	-		+		+
Kotval & Mullin (1997)	+	+	+		
Leistriz, Knapp, Root, & Walzer (1996)	+		+	+	
Mayer, Adam (2018)	+		+	+	
Powers & Hegarty (2001)	+			+	
Raimi, Daniel (2017)	+			+	
Sanzillo, Tom (2017)	+			+	+

The impacts used in Table 2 are broad categories that embody the findings of each article. The economic distress category includes loss of local businesses, loss of tax revenue, high unemployment percentages, a decrease in median household income, and loss of school district funding. These impacts were placed into one category because each impact places a burden on the local economy (Pettinger, 2017). The tax increase category involves the local government’s choice to raise property and school taxes. Other types of taxes are not included because these were the only types of tax increase found within the literature (Haller, 2014; Kotval & Mullin, 1997).

The categories regarding re-employment and the use of public programs are useful in determining the state of the community’s economy. If the displaced workers were reemployed, then there would not be a drastic change in employment rates and median household incomes (Haller, 2014; Haller, et al., 2017; Kotval & Mullin, 1997; Leistriz, et al., 1996; Mayer, 2018). The use of public programs category refers to if the local government implemented any policy as

a result of the closure. Policies include tax reliefs, tax incentives, federal aid, subsidized loans, funded job fairs, and funded job training sessions (Cole, 1987; Greco & Yamato, 2019; Haggerty, et al., 2018; Haller, 2014; Leistritz, et al., 1996; Mayer, 2018; Powers & Hegarty, 2001; Raimi, 2017; Sanzillo, 2017). The existence of public programs in a community suggests the local government is aware of the potential effects of economic distress, and are attempting to lessen those effects by using programs as a response mechanism to a closure (Cole, 1987; Greco & Yamato, 2019; Haggerty, et al., 2018; Haller, 2014; Leistritz, et al., 1996; Mayer, 2018; Powers & Hegarty, 2001; Raimi, 2017; Sanzillo, 2017). The public programs category also includes any programs implemented by the business to assist the employees. Programs include job training sessions, surveys, and interview and resumé training (Foderaro, 2017; Goldberg, 1998; Larson, 2014). These two categories provide insight into how much economic distress a community may experience after a closure if re-employment and programs are used.

The other category includes responses in terms of population growth, promotions of other industries, a transition to other types of energy plants, and repurposing of the plant site (Cole, 1987; Greco & Yamato, 2019; Haggerty, et al., 2018; Haller, 2014; Leistritz, et al., 1996; Mayer, 2018; Powers & Hegarty, 2001; Raimi, 2017; Sanzillo, 2017). Through the categorization of the articles, various comparisons can be made across each table.

2.2.3 Findings of Literature

Although closures occur throughout the US, these eleven studies highlighted the East Coast and Midwest region, where closures occur more frequently. Therefore, location is useful in finding where major employer closures may occur in the future. Since location is useful, I think it is important for communities in these regions to prepare ahead of time so that the effects of economic distress are minimized. Of the eleven articles, none of the research questions are

exactly the same. However, the questions focus on the same area of study, economics. More specifically, how the local economy changes after a closure. The most common economic impacts of the eleven articles are economic distress and the use of public programs. Ten of the articles found economic distress and nine found the use of public programs.

There were differences among impacts when the type of closure is considered. For example, studies that looked at nuclear power plants varied in their findings. Of the four, three saw economic distress, one found economic growth, two found tax increases, three found reemployment, and two found the use of public programs (Greco & Yamato, 2019; Haller, 2014; Haller, et al., 2017; Kotval & Mullin, 1997). Two of the articles found an increase in taxes, and both were a result of a nuclear power plant closure (Haller, 2014; Kotval & Mullin, 1997). These articles found that tax increases were used because the nuclear power plant in each community provided a substantial amount in tax revenues. In Wiscasset, ME, Maine Yankee Nuclear Power Plant provided 96% of the local tax revenues (Haller, 2014). Meanwhile, in Rowe, MA, Yankee Rowe Nuclear Power Plant provided 33% of the local tax revenues (Kotval & Mullin, 1997). In comparison to the other closures reviewed, nuclear power plants provided the most in local tax revenue. Therefore, the local governments had to include tax increases as a means to battle economic distress along with the use of public programs such as job fairs, training sessions, and public aid.

Haller, Haines, & Yamamoto (2017) found opposing results for nuclear power plant closures. From their regression analysis, they found that economic growth and re-employment occurred over a ten-year period after the closure of a nuclear power plant. Specifically, per capita income increased, and unemployment rates decreased. Per capita income increased on average \$1,361 with a 99% confidence interval. Additionally, employment increased by 1.26% with a

99% confidence interval. These findings suggest that a nuclear plant closure will be beneficial to the community. They credited the economic growth to citizens being less afraid to live and work in the area as compared to when the plant was operating. They claim the fear of living near a nuclear site also declines the longer the plant is non-operational. Thus, creating an environment that new residents and businesses owners will look for. Because Haller, Haines, & Yamamoto (2017) were the only researchers to come to this conclusion, it is difficult to determine how generalizable their findings are.

As for the other types of closures, all resulted in economic distress and public programs were used as the means to battle the distress. Four of the eleven articles studied and cited the use of the same relationship between economic distress and public programs (Haggerty, et al., 2018; Mayer, 2018; Raimi, 2017; Sanzillo, 2017). The non-nuclear closures provided only 1-5% of the local tax revenue, allowing communities to use other methods to replace the lost tax revenue such as repurposing plant sites and transitioning the local economy to a different industry (Haggerty, et al., 2018; Mayer, 2018; Raimi, 2017; Sanzillo, 2017). The non-nuclear closures also had the same relationship between the categories of economic distress and the use of public programs. Public programs were the method that which communities battled economic distress in order to ensure the distress was short-term (Cole, 1987; Leistritz, et al., 1996; Powers & Hegarty, 2001).

The only impact to be independent of the closure type is the reemployment of displaced workers. Reemployment occurred in communities where the local governments provided job fairs, training sessions, and public aid, which happened in five of the eleven communities (Haller, 2014; Haller, et al., 2017; Kotval & Mullin, 1997; Leistritz, et al., 1996; Mayer, 2018).

Table 1 also indicates that the research design and methods may lead to different findings. The case study (single or multiple) designs and survey and interview methods are used the most to gather data on the topic of major employer closures, and only one of the eleven articles used a different design and method, Haller, Haines, and Yamamoto (2017). In comparison, Haller, Haines, and Yamamoto (2017) article utilized the use of available data and a field experiment, specifically the Non-equivalent Comparison Group. The research was the only one to use regression analysis and a quasi-experiment (Haller, Haines, & Yamamoto, 2017). As a result of this design and method, Haller, Haines, and Yamamoto (2017) found that the long-term impacts of a nuclear power plant closure are economic growth and increased employment rates. Because of Haller, Haines, and Yamamoto's (2017) opposing result coming from the article with a different design and method, it is possible that certain research designs and methods will lead to opposing results from the more commonly used case study design. More quantitative research would need to be conducted to verify if Haller, Haines, and Yamamoto (2017) found an accurate relationship.

Lastly, the time frame research was conducted is short-term for all articles except Haller, Haines, and Yamamoto (2017). The data collected through available resources provided them with ten years' worth of data. In comparison, all other articles used either available data from 1-5 years prior to their studies and/or collected data for 1 year. The difference in time frames may also be a factor in the opposing findings of Haller, Haines, and Yamamoto (2017).

2.2.4 How a Community can Survive a Closure

The literature review suggests that a community can survive a closure if there are programs and tax increases implemented to battle economic distress. Of the eleven articles, ten experienced economic distress, and nine made use of public programs and/or policies. For

example, Bloomington, IN used public policies as a mechanism to limit the community's economic distress. The programs used here were federal aid, repurposing of the coal sites, promotions of new industries, and transitioning to a new type of energy plant (Sanzillo, 2017). The qualitative analysis of Haggerty, Haggerty, Roemer, & Rose (2018) on the same community also shows that these policies discussed by T. Sanzillo (2017) will account for most of the lost tax revenue associated with the closure. The communities of Colorado and Utah made use of different programs, job fairs, and training to battle economic distress (Mayer, 2018). These programs addressed the high unemployment rates associated with economic distress. Luckily, by providing job fairs and training, the local governments assisted their citizens in reemployment and battled economic distress (Mayer, 2018).

Kotval & Mullin (1997) found when policies and programs were not implemented to battle the negative impacts, the community would suffer. Because of the lack of policies, the community of Rowe, MA experienced the negative impacts of: property tax rate increases, loss of other local businesses, and a decrease in funding for the local school district (Kotval & Mullin, 1997). From these relationships, the articles suggest that the amount of government intervention after a closure correlates to the number of negative impacts. Government intervention includes tax increases and the creation of public programs. Two of the articles found that tax increases attempted to make up for the tax revenue lost by the closure (Haller, 2014; Kotval & Mullin, 1997). Tax increases, however, did not lead to avoidance of economic distress. Furthermore, a community can survive economic distress, if the government is actively involved.

2.3 *Discussion of Literature*

2.3.1 Summary of Main Findings

From this literature review, the main findings include: 1) closure types have different impacts on communities and 2) implementation of public programs is most beneficial for the residents of the community. After comparing the literature, closures of the same type gave the same results. Meanwhile, closures of different types gave different results. This was shown through the similarities in nuclear plant closures and differences with non-nuclear closures. Because of the differences between closure types, communities can predict which impacts will occur based on their specific closure type. Additionally, closure type can provide insight into which methods work best for battle economic impacts. For the non-nuclear closures, repurposing of sites and economic transition was more beneficial in comparison to the job fairs, training sessions, and public aid received by those experiencing a nuclear closure. Likewise, implementing public programs is beneficial if the community wish to battle the economic impacts effectively and increase employment rates.

3 Chapter Three: Research Questions

3.1 Question #1

What are the economic impacts on rural nuclear power plant host communities after the plant closes?

This question is answered through the analysis of the three cases. By answering this question, the gap between the broad material in Chapter 2 and the specificity of Buchanan, NY should decrease. These cases will provide an understanding of how nuclear power plant closures differ from other types of closures. From the literature review, it is clear that the economic

impacts for nuclear host communities are different and more difficult to overcome. Specifically, the repurposing of the site to transition into a new industry and keeping displaced workers from migrating out of the community. Additionally, since the articles do not address all of the five categories, the cases will decrease the gap in information regarding economic impacts.

Understanding the differences between a non-nuclear closure and a nuclear closure will allow for policy recommendations to be made that address the impacts that characteristic of nuclear closures.

3.2 Question #2

Based on the other cases, what can we expect to happen in Buchanan, NY with the closure of Indian Point?

The purpose of this question is to make comprehensive recommendations to the government officials of Buchanan, NY. Using the three cases on top of the nuclear closures from the literature review will provide further insight into what can happen in Buchanan, NY. Two of the cases also occurred within the last ten years, which will help determine if battling the economic impacts has been successful or not for recent closures. Because the cases are meant to fill the gap between the literature, the recommendations to Buchanan, NY will address the five categories of economic impacts. Furthermore, the recommendations to Buchanan, NY can then be applied to other nuclear plant host communities going through decommissioning. Thus, improving the external validity further.

4 Chapter Four: Methods

4.1 Question #1 Methods

In order to answer Question #1, a multiple case study analysis of three host communities that experienced a nuclear power plant closure will be completed. Indian Point Energy Center

employs 750 people within the Village of Buchanan, home to 2,200 (Entergy Nuclear, 2020). The three cases selected have similar characteristics to the workforce at Indian Point Energy Center (± 200) and similar populations to Buchanan, NY ($\pm 1,500$). The three communities and plants chosen are; 1) Wiscasset, ME home to Maine Yankee Nuclear Power Plant 2) Crystal River, FL home to Crystal River 3 Nuclear Plant, and 3) Carlton, WI home to Kewaunee Power Station.

The method for data collection was adapted from Kayastha, Reardon, Mancovsky, & Hill (2016). A collection of newspaper articles from each community were found using Google Scholar and the library resources available at Rochester Institute of Technology. I then analyze the articles for the same economic impacts as those discussed in the literature review. Once each case is analyzed, a cross-case analysis will be completed by comparing the impacts experienced in the communities to find similarities and differences.

Yin (2009) describes case studies as the incorporation of both quantitative and qualitative evidence that researches an issue with various sources of evidence and gathering data to reach a conclusion. A discussed trait of case studies is the lack of external validity. For example, the economic impacts in communities of the United States may not be suitable for the economic impacts in communities outside of the US. However, the purpose of this research is to find the economic impacts associated with the closure of US nuclear facilities. The impacts experienced in other US communities provided insight to what may occur in Buchanan, NY, so that policy suggestions can be made to the officials of Buchanan, NY.

4.2 Question #2 Methods

Lastly, a collection of newspaper articles will be found regarding Buchanan, NY and Indian Point Energy Center. The predicted impacts discussed in these articles will also be

categorized in the same manner as the other cases. Using the results from the other cases, policy recommendations can be formulated to battle the predictions discussed in the local newspapers. Any policies in the three cases that benefited the communities will be altered in order to fit Buchanan, NY. The recommendations can be found in Chapter Ten. Additionally, the recommendations can be generalized for other community officials who are undergoing a nuclear power plant closure.

5 Chapter Five: Maine Yankee Nuclear Power Plant

5.1 Background

Maine Yankee Nuclear Power Plant is located in Wiscasset, Maine and operated from 1972-1996. Wiscasset, ME is a town of approximately 3,700 located in the mid-coastal region of Maine (MSL, 1998). Maine Yankee provided one-quarter of the entire state of Maine's energy (Brogan, 2016). While the plant was operating, there were around 500 full-time workers and contractors, and when decommissioning started, the workforce decreased slowly to 200 workers (Goldberg, 1998). Maine Yankee Atomic Power Company decided to close the plant in 1996 when the plant was no longer economically viable due to an investigation by the NRC that found various safety violations in the plant (MSL, 1998). The decommissioning process began in 1996 when power generation halted, and the plant permanently closed by August 1997. However, the decommissioning process would continue until 2005 (Maine Yankee, 2020). Since the decommissioning process has ended, the site has been donated 200 acres to environmental conservation and 400 acres are being repurposed for commercial use (Maine Yankee, 2020).

Prior to closing the plant, Maine Yankee Atomic Power Company experienced varying opinions regarding the plant, leading to a divide in the community (Ferrazza, 2013). On one hand, the state and federal regulators assigned to the plant were extremely optimistic in regard to

the operations of the plant. They were there to ensure the community that the plant was operating safely under NRC regulations. However, when the news broke that the steam tubes were leaking radioactive isotopes, rumors that the regulators were bought out by Maine Yankee Atomic Power Company began to spread (Ferrazza, 2013). These rumors were from the opposing viewers who were mainly local environmentalist groups. The groups claimed the plant was violating other safety regulations beyond the steam tubes. This caused a stressful divide in the local residents because they did not know where the truth laid (Ferrazza, 2013). Many of the residents relied on Kris Ferrazza (2013), the new journalist in town, to provide objective coverage. Luckily, she was able to gather information from all sides, providing a full coverage of the viewpoints, allowing for the public to make their own decisions concerning the plant. Her coverage led to the all the actors being supported by some and not by others (Ferrazza, 2013).

Currently, Maine Yankee Atomic Power Company is being supported by more of the population because the federal government has not yet removed the waste on site which was scheduled to be removed in 1999 (Hamilton, 2017; Zambito, 2019b). By 2019, the company successfully sued the federal government four times, winning \$35 million for Maine Yankee in the most recent lawsuit (Flaherty, 2019). Because of the current state of the plant site, the community has become wary of the federal government's promise to relocate the waste and has looked to the company's community board for monthly updates (Hamilton, 2017). The updates are the only times information regarding the plant is given to the community since the plant's closure (Hamilton, 2017).

5.2 Economic Impacts

Economic Distress	Tax Increase	Re-employment of displaced employees	Creation of Public Programs	Other
<ul style="list-style-type: none"> • The initial loss of tax revenue was 96%. • Between 1996 & 2013, Wiscasset lost 50% of tax revenue. • Poverty doubled from 1996-2013. • In 2015, local professionals and businesses were still closing from loss of revenue. • School district cannot provide health insurance for employees. • School district cannot offer extracurriculars. 	<ul style="list-style-type: none"> • By 2013, property tax rates increased 10x. 	<ul style="list-style-type: none"> • In 1998, 60% of laid off employees found new employment. • Most of that 60% had to relocate. 	<ul style="list-style-type: none"> • Yankee held 78 job fairs and hundreds of counseling sessions by 1998 for displaced employees. 	<ul style="list-style-type: none"> • Town services were cut. • By 2015, the High School enrollment was half of the 1996 enrollment.

(Abel, 2013; Goldberg, 1998; Rousmaniere, 2015)

5.2.1 Economic Distress

The articles collected regarding Wiscasset, ME acknowledge that the economic status of the town is largely due to the closure of Maine Yankee. Almost twenty years after the closure of Maine Yankee, Wiscasset, ME is still experiencing economic distress (Rousmaniere, 2015).

Most community members discuss the loss of town services after the closure such as garbage and recycling, sewer, and road construction. During Maine Yankee’s operation, Maine Yankee Atomic Power Company paid for all of these services through the taxes the company provided to the town. These services were possible because the company paid approximately 96% of the town’s budget. Therefore, once the plant closed the total tax revenue from the company would decrease greatly. In 1996, the company was only paying 10% of its original tax payment to the town of Wiscasset (Abel, 2013). By 1998, the total loss in tax revenue was \$7 million (Goldberg,

1998). Further along in 2013, the town was still functioning on a budget that was 50% less than the budget when the plant was fully operation (Abel, 2013). On top of losing tax revenue, Wiscasset also experienced a decline in employment (Abel, 2013; Goldberg, 1998; Rousmaniere, 2015). Once the plant began to decommission, and the number of employees decreased at the plant, a ripple effect started that would trickle down into the local businesses (Rousmaniere, 2015). Without the 600 full-time workers, local business revenue decreased, causing restaurants and professional businesses to close. Thus, increasing the unemployment rate in Wiscasset (Abel, 2013; Goldberg, 1998). As a result, the poverty level doubled within the town, and remained doubled in 2013 (Abel, 2013). Even in 2015, the unemployment did not return to levels that was similar to 1996 and local businesses were still closing (Rousmaniere, 2015).

These economic changes led the town officials to make tough decisions in order for the community to receive as many amenities as possible within budget. Additional cuts were made besides the ones previously mentioned. Extensive budget cuts were made to the Wiscasset School District (Abel, 2013; Goldberg, 1998). Prior to 1998, the school budget could be broken down to \$12,000 per student to provide extra curriculums, state of the art equipment, field trips, etc. (Goldberg, 1998). A school budget to maintain that amount of spending was no longer possible without increasing school taxes. Instead, school employees were laid off, extra curriculums cut, and health insurance was no longer provided for employees (Abel, 2013; Goldberg, 1998).

5.2.2 Tax Increases

With a great loss in tax revenue, Wiscasset had to devise a way to offset the impacts in order to keep the town functioning. The majority of Maine Yankee's tax payments went towards property taxes for the plant site and the various properties within the town. Because of the loss in

property taxes, property taxes were increased almost immediately following the decision to decommission the plant (Abel, 2013; Goldberg, 1998; Rousmaniere, 2015). Goldberg (1998) claimed that property taxes could possibly double or triple in the future following decommissioning. That would've been the better scenario for the citizens of Wiscasset. Instead, seventeen years after the plant closed property taxes have increased by ten times from \$1.87 per \$1,000 to \$18.71 per \$1,000 with an expected increase to continue (Abel, 2013; Brogan, 2016; Rousmaniere, 2015).

5.2.3 Re-employment of Displaced Workers

From the article collection, the future for the Maine Yankee employees was discussed the least. Of the 500 workers, approximately 60% found new jobs, and most being employment at other nuclear plants in the New England region (Goldberg, 1998). This caused these workers to relocate, adding to the loss in local business revenue and burdens those businesses experienced. Of the other 40% workers, 100 were eligible to retire and chose to do follow that path, and 166 workers were kept at the plant for decommissioning (Goldberg, 1998).

5.2.4 Creation of Public Programs

Just as the future of workers was discussed minimally, the same occurred for programs that were implemented to help either the displaced workers or community. The only programs offered were job fairs and counseling sessions held by Maine Yankee Atomic Power Company for the displaced workers (Goldberg, 1998). The purpose of these fairs and sessions was to prepare the workers for interviews and other technical jobs that occur at different nuclear plants or other energy plants (Goldberg, 1998).

5.2.5 Other

Interestingly, there were not many impacts from the articles that did not fit into the four previous categories. However, Rousmaniere (2015) discusses the impact on the school district's enrollment. Over the nineteen years, the Wiscasset High School enrollment has dropped down from 950 in 1996 to 550 in 2015 (Brogan, 2016; Rousmaniere, 2015). The drop of enrollment is from families who lost their jobs and relocated out of the town and school district lines.

6 Chapter Six: Crystal River 3 Nuclear Plant

6.1 Background

Crystal River 3 Nuclear Plant operated from 1976-2013 under Duke Energy, and is located in Crystal River, Florida (Baucum, 2017). During its operation, CR-3 provided energy mostly for the Tampa Bay metropolitan area with a population of approximately 3,000 in Crystal River (U.S. CB, 2020). The closure was decided in 2009 because the containment structure was damaged while replacing the steam generators. Luckily, operation was halted during this period, so there was not a radiation leak. Duke Energy attempted to fix the damage to the structure, but later caused further damage to the structure. Because of the amount of damage, it was decided that decommissioning the plant was the more economical choice (NRC, 2019). Currently, Duke Energy is decommissioning the plant under an accelerated plan that would complete decommissioning by 2027 instead of the original date of 2074. Since its closure, the workforce has decreased from about 600 to 70 (Baucum, 2017). In the future, Duke Energy plans to repurpose the site, but does not wish to sell the property (Duke Energy, 2020).

As Florida's second largest utility, Duke Energy provides utility services to 1.8 million customers with the goal to "remain committed to making smart, forward-thinking and thoughtful business decisions that protect and benefit our customers" (Bay News, 2019; Spear, 2019).

Following the announcement of closure, many Duke customers did not share this feeling and were upset that their rates rose to cover the repairs that ultimately failed (Spear, 2019). In response to their upset customers, Duke chose to improve their relationship with their customers through surveys and luncheons (Kayastha, et al., 2016; Larson, 2014). Additionally, a new plan for decommissioning, customers are expected to see a return of \$100 million unused funds that were taken as a trust fund for decommissioning between 1977-2001. With the return of funds, the hope is that customers will overlook the previous increase in rates (Mahoney, 2020).

6.2 Economic Impacts

Table 4: Summary of Economic Impacts for Crystal River Power Plant				
Economic Distress	Tax Increase	Re-employment of displaced employees	Creation of Public Programs	Other
<ul style="list-style-type: none"> • Within a year of closing, Citrus County lost 7.5% GDP. • 26% of the county's tax revenue was lost • 100 government workers were laid off as a response by 2016. • School district lost \$8 million. 	<ul style="list-style-type: none"> • By 2016, property taxes increased 31%. 	<ul style="list-style-type: none"> • 55% of CR-3 employees were relocated to other Duke facilities. 	<ul style="list-style-type: none"> • Duke held job fairs and public luncheons for employees and community residents. • Duke also offered relocation packages for employees relocating 50+ miles. 	<ul style="list-style-type: none"> • Town services were cut. • Community centers and libraries were closed. • Energy bills increased to fund new natural gas plant at the CR-3 site.

(Allen, 2013; Harwell & Behrendt, 2013; Larson, 2014; Penn, 2013; Penn, 2014; Trigaux, 2015)

6.2.1 Economic Distress

The Tampa Bay metropolitan area and specifically Citrus County experienced economic distress similar to Wiscasset, ME. Like Maine Yankee Atomic Power Company, Duke Energy paid a vast amount of the county's tax revenue, 23% (Allen, 2023; Harwell & Behrendt, 2013). During CR-3's operation, Duke Energy's tax bill to the county was \$35 million (Harwell & Behrendt, 2013). Right after Duke Energy announced the plans for decommissioning, Penn (2013, 2014) predicted that the loss in tax revenue would be massive. Penn was correct, the decommissioning would lead to a decrease of 85.48%, \$144,803,914, in tax contribution over

four years from Duke Energy and the tax bill would decrease to \$13 million (Harwell & Behrendt, 2013; Kayastha, et al., 2016). In response to the decrease in tax contribution, Citrus County officials had to make similar choices to those made in Wiscasset, ME. This included the closure of libraries, community centers, and a decrease in funding for roads and schools. School districts within the county saw a total decrease of \$8 million in budgets (Harwell & Behrendt, 2013; Kayastha, et al., 2016). Additionally, within a year of closure, Citrus County had a 7.5% decrease in GDP. A decrease in GDP highlights the distress the county's economic was experiencing because in the same year other US energy reliant counties saw an increase in GDP (Kayastha, et al., 2016; Trigaux, 2015). Moreover, the Tampa Bay metropolitan area which includes Citrus County also experienced a decrease in GDP from the CR-3 closure. In 2014, eight of the sixteen US metropolitan areas experienced the opposite with a 6% increase in GDP, highlighting the distress occurring in the Tampa Bay area (Trigaux, 2015). The loss in GDP can be tied to not only the loss in tax revenue, but the unemployment increases due to the CR-3 closure.

As of 2013, Citrus County unemployment was 9%, and with the announced closure, the percentage was expected to rise in the following years (Harwell & Behrendt, 2013). In response to the closure, local businesses closed, and 100 county workers were laid off. Along with the plant workers being displaced, both of these added to the number of jobs lost. The loss of jobs also added to school district official's concerns. District superintendents were worried that employees whose spouse's worked at CR-3 would be relocated, causing their employee to also be relocated and thus, leaving their position at the school (Harwell & Behrendt, 2013). Interestingly, Citrus County did not experience a rise in unemployment even with the loss of jobs. Instead, the county experienced a constant decrease in unemployment percentages that was

consistent with the rest of Florida and the US as a whole from 2013-2019 (FED, 2020). The cause for the decrease in unemployment is therefore, not correlated to the closure of CR-3, and further research would need to be conducted to determine why Citrus County did not experience an increase like Wiscasset, ME.

6.2.2 Tax Increases

Also, like Wiscasset, ME, Citrus County experienced tax increases as a result of the closure of CR-3. According to Allen in 2013, it was unknown how much taxes would increase and which ones, but some sort of increase was forthcoming. Penn (2013, 2014) predicted that the property and school taxes specifically would increase. Both Allen (2013) and Penn (2013, 2014) were correct. Citrus County sued Duke Energy because the company claimed it was paying too much in taxes and chose not to pay the full \$35 million tax bill prior to announcing the decommissioning. The dispute only heightened once the decommissioning was announced and Duke Energy paid even less of the tax bill. Thus, forcing county officials to battle the loss with tax increases (Allen, 2013). In 2016, property taxes rose 31% (Kayastha, et al., 2016). The goal of raising property taxes was to offset the loss in tax revenue.

6.2.3 Re-employment of Displaced Workers

Similar to the workers at Maine Yankee, many of the CR-3 employees found employment at other Duke Energy facilities. Harwell & Behrendt (2013) found that all 600 employees were offered positions to remain in the company. Of the 600 employees, 55% accepted positions at Duke's nuclear facilities in the Carolinas or the fossil fuel facilities in Florida (Kayastha, et al., 2016; Larson, 2014). Those that took positions in the Carolinas had to relocate, and those who remained in Florida either commuted or relocated (Harwell & Behrendt,

2013). Because of majority of the employees accepting other jobs, relocation was probable. Thus, causing the concern of superintendents that was discussed previously.

6.2.4 Creation of Public Programs

Unlike Maine Yankee Atomic Company, Duke Energy offered public programs for the employees at CR-3 and the community's residents. The programs offered included job fairs for employees, public surveys, and community luncheons (Kayastha, et al., 2016; Larson, 2014). The job fairs would prepare their employees for the next step in their careers, and the community surveys and luncheons allowed Duke Energy to hear the concerns of the public. Additionally, relocation packages were offered to employees who had to relocated 50 or more miles from their original permanent residence (Larson, 2014). Through these programs, Duke Energy acknowledged the difficult times ahead for the community and strived to maintain a direct relationship with their employees and community.

6.2.5 Other

Along with the decommissioning of CR-3, Duke Energy is adding a natural gas plant to the Crystal River Power Station site. The plant is expected to cost approximately \$3 billion that Duke Energy customers would pay through an increase in their electricity rates (Penn, 2013; 2014). Penn (2013; 2014) also predicted rates would decrease \$5-10 once CR-3 stopped operating. However, with the construction of the natural gas plant, the decrease is less likely and instead expected to rise within the first couple years of construction (Allen, 2013). The natural gas plant there is hope for the displaced CR-3 employees and others in the community searching for employment.

7 Chapter Seven: Kewaunee Power Station

7.1 Background

Kewaunee Power Station was owned and operated by Dominion Energy from 1973-2013 in Carlton, Wisconsin (NRC, 2018b). As an agricultural town, Carlton is home to approximately 1,000 people with only a few plant workers who resided in the town (Ryman, 2017). While operating, Kewaunee Power Station provided mostly energy to the Green Bay and Appleton areas of Wisconsin along with the rest of the state (Kucera, 2018). Dominion chose to close the plant because of the falling prices of electricity due to the availability of natural gas. It was decided in December 2012 that Kewaunee Power Station was no longer economically viable, and that decommissioning processes would begin in mid-2013 (NRC, 2018b). The plant had a workforce of 600 which decreased to 140 for decommissioning (Hay, 2017). However, in 2017, the workforce decreased further to 50 full-time workers once all of the remaining fuel was safely transported to a storage site (Hay, 2017). Currently, Dominion has not released plans for the future of the 900-acre site (Ryman, 2017). However, there is hope that Kewaunee County will be selected for a new Wisconsin State Prison at a different site, which would offset the jobs lost at Kewaunee Power Station (Ryman, 2017).

Prior to the announcement of decommissioning, the residents of Carlton were pleased with the operations of the plant and the actions of Dominion (Bosman, 2015). With the decommissioning announcement in October 2012, many residents accused Dominion of abandoning the community and taking the revenue and jobs with them (Bosman, 2015). The relationship between Dominion and Carlton began to disintegrate when residents realized the 600 workers would be forced to relocate if they wish to stay within the nuclear industry. The feeling

of abandonment has cause animosity towards Dominion, leading the company to decide to offer the bare minimum to Carlton (Dotson, 2014).

7.2 Economic Impacts

Table 5: Summary of Economic Impacts for Kewaunee Power Station				
Economic Distress	Tax Increase	Re-employment of displaced employees	Creation of Public Programs	Other
<ul style="list-style-type: none"> • Kewaunee County lost 30% of its tax revenue by 2015. • Between 2014-2018, utility employment numbers decreased by 1,035. • Local businesses were had to close from loss of revenue. 	<ul style="list-style-type: none"> • Wisconsin limits a county's tax levy. Therefore, taxes could not be increased enough to offset tax revenue loss. • In 2017, a 0.5% sales tax was passed to increase tax revenue. 	<ul style="list-style-type: none"> • Dominion did not offer employment at other facilities, forcing displaced employees to find employment on their own. • Many employees found work locally that paid much less. 	<ul style="list-style-type: none"> • US Labor gave an \$800,00 grant to help displaced employees find employment. • An economic consultant was brought in to create an economic revitalization plan. • The plan was never initiated because it would've cost \$1.5 million. 	<ul style="list-style-type: none"> • A lawsuit occurred in 2014 regarding the worth of the plant and site. Dominion won the lawsuit, causing Kewaunee County, School District, and Technical College to repay \$11.9 million to Dominion. • The county is a candidate for a state prison which would bring in tax revenue and employment.

(Content, 2015; Finucane, 2016; NEI, 2015; OEA & DWD, 2020; Ryman, 2017)

7.2.1 Economic Distress

Carlton, WI experienced similar economic conditions to that of Wiscasset, ME and Citrus County, FL. When Dominion announced the closure of the power station, predictions indicated the county and town would lose tax revenue, jobs, utility payments, and local businesses would close (Content, 2015; Finucane, 2016; NEI, 2015, Ryman, 2017). All of the collected articles indicate that the predictions came true and other impacts occurred as well. However, in 2017, Kewaunee County Board Chairman Robert Weidner said, "the county is going to survive" (Ryman, 2017). This statement came after a loss of 30%, in annual tax revenue from the closure of Kewaunee Power Station (NEI, 2015). Opposing the other communities analyzed, Carlton and Kewaunee county had a deal with Dominion that tied the amount of electricity generated to the amount of funds given to the local government and schools. Therefore, the loss of the power

station resulted in a decrease for both the local government and school budgets (Content, 2015). Of the three cases, Kewaunee County's unemployment percentage experienced the opposite of what was found in the other two communities. When the plant stopped operating in 2013, the county's unemployment percentage was 5.8% (Ryman, 2017). Two years later in 2015, the county lost 15% of its employment from the closure, but a massive change in unemployment percentage did occur (NEI, 2015). Then, in an interesting turn, the county's unemployment percentage would decrease to 2.6% by 2017 (Ryman, 2017). The decrease in unemployment is shocking because from 2014-2018 Kewaunee County lost 225 utility jobs related to the Power Station (OEA, & DWD, 2020). However, like CR-3, the state of Wisconsin and the US were experiencing decreasing unemployment percentages during this time period. Further research would be needed to determine why the unemployment was decrease despite the loss of a major employer. Unlike the other communities evaluated, Carlton officials reacted to the closure in a way that would consequently damage the town's ability to avoid further economic distress and other economic impacts.

When Dominion announced the closure, Carlton officials would re-assess the plant's worth and claim that Dominion owed the town in taxes, doing so would lead to a harmful lawsuit. In 2014, a year after the announcement, Carlton officials assessed the plant to be worth \$457 million. By assessing the plant to be \$457 million, would have meant Dominion owed Carlton in property taxes. However, the town officials were aware that Dominion could sue the town if company officials believed the assessment to be overestimated. If the town was sued and lost, property tax refunds would have to be made to Dominion. At the time, Dominion believed the plant was only worth a bit over \$1 million, resulting in the town being sued. The settlement landed in favor of Dominion, leading to Kewaunee County, Kewaunee School District and

Northeast Wisconsin Technical College would have to repay \$11.9 million in refunds or credits to Dominion over 10 years. Intriguingly, the town of Carlton was not included in the settlement (Ryman, 2017). Because of the lawsuit, taxes would have to increase to offset the loss of tax revenue and payments to Dominion.

7.2.2 Tax Increases

Not only from the closure, but the lawsuit between Carlton and Dominion lead to two different tax increases. The first tax to be increased was property taxes. However, Wisconsin there are state imposed limits on a county's tax levy. Therefore, Kewaunee County could only increase property taxes a certain amount. The amount allowed was not explicit in this collection of articles, but it is clear the increase was not enough to offset the closure and lawsuit (Content, 2015). The next step was for the county to implement a 0.5% sales tax in April 2017. The revenue from the sales tax would be \$1 million, offsetting an annual loss of \$750,000 (Ryman, 2017). Despite the new tax, the county's loss of 30% in tax revenue will not be made up for.

8.1.1 Re-employment of Displaced Workers

From this collection of articles, only one discussed the re-employment of employees from the Power Station. Ryman (2017) found that employees either relocated to other nuclear plants or remained in the Kewaunee region and found lower paying jobs. With such little information on the Kewaunee Power Station employees, it is difficult to determine how their loss of employment impacted themselves, their families, and the community.

7.2.3 Creation of Public Programs

Unlike the other two communities, Kewaunee and Carlton public officials created programs for the displaced employees and community residents. Economic development groups within local government brought in a consultant to create a revitalization plan for the economy.

The consultant put together, surveys & workshops with stakeholders to create a report & \$1.5 million action plan (Content, 2015). Unfortunately, not all of the actions in the plan could be fulfilled due to financial reasons. Public officials requested that Dominion provide funds to complete the action plan, but Dominion refused (Finucane, 2016). In addition to the action plan, the US Department of Labor gave \$800,000 as a grant to help Kewaunee Power Station employees get re-employed elsewhere. The grant was meant to create resources for the displaced employees to prepare for interviews and new job positions (Content, 2015). However, there is not discussion on whether or not this grant was successful in achieving its goal.

Unlike Maine Yankee Power Company and Duke Energy, Dominion also halted their donations to the community. This included financial donations and programs to help their employees. Thus, ending public programs rather than creating them (Finucane, 2016).

7.2.4 Other

There is hope for the economy of Carlton and Kewaunee County. The hope is the potential of a state prison being built in the county (Ryman, 2017). If the county were to be selected, jobs would be created, and tax revenue increased. Along with the slight tax increases, the possibility of a new large employer may be enough to take the community out of economic distress.

8 Chapter Eight: Indian Point Energy Center

8.1 Background

As the largest nuclear plant in the state of New York, Indian Point Energy Center has acted as a major employer for fifty-eight years with many economic characteristics (NEI, 2015). The Nuclear Energy Institute (2015) found the plant had an annual economic output of \$1.4 billion for the five-county area of Bronx, Orange, Putnam, Rockland and Westchester. On the NY state and US federal level, the plant's annual economic output was \$1.6 billion and \$2.5 billion, respectively (NEI, 2015).

Since the 1970s the companies that owned IPEC have both experienced strong relationships with the local residents and officials. This is illustrated through Buchanan's town crest which includes the symbol for atomic energy (Zambito, 2020). Buchanan's Mayor Theresa Knickerbocker and Superintendent Joseph Hochreiter point out how beneficial the plant has been for the community specifically through the services that are available because of the large tax contributor (Zambito, 2020). Even though the plant is closing from initial pressure of environmentalist groups, Mayor Knickerbocker reminds her residents just how much good the company has done for the community despite her residents not needing the reminder. Most of the benefits she refers to include over fifty years of jobs, tax revenue, donations, and carbon free energy (Zambito, 2020). As the voice for the majority of the community, Mayor Knickerbocker's remarks demonstrate how important the plant has become for the community. With a positive outlook on the plant and company, it is expected that Entergy will facilitate the community as much as it can to improve the economic status once the plant closes (Zambito, 2020).

8.2 Predicted Economic Impacts

Table 6: Predicted Economic Impacts for Indian Point Energy Center				
Economic Distress	Tax Increase	Re-employment of displaced employees	Creation of Public Programs	Other
<ul style="list-style-type: none"> • Village of Buchanan will lose 50% of its budget. • Town of Cortlandt will lose 2% of its budget. • Westchester County will lose 1% in property taxes. • A total loss of 16,000 jobs is predicted at the local, state, and federal levels. • Local businesses are expected to lose 40% in annual revenue. • School district closing 1 of 3 elementary schools. • By 2025, the school district will lose \$60.5 million. 	<ul style="list-style-type: none"> • The 2020-2021 school budget required an 8.7% rise in school taxes. • School taxes could increase 13% in the future. • Property taxes are expected to rise 13% annually between 2021-2025. 	<ul style="list-style-type: none"> • Entergy hopes to employ most of the displaced workers at other facilities. • By 2021, 40% of IPEC's workforce is eligible for retirement, allowing those employees to not seek new employment. 	<ul style="list-style-type: none"> • NYS Department of Labor has been holding resumé services, interview training, and job fairs for IPEC employees. • Entergy will be holding retraining programs for other utility jobs. • Governor Cuomo promised relocation funds for employees being relocated. • State legislation has been passed to add \$24 million to the state budget for energy communities that lose their utility site. 	<ul style="list-style-type: none"> • An expected 1% rise in energy bills. • Loss of community services. • Fire dept and libraries will lose funding.

(Foderaro, 2017; Hendrick Hudson School District, 2019; Mills & Lesser, 2016; Moore, 2018; NEI, 2015; Pezzullo, 2020; Reif, 2017; Zambito, 2018; Zambito, 2019a; Zawacki, 2019)

8.2.1 Economic Distress

The collection of articles for Indian Point are expecting various indicators of economic distress. Indicators include loss in tax revenue, increase in unemployment, loss of local businesses, closures of schools, etc. (HHSD, 2019; Mills & Lesser, 2016; Moore, 2018; NEI, 2015; Pezzullo, 2020; Zambito, 2018; Zambito, 2019a; Zawacki, 2019). Unlike the three communities, there is discussion of how the closure is expected to cause a loss in tax revenue for local, state, and federal governments. A total of \$340 million will be lost in tax revenue to these levels of government (NEI, 2015). The local governments that will lose revenue, mostly from property taxes, are the Village of Buchanan, the Town of Cortlandt, and Westchester County. Buchanan is expected to lose 50% of the village budget, a total loss of \$4 million by 2025 (Pezzullo, 2020; Zawacki, 2019). Cortlandt is anticipated to lose 2% of its budget, \$800,000 per

year (Pezzullo, 2020; Zawacki, 2019). Westchester County is predicted to lose 1% of the county's total property tax revenue (Zawacki, 2019). In total the loss in revenue from property taxes will be \$30 million between the local and New York State governments (NEI, 2015). The various tax revenue losses will come directly from Entergy no longer paying the same amount in property taxes as well as businesses and residents leaving the area in response to the plant closure. Local businesses are likely to close if the annual revenue relied on accommodating Entergy employees throughout the work week, causing a greater loss in property taxes. Additionally, if displaced employees need to relocate, the local community will also lose their property tax share. Tax revenue is particularly intertwined with the actions of both the company and residents. Because of the link between the company and residents and the findings of the NEI, I predict the same direct and indirect changes can occur for income taxes and other taxes in the communities impacted by the closure of Indian Point.

Similar to the Maine Yankee Atomic Power Company, a deal was made with the local governments and Entergy regarding tax revenue. Entergy agreed to pay 10% of its original tax revenues for ten years after the plants closure. By doing so, the loss of tax revenue from the company will not be as much, alleviating some financial burden on the local economy (Zawacki, 2019). Beyond tax revenue, the local school district will be greatly impacted.

Hendrick Hudson School District serves the six hamlets, villages, towns, and city surrounding Indian Point Energy Center, receiving a large amount of funds and donations from Entergy. Currently, Entergy pays 1/3 of the school district's budget, equating \$24 million. The loss for the upcoming academic year 2020-2021 will be \$3.9 million, and as the years go on, the loss will only increase (Pezzullo, 2020). Over the next five years, the total loss in school budget will equate to \$60.5 million, 33% of the total school budget (HHSD, 2019; Pezzullo, 2020;

Zawacki, 2019). Beyond the loss in budget, the district will also be losing a massive benefactor. Entergy has been involved with the school district since the company purchased Indian Point. The involvement includes donations, scholarships, and workshops to encourage a STEM education during primary education and higher education (Zawacki, 2019). The biggest concern for school officials and district families are the choices that must be made in light of losing such an enormous influencer. With Unit #2 closing in April 2020 and Unit #3 closing in April 2021, Joseph Hochreiter, the superintendent, has discussed layoffs, school tax increases, cuts to extracurriculars, and the closure of an elementary school (Moore, 2018; Pezzullo, 2020; Zambito, 2018). The future of the Hendrick Hudson School District is sure to change greatly along with the rest of the community.

Like Wiscasset, ME, the community surrounding Indian Point is expected to experience a large increase in unemployment. Foderaro (2017) recognized that a rise in unemployment was looming but did not have the resources to provide an exact number. However, researchers before him were able to provide the looming number of job losses. In 2015, the Nuclear Energy Institute predicted at its peak the total number of jobs lost could reach 16,600. This number is made up of jobs lost at 5,300 in the local counties, another 2,300 in the rest of New York and another 9,000 throughout the United States. Since Indian Point employs approximately 750 employees, most of these job losses will be from indirect industries such as government positions, public services, professionals, etc. (NEI, 2015). Of the 7,600 jobs lost among the local and state areas, 650 of them will be government positions (NEI, 2015). However, these predictions could be decreased or increased depending on what industries replace Indian Point. The number for job losses in New York State could reach 26,000 to 40,000 per year during a fifteen-year period (2016-2030) (Mills & Lesser, 2016). These numbers consider the jobs from the plant and those that will be lost as a

ripple effect. Locally, businesses are expected to lose 40% in annual revenue, causing business closures and job loss (Zambito, 2018; Zawacki, 2019). The loss of jobs and local business will also decrease the annual tax revenue for the surrounding community, making community services more difficult to provide.

In response to Indian Point's closure, the community must consider which services are necessary, and which can receive a budget cut. The services discussed the most are the fire department, libraries, police, highway department, wastewater, and garbage/recycling. In 2018, a community-wide survey was sent out to determine which service the residents felt could be cut completely or receive a budget cut (Zambito, 2018). By 2020, the fire department has lost 64% of its budget and the library 28%. These types of services are expected to continue to lose funding as the years go on. In order to maintain services like these, there would have to be an increase in taxes.

8.2.2 Tax Increases

Like the other three communities, taxes have increased and are expected to rise for the communities surrounding Indian Point. Property and school taxes are the two taxes that would be increased (Foderaro, 2017; Zawacki, 2019). There has already been a school tax increase for 2020-2021 of 8.7%. In the future school taxes are expected to increase 13% from the amount that was paid for 2019-2020 (Pezzullo, 2020; Zambito, 2018). The Hendrick Hudson School District (2019) claims that property taxes for residents will likely increase, on average, 13% every year for the next four years (2021-2025). Community officials hope raising these taxes, town services and school services will not be impacted too much by the loss of tax revenue from Entergy.

8.2.3 Re-employment of Displaced Workers

Since the announcement of decommissioning, Entergy has given very little specifics regarding the future for their employees. The lack of specifics may be related to the number of employees that are eligible for retirement come 2021. By 2021, 40% of Indian Point's employees are eligible for retirement, meaning Entergy may not offer many jobs for employees elsewhere (Zambito, 2018). Entergy claims it will re-employ some employees at other Entergy owned plants. However, the employees that remain employed with Entergy will have to relocate because all other Entergy energy sites are located in the Southern region of the country (Foderaro, 2017; Zambito, 2018). The NEI (2015) predicts six years after closing, about 3,300 people would move out of state. Twenty years after closure the number could be around 4,800 because of work displacement and relocation for re-employment. From this data it is expected that employee re-employment will occur but will also result in relocation.

8.2.4 Creation of Public Programs

Unlike the other three communities, both the company and state government are creating programs to help the community's economy and the plant's employees. If employees choose to not be re-employed at other Entergy sites, Entergy will be offer job training sessions for other utility jobs in New York (Foderaro, 2017). In 2017 as well, New York Governor Andrew Cuomo promised Indian Point employees will be offered relocation funds, the opportunity to work at other plants and utilities in New York state, and can receive training in renewable technologies (Reif, 2017). Two years after this promise, the NYS department of labor began holding resume services, LinkedIn training, interview services, and job leads for Entergy employees, showing that Governor Cuomo kept his promise (Zawacki, 2019). Governor Cuomo also wanted to assure Entergy employees that remained for decommissioning would not lose their employment when

the decommissioning company took over the process. He did so by having state legislation written to prevent the hired decommissioning company from laying off Entergy workers for cheaper unskilled workers (Zawacki, 2019). Governor Cuomo did not stop there. In April 2019, Cuomo announced he would be adding \$24 million to the 2021 state budget for energy communities that would experience plant closures. However, because these funds are for all energy communities across the state, Buchanan and Cortlandt would not receive enough to even make up for the expected losses. The total bill is also far less than the revenue Buchanan and Cortlandt is predicted to lose (Pezzullo, 2020; Zambito, 2019a). Even though the bill would not cover the predicted loss of revenue, the programs being established by the state government and Entergy are far more extensive than the programs found in the other communities.

8.2.5 Other

Along with tax increases, electricity rates are expected to rise for the communities that Indian Point serves. Mills and Lesser (2016) predict various increases over a fifteen-year period from 2016-2030; 1) New York State annual electric expenditures would increase by \$1.5 billion–\$2.2 billion. 2) A residential household could see an increase in electric bills of \$76–\$112 each year. 3) Commercial customers can expect an increase of \$772–\$1,132 per year. 4) An industrial customer's electric bills could rise \$16,716–\$24,517. 5) The largest increase would be for transportation customers, such as the subway system, of \$1.26–\$1.85 million per year. Zambito (2019a) also predicts a \$0.76 increase each month in electricity rates while the state finds alternatives to replace the energy generated by Indian Point.

9 Chapter Nine: Discussion

9.1 Summary of Economic Impacts

Table 7: Summary of Economic Impacts for All Cases					
Case	Economic Distress	Tax Increase	Re-employment of Displaced Employees	Creation of Public Programs	Other
Maine Yankee Nuclear Power Plant	+	+	+	+	+
Crystal River 3 Power Plant	+	+	+	+	+
Kewaunee Power Station	+	+	+	+	+
Indian Point Energy Center	+	+	+	+	+

The findings of each case are summarized in Table 7, using the categories from Table 2 in the literature review. The biggest difference between the cases and the journal articles in the literature review is that each collection of newspaper articles discussed all five categories. None of the studies in the literature review discussed all five categories. The difference may be a result of the newspaper reporters attempting to address every possible impact. Furthermore, newspaper articles are not conducted using scientific methods and design, calling into question the accuracy of the articles. Since many of the newspaper articles do not cite the source of the information, it is difficult to accurately determine the creditability. Meanwhile, the journal articles in the literature review focus on very few economic impacts in order to answer the author's specific research question. Because journal articles are specific in design, it is possible that the closures discussed in the journal articles did cause other economic impacts in addition to the ones directly reviewed in the article. Since economic impacts in all five categories exist for the four cases, it can be assumed that other nuclear plant closures will cause impacts that fall in each category.

9.2 *Case Discussions*

9.2.1 Maine Yankee Nuclear Plant

From this collection of articles, it is clear that Wiscasset officials did not do enough to prepare the community and battle the economic impacts. The lack of public programs specifically shows that the community's officials did not have an arsenal of policies already made for when the plant closed. Originally, Maine Yankee was not planned to undergo decommissioning until 2008, so the early decommissioning came as a shock to the community that expected the plant to be there for twelve more years (Kanes, 2010). However, with a technology like nuclear, it is difficult to claim a plant will operate for its entire expected lifetime. The various safety risks and annual investigations connected to nuclear energy lead to unexpected decommissioning (Collingridge, 1992). Additionally, the extensive capital investments to maintain a nuclear power plant are difficult to maintain especially when a much cheaper option for energy is available like natural gas (Collingridge, 1992). It also appears the relationship between the community and Maine Yankee Atomic Power Company also impacted how the community officials handled the closure. At the time of closure, the community was divided regarding the true operations of the plant. The worry that regulators were bought out by the company caused residents not to trust the information and actions of the company, causing some residents hoping for their community officials to act against the company and for their community (Ferrazza, 2013).

Because of these characteristics, Wiscasset officials should have developed policies when Maine Yankee Atomic Power Company began discussing their closing options for Maine Yankee. Their lack of preparedness lead town officials to only have the option to raise taxes and cut local services that were previously free of charge to the community. The lack of preparedness

put Wiscasset, ME in the same situation as Rowe, MA when Yankee Rowe closed. With such a heavy reliance on Maine Yankee, town officials should have focused on transitioning the community's economy to something new by using the land donated by Maine Yankee Atomic Power Company. The 400 acres donated by Maine Yankee Atomic Power Company had the ability to be repurposed fairly quickly in comparison to the rest of the site, but those acres were not commercialized quick enough. If the acreage was commercialized, new jobs would have been created for displaced workers, and the further closure of local businesses may not have occurred. In order to attract new businesses to the site, town officials could have offered tax incentives to businesses such as manufacturing, tourism, administrative, etc. Town officials also could have created programs for the Maine Yankee displaced workers.

In order to keep the workers within the community, Wiscasset officials should have offered job fairs and re-training programs on top of the ones being offered by Maine Yankee Atomic Power Company. The fairs and re-training offered by the company would assure the workers would remain within the nuclear industry, specifically within New England at other Yankee nuclear plants. Despite the efforts to offer employees new employment, it would mean the workers would have to leave the Wiscasset community. As population declines from relocation, the town would lose the market actions and tax revenue of the employees. Because of this direct impact of population decline, the prevention of relocation is crucial to a community like Wiscasset, ME.

Relocation could have been prevented if the town offered the same resources to the workers as well as repurposing the acreage. If the acreage was repurposed faster than it was, the town could have offered interview sessions, job fairs, and re-training programs that reflected the incoming businesses. The collaboration between company and community officials would also

benefit the community further so that goals are accomplished, and compromises are made. Through collaboration and compromise, Maine Yankee Atomic Power Company and Wiscasset could have offered joint interview sessions, job fairs, re-training programs, and even town hall meetings to discuss public opinions. It would have been more beneficial if officials acted quicker and collaborated with Maine Yankee Atomic Power Company rather than only increasing taxes and cutting town services.

9.2.2 Crystal River 3 Nuclear Plant

Overall, the economic status of Citrus County and Crystal River appears to have the ability to recover after the closure of CR-3. The biggest indicator of poor economic conditions is the 7.5% decrease in GDP during a year where other energy counties and metropolitan areas were growing (Kayastha, et al., 2016; Trigaux, 2015). Like Wiscasset, ME the announced decommissioning was earlier than the community expected, leaving a lack of public policies implemented by the community's officials. Citrus County officials could have been more active through the use of job fairs, training sessions, attending the Duke luncheons, etc. which would have led to other indicators of economic distress to be avoided. However, the actions taken by Duke Energy seem to benefit the community's economy, combating the poor economic conditions.

Officials that are active in the decommissioning process could have avoided the economic distress. By attending events held by Duke Energy or arranging meetings with the company, the decrease in GDP, loss of 100 government jobs, large decrease in road and school funding could have been evaded or minimized. By being more active, community officials would have understood what community members were most worried about, and what members would like to see as a response to the closure. The activity by Duke Energy in the community shows

that there is only so much a company can accomplish when protecting the host community. Therefore, the collaboration between company and community officials is necessary to create policies in the company and community that would benefit the employees and citizens once the nuclear plant has closed. By collaborating, the tax dispute also could have been avoided, meaning property taxes may not have been risen so much. However, in terms of unemployment and re-employment for displaced employees, Citrus County and Crystal River did better than Wiscasset, ME.

Citrus County and Crystal River did not experience such a large increase in unemployment and poverty when compared to Wiscasset, ME. As mentioned prior, the decrease in unemployment percentage for the county followed the trend for the rest of Florida and the US. Thus, showing the closure of CR-3 did not have a direct influence on the county's unemployment rate. The decrease in unemployment in Crystal River is most likely influenced by the construction of a new natural gas plant that would create more jobs than the number of jobs lost from CR-3. Additionally, the employees from CR-3 were given the opportunity to stay employed with Duke Energy in Florida or the Carolinas. By doing so an unemployment increase was prevented. The construction of the natural gas plant is also crucial to maintaining employment within the community. Like Wiscasset, the prevention of relocation is vital to the local community's maintenance of additional loss of market actors and tax revenue.

With Duke Energy being active in the community and its employees, Citrus County and Crystal River have the ability to make up some of the lost tax revenue. The natural gas plant specifically will be most helpful in restoring tax revenue and preventing relocation. With tax revenue restored and a decrease in unemployment a few things should occur in the future; the

GDP should rise, funding returned to roads and schools, and a return to property tax rates prior to CR-3 decommissioning.

9.2.3 Kewaunee Power Station

Unlike the other two communities, both Dominion and public officials lacked in action to help the community to adjust once the nuclear plant closed. As discussed with the other communities, collaboration between community officials and company officials would most benefit the community once the plant closed. However, the relationship between Dominion, Carlton, and Kewaunee County is weak. With such a weak relationship, the well-being of the community was not a priority. The lawsuit and lack of programs for employees highlights the feelings from both parties. Additionally, the public officials were invested with receiving tax payments from Dominion instead of writing and implementing new policies. The discontinuation of programs provided by Dominion as well as the limitations on taxes placed the public officials in a difficult position to create policies that would benefit the community. These impacts ultimately led to the relocation of most of the displaced employees to other nuclear communities. If the employee stayed with Dominion, this meant relocation to the East Coast (Dotson, 2014). Relocation out of the community made the economic distress worse for those that were left in the community. Because so many market actors and additional tax revenue were lost, Carlton was stuck battling economic challenges on every end. The economic conditions were so poor, the federal government chose to step in.

Because the relationship between government and company and public programs were so poor, US Department of Labor acknowledged the struggling community with a grant. The grant was meant to help the displaced workers remain in the community and find new employment. Carlton and Kewaunee County are the first community examined that experienced federal

government involvement. The involvement of the federal government alone highlighted how little was being done for the Kewaunee County and Carlton community. Moreover, the grant exemplified how important it was for the survival of the community that the displaced employees found employment locally. If the company and community officials were focused on the status of displaced employees, local businesses, and local economy, an action plan could have been devised that was not an economic burden. The revitalization plan would have provided the pathway that would've transformed the local economy in order to offset the impacts caused by the Power Station closure.

Generally, like the County Chairman said, the Kewaunee community will be able to recover from the closure of the Power Station. The recovery of the community will mostly come from the decrease in unemployment trend, increase in property taxes, and the sales tax to offset \$750,000. With more residents working, the town and county will receive a larger amount in tax revenue from payroll and income taxes than previous years when unemployment was high. Additionally, if a state prison is established in Kewaunee County, an even greater number of jobs will be created to increase the tax revenue. The increase in property taxes and the sales tax also increases the total annual revenue. With an increase in tax revenue, the local government and school budgets can also increase to return to levels similar to when the Power Station was operating. Since Kewaunee County and Carlton experienced only a loss in tax revenue as the largest indicator for economic distress, this shows the community was not impacted as much as the other two communities, specifically Wiscasset, ME.

The major concern for Kewaunee County and Carlton is the lack of collaboration between Dominion and government. The collaboration would've allowed both parties to understand the community's concerns like Duke Energy did. Furthermore, collaboration

could've resulted in other policies besides tax increases such as the revitalization plan. Even though the community will recover, the methods to recovery could have been very different if the company and government collaborated.

9.2.4 Indian Point Energy Center

Of the four communities, Buchanan, Cortlandt, and Westchester County appear to have the most promising recovery in the future. The likely similarities between this community and the other three cases includes a significant loss in tax revenue, cuts to community services, an increase in taxes, and expected increase in unemployment. However, the major difference will be the collaboration of both Entergy and the NYS government. Collaboration has been a factor since the announcement of decommissioning and is likely due to the positive relationship between the community and company. By recognizing the community's dependence on Indian Point and the partnership that the plant has with the community, both parties have chosen to act to prevent a collapse of the local economy. The resources offered to Indian Point employees will allow most to be re-employed whether it is within NYS or remaining with Entergy. State legislation will also be beneficial for the community and Indian Point employees. The added budget in 2021 should provide some funds to transform the economy or even create a revitalization plan like Kewaunee attempted to create. The only concern would be a large portion of the displaced workers being relocated. This would hurt Buchanan further because the tax base and market actions would decrease even more. The goal is to keep the population of the community similar to when the plant was operating to prevent further distress. Because the decommissioning process is just beginning in 2020 when one of the two units' halts operation, it is difficult to say what will happen for sure. Further research should be conducted five years into

decommissioning to understand what the community has done and to determine if the predictions occurred.

9.2.5 Explanation for Differences

From the four communities, it seems the differences stem from how much of the community's tax revenue came from the plant and the relationship between local government and company. Wiscasset, ME experienced the most economic distress of the four communities. With 96% of their community budget coming from Maine Yankee tax revenues, Wiscasset was challenged with transforming almost their entire economy and services (Abel, 2013). In comparison, Crystal River lost 26%, Kewaunee County lost 30%, and Buchanan will lose 50% of their budgets from tax revenue (Harwell & Behrendt, 2013; NEI, 2015; Zawacki, 2019). Of the four energy companies, Maine Yankee Atomic Power Company, Duke Energy, and Entergy offered services to the community and displace employees in response to the closure. Dominion however did not offer services to Kewaunee County.

In comparison to the other three companies, Dominion did not engage with the surrounding community whatsoever. Interestingly, Dominion and the town of Carlton instead were in the middle of a lawsuit to determine the value of the plant. As a result, the community had to pay the company in refunds or credits (Ryman, 2017). Because of the lawsuit, the relationship between the local government and company disintegrated. Without a positive relationship, Dominion did not offer any services to the employees or community, leading to community officials battling all of the economic impacts on their own. Deprived of any support from Dominion, employees had to figure out whether or not they would be hired by the company elsewhere as well. The US Labor Department recognized the employees were struggling to find new employment, leading to a grant in order to alleviate some of the financial burdens when

trying to find employment (Finucane, 2016). With the community paying Dominion in refunds or credits, a sales tax was issued in order to offset tax revenue loss along with an increase in property taxes (Content, 2015; Ryman, 2017). Despite the complications between the community and Dominion, the community is expected to recover.

With such a great loss in tax revenue, Wiscasset was forced to change how the community functioned in order to maintain as many services as possible. This extreme change in community functions was not seen in the other three communities. In order to maintain functionality, community officials were forced to increase taxes. However, with an increase in unemployment and poverty as a response to the plant closure, the increase in taxes did not offset the loss of tax revenue enough. Without a large enough offset, it was more difficult for Wiscasset to offer services such as garbage pickup as well as a major cut to the school district budget (Abel, 2013; Goldberg, 1998; Rousmaniere, 2015). Maine Yankee Atomic Power Company offered as much as they could to employees but did not engage much in the transformation of Wiscasset's economy. Besides the donation of acreage for repurposing and conservation and job fairs, the company did not offer direct services to the community. However, this involvement is still more than the involvement of Dominion in Kewaunee County. By offering the few services, 60% of the Maine Yankee displaced employees found new employment. A similar outcome did not occur for the displaced employees of the Kewaunee Power Station. Despite the efforts from both the company and local government, Wiscasset experienced increases in unemployment, taxes, and poverty within the last five years (Rousmaniere, 2015).

The difference between Crystal River, FL and Buchanan, NY with the other two communities is the active collaboration between company and government. Duke Energy actively got involved with their employees, government officials, and the surrounding

community through surveys and luncheons in order to understand what concerns their stakeholders had regarding the closure (Kayastha, et al., 2016). By understanding the concerns of those who will be impacted, Duke Energy was able to create programs inside the company. Duke offered job fairs, relocation packages, and jobs within the new natural gas plant (Larson, 2014). From these programs, 55% of the nuclear plant employees were employed at other Duke Energy facilities (Kayastha, et al., 2016). With the natural gas plant, government officials will be able to offset some of the tax revenue loss from the nuclear plant. The construction of the natural gas plant also allowed government officials to only raise property taxes by the necessary amount (Penn, 2013; 2014). It is expected that the natural gas plant will play a key role in the recovery of Crystal River.

Government and company officials in NY most likely learned from the actions of the officials in Crystal River. The difference between the two is that the state government is playing the primary role in offering services to the community and employees. Like Duke Energy, the NYS government is offering relocation packages to Indian Point employees that take utility jobs elsewhere in the state (Reif, 2017). Additionally, the NYS government has passed legislation to help communities after an energy plant closure and offered resumé services to employees (Zambito, 2019a; Zawacki, 2019). Entergy is also offering job fairs and training sessions similar to Maine Yankee Atomic Power Company and Duke Energy. How these programs will impact how many Indian Point employees is unknown, but based on Wiscasset and Crystal River it can be assumed a large percentage of Indian Point employees will be hired after the closure. It can also be assumed that the economic impacts on the surrounding community will not be severe because of NYS legislation. With Buchanan, NY having the most collaboration between

government and company, the negative impacts seen in other communities may not occur in Buchanan.

9.3 *Answers to Research Questions*

9.3.1 Question #1

From the literature review and case analysis, it is clear that rural nuclear plant host communities will experience more of the economic impacts within the five categories. The cases showed that the host communities experienced economic impacts throughout all five categories which were not all addressed in the literature. The literature did not discuss tax increases and the reemployment of the plant employees. Through the collection of newspaper articles, this information gap was filled which showed that each community experienced tax increases and a large portion of employees were reemployed in the three cases. I expected there to be tax increases in every community, but did not expect the large percentages of employees to be reemployed in each community. I did not expect that outcome because very few articles in the literature review discussed this impact. Thus, leading me to believe that reemployment did not occur in every community. Because of the difference between the literature and cases, it is clear nuclear and non-nuclear communities will experience different impacts. The dissimilarity also allowed for Recommendation #2 to be formulated which is discussed in section 10.2.2.

9.3.2 Question #2

Based on the other cases, Buchanan, NY can expect similar impacts to that of Wiscasset, ME and Crystal River, FL. These two cases had some collaboration between government and company which allowed for a large reemployment percentage and minimal economic distress. However, with the key involvement of the NYS government, Buchanan can expect even less economic distress and an even large reemployment percentage. Even though property taxes are

expected to increase, it may not be as much because of NYS legislation. With the collaboration between government and company a bright future for Buchanan, NY is expected. From the cases and the current relationship between the NYS government and Entergy, Recommendation #1 was formulated in section 10.2.1. In a more general outlook, Recommendation #3, section 10.2.3, was formulated with the hope that future closures will create relationships like the NYS government and Entergy.

10 Chapter Ten: Limitations & Policy Recommendations for Buchanan, NY

Officials

10.1 Limitations

10.1.1 Limitation #1

By using these methods, a few limitations were introduced. First, this method only took into account cases that are similar to the population of Buchanan, NY. Each of the three cases was at most $\pm 1,000$ to that of Buchanan, NY. The possible outcomes for large communities could differ in comparison to these small communities.

10.1.2 Limitation #2

Second, when data began to be collected, the COVID-19 global pandemic occurred, not allowing interviews with Buchanan officials. Before the pandemic, interviews were considered as a method and officials agreed to have in person interviews or telephone interviews. Once the pandemic started officials were no longer available for any type of interview, especially because Westchester County was the first to experience a major outbreak in New York (Bendix, 2020). By only collecting newspaper articles, there is a vast amount of scientific information that is lost from other academic articles and government data. Additionally, many of the articles found

during the literature review did not consider all of the economic impacts in the five categories. Because of the lack of scientific research and information regarding all five categories, the use of newspapers decreased the internal validity of this research. As mentioned prior, the use of newspaper articles questions the accuracy of the information provided. Therefore, the information that is able to be accessed is minimal. Further scientific research would also need to be conducted once Indian Point is further along in the decommissioning process to understand the true impacts to the community.

10.2 Implications for Policy and Practice

As seen throughout the four cases, government intervention is useful for ensuring a community's survival. Therefore, local governments should create policies similar to those found in the literature review and cases.

10.2.1 Recommendation #1: Reemployment within the Community through Public Programs

I believe the most important impact to battle is unemployment because of the varying indirect impacts that stem from it. The goal is to reemploy as many of the displaced employees within the community to prevent further economic distress from population decreases. The policies that were most useful to battle this impact are the government-funded or company-funded job fairs and training sessions. Because of these programs, displaced employees were able to offer their labor to other employers or retrain their skills to fit a different industry. As a result, these employees were then able to apply their new skills to a new place of employment. Finding new employment benefited communities because unemployment rates remained low and median household incomes did not change drastically. Without the reemployment of displaced employees, transitioning to a new industry may not be possible, and the tax increases for the

employed may never be repealed because of a high unemployment rate. Therefore, I think for a community to survive a closure fully, reemployment of displaced employees within the community should be the primary focus. With a direct impact stabilized, the community can then focus on the other direct and indirect impacts mentioned in Figure 1.

10.2.2 Recommendation #2: Create Collaboration between Government and Private Company

Furthermore, policymakers should establish a collaborative relationship with the company to create a comprehensive policy that includes methods towards reemployment, tax increases, and transitions of industry. As seen in the cases, the communities such as Crystal River and Buchanan, had strong relationships with the energy company and were able to plan more accordingly.

Because a collaborative relationship is necessary, companies should also consider policies that help employees and the community if the company should ever close down. The most beneficial way to do help employees and the community would be to offer job fairs and training sessions as discussed prior but provided through the employer. Company officials should consider these policies because closures are not decided by the employees and the community. In order to create a closure method that is best for the community, surveys and meetings like the luncheons that Duke Energy held would be most helpful. Actively engaging with the employees and community allows for employees to enhance their skill set and enter a new industry as well as understand the community's concerns.

I believe Entergy and the NYS government are on the correct path to ensure the community's survival. The expected programs and legislation take into account the concerns

discussed above and include the types of policies discussed that would most benefit the community.

10.3 Implications for future Research

10.3.1 Recommendation #1: Completion of More Quantitative Studies

As seen with the literature review and collection of articles, there are very few quantitative studies regarding the economic impacts of closures. The one quantitative study in the literature review found opposing results, economic growth and increased employment occurred after a nuclear power plant closure (Haller, Haines, & Yamamoto, 2017). By using a regression analysis over a ten-year period, the study was able to provide long-term answers for how a major employer closure, specifically a nuclear plant closure, can impact a community. Additionally, the ten-year time frame was specific to this study. For the collection of articles, many of authors used government provided data rather than conduct a long-term quantitative study of their own. Because Haller, Haines, & Yamamoto (2017) comes to opposing results and authors did not conduct research of their own, there is a need for long-term quantitative research in order to determine the economic impacts of a nuclear power plant closure.

11 Chapter Eleven: Conclusion

Based on this thesis, rural communities can survive the economic impacts of a nuclear power plant closure through the use of various public programs and policies as well as the collaboration between company and government. Because of the lack of places of new employment in rural communities, it is important for displaced employees to enhance their skill sets to find jobs elsewhere. Through these programs and policies, a community can survive a major employer closure. In order to create effective policies and programs, the company and government must collaborate. Collaboration includes holding joint job fairs, training sessions,

and community meetings. In addition to these policies and programs, an increase in certain taxes can also help offset the economic burden caused by the closure. In the case of Indian Point, state legislation can also be used to help the community offset the loss of tax revenue. It is crucial for the future of Buchanan and Cortlandt that Entergy and NYS government continue their collaboration. Despite these findings, more long-term research is needed to quantitatively understand the economic impacts, and how public policies and programs can deter the effects on a community. In the future, a long-term quantitative study of Buchanan and Cortlandt would be able to show whether or not the community experiences long-term economic burden.

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