Energy Accessibility in Urban and Rural Communities

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By

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Introduction

Failing Infrastructure

Modern American society revolves around the rapid development of technology. It is in a state of rapidly increasing demand for electricity, a variety of power sources, and an aging electrical infrastructure. The fragile American electric system has been failing to supply reliable power to its consumers and having a profound effect. In 2003, the Northeast Blackout affected over 50 million people and cost between $4.5 billion and $10.3 billion in economic losses ("Power Infrastructure," 2016).

In 2017, the American Society of Civil Engineers rated the electrical infrastructure with a D+ in their infrastructure report card ("ASCE's 2017 Infrastructure Report Card," n.d.). It was also stated that electrical infrastructure needs was ranked third with an estimated need of $934 billion. As a result of the failing infrastructure, access to electricity has become unreliable. The lack of consistent electricity has been associated with multiple negative effects revolving around chronic and persistent poverty. This includes detriments in economic prosperity, overall health of the community, and children's education. The failing infrastructure of the electric grid that exists across the United States presents communities with obstacles that hinder their development and success.

Electrical Inequality

Access to electricity is consistently defined as a factor that facilitates the development and growth of communities. Without access to a reliable electric grid, communities suffer from less economic opportunities, poor healthcare, and fragile infrastructure ("Energy Inequality—Conceptual Notes and Declarations—IIASA," n.d.).

Access to electricity differs between communities throughout the United States. Perhaps the most significant difference occurs between urban and rural communities. Regardless of geographic location, most households have at least basic access to electricity. However, electric grid reliability differs across the country due to increasing volatile demand and aging infrastructure. Therefore, the relationship between a community and its respective electrical infrastructure creates a unique sociotechnical system**.** In my research project, I will investigate the possible effects of the weak electrical infrastructure in the United States and its impact on rural and urban communities.

Background

The development of the electrical infrastructure in the United States began in the early 20th century ("History of Electricity," n.d.). The electrical infrastructure in the United States was initially developed to revolve around cities, where most of the industrial revolution was taking place in the early to mid 1800s. Over the following century, infrastructure was slowly built in order to bring electricity to rural areas. As electricity became available to most households in American communities, access to electricity became a necessary part of developing societies.

Urban communities were the first recipients of streamlined electricity in the late 1800s. Cities were determined to be the most suitable economic option for the development of electrical infrastructure because of the large amount of customers per square foot. The first centralized power station was opened in 1882 in lower Manhattan and was called the Pearl Street Station ("History of Electricity," n.d.). Coal was transported to the Pearl Street Station via horse and wagon, and was then used to power jumbo steam powered engines to spin generators and generate electricity. Electricity was then distributed to consumers who lived within one square mile of the facility. Today, the demand for electricity in New York City is so high that most the demand is supplied by supplemental generation facilities in upstate New York, hundreds of miles away from the consumer (Rueb, 2017). The success of this system depends on the ability of the weak infrastructure to work reliably. As a result, the major problem facing cities today is that the extremely high demand cannot be satisfied by the aging electrical infrastructure.

By 1930, most households in cities had basic access to electricity. In comparison, only one out of ten households in rural areas had access to electricity (“History of America’s Electric Cooperatives,” 2016). Rural communities were not seen as an economically favorable option for utilities to invest in. As a result, the government mandated the development of electrical infrastructure in isolated areas by the Rural Electrification Act in 1936, which initiated the development of local cooperatives (Beatrice & Us, n.d.). Currently, most rural communities have access to electricity through a local cooperative. Cooperatives are non-profit, customer-owned energy companies that deliver electricity to rural areas across the United States (“America’s Electric Cooperatives,” 2017). While most rural communities do have basic access to electricity, the smaller amount of customers per square mile enables utilities to prioritize other customers. Therefore, these communities often experience power outages and long repair times. In the following research, the impact of the electricity reliability on urban and rural areas will be evaluated.

Case Study

Data Collection

Every community has their own history regarding the implementation and management of their respective electrical grid. Therefore, each community has a specific relationship with electricity that forms a unique sociotechnical system. In my research, I will examine a case study of two sociotechnical systems to compare urban and rural communities with respect to their electrical infrastructure.

In the case study, each sociotechnical system was evaluated by measuring the reliability and the impacts of their respective electric grids. The reliability of the electric grid is typically evaluated using two indicators – security and adequacy. The security of the grid is the system's ability to maintain stability in response to disturbances. The adequacy of the grid is the ability of the grid's supply to sufficiently meet the demand (Gu, Zhang, Ma, Yan, & Song, 2018). The security and adequacy of the grid can be measured by analyzing certain characteristics of power loss events. In this case study, the length and frequency of a power loss event were used as the main indicators of electric grid reliability.

The data for power outages was obtained from two main sources - the U.S. Energy Information Administration and the electricity utilities themselves ("Annual Electric Power Industry Report, Form EIA-861 detailed data files," n.d.). From these data sources, there are three statistics that are used to measure the impacts of power outages, and thus evaluate the overall reliability of the electric grid. The three statistics are the System Average Interruption Duration Index (SAIDI), the System Average Interruption Frequency Index (SAIFI), and the Customer Average Interruption Disruption Index (CAIDI). SAIDI represents power loss duration; SAIFI represents power loss frequency; and CAIDI represents customer disruption. They are described further below: (*EIA Reliability Metrics video*, 2018)

Statistic	Definition	Calculation	Unit	Median Value
SAIDI – System Average Interruption Duration Index	Average duration of interruption	$SAIFI * duration\ of\ power\ loss\ (minutes)$	Time (minutes, hours)	90 minutes
SAIFI – System Average Interruption Frequency Index	Percentage of customers affected	$\frac{number\ of\ customers\ affected}{number\ of\ customers\ in\ the\ system}$	Interruptions per customer	1.10 interruptions per customer
CAIDI – Customer Average Interruption Disruption Index	Average duration of interruption per customer	$\frac{SAIDI}{SAIFI}$	Time (minutes, hours)	81.6 minutes

Table 1 – Statistics used to measure the reliability of the electric grid servicing a certain region. The median value indicates the median value of all electricity systems across the United States.

Geographical Nodes

Two locations were selected for the case study by identifying significant criteria. The following criteria were used to identify an urban and rural node:

	Urban	**Rural**
Total Population	> 50,000	< 2,500
Population Density	> 1,000 / sq. mi.	< 1,000 / sq. mi.
Power loss event	Recorded by the EIA and discussed in local news	Recorded by the EIA and discussed in local news

Table 2 – Criteria used to select locational nodes for the case study.

The first criteria identified was the total population of the node. According to the United States Census, an urban area is a location with more than 50,000 people. In contrast, any area with a population less than 2,500 people is considered rural. Lastly, they further define an "Urban Cluster" as having a population between 2,500 and 50,000 people (Bureau, 2019). The second criteria chosen was population density. This metric adds context to the total population metric by showing how compactly populated the node is. Lastly, the third criteria chosen was the occurrence of a power loss event that was recorded by the EIA and mentioned in local news.

In addition, the following two criteria were controlled to eliminate the presence of confounding variables:

1. State
2. Utility operation

Both nodes were located in the same state within the United States so that they were both participants in the same electricity market. Also, the electric grid for both nodes were operated by the same utility.

Following the criteria set, Monroe County (which includes the city of Rochester) was chosen as the urban node, and Orleans County was chosen as the rural node. The criteria had limitations and therefore do not fit all of criteria initially set. For example, each node is operated by a different utility. Monroe County is operated by Rochester Gas & Electric, while Orleans County is operated by New York State Electric & Gas. While they are different utilities, both are subsidiaries of AVANGRID, and therefore have many of the same service requirements and distribution sources. In addition, both locations meet the urban/rural population requirements.

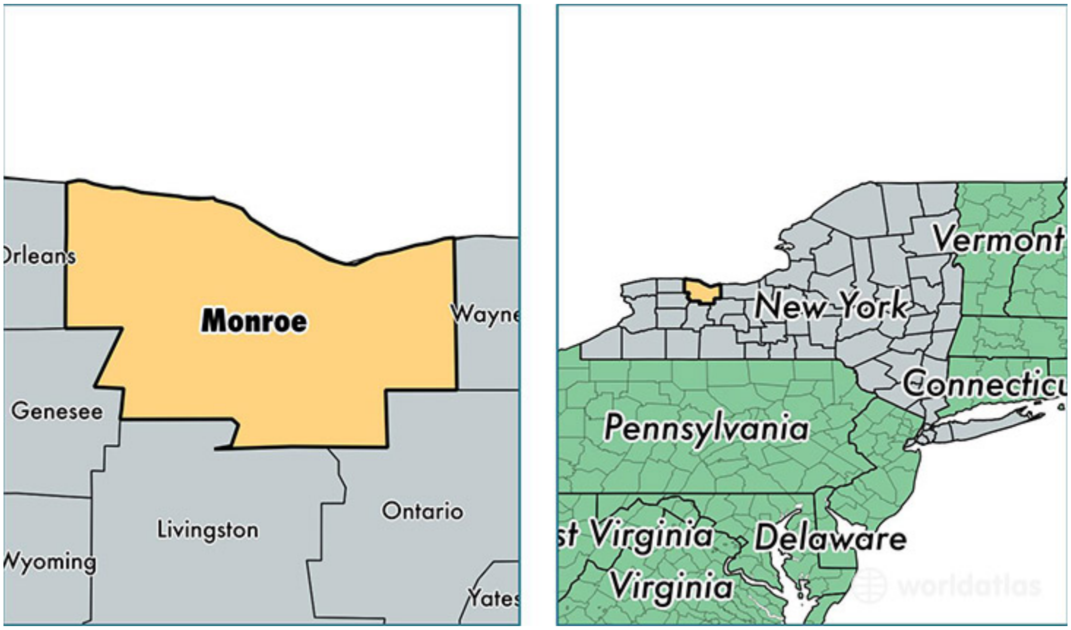


Figure 1 – Monroe County; urban node.

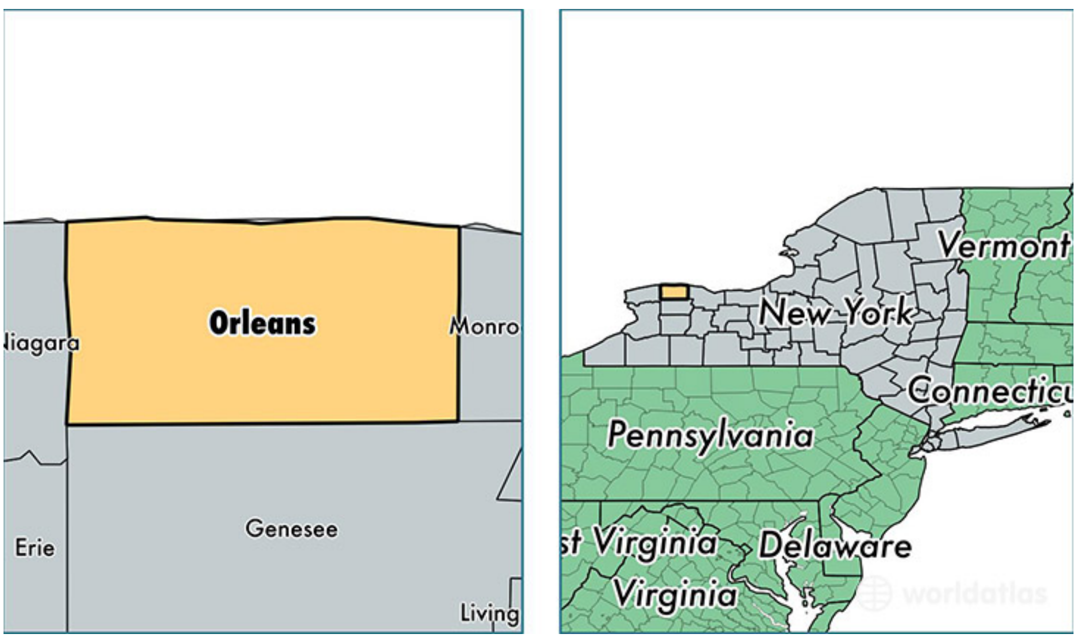


Figure 2 – Orleans County; rural node.

	Monroe County (Rochester)	Orleans County
Total population	741,274	43,028
Population density	1,127.9	110.3
Power loss occurrence	March 2017 Wind Storm	March 2017 Wind Storm
State	New York	New York
Utility market	NYISO	NYISO
Utility	Rochester Gas & Electric	New York State Electric & Gas

Table 3 – Characteristics of each location.

One power loss event was chosen for both nodes. On Wednesday, March 8, 2017, there were extremely high winds throughout the western region of New York. This event resulted in thousands of citizens without power throughout the area. In Monroe County, there were 144,119 customers without power on Thursday morning (WHAM, 2017). In Orleans County, there were 7,551 customers without power ("Power failure from windstorm will be 'multi-day event,' utilities say," 2017). Both counties shut down a number of facilities, such as schools, roades, churches, daycares, and courthouses. Most customers throughout both regions were out of power for two days, until Friday night.

	Monroe County (Rochester)	Orleans County
Total Population	741,274	43,028
Population without power	144,119	7,551
Percentage of population without power	19.44 %	17.55 %

Table 4 – Number of customers that lost power during the 2017 Windstorm in Western New York State.

Reliability Metrics

Lastly, the reliability metrics could not be calculated for each locational node. Reliability metrics are reported to the Energy Information Agency (EIA) annually, by each utility, for all of the territory that they service. As a result of the limited data available, reliability statistics were drawn from the utilities for each node over a five year period (2013-2018). Then, the median was calculated for each statistic.

Statistic	**Monroe County (Rochester)**	**Orleans County**	**National Median**
SAIDI	133.8 minutes	208.2 minutes	90 minutes
SAIFI	0.889 interruptions/customer	1.37 interruptions/customer	1.10 interruptions/customer
CAIDI	151.594 minutes	151.499 minutes	81.6 minutes

Table 5 – Median statistics for each node.

The following graphs display annual reliability values for each locational node:

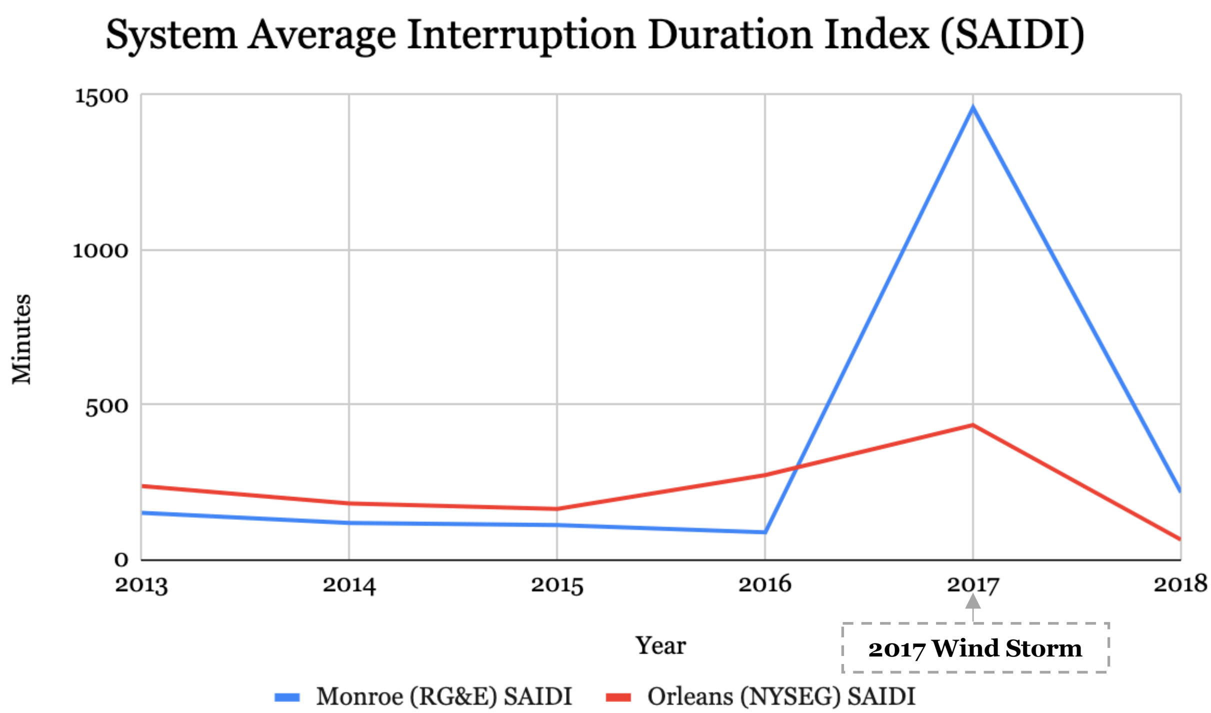


Figure 3 – SAIDI values for Monroe County (RG&E) and Orleans County (NYSEG) between the years of 2013 and 2018. SAIDI represents the average duration of interruption from a power loss event, with a longer average duration indicating lower reliability. Orleans County consistently has a higher SAIDI value than Monroe County, except in 2017 and 2018. The United States average SAIDI event is 90 minutes, which is around half of the average value for both counties. During the power loss event, the SAIDI value for Monroe County is approximately 15 times greater than the national average.

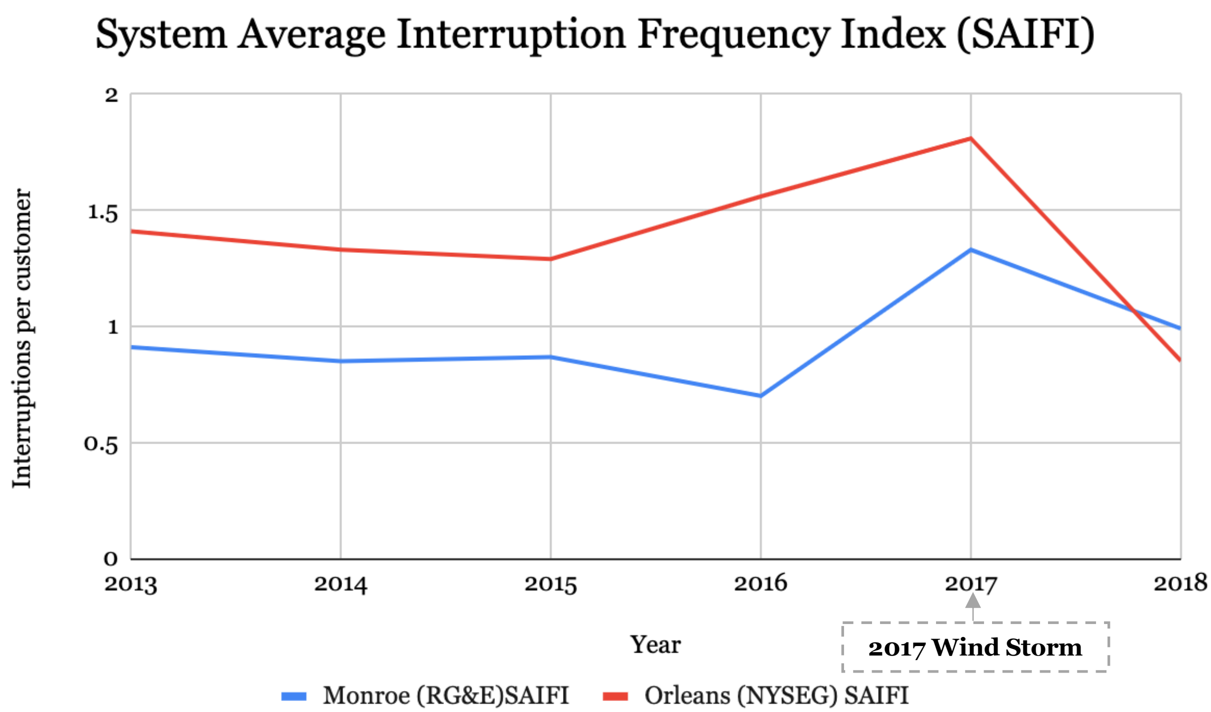


Figure 4 – SAIFI values for Monroe County (RG&E) and Orleans County (NYSEG) between the years of 2013 and 2018. SAIFI indicates the power loss frequency by calculating the average number of interruptions per customer. A higher SAIFI value indicates a lower electric grid reliability. Orleans County consistently has a higher frequency of interruptions, except for 2018. The United States SAIFI value is 1.1 interruptions per customer. During the 2017 power loss event, both counties' SAIFI values jump higher than the national average.

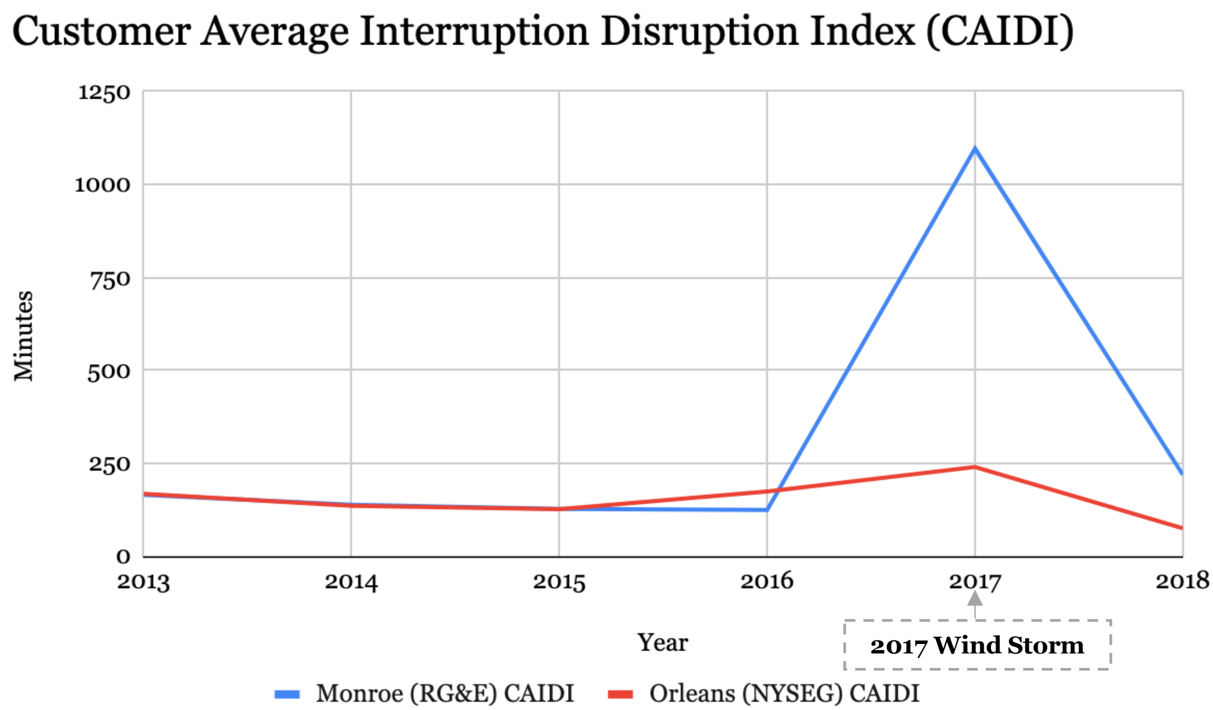


Figure 5 – CAIDI values for Monroe County (RG&E) and Orleans County (NYSEG) between the years of 2013 and 2018. CAIDI values represent the average duration of interruption per customer, with a higher CAIDI value indicating a lower electric grid reliability. Monroe County and Orleans County generally had equivalent CAIDI values, except in 2017 during the major power loss event. The United States average CAIDI value is 81.6 minutes, which is about 70 minutes lower than both of the average values for Monroe County and Orleans County. In addition, the CAIDI value for Monroe County is approximately 14 times greater than the national average.

Data Analysis

Reliability Analysis

Compared to national standards of electric grid reliability, both Monroe County and Orleans County have relatively poor reliability. In all three categories, both systems are worse than the national averages. The only exception is the SAIFI value for Monroe County, which probably means that the disruption events were longer and less frequent.

Statistic	**Monroe County (Rochester)**	**Orleans County**	**National Median**
SAIDI	133.8 minutes	208.2 minutes	90 minutes
SAIFI	0.889 interruptions/customer	1.37 interruptions/customer	1.10 interruptions/customer
CAIDI	151.594 minutes	151.499 minutes	81.6 minutes

Table 6 – Average median statistics for each node.

By comparing the urban and rural nodes, it can be shown that the Orleans County system (the rural node), generally has worse electric reliability. However, in the wake of the major power loss event, the data demonstrates that the Monroe County system is more susceptible to system collapse during a major event. This is indicated by the SAIDI and CAIDI reliability factors, which both measure duration of power loss for the customer. In 2017, the SAIDI value and CAIDI value for Monroe County is approximately 15 and 14 times greater than the national average, respectively. From this momentous drop in electric grid reliability, it was hypothesized that there would be detrimental impacts on the community of Monroe County. This hypothesis is explored further below.

Previous Research on the Impacts of Electrical Inequalities

Previous research has shown that energy inequalities are accompanied by income inequalities, gender inequalities, and inequalities in other developmental areas of a community. These additional inequalities present as obstacles for success, aiding in chronic and persistent poverty. (*Energy Inequality—Conceptual Notes and Declarations—IIASA*, n.d.). The direct links between energy inequality and community development have been previously assessed in studies. The three categories of impacts that are typically evaluated are economic, health, and educational impacts.

Economic – The economy is composed of the production and consumption of goods and services that serve different areas of people's needs and wants. Today, each sector of the economy is connected to another through supply chains or collaboration among businesses. Collaboration among groups and individuals has resulted in astound amounts of innovation and creativity, but has also created a very interdependent network. "The increased interdependency brings many benefits but also challenges, where one consequence is that the failure impact in a system can propagate to others" (Gu et al., 2018). One possible form of a failure impact is a power outage, and thus can have adverse events on the economic success of a community. Previous studies have attempted to quantify the economic impact of power loss events using various economic models (such as the Input-Output model and the Inoperability Input-Output model). For example, these models produced an estimate that the 2003 North American blackout resulted in an economic loss of $6 billion (*North American Energy Resilience Model*, 2019).

Health – Complex health systems require electricity for many different tasks; such as storing and retrieving patient information, using electronic medical devices, regulating indoor temperatures, and facilitating communication between different entities. Unreliable electricity delivery compromises these tasks to an extent that puts many patients at risk. Within a hospital, all patients that are on life-sustaining measures are compromised. Within the community, consumers with chronic conditions are at risk due to fluctuations of temperature or the inability to use at home medical devices. Multiple studies have shown that power loss events have resulted in increased mortality rates (Anderson & Bell, 2012), hospitalizations for respiratory conditions (*Health Impact in New York City during the Northeastern Blackout of 2003—Shao Lin, Barbara A. Fletcher, Ming Luo, Robert Chinery, Syni-An Hwang, 2011*), and emergency medical service calls regarding medical device failures (Rand et al., 2005). In a study performed on the health impacts of New York City power loss events, it was determined that "all-cause mortality was positively associated with the 1999, 2003, and 2006 outages" (Dominianni et al., 2018). As shown in these previous studies, electricity inequality have the potential to cause public health and safety concerns.

Education – The education system provides more than just a learning environment for children – it also acts as a home with a proper support system, furniture, heat, and food. A school's ability to provide all of those needs at a sufficient quality relies on its access to electricity. Within the home, a child's access to electricity and internet enable the creation of a motivational learning environment that emphasizes the value of knowledge and education. Without electricity, learning is not made accessible at home for many reasons; including the inability to see (inhibiting reading or writing), limited access to resources, and barriers to communication between teachers and parents. These circumstances detract from the emphasis on education, which ultimately reduces a student's ability and desire to graduate high school and/or college.

Demographic Analysis

Once the reliability of the local electric grid was measured for each node, the effects of the grid on its respective community were analyzed using certain parameters. Three categories of impacts were analyzed - economic impacts, health impacts, and educational impacts.

The first focus of analysis are on the demographics of the communities. The following indicators were chosen to provide a wholistic representation of the sociotechnical system being studied. The economic impact was determined using the average household income, the per capita income, and the unemployment rate of each node. Average household income and per capita income were chosen because they are common indicators of economic health, and are the standard for comparing wealth and affluence between two communities. The unemployment rate was chosen as a measurement of economic participation. During a power loss event, the production and efficiency of the economy drops, resulting in loss of work and income for many individuals.

The health impact was determined using the birth rate, the fertility rate, and the death rate of each node. The birth rate and death rate of an area were chosen as measurements of population growth or decline. The fertility rate of an area often represents the rate of growth of a population. As discussed previously, power loss events have been associated with an increase in mortality rates, but a decrease in birth rates and fertility rates.

The educational impact was determined by using high school graduation rates and high school dropout rates. The qualifications of the working class often correlate to their individual wealth, but also the economic success of the community that they contribute to. In addition, power loss events pose an additional challenge to children that are struggling to continue their education. This results in a shift in their priorities, and neglecting the importance of education.

Economic Impact

The following tables display the data collected representing the economic impact of electricity reliability on a sociotechnical system.

	2013	2014	2015	2016	2017	2018	Average
Monroe County	$70,190	$70,767	$70,955	$72,464	$75,077	$77,604	$72,843
Orleans County	$58,931	$57,666	$56,908	$59,724	$60,952	$64,365	$59,758

Table 7 – Average Household Income (In 2017 Inflation Adjusted Dollars) between 2013-2018 for Monroe County and Orleans County.

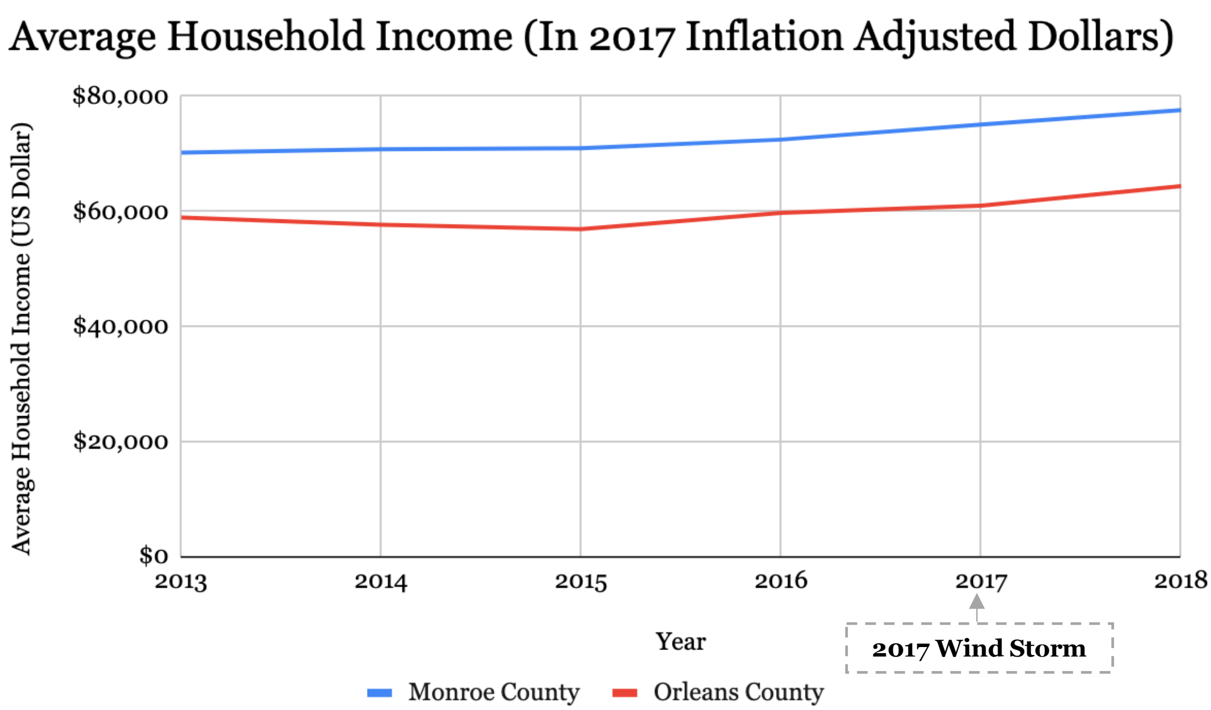


Figure 6 – Average Household Income (In 2017 Inflation Adjusted Dollars) between 2013-2018 for Monroe County and Orleans County.

	2013	2014	2015	2016	2017	2018	Average
Monroe County	$28,372	$29,170	$29,424	$30,194	$31,291	$32,502	$30,159
Orleans County	$22,255	$22,350	$22,070	$23,332	$23,929	$25,261	$23,200

Table 8 – Per capita income between 2013-2018 for Monroe County and Orleans County.

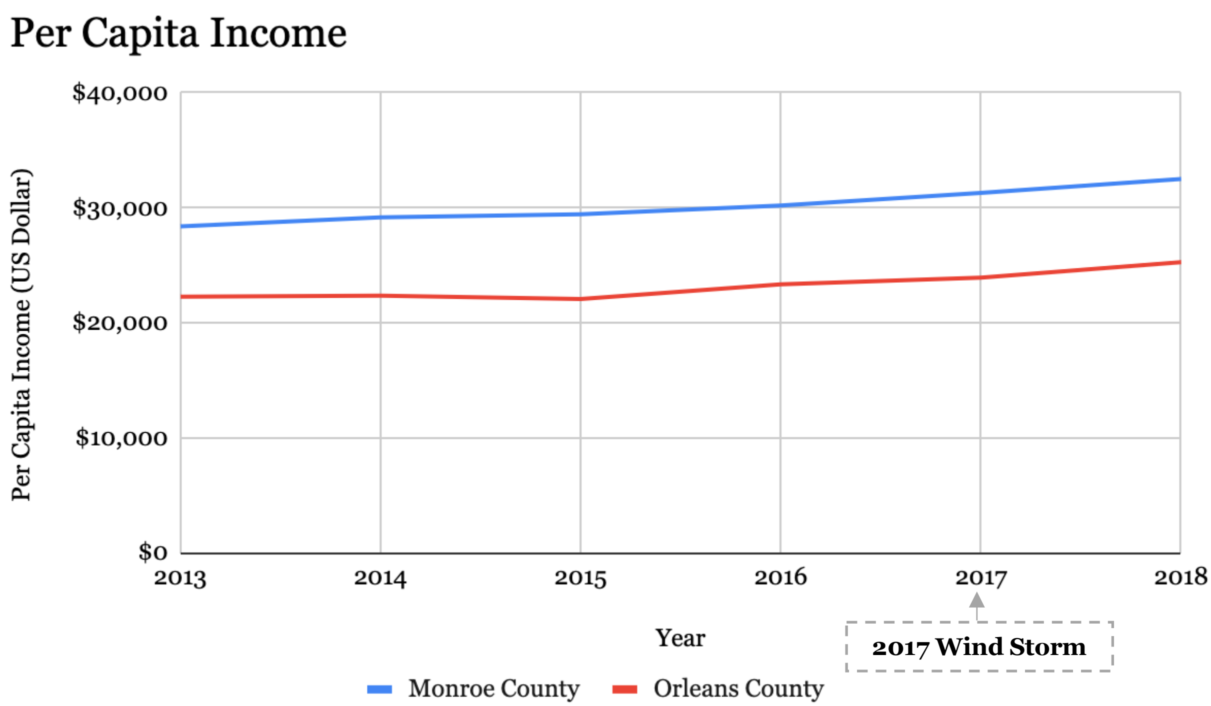


Figure 7 – Per capita income between 2013-2018 for Monroe County and Orleans County.

	2013	2014	2015	2016	2017	2018	Average
Monroe County	5.38	5.2	4.99	4.73	4.26	3.8	4.73
Orleans County	6.53	5.97	4.97	4.18	3.63	2.93	4.701666667

Table 9 – Unemployment rate between 2013-2018 for Monroe County and Orleans County.

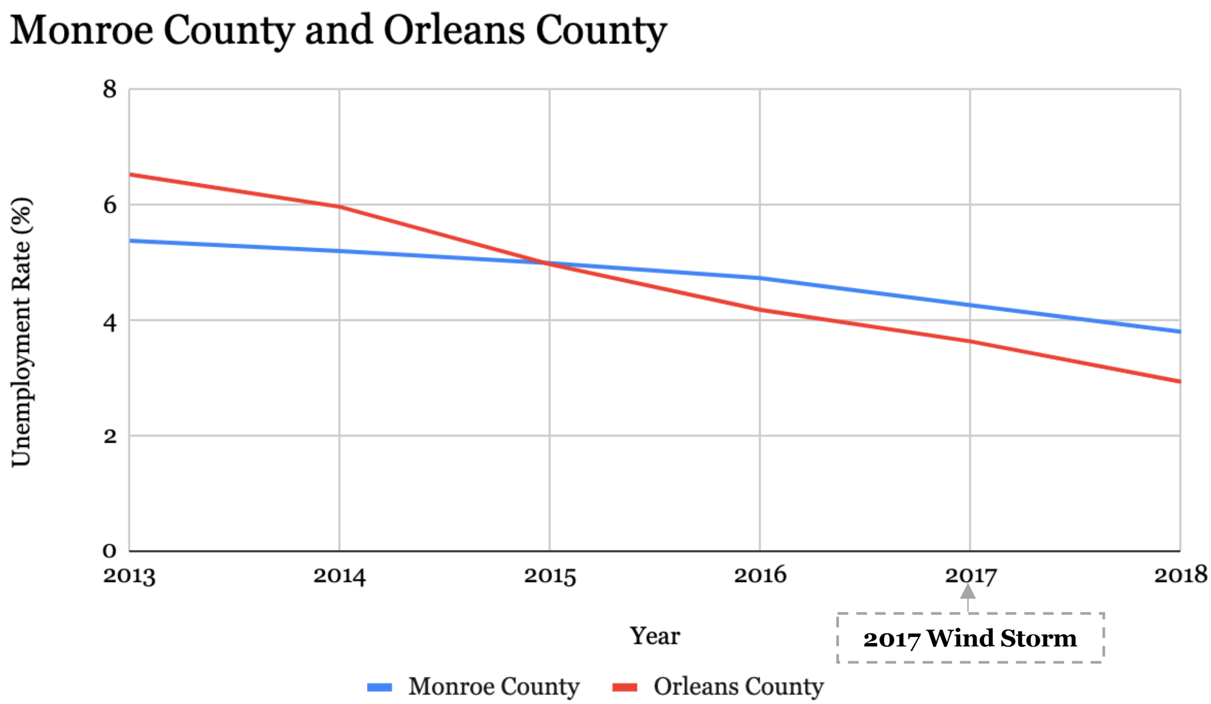


Figure 8 – Unemployment rate between 2013-2018 for Monroe County and Orleans County.

When comparing the two locational nodes, Orleans County has a lower average household income, per capita income, and unemployment rate. As stated previously, Orleans County generally has lower electric grid reliability. Therefore, this data is consistent with previous research showing that poor electric reliability negatively impacts the economy of its respective sociotechnical system.

Health Impact

The following tables display the data collected representing the health impact of electricity reliability on a sociotechnical system. Data was collected from the NYS Department of Health (*Vital Statistics of New York State*, August 2019).

	2013	2014	2015	2016	2017	Average
Monroe County	11.1	11.2	10.9	10.7	10.5	10.88
Orleans County	9.8	10	10.8	9.8	10	10.08

Table 10 – Birth rates between 2013-2017 for Monroe County and Orleans County. Live birth rates are based on live births per 1,000 population.

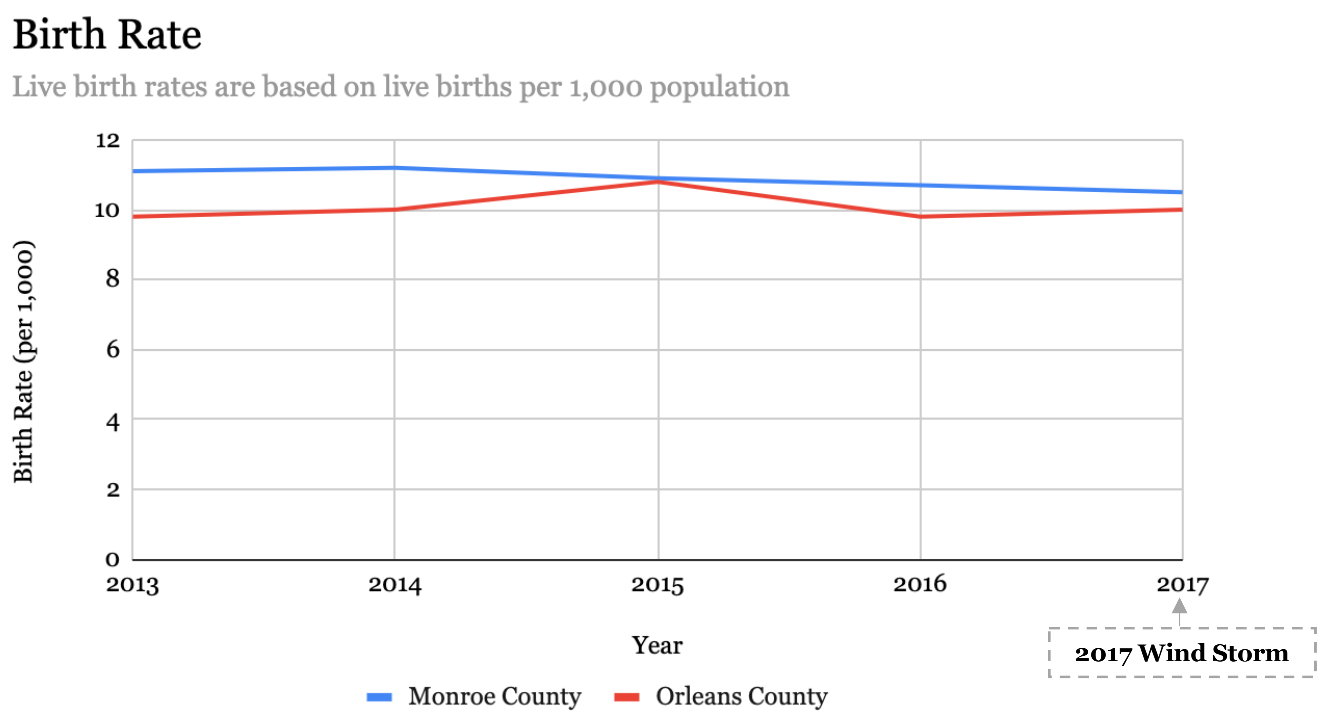


Figure 9 - Birth rates between 2013-2017 for Monroe County and Orleans County. Live birth rates are based on live births per 1,000 population.

	2013	2014	2015	2016	2017	Average
Monroe County	55.4	55.8	54.7	54	53.2	54.62
Orleans County	53.8	55	60.2	55.4	56.5	56.18

Table 11 – Fertility rates between 2013-2017 for Monroe County and Orleans County. Fertility Rates based on live births per 1,000 female population 15-44.

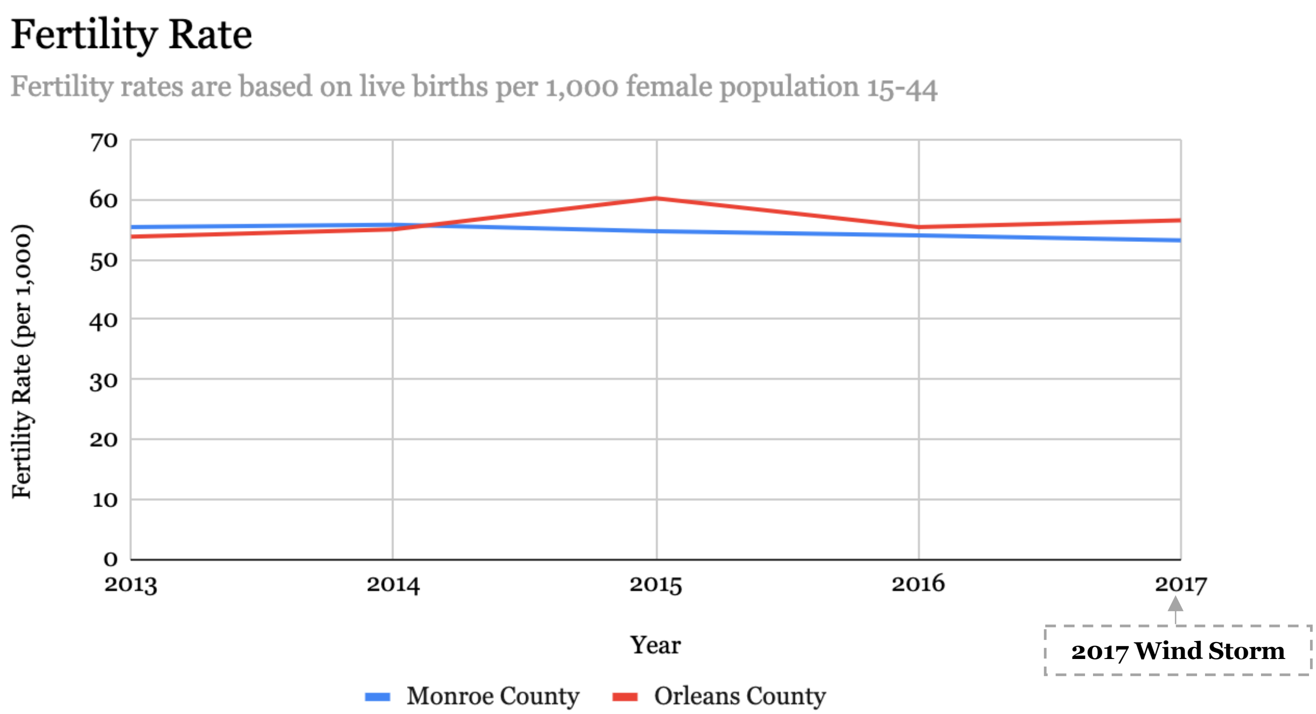


Figure 10 – Fertility rates between 2013-2017 for Monroe County and Orleans County. Fertility Rates based on live births per 1,000 female population 15-44.

	2013	2014	2015	2016	2017	Average
Monroe County	8.4	8.7	8.9	8.8	9.0	8.8
Orleans County	10.4	10.2	9.7	10.2	11.1	10.3

Table 12 – Death rates between 2013-2017 for Monroe County and Orleans County. Death rates are based on deaths per 1,000 population.

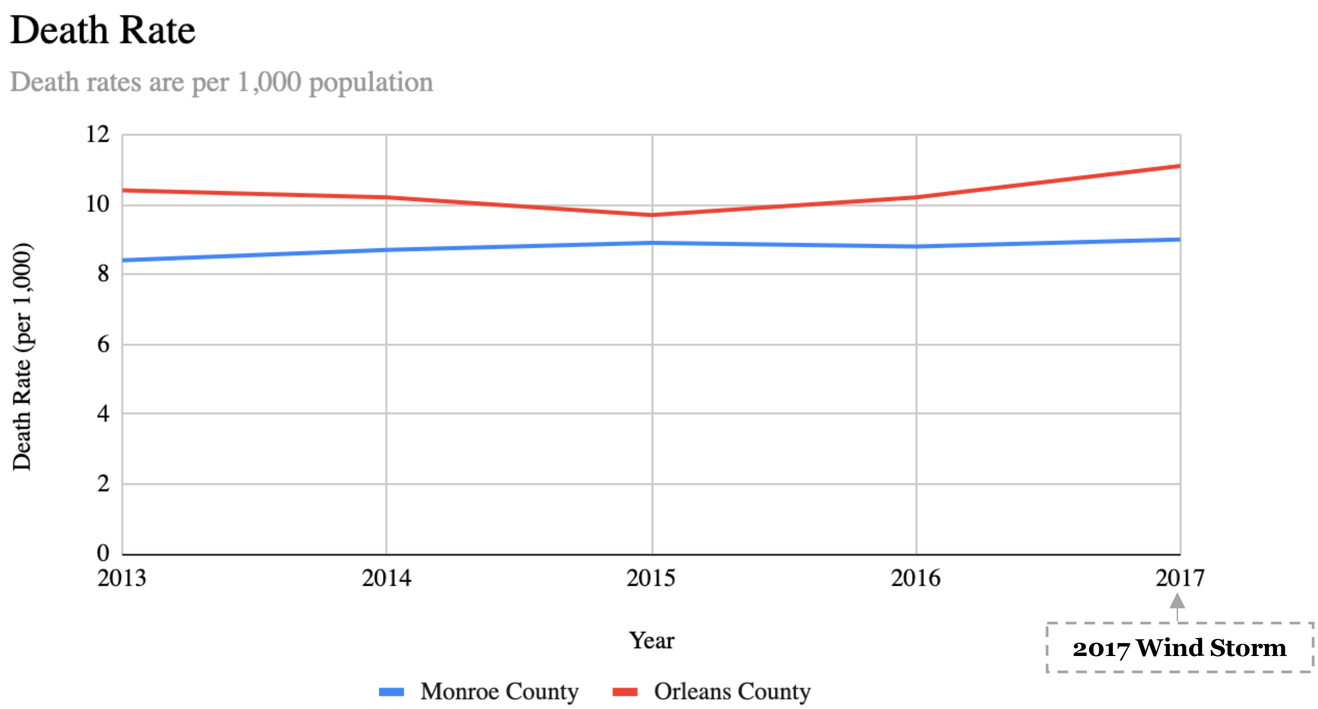


Figure 11 – Death rates between 2013-2017 for Monroe County and Orleans County. Death rates are based on deaths per 1,000 population.

The health data presented shows that both Monroe County and Orleans County are relatively equivalent for birth rate and fertility rate. In 2017, the United States average death rate was 8.64 deaths. For Orleans County in 2017, the death rate was 11.1, which is considerably higher. Again, this supports the idea that poor electricity reliability negatively impacts the public health of its respective sociotechnical system.

Education Impact

The following tables display the data collected representing the education impact of electricity reliability on a sociotechnical system.

	2013	2014	2015	2016	2017	2018	Average
Monroe County	89.6 %	89.88 %	90.15 %	90.38 %	90.3 %	90.31 %	90.103 %
Orleans County	85.54 %	85.77 %	85.41 %	86.32 %	86.91 %	87.11 %	86.176 %

Table 13 – High school graduation rates between 2013-2018 for Monroe County and Orleans County.

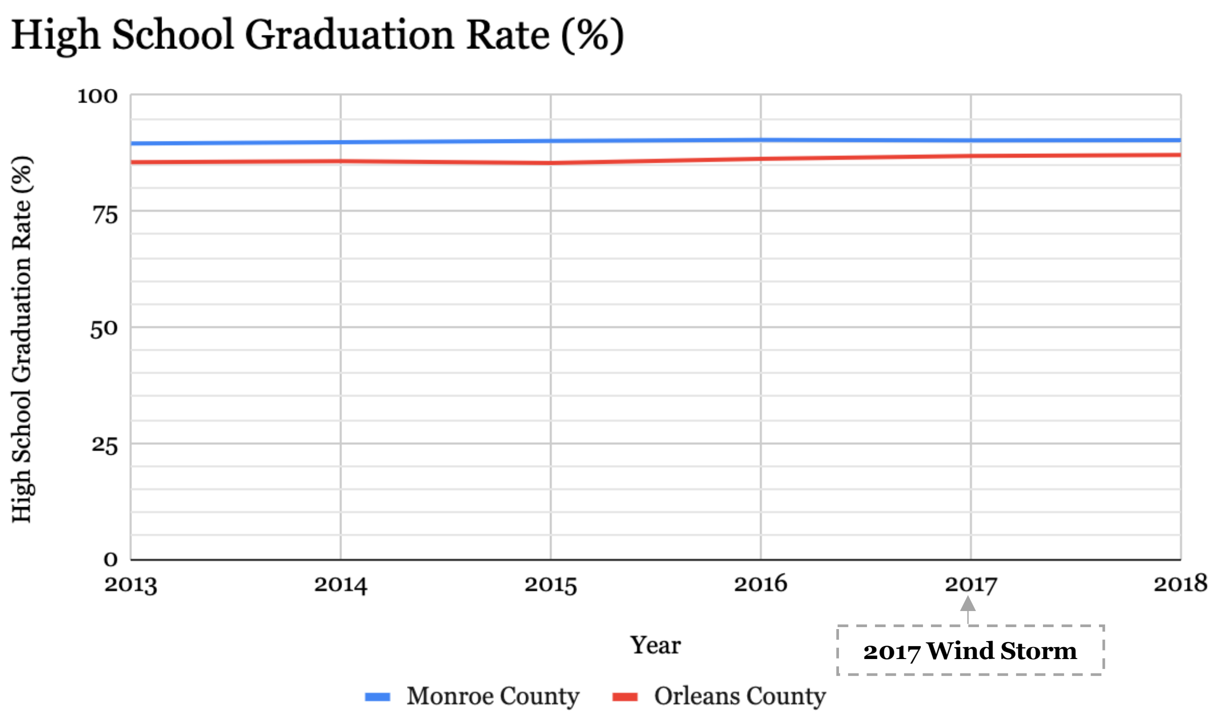


Figure 12 – High school graduation rates between 2013-2018 for Monroe County and Orleans County.

	2013	2014	2015	2016	2017	2018	Average
Monroe County	3.9 %	3.61 %	3.75 %	3.23 %	3.06 %	2.79 %	3.39 %
Orleans County	13.86 %	14.4 %	13.66 %	14.14 %	11.18 %	10.29 %	12.921 %

Table 14 – High school dropout rates between 2013-2018 for Monroe County and Orleans County.

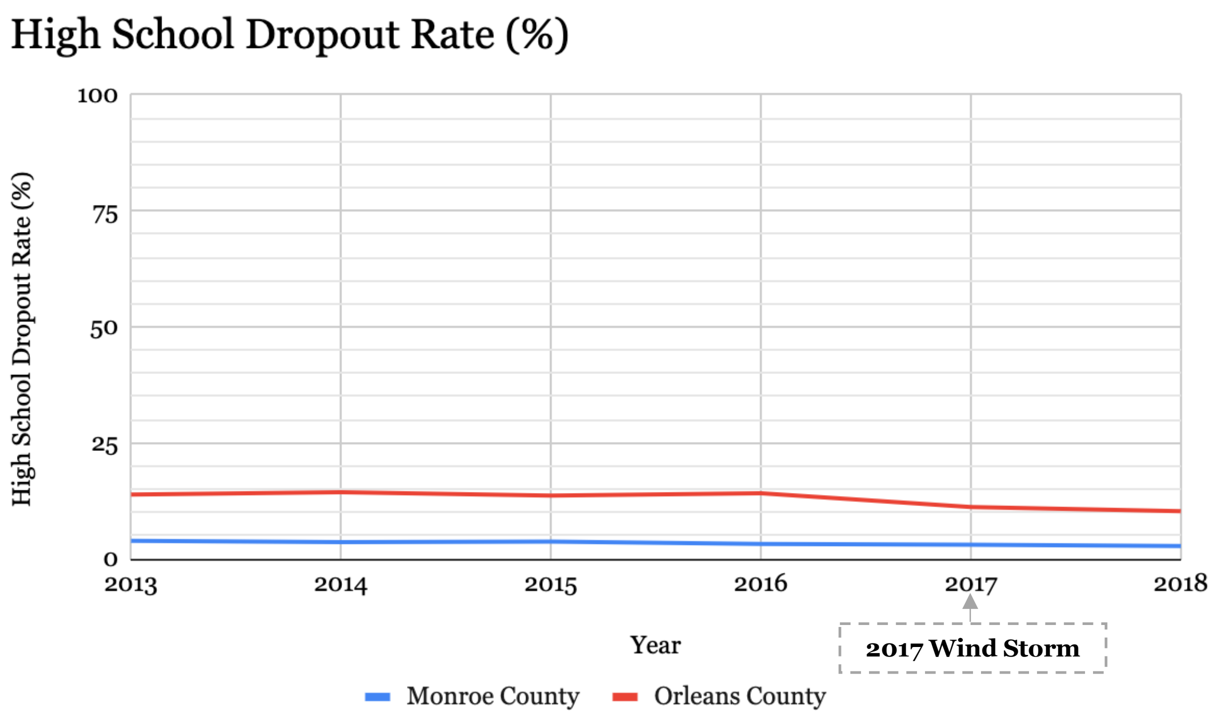


Figure 13 - High school dropout rates between 2013-2018 for Monroe County and Orleans County.

From this data, it is apparent that there is a significant difference among the high school dropout rates for each locational node. In 2017, the average high school dropout rate in the United States was 5.4%. At this time, Orleans County had a dropout rate that was at least two times greater than the national average. This strongly supports the idea that poor electricity reliability negatively impacts the quality of education that children receive in their community.

The Interdependency of Electricity, Economics, Health, and Education

Access to electricity has been directly and indirectly tied to community growth and development. Any loss of electricity poses as an obstacle a community's success. When there is a power outage, there are economic, health, and educational impacts. These have all been reflected in the locations chosen for the case study. While these impacts can be shown in demographic statistics, they also extend throughout the rest of the sociotechnical system.

Different aspects of a sociotechnical system can be considered actors that influence and shape other elements of the system. For example, an individual's economic status may determine their health care status. If something affects their economic status, their health care status will probably change in response. The actors within a system are interdependent and when one is affected, the impact ripples throughout the system. As discussed previously, it is clear that electricity access does have some role in these systems, whether it is direct or indirect.

In my analysis of economic, health, and education metrics, there were no major fluctuations during the year of the power outage event. This further emphasizes the point that there are many other actors within each sociotechnical system that affect the economic, health, and education indicators examined. This limitation must be taken into consideration when examining the results of this study. It can be inferred that other actors may magnify or reduce these statistics as well. Therefore, I am concluding that based on the data I have collected, it is plausible that there is a connection between a community's electricity reliability and its economic, health, and education status.

Conclusion

Access to reliable electricity plays a large role in the development of a community. Communities across the United States have different histories, cultural norms, and political structures that all shape the function of their sociotechnical system. My research has shown that the relationship between a community and its electric grid creates a unique sociotechnical system. The reliability or unreliability of sections of the electric grid can translate into other forms of inequality across a sociotechnical system. While my research did show that these connections are plausible, there are many other factors at play within a community that also impact the categories that I have studied. This concept highlights the wide range of interdependencies that exist within the society that we currently live in, and how growing electricity access has played a large role in that shift. Looking forward, the factor of electricity access will also play a large role in the era of the COVID-19 pandemic, as the world is forced to stay at home and rely on technology to perform normal daily actions. The sociotechnical systems that previously existed between a community and its electricity distributor will be forced to adjust in order to satisfy the new needs that are presented.

Appendix

Data Collection Summaries

Location Characteristics

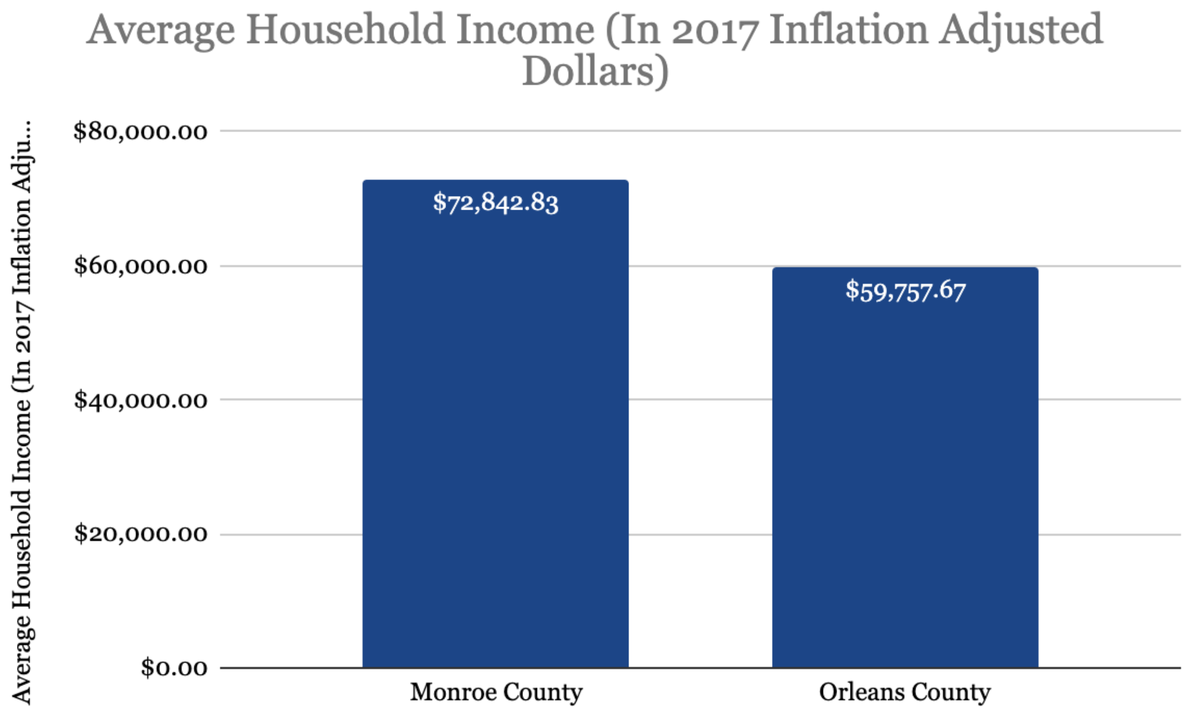
	Monroe County (Rochester)	**Orleans County**
Total population	741,274	43,028
Population density	1,127.9	110.3
Power loss occurrence	March 2017 Wind Storm	March 2017 Wind Storm
State	New York	New York
Utility market	NYISO	NYISO
Utility	Rochester Gas & Electric	New York State Electric & Gas
SAIDI	356.7233333 minutes	224.7578333 minutes
SAIFI	0.9413 interruptions/customer	1.3753 interruptions/customer
CAIDI	311.714 minutes	152.9893 minutes

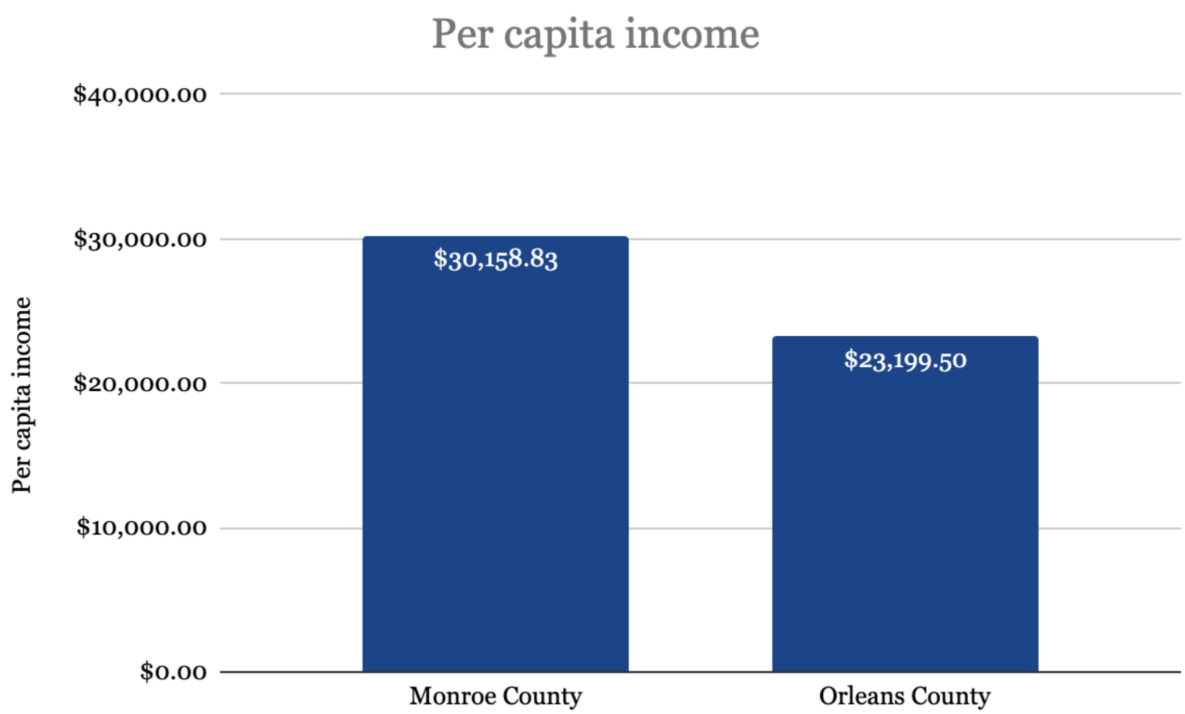
Table 15 – Compiled data collected for each node.

Data Summary of Economic Impact

		2013	**2014**	**2015**	**2016**	**2017**	**2018**	**Average**
Monroe County	Average Household Income (In 2017 Inflation Adjusted Dollars)	$70,190	$70,767	$70,955	$72,464	$75,077	$77,604	$72,843
	Per capita income	$28,372	$29,170	$29,424	$30,194	$31,291	$32,502	$30,159
	Unemployment Rate	5.38	5.2	4.99	4.73	4.26	3.8	4.73
Orleans County	Average Household Income (In 2017 Inflation Adjusted Dollars)	$58,931	$57,666	$56,908	$59,724	$60,952	$64,365	$59,758
	Per capita Income	$22,255	$22,350	$22,070	$23,332	$23,929	$25,261	$23,200
	Unemployment Rate	6.53	5.97	4.97	4.18	3.63	2.93	4.70167

Table 16 – Economic statistics for Monroe County and Orleans County between 2013 and 2018.


Average Household Income (In 2017 Inflation Adjusted Dollars)
Average Household Income (In 2017 Inflation Adju...
$80,000.00
$60,000.00
$40,000.00
$20,000.00
$0.00
$72,842.83
$59,757.67
Monroe County
Orleans County


Per capita income
Per capita income
$40,000.00
$30,000.00
$20,000.00
$10,000.00
$0.00
$30,158.83
$23,199.50
Monroe County
Orleans County

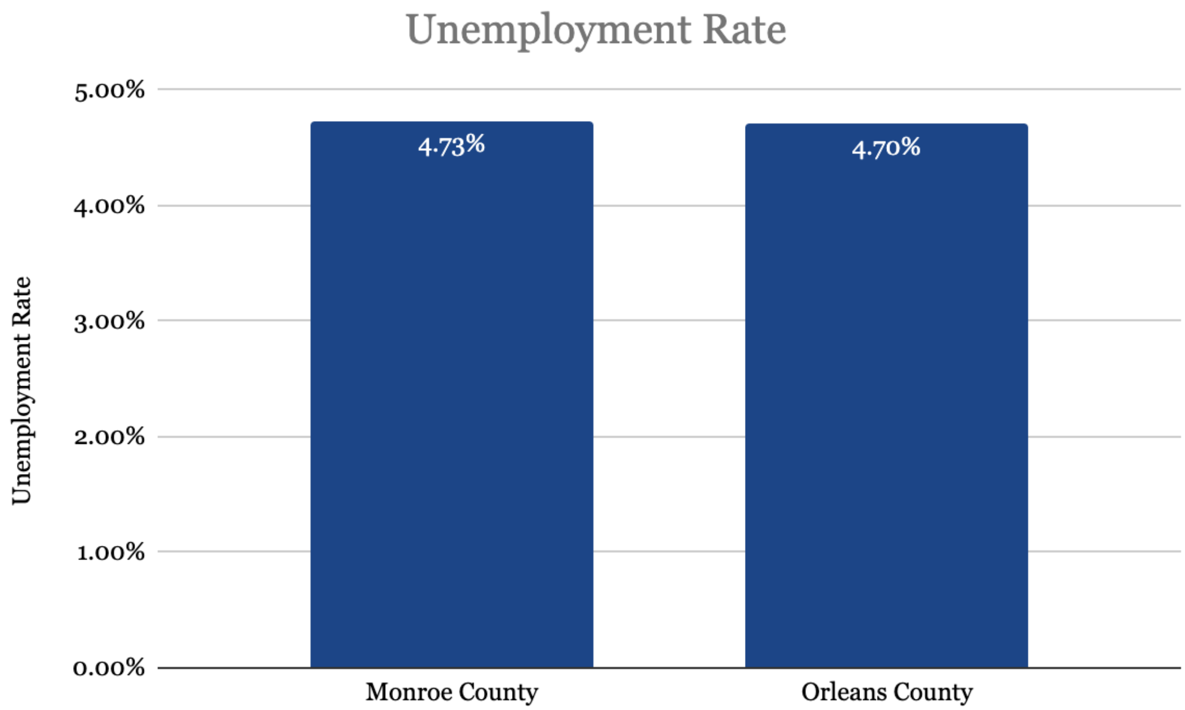


Figure 14 – Average economic statistics for Monroe County and Orleans County between 2013 and 2018. Average Household Income (top), Per capita income (middle), Unemployment rate (bottom).

Data Summary of Health Impact

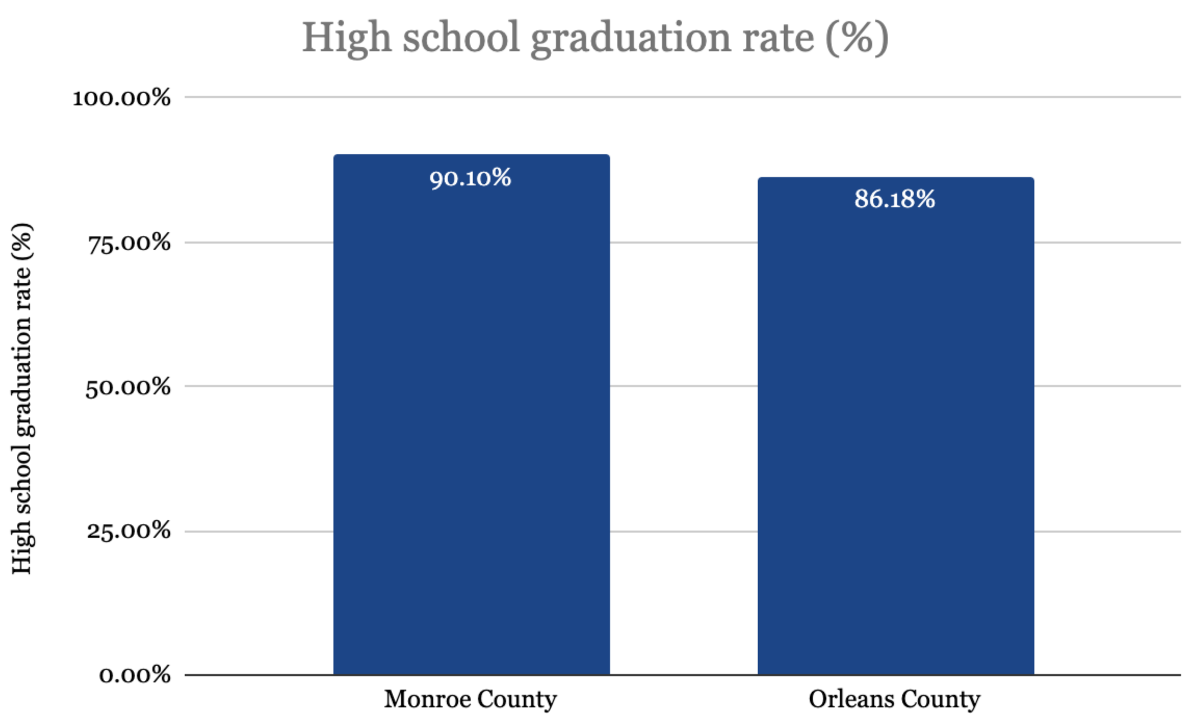
		2013	2014	2015	2016	2017	Average
Monroe County	birth rate	11.1	11.2	10.9	10.7	10.5	10.9
	fertility rate	55.4	55.8	54.7	54.0	53.2	54.6
	death rate	8.4	8.7	8.9	8.8	9.0	8.8
Orleans County	birth rate	9.8	10.0	10.8	9.8	10.0	10.1
	fertility rate	53.8	55.0	60.2	55.4	56.5	56.2
	death rate	10.4	10.2	9.7	10.2	11.1	10.3

Table 17 – Data summary of health impact for Monroe County and Orleans County between 2013-2017.

Data Summary of Educational Impact

		2013	2014	2015	2016	2017	2018	Average
Monroe County	High school graduation rate	89.6%	89.88%	90.15%	90.38%	90.3%	90.31%	90.103%
	School dropout rate	3.9%	3.61%	3.75%	3.23%	3.06%	2.79%	3.39%
Orleans County	high school graduation rate	85.54%	85.77%	85.41%	86.32%	86.91%	87.11%	86.176%
	School dropout rate	13.86%	14.4%	13.66%	14.14%	11.18%	10.29%	12.9216%

Table 18 – Education statistics for Monroe County and Orleans County between 2013 and 2018.



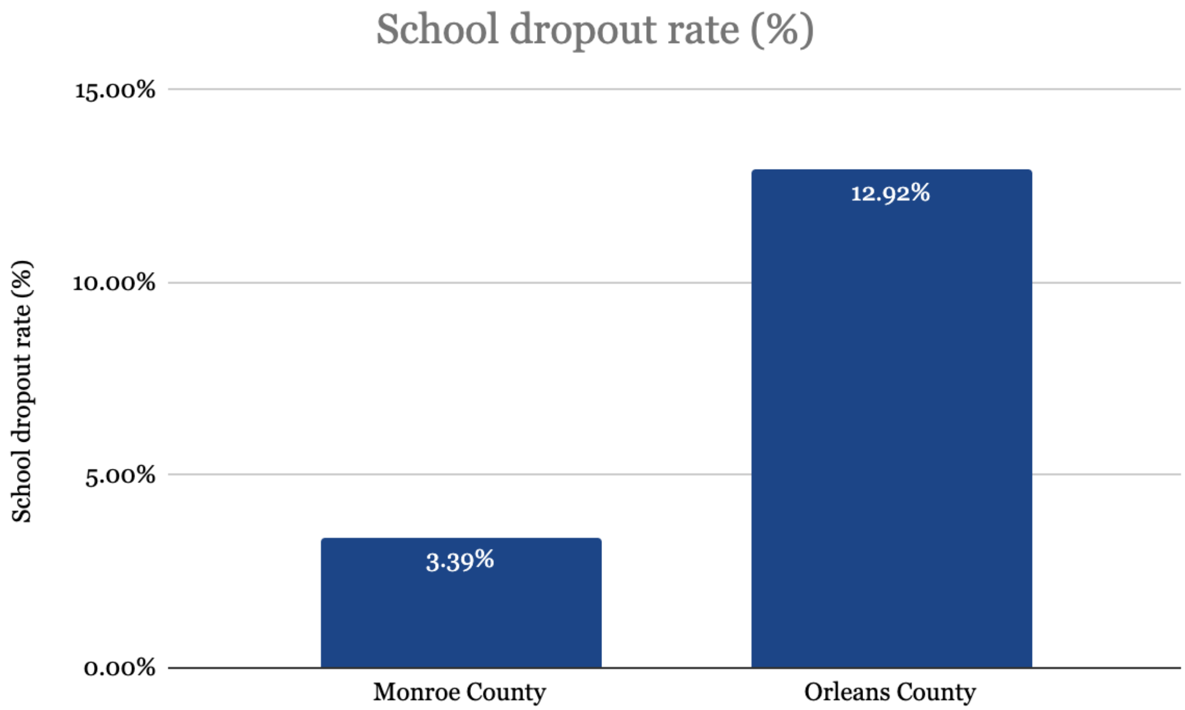


Figure 15 - Average education statistics for Monroe County and Orleans County between 2013 and 2018. High school graduation rate (top), school dropout rate (bottom).

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