The Economic Impact of DUKE ENERGY®

A Statewide and Regional Analysis

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DUKE ENERGY®

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Executive Summary

Duke Energy is one of the largest electric power holding companies in the United States, with approximately 7.5 million U.S. customers and $22.7 billion in total annual operating revenues. A significant portion of this customer base is located in South Carolina, with Duke Energy servicing 30 of the state's 46 counties. As such, Duke Energy has long maintained a sizable economic presence in South Carolina through its role as a major employer that invests heavily in the local region. Not only does Duke Energy employ many high-wage, high-skilled workers, but it also supports an extensive local supply chain that extends to virtually every county in South Carolina. In addition, the recent $3 billion grid improvement project that Duke Energy has committed to in South Carolina – known as the Power/Forward Carolinas Initiative – represents one of the largest capital investments to the state in recent years and will help boost the state's rate of economic growth in the coming decade. It will also reduce the number of unanticipated power outages to both commercial and residential customers, thereby helping to avert economic losses that result from these outages. The purpose of this study is to specifically quantify each of these economic benefits to South Carolina – both at the state and county levels. The key findings of this study are as follows:

- The annual economic impact of Duke Energy on the state of South Carolina currently totals approximately $6.6 billion. This figure reflects the dollar value representing all final goods and services produced in South Carolina that can be attributed (either directly or indirectly) to Duke Energy. This impact corresponds to 15,189 jobs and $969.4 million in labor income that would not exist otherwise.

- This $6.6 billion impact extends to every county in South Carolina, with the highest impacts occurring in the counties of York ($1.1 billion), Oconee ($1.1 billion), Greenville ($838.3 million), Darlington ($756.8 million), and Spartanburg ($686.4 million).

- Duke Energy purchases a relatively high percentage of its raw materials from local vendors relative to other South Carolina firms because of the need to minimize lead times, reduce transportation costs, and have access to knowledge and experience with respect to local geographic conditions. This local purchasing behavior, in turn, dramatically increases the economic impact of Duke Energy relative to other firms of similar size by generating additional rounds of local spending activity.

- The employment multiplier effect associated with the current, ongoing activities of Duke Energy is estimated to be approximately 3.6. In other words, for every 10 jobs created by Duke Energy, another 26 jobs, on average, are created elsewhere in South Carolina. This employment multiplier is one of the highest among all industries in South Carolina and is largely the result of the relatively high percentage of local expenditures the company makes within the state.

- Duke Energy also contributes to a high-quality workforce as measured by wage levels. The average job supported by Duke Energy (either directly or indirectly) pays an annual wage that is approximately 53.8 percent higher than the average job in South Carolina.

- The net annual contribution that Duke Energy makes to South Carolina gross state product is approximately $2.6 billion. This implies that Duke Energy generates economic activity that brings in about $132.9 million in tax revenue annually for the state of South Carolina.

- Capital investments associated with the ten-year Duke Energy Power/Forward Carolinas Initiative will generate $5.8 billion in total economic output for the state between 2017 and 2026. The peak investment period will occur in the year 2025, with an anticipated economic impact of $961.9 million that will support a total of 5,409 jobs across South Carolina.

- The contribution to South Carolina's overall rate of economic growth resulting from capital investments associated with the Power/Forward Carolinas Initiative project is substantial. In particular, the grid improvement project is anticipated to boost South Carolina's annual rate of employment growth over and above its baseline rate by up to 0.4 percentage points. This implies that Duke Energy's contribution to statewide economic growth in the coming decade will likely be comparable to the contribution of one of advanced manufacturing's major sub-sectors (e.g., aerospace, automotive, or tires).

- The grid improvement project will also generate long-term economic gains by helping to prevent future unanticipated power losses to residential, commercial, and industrial customers. Specifically, this study estimates that by the year 2028 these reliability improvements will generate gross benefits for business and households that will total between $503 million and $724 million annually. This will be partially offset by rate increases that will total approximately $530 million annually by 2028.

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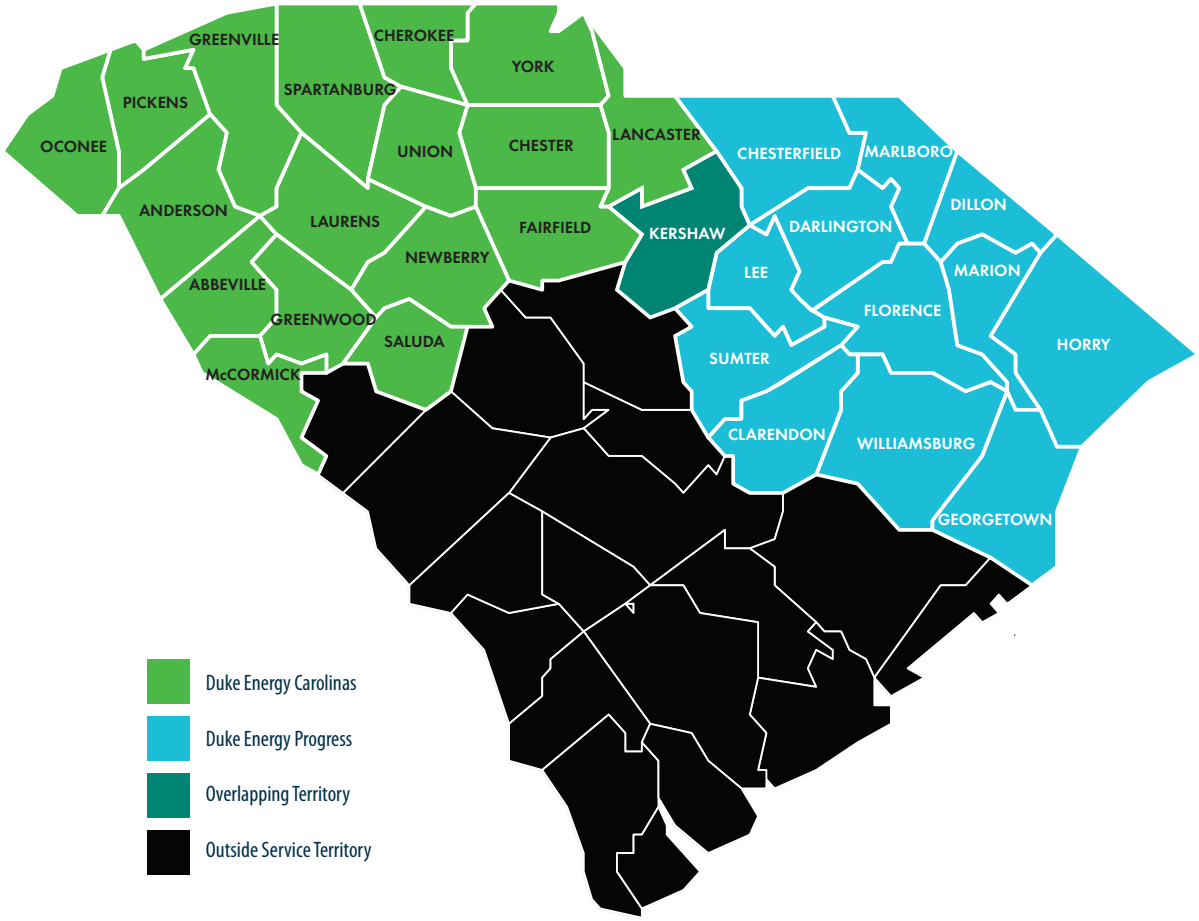
Section I – Overview

Duke Energy is one of the largest electric power holding companies in the United States, which supplies and delivers 52,700 megawatts of electric generating capacity to approximately 7.5 million U.S. customers. Headquartered in Charlotte, North Carolina, Duke Energy serves six states in the Southeast and Midwest and owns and operates a diverse array of power generation assets – including a portfolio of renewable energy assets. With total operating revenues of $22.7 billion across its six state region, the economic footprint of Duke Energy is significant.

In South Carolina, Duke Energy serves 30 of the state's 46 counties and is a major driver of the Palmetto State's economy – particularly within the Upstate, Rock Hill, and Florence/Pee Dee regions. As a Fortune 125 public utility that provides the energy needs for a large customer base consisting of both residential and commercial clients, Duke Energy employs a sizable workforce and also supports an extensive supply chain network throughout the state that generates considerable economic ripple effects across many industries. These ripple effects include additional indirect job creation that supports higher incomes for South Carolina residents and a substantial increase in overall economic activity. Figure 1 highlights the South Carolina counties in which Duke Energy directly operates.[1]

Figure 1 - Duke Energy Service Territory in South Carolina by County



[1]Note that Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) are both subsidiaries of the Duke Energy Corporation

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In addition to these current operations, Duke Energy is also planning a new $25 billion 10-year capital investment project across its six-state region to modernize its electric grid - $3 billion of which will be specifically invested in South Carolina. Known as the Power/Forward Carolinas Initiative, this project will represent one of the largest capital investments in South Carolina that the state has experienced in many years and will generate a significant uptick in economic growth across the state. To put this into perspective, note that the South Carolina Department of Commerce (Commerce) documented that capital investment in South Carolina for the 2016 calendar year totaled approximately $3.4 billion. Thus, the grid improvement project represents a nearly 10 percent increase in total capital investment for the state for each of the next ten years. Put another way, the average annual capital investment of the grid improvement project - $333 million – would rank 2nd among all capital investment announcements by Commerce in 2016. Table 1 illustrates this hypothetical ranking.

Table 1 – Top 10 S.C. Department of Commerce Economic Development Announcements in 2016[2]

Ranking	Company Name	County	Capital Investment
1	Teijin Ltd.	Greenwood	$600 million
N/A	*Duke Energy*	*Multiple Counties*	*$333 million*
2	China Jushi	Richland	$300 million
3	Michelin North America	Spartanburg	$270 million
4	Adger Solar	Clarendon	$200 million
5	Robert Bosch LLC	Dorchester	$175 million
6	Blackbaud	Berkeley	$154 million
7	Evonik Industries	Berkeley	$120 million
T8	NARENCO	Allendale	$85 million
T8	Ritrama, USA	Spartanburg	$85 million
T10	Techtronic Industries	Anderson	$75 million
T10	Tower Automotive	Greenville	$75 million

The grid improvement project will specifically consist of incorporating new technologies to improve the customer experience and to increase efficiency as well as to help better prepare for and address various weather-related and physical attacks on the grid. It is also designed to help to reduce the number of unplanned in-state power outages to residential, commercial, and industrial customers, thereby reducing the current economic losses that arise each year as a result of these outages.

Thus, the total economic impact of Duke Energy in South Carolina in the coming years will arise from both its ongoing operations as well as from its new grid improvement project. The economic impact of Duke Energy is also relatively unique in that it serves a critical need of South Carolina – namely through providing employment opportunities for South Carolinians in rural areas of the state to an extent that few other organizations are able to do.

The purpose of this study is to estimate the economic impact of Duke Energy on the state of South Carolina at both the state and county levels. This economic impact will consist of three components as outlined above: (1) estimating the current total economic impact of Duke Energy on South Carolina – including all ongoing operations and associated business activities; (2) estimating the economic impact of the multi-year Power/Forward Carolinas Initiative, which in South Carolina will total approximately $3 billion worth of capital investment; and (3) assessing the economic impacts that would arise from any decrease in power outages resulting from the improved infrastructure and thus improvements in reliability – both at the industry and household levels.

[2]https://www.sccommerce.com/sites/default/files/2016_year_end_results_final_report_0.pdf

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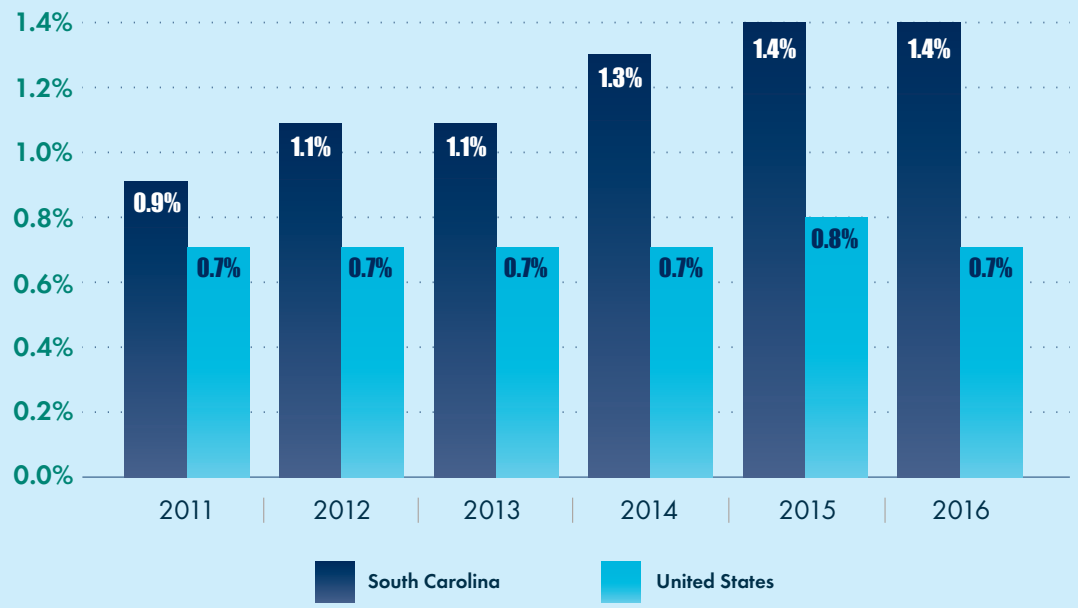
Accommodating the Increasing Demand for Electricity in South Carolina

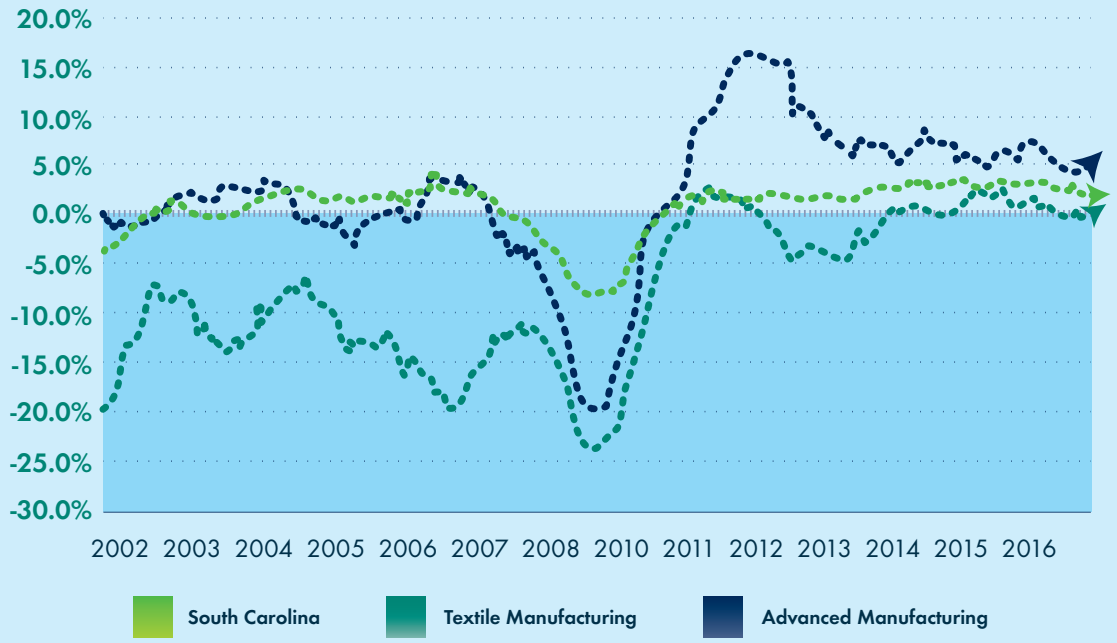
Since the year 2000, South Carolina has been experiencing several trends that – from an economic perspective – have greatly benefitted the state. The first of these trends is a relatively high rate of population growth. With the aging of the United States population and the accompanying retirement of the baby-boomer generation, more Americans are now looking to re-locate to retirement destinations that have (among other things) a low cost of living, a pleasant climate, and access to both natural and recreational amenities. South Carolina provides many of these advantages and has long been known as a prime retirement destination. As such, South Carolina's rate of population growth has increased in recent years as the baby-boomers transition into retirement. Figure 2 highlights the changing demographics of the South Carolina population, much of which is due to in-migration. Notice that South Carolina has consistently outpaced the population growth of the United States since 2011 by roughly 0.5 percentage points. This population growth serves to support the tourism, housing, and leisure and hospitality industries – among others.

Figure 2 - Annual Population Growth in South Carolina and the United States
Source: U.S. Census Bureau



The second trend that has benefitted South Carolina's economy in recent years is the resurgence that has occurred in the state's manufacturing industry. Specifically, South Carolina has experienced significant growth in the automotive, aerospace, and tire sectors – collectively known as advanced manufacturing – which has been the primary driver of economic growth in the state since 2010. These sectors have replaced textile manufacturing, which has been in steady decline since the early 1990s as a result of increased globalization. Figure 3 specifically illustrates how the steady decline in South Carolina's textile industry was replaced by advanced manufacturing and how advanced manufacturing has been generating employment gains at more than twice the rate of the state's overall average.

Figure 3 - Annual Employment Growth in South Carolina
Source: U.S. Bureau of Labor Statistics (QCEW)



The U.S. Energy Information Administration (EIA) currently projects that total national energy consumption will increase at an average annual rate of approximately 0.3 percent through the year 2050.[3] Because of the twin forces of population growth and advanced manufacturing employment growth in South Carolina – both of which exceed the national average – it is likely that there will be an accompanying increased demand for energy in the coming years in South Carolina that exceeds the national average for residential, commercial, and industrial consumers. The Power/Forward Carolinas Initiative is largely the result of the efforts of Duke Energy to accommodate this anticipated increase in statewide demand.

[3]Source: U.S. Energy Information Administration, Annual Energy Outlook 2017

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Providing Job Opportunities Outside of Metropolitan South Carolina

Although South Carolina has been consistently outpacing the United States in its rate of economic growth throughout the eight-year expansion that has followed the Great Recession, this rate of growth has not extended to all regions of the state. For example, of the 46 counties in South Carolina, only 6 currently have unemployment rates that are below that of the state average (4.0%).[4] Much of the employment gains that the state has experienced has been concentrated within the three major metropolitan regions of the state: Greenville/Spartanburg, Columbia, and Charleston.

Spotlight on Rural South Carolina

One ongoing priority for South Carolina has been to create additional employment opportunities for residents living in non-metropolitan areas of the state. Duke Energy has helped to generate these opportunities and support economic activity in these regions through its large presence that extends to both the metropolitan and rural areas of the state.

Specifically, Duke Energy currently employs workers in 19 of South Carolina's 46 counties. Of these 19 counties, 18 currently have unemployment rates above the state average. Figure 4 ranks the 46 counties by their unemployment rates and illustrates (in light blue) the counties in which Duke Energy employs a workforce. Note that Duke Energy employs workers in counties ranked among the highest in unemployment – including Williamsburg (6.7%), Marion (7.2%), and Fairfield (8.9%). The Power/Forward Carolinas Initiative will generate additional employment opportunities for these counties and increase overall economic growth in the coming decade.

[4]All unemployment rates listed in this report reflect the August 2017 figures provided by the U.S. Bureau of Labor Statistics (BLS).

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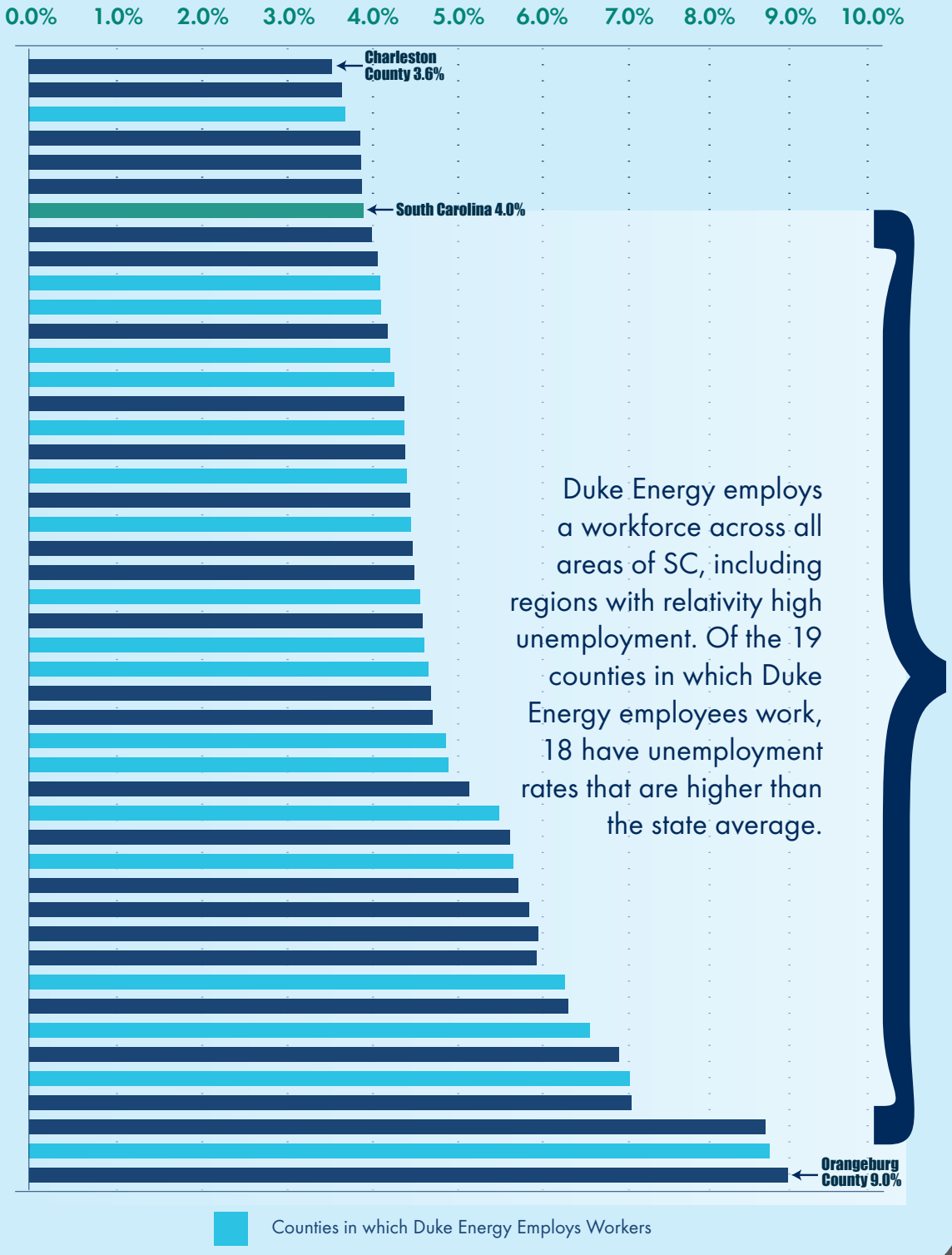
Figure 4 - South Carolina Unemployment Rates by County
Source: U.S. Bureau of Labor Statistics (LAUS): August 2017



Given the growth trends in South Carolina's industry and population base, the importance of Duke Energy will continue to grow in the coming years. This includes Duke Energy's role as both a primary electricity provider servicing the state's population and as a major economic driver for South Carolina that supports a sizable employment base in both the rural and metropolitan regions of the state.

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Section III – Economic Impact Methodology

Duke Energy is an electric power holding company operating in South Carolina that employs a large workforce and supports an extensive supply chain network throughout the state in order to facilitate its ongoing operations. The expenditures made by Duke Energy through various purchases with local businesses and through wages and salaries paid to employees introduce new spending activity at a statewide and regional level that would not exist otherwise. As a result, the presence of Duke Energy provides a stable base of activity that also helps contribute to long-run economic growth.

Yet these activities do not provide a complete picture of the impact of Duke Energy to South Carolina's economy. The expenditures that occur as part of the ongoing operations of Duke Energy represent direct economic activity within the region. However, these expenditures also lead to additional job creation and economic activity throughout the local region by way of the economic multiplier effect (or economic ripple effect).

Economic multiplier effects can be divided into direct, indirect, and induced impacts. The direct effect represents the initial change in economic activity. This includes, for example, the initial dollars that are injected into the economy of South Carolina directly through any ongoing maintenance efforts on the part of Duke Energy. This would include any employee wages and benefits, construction materials purchased, transportation equipment, or other overhead and administrative costs. This spending increases demand for goods and services and leads to the creation of new jobs and more income for employees and suppliers of the construction maintenance firms hired by Duke Energy.

The indirect effect reflects all of the additional economic impacts resulting from inter-industry linkages between other local businesses in South Carolina. For example, consider an equipment purchase that is made by Duke Energy to replace and upgrade existing infrastructure as part of standard grid maintenance. In this situation, the equipment provider would, as a result of Duke Energy's purchase, experience an increase in demand. This would require this equipment provider to purchase additional raw materials to accommodate the new increase in demand and to potentially hire additional employees if the increase in demand were high enough. The vendors of the equipment providers would then experience an increase in demand and have to purchase additional inputs as well, and so on. These indirect effects ripple through the economy of South Carolina.

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The induced effect reflects additional economic activity that results from increases in the spending of household income. For example, when the aforementioned equipment provider hires new workers to satisfy an increase in demand, these workers will earn incomes. They will then spend part of this new income locally on, for example, food, entertainment, or housing. These industries will then see an increase in demand for their goods and services, which will lead to higher incomes for some of their employees, part of which will also be spent locally.

These successive rounds of indirect and induced spending do not go on forever, which is why a specific value can be calculated for each of them. In each round, money is "leaked out" for a variety of reasons. For example, firms may purchase some of their supplies from vendors located outside of the local area. In addition, employees will save part of their income or spent part of it with firms located outside of South Carolina. In order to determine the total economic impact that will result from an initial direct impact, economic multipliers are used. An economic multiplier can be used to determine the total impact (direct, indirect, and induced) that results from an initial change in economic activity (the direct impact). Multipliers are different in each sector of the economy and are largely determined by the size of the local supplier network as well as the particular region being examined. In addition, economic multipliers are available to calculate not just the total impact, but also the total employment and income levels associated with the total impact.

To estimate the economic impacts in this study, a detailed structural model (known as an input-output model) of South Carolina that contains specific information on economic linkages between all industries within the state was used. Separate input-output models were also created for each of the 46 county regions within South Carolina such that county-level estimates of Duke Energy's economic impact could also be determined. The input-output modeling software IMPLAN was used to calculate all estimates.

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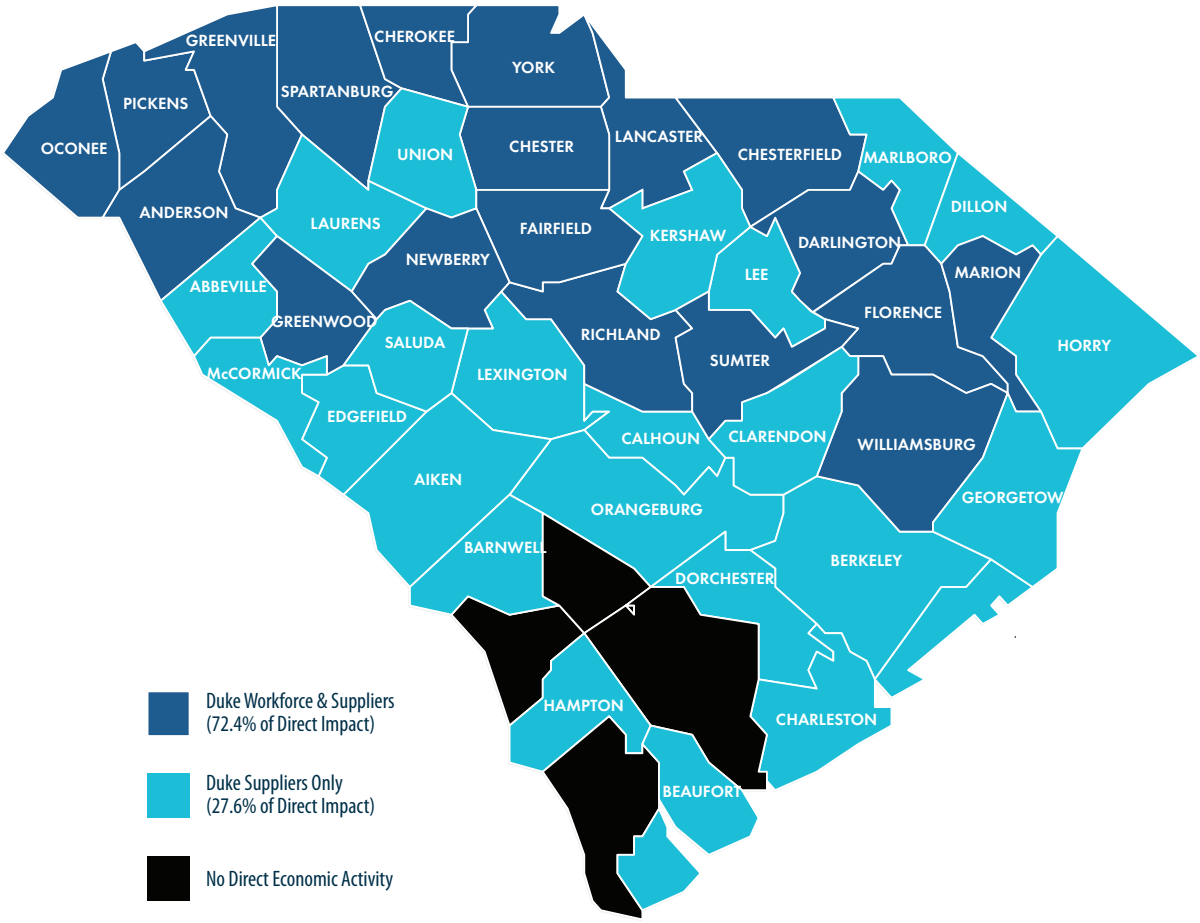
Section IV – The Economic Impact of Duke Energy on South Carolina

Current Economic Activity of Duke Energy

During the 2016 calendar year, Duke Energy – including both Duke Energy Progress (DEP) and Duke Energy Carolinas (DEC) – employed a workforce of 4,224 FTEs accompanied by total non-labor expenditures of approximately $567.0 million.[5] These non-labor expenditures include capital equipment purchases, professional services, construction/remodeling efforts, and other general operating expenses associated with the ongoing business activities of Duke Energy. Although the Duke Energy workforce is primarily concentrated within the 19-counties in and around its service territory, the economic impact of Duke Energy extends to all virtually all counties across South Carolina. The $567.0 million in non-labor expenditures cited above represent purchases made with in-state suppliers that are spread across 42 of South Carolina's 46 counties. Figure 5 specifically highlights the counties in which Duke Energy employees work and the additional counties in which Duke Energy has a direct economic impact solely through the various non-labor expenditures it makes. Note that approximately 72.4 percent of Duke Energy's direct economic activity occurs within the 19-county region in which its employees are located. Thus, even though the 19-county region in which its employees are located is the biggest economic beneficiary, the economic footprint of Duke Energy is far larger – extending to 42 of South Carolina's 46 counties.

Figure 5 - County-Level Distribution of Duke Energy's Direct Economic Activity



[5]FTE refers to the number of "full-time equivalent" employees.

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Economic Impact: South Carolina

The structural input-output model estimates economic impacts in terms of three specific measures: economic output, employment, and labor income. Economic output is simply defined as the dollar value of the final goods and services purchased that can be attributed (directly or indirectly) to all ongoing operations associated with Duke Energy. It can also be thought of as an aggregate measure of total spending resulting from an initial direct expenditure. Because it includes all spending by consumers and businesses on both goods and services, it is an all-inclusive measure of the impact on total economic activity. Employment measures the impact on jobs in terms of the total number of FTE positions. Labor income represents total employee compensation, including wages, salaries, and benefits.

As described above, during 2016 Duke Energy employed 4,224 FTE workers in South Carolina with an accompanying $567.0 million non-labor expenditures.[6] These direct economic impacts also lead to indirect and induced impacts through increases in demand for goods and services in other related industries and through increases in household spending activity – all of which are estimated using economic multipliers. Each impact is reported in Table 1, along with the accompanying totals. These totals represent the overall impact of Duke Energy on South Carolina.

Table 1 – Economic Impact of Duke Energy on South Carolina

	Employment	Labor Income	Economic Output
Direct Impact	4,224	$517,081,233	$5,116,226,823
Indirect Impact	6,258	$269,823,601	$838,687,068
Induced Impact	4,707	$182,484,633	$607,911,374
Total Impact	15,189	$969,389,467	$6,562,825,265

The 4,224 FTE employees that work for Duke Energy (along with all associated non-labor expenditures) generate approximately $5.1 billion in annual economic output. This level of direct economic activity leads to indirect effects totaling approximately $838.7 million in economic output and 6,258 jobs. These estimates reflect the increased demand for goods and services of local suppliers resulting from in-state expenditures on the part of Duke Energy. The direct economic activity also leads to induced effects totaling $607.9 million in economic output and 4,707 jobs. This is a reflection of economic activity in South Carolina generated across all industries that is the result of increased household spending. The combination of the direct, indirect, and induced effects leads to a total economic impact of approximately $6.6 billion, which is associated with 15,189 jobs across South Carolina.

The employment multiplier associated with all of Duke Energy's economic activities in South Carolina is approximately 3.6. This implies that for every 10 jobs that are supported directly by Duke Energy, an additional 26 jobs are created elsewhere in South Carolina. This employment multiplier effect is one of the highest among all industries in South Carolina and provides Duke Energy with an ability to scale up employment in ways that most other South Carolina firms cannot. The average employment multiplier across all industries in South Carolina is approximately 1.8.[7]

This employment scaling effect is a key finding of this study and reflects one of the primary reasons why Duke Energy is such a powerful economic engine in South Carolina.

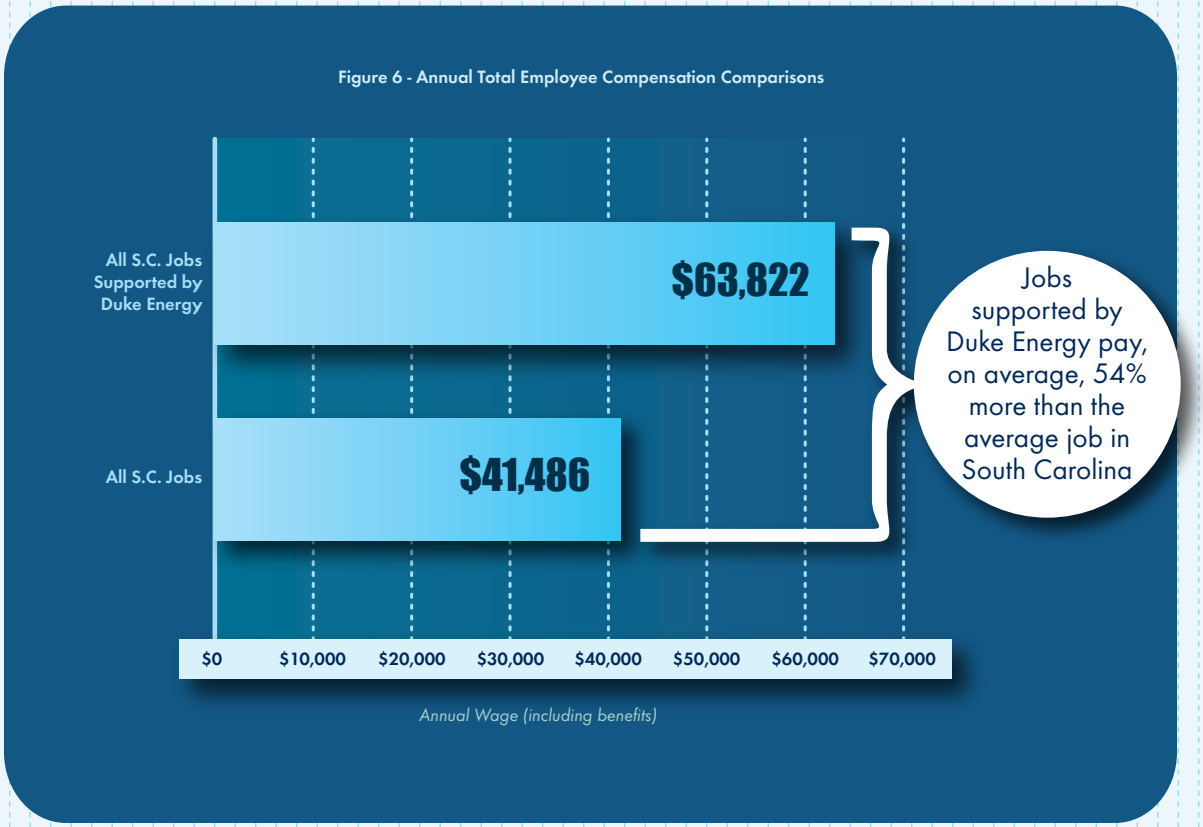
[6]Each non-labor expenditure provided by Duke Energy was first categorized into a specific North American Industry Classification System (NAICS) code and then incorporated into each region's input-output model where appropriate.
[7]This average employment multiplier was calculated using input-output models for the state of South Carolina and incorporating the most recently published industry-level data.

The utilities industrial sector often has a substantially higher multiplier effect within a local region than most others. The reason for this difference arises from two primary factors: (1) the necessity of minimizing lead times; (2) the necessity of local experience. In both cases, these necessities incentivize utility companies to purchase raw materials locally, thus creating a larger in-state supply chain. The larger in-state supply chain is what generates the higher multiplier effect.

First, because of the relatively high demand for electricity and grid maintenance, any firms in the utility sector's supply chain that can design, manufacture, deliver, or install infrastructure in a short time period will have a distinct competitive advantage over those that cannot (i.e., those firms that can minimize lead times). The availability of steel, in particular, is a critical component of this supply chain. The size and weight of raw infrastructure materials keep transportation costs high, which also makes local manufacturers that can minimize shipping times and distances beneficial. Further, any company that is hired by a utility to construct or install grid infrastructure will have to use construction crews. If these construction crews are hired from within the region and do not have to relocate, this provides a significant cost savings.

Local knowledge and experience is a second factor that drives utilities to purchase from local vendors. The requirements for the construction, installation, and maintenance of grid infrastructure can vary significantly by region, and experience with respect to local conditions matter. This can include – for example – local knowledge on geographic conditions (e.g., soil consistency) or regarding the permitting process.

Duke Energy also generates and supports high-wage, high-skilled employment opportunities for South Carolinians. These contributions can be directly observed by examining wage levels. Duke Energy supports a total of 15,189 employees across South Carolina with $969.4 million in associated labor income. These figures imply that the average job supported, directly or indirectly, by Duke Energy pays an annual total employee compensation (including wages and benefits) of $63,822. This is approximately 54 percent higher than the average total employee compensation in South Carolina ($41,486), as illustrated in Figure 6.



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Economic Impact: County-Level and Regional Break Downs

The $6.6 billion annual economic impact that Duke Energy supports in South Carolina is not uniformly distributed across the state. As has already been shown, Duke Energy employs a workforce in 19 counties and makes in-state purchases from suppliers in 42 South Carolina counties. These labor and non-labor expenditures, in turn, generate additional rounds of local spending that cascade across the entire state. The majority of the multiplier effects that are generated from spending within any given county, however, occur either within the county itself or in immediately adjacent counties. Figure 7 shows the complete county-level distribution of the $6.6 billion economic impact of Duke Energy, with Table 2 providing a more detailed breakdown of those counties with the highest impacts.

Figure 7 - County-Level Distribution of Duke Energy's Current Total Economic Impact

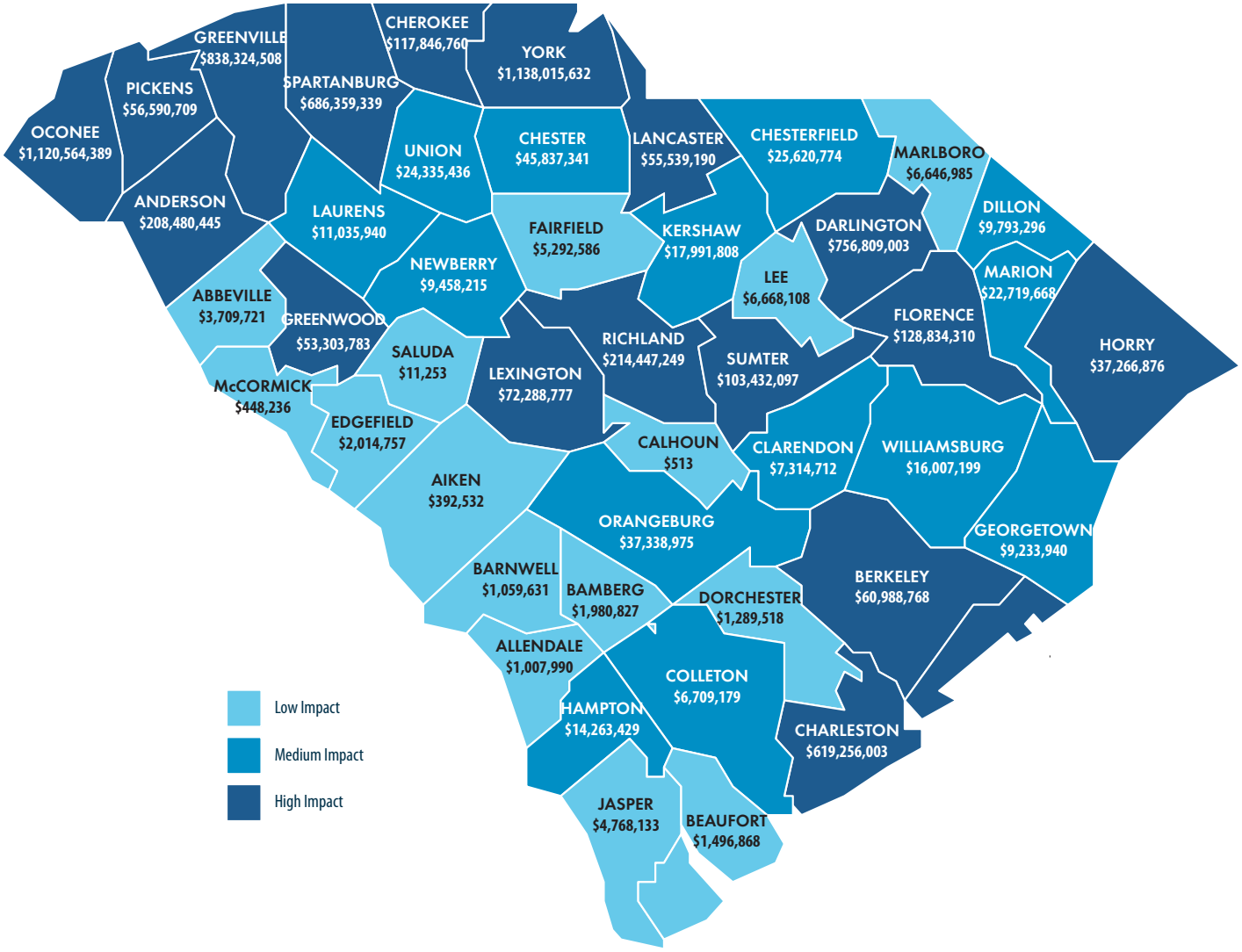
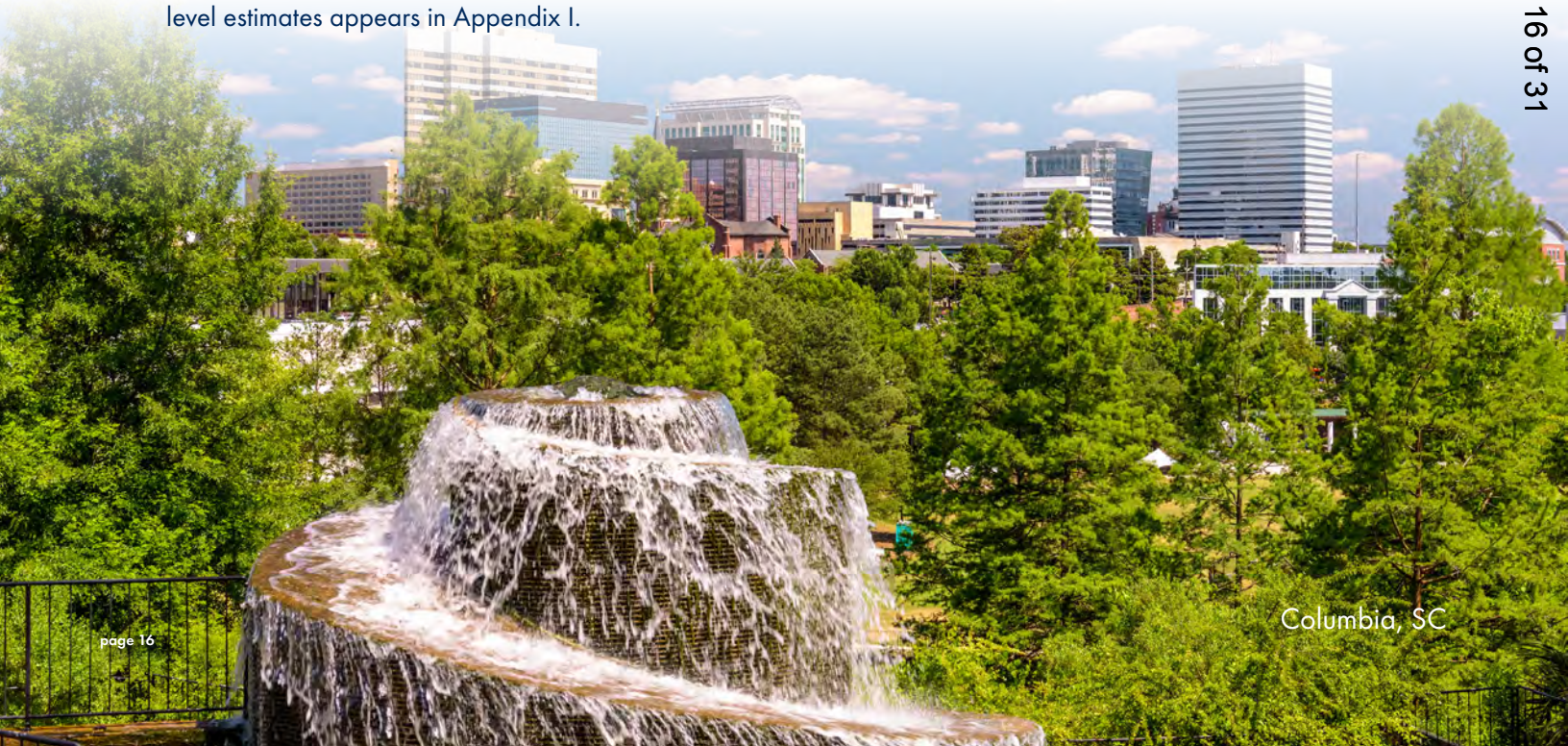


Table 2 – Counties Containing Highest Dollar Volume of Duke Energy Economic Impacts

County	Total Employment	Total Labor Income	Total Economic Output
York	3,039	$223,312,948	$1,138,015,632
Oconee	3,267	$257,040,059	$1,120,564,389
Greenville	1,766	$97,331,311	$838,324,508
Darlington	2,076	$152,112,583	$756,809,003
Spartanburg	1,199	$53,569,623	$686,359,339
Charleston	1,027	$42,345,515	$619,256,003
Richland	360	$15,485,301	$214,447,249
Anderson	469	$28,270,241	$208,480,445
Florence	323	$20,358,054	$128,834,310
Cherokee	200	$8,588,012	$117,846,760
Sumter	191	$9,187,002	$103,432,097
Lexington	120	$4,943,199	$72,288,777
Berkeley	101	$4,170,490	$60,988,768
Pickens	114	$5,958,040	$56,590,709
Lancaster	131	$8,028,786	$55,539,190
Greenwood	116	$6,589,736	$53,303,783

Although it is dispersed throughout South Carolina, the majority (78.6%) of Duke Energy's economic impact is contained within York, Oconee, Greenville, Darlington, Spartanburg, and Charleston counties. Further, Figure 7 illustrates that the "high impact" counties largely represent the major metropolitan regions of South Carolina. This is to be expected given that firms within the utility supplier network are more likely to be located within a major metropolitan region.

It is also important to recognize that the size of the economic impacts listed depend greatly on the source of those impacts. For example, while Duke Energy's highest impact occurs in York County when measured by economic output, its highest impact is in Oconee County when measured by employment. This is a result of the fact that Duke Energy has more employees working in Oconee County than in York County, even though Duke Energy spends more with suppliers (i.e., non-labor expenditures) in York County than in Oconee County. A breakout of all county-level estimates appears in Appendix I.



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Economic Impact: Contributions to State Tax Revenue

Another major impact of Duke Energy comes from the increase in state tax revenue that results from the economic activity it supports. As summarized in Table 3, the total economic impact of Duke Energy for the state of South Carolina approximates $6.6 billion.

Historically, every additional dollar that is generated in economic activity (i.e., nominal gross state product) within South Carolina also generates 5.1 cents in new state tax revenue.[8] By applying this figure to the economic activity generated by Duke Energy, the tax revenue from this total volume of activity can be estimated.[9] Table 3 displays these results, which show that the annual total estimated tax revenue that arises from Duke Energy is approximately $132.9 million.

Table 3 – Annual State Tax Revenue Derived from Duke Energy

Category	Dollar Value
Estimated Economic Output for South Carolina	$6,562,825,265
Estimated Tax Revenue Generated for South Carolina	$132,875,788

[8]The historical relationship between South Carolina nominal gross state product and the South Carolina general funds revenue (as measured and tracked by the South Carolina Board of Economic Advisors) was estimated using industry-standard time-series regression techniques.
[9]Economic output represents the value of industry production and is therefore not synonymous with gross state product. As such, the dollar value of all intermediate inputs was subtracted from economic output before the 5.1-cent estimate was applied to estimate total tax revenue.

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Section V – The Economic Impact of Duke Energy's Power/Forward Carolinas Initiative

Duke Energy is currently in the early stages of executing a $25 billion, 10-year capital investment project across its six-state region to modernize its electric grid - $3 billion of which will be specifically invested in South Carolina. This project, known as the Power/Forward Carolinas Initiative, will consist of incorporating new technologies to improve the customer experience and to increase efficiency as well as to help better prepare for and address various weather-related and physical attacks on the grid. It is also designed to help to reduce the number of unplanned in-state power outages of residential, commercial, and industrial customers, thereby reducing the current economic losses that arise each year as a result of these outages. This section of the report will estimate the potential economic impacts of the Power/Forward Carolinas Initiative that arise from (1) capital investments in South Carolina's electricity infrastructure and (2) benefits to South Carolina businesses and households from increased electric grid reliability. The strategic programs associated with the grid improvement plan are as follows:

Strategic Program	Descriptions
Advanced Metering Infrastructure (AMI)	Providing customers payment options, usage data, and energy-savings tools, as well as automating functions like meter-reading, connects and disconnects, and outage detection.
Self-Optimizing Grid (SOG)	System capacity and technology to locate and isolate faults (short circuits), and automatically reconfigure the system, thus shortening or even eliminating outages for many customers.
Targeted Underground (TUG)	Converting heavily treed neighborhoods prone to power outages from overhead to underground construction to decrease outages, reduced momentary interruptions (blinks), improve major storm restoration time, and improve customer satisfaction.
Distribution Hardening & Resiliency	Upgrading equipment to address the leading causes of trouble, reducing outages and momentary interruptions, and making the system more resilient to major hurricanes, ice storms, as well as routine storms.
Advanced Systems	Upgrading systems that manage grid devices, monitor equipment health, analyze data from monitoring sensors to improve system operations and maintenance activities, make communication faster and enable self-healing techniques.
Communications Network Updates	Providing high-speed, high bandwidth, secure communications pathways (fiber optic and wireless) for the increasing number of smart components, sensors, and remotely activated devices on the transmission and distribution systems.
Transmission Investment	Equipment upgrades, flood mitigation, physical and cyber security and system intelligence to make a smarter and more reliable and secure transmission system.

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Economic Impact: Capital Investments in South Carolina Electricity Infrastructure

The Power/Forward Carolinas Initiative will take place from 2017 to 2026. Approximately $3 billion worth of capital and infrastructure purchases will be made with businesses located in South Carolina, and Duke Energy will expand their total employment by 2,388 to oversee and carry out all grid improvement related functions and strategic programs. Both capital investment and hiring will be scaled up over time, with peak operations associated with the initiative occurring in 2025. Table 4 summarizes the total annual economic impacts associated with the Power/Forward Carolinas Initiative on South Carolina, which include all associated economic multiplier effects. Note that the total annual impacts will range from approximately $184 million in 2017 to $962 million in 2025. This level of activity, in turn, will support between 1,037 and 5,409 total jobs in South Carolina.

Table 4 – Total Annual South Carolina Economic Impact of Duke Energy's Power/Forward Carolinas Initiative: 2017-2026

Year	Total S.C. Economic Output	Total S.C. Employment (FTE)	Total Number of Duke Energy Employees (FTE)[10]	Total S.C. Labor Income
2017	$184,392,527	1,037	458	$60,247,721
2018	$264,366,686	1,486	656	$86,378,177
2019	$480,031,511	2,699	1,192	$156,843,692
2020	$437,798,606	2,462	1,087	$143,044,671
2021	$541,696,128	3,046	1,345	$176,991,757
2022	$715,080,114	4,021	1,775	$233,642,589
2023	$710,255,158	3,993	1,763	$232,066,101
2024	$776,940,371	4,368	1,929	$253,854,577
2025	$961,991,072	5,409	2,388	$314,317,348
2026	$689,664,853	3,878	1,712	$225,338,502
Total Economic Impact between 2017 and 2026: $5,762,217,025				
An average of nearly 3,300 jobs supported per year between 2017 and 2026				

[10]Note that the total number of Duke Energy employees in this column was estimated by assuming that all 2,388 anticipated hires would be working on the grid improvement project by the year 2025. This employment number was then scaled during the remaining years to correspond to annual capital investment dollars provided by Duke Energy.

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In order to accurately capture the magnitude that the Power/Forward Carolinas Initiative will have on South Carolina's economy, the estimates displayed in Table 4 were integrated into a long-run state level forecast to provide perspective on the extent to which this grid improvement will affect overall employment growth rates. Employment growth is the single best indicator for the health of any local region, and as such it is an appropriate metric to use to gauge the extent to which the grid improvement plan will affect overall economic growth in South Carolina. Figure 8 provides annual employment growth rates from 2011 to 2026, including historical rates, a projected "baseline" growth rate, and a growth rate incorporating the anticipated employment gains from the grid improvement.

Figure 8 - South Carolina Employment Outlook: 2018-2026

South Carolina's baseline employment growth trend is represented by the black arrow in Figure 8. This is specifically calculated by using the average annual change in the rate of employment growth from 2000 to 2017. [11] This average annual change is then assumed to continue through 2026. While employment growth clearly deviated from this trend between 2012 and 2016, this was due in large part to significant gains in advanced manufacturing. These gains were specifically the result of major job announcements among both new and existing South Carolina firms within the aerospace, automotive, and tire industries. These industries helped to increase the state employment growth rate to nearly 3.0 percent in 2014 and 2015.

In the absence of further industry gains of comparable size, this study assumes that the long-run employment growth trend outlined in Figure 8 will continue over the next decade in order to highlight how the Power/Forward Carolinas Initiative has the potential to affect employment growth in South Carolina in a similar manner to advanced manufacturing's impact in recent years. As Figure 8 illustrates, the grid improvement plan will likely increase South Carolina employment growth by up to 0.4 percentage points above its baseline rate in the coming decade.

[11] Since the year 2000, South Carolina's employment growth rate has increased, on average, by approximately 0.06% each year.
The baseline employment growth trend projects this rate forward through 2026 using the most recently available employment growth figures available (August 2017) as a starting point.

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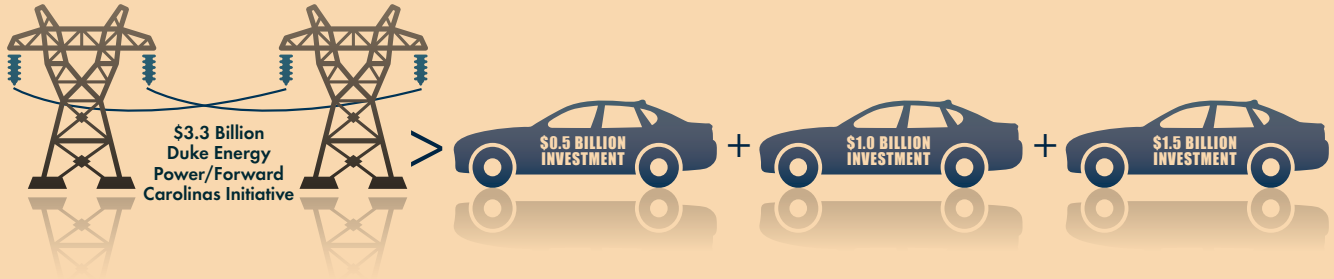
To put this additional growth in context, recent announcements from automotive manufacturers either expanding or relocating to South Carolina have ranged from $0.5 billion to $1.5 billion, implying that the Power/Forward Carolinas Initiative is roughly equivalent to three major automotive manufacturing announcements in the state.

This implies that Duke Energy's contribution to statewide economic growth in the coming decade will likely be comparable to the contribution of one of advanced manufacturing's major sub-sectors (e.g., aerospace, automotive, or tires).



As with the standard, ongoing operations of Duke Energy, the majority of the impact of the Power/Forward Carolinas Initiative will be concentrated within counties that either (1) contain a workforce hired by Duke Energy to complete the initiative or (2) contain the major vendors/suppliers that Duke Energy is purchasing raw materials from to build the planned infrastructure. As a result, the distribution of the county-level impacts will not necessarily be directly tied to the distribution of Duke Energy's customer base in South Carolina. A summary of the county level distribution of these impacts from 2017 to 2026 appears below in Figure 9. Table 5 displays the top county level impacts that will likely occur during the peak construction year of 2025. Although the impacts themselves are very different, the distribution is fairly similar to that of the current operations of Duke Energy.

Figure 9 - County-Level Distribution of Duke Energy's Power/Forward Carolina's Initiative Total Economic Impact: 2025

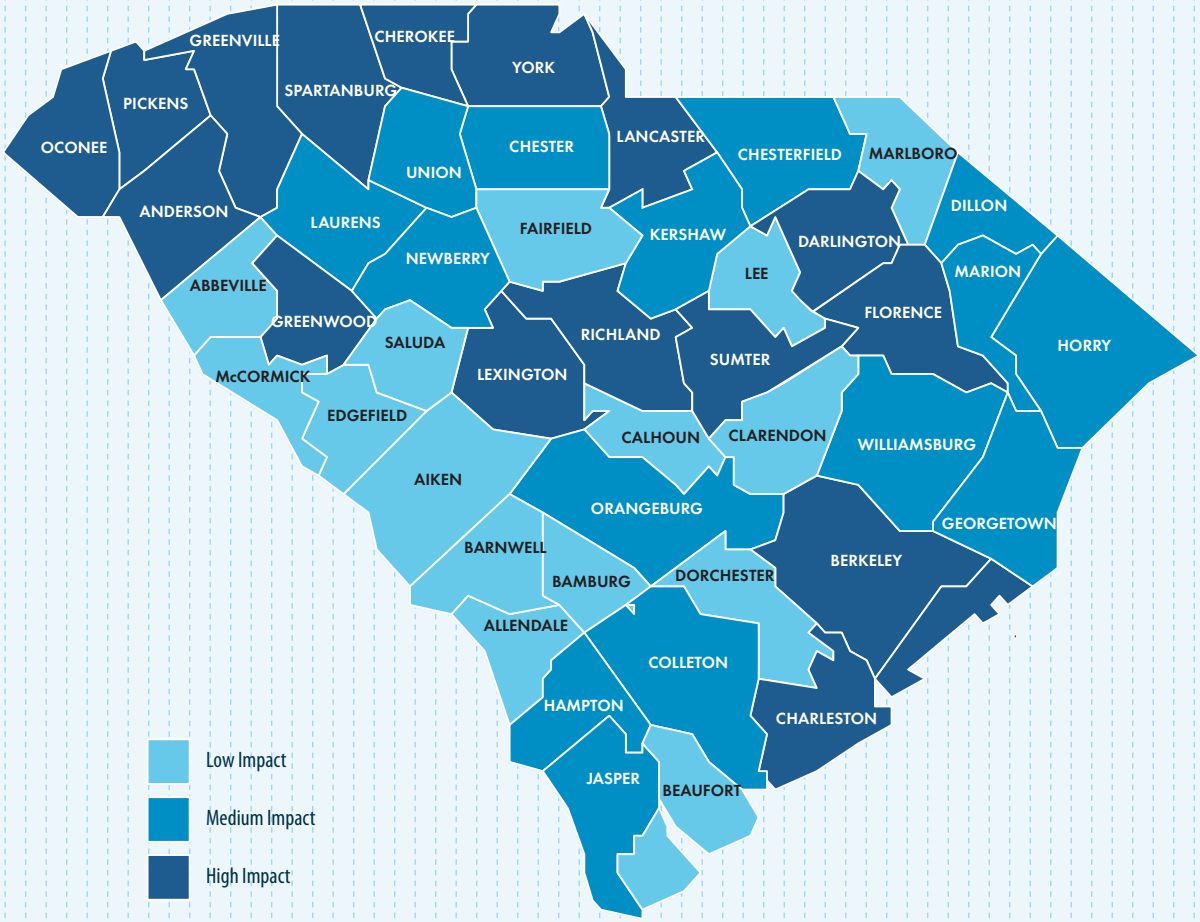


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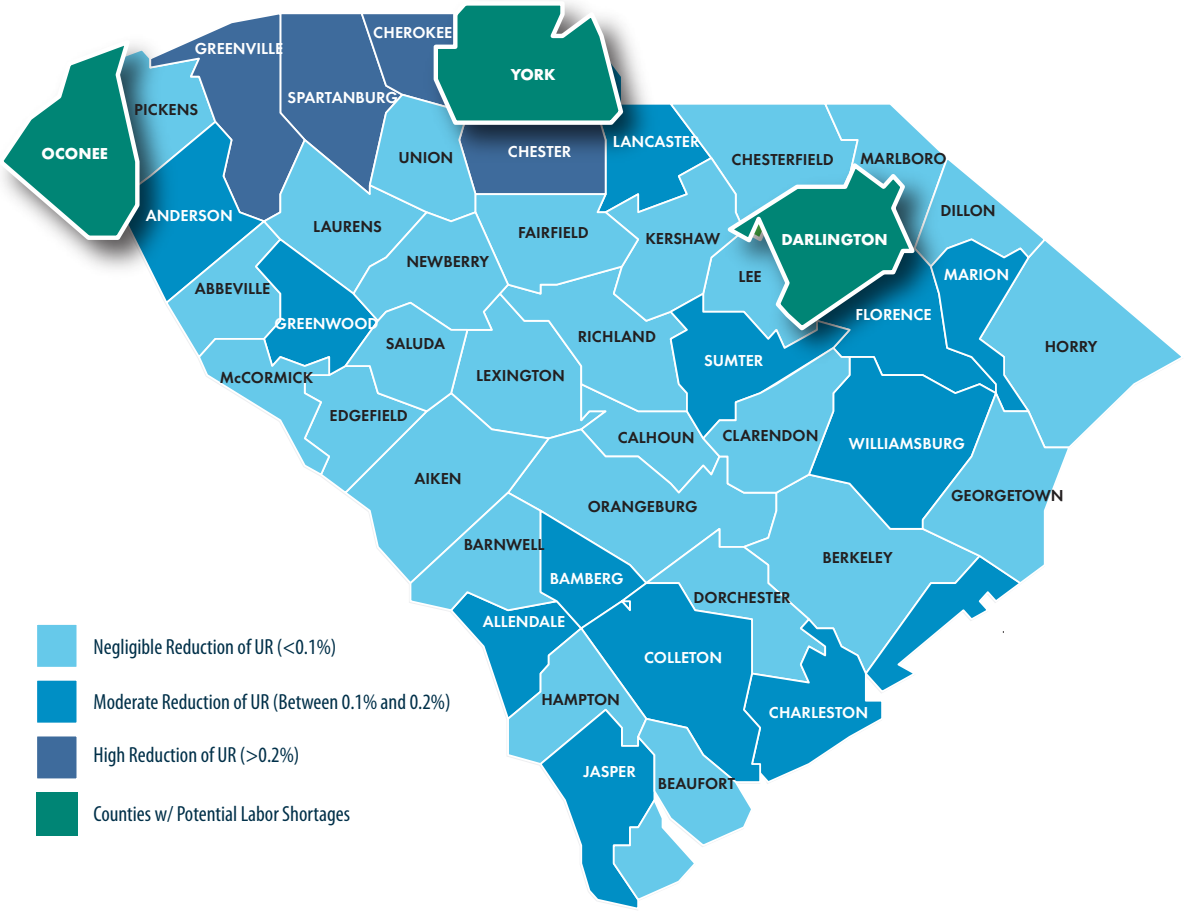
Table 5 – Economic Impacts of Power/Forward Carolinas Initiative on Highest Impacted Counties in 2025

County	Total Employment	Total Labor Income	Total Economic Output
York	1,198	$69,595,414	$213,001,818
Oconee	1,352	$78,566,877	$240,459,634
Greenville	585	$33,976,700	$103,988,159
Darlington	831	$48,269,224	$147,731,465
Spartanburg	323	$18,784,339	$57,490,834
Charleston	257	$14,930,365	$45,695,467
Richland	91	$5,278,541	$16,155,358
Anderson	163	$9,483,081	$29,023,659
Florence	121	$7,043,446	$21,556,978
Cherokee	51	$2,976,065	$9,108,464
Sumter	55	$3,175,427	$9,718,624
Lexington	29	$1,690,533	$5,173,999
Berkeley	24	$1,417,006	$4,336,850
Pickens	35	$2,041,589	$6,248,432
Lancaster	47	$2,710,626	$8,296,067
Greenwood	39	$2,254,443	$6,899,886

Although the documented county-level increases in total employment due to the Power/Forward Carolinas Initiative will represent significant gains for South Carolina over the next decade, they also have the potential to introduce new workforce challenges for the state. For example, while more densely populated metropolitan counties such as Greenville, Richland, and Charleston are likely to have a sufficient workforce supply to accommodate the employment needs for this initiative, it is possible that some rural counties will not. In addition, the fact that the new workforce required by Duke Energy will consist primarily of high-skilled, technical positions means that only a subset of the available workforce in both metropolitan and rural counties will qualify.

Figure 10 highlights the counties in South Carolina projected to experience the biggest declines in unemployment as a result of the grid improvement plan. Note that Oconee, York, and Darlington counties are projected to be the three counties most likely to experience a workforce shortage as a result. This is due to a combination of the following: (1) Duke Energy anticipates hiring a relatively large number of workers from in and around these counties and (2) these counties already have low unemployment rates and thus a relatively low supply of unemployed workers from which to hire.

Figure 10 - Power/Forward Carolinas Initiative: Impact on Unemployment Rates (UR) by County



To help address these workforce needs, Duke Energy has created strategies focused on energy career awareness, strategic partnerships, and education pathways for careers in energy. Specifically, Duke Energy partners with several colleges in the Carolinas that educate future lineworkers, engineers, and other roles critical to the success of the grid improvement plan. Duke Energy is also partnering with other utilities in the region to form the Carolinas Energy Workforce Consortium (CEWC) to collectively raise awareness of energy jobs, promote statewide workforce development efforts, and make stronger connections with education partners to build the future pipeline of talent for the industry. Additionally, the Duke Energy Foundation is investing in high performing, sustainable programs and initiatives that contribute to the goal of building a diverse workforce of the future. Duke Energy Foundation grants fund education programs and initiatives focused on K-12 science, technology, engineering and math (STEM) skills, early childhood literacy and workforce development. Programs like these help to foster an interest in the STEM fields, support job readiness, and to create the next generation of workforce business and industries need to be successful.

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Economic Impact: Improvements in South Carolina Electric Infrastructure Reliability

In addition to the temporary economic impacts that will arise over the next decade from Duke Energy's capital investments in the state's electricity infrastructure as documented above, grid improvements will also have long-run positive impacts on South Carolina's economy by reducing unplanned power outages and the associated costs these unplanned outages impose on customers across Duke Energy's 30-county service area. Unplanned power outages are typically divided into two categories: non-major events (or normal service interruptions) and major events.

Non-Major Event Disruptions

In 2016, Duke Energy serviced a total of approximately 740,000 retail customers in South Carolina, of which 16.4 percent were business (i.e., non-residential) customers. Retail customers currently experience approximately $334 million in annual outage costs related to normal-service interruptions (non-major events); businesses comprise over 98 percent of this total impact. Upon completion of the Power/Forward Carolinas Initiative, this study estimates that these costs could be reduced by up to 57 percent. Annual outage costs are projected to grow to nearly $565 million by 2028 without the grid investment due to anticipated declines in reliability using current infrastructure.

Duke Energy estimates grid reliability using two industry-standard measures, excluding Major Event Days (MEDs):

- *System Average Interruption Frequency Index (SAIFI): total number of sustained (>5 minutes) customer interruptions divided by the total number of customers served*
- *System Average Interruption Duration Index (SAIDI): total customer interruption duration (in minutes) divided by the total number of customers served*

Figures 11 and 12 highlight the specific changes to SAIFI and SAIDI values that Duke Energy anticipates will occur both with and without grid improvements through the year 2028. The projected improvements to SAIFI and SAIDI denoted in Figure 11 will then lead to grid reliability improvements of 51.8 percent and 58.4, respectively, as shown in Figure 12. These projected changes, in turn, provide the basis to evaluate the economic impact of grid improvements for non-major event disruptions.

Figure 11 - SAIFI and SAIDI Projections: 2018-2028

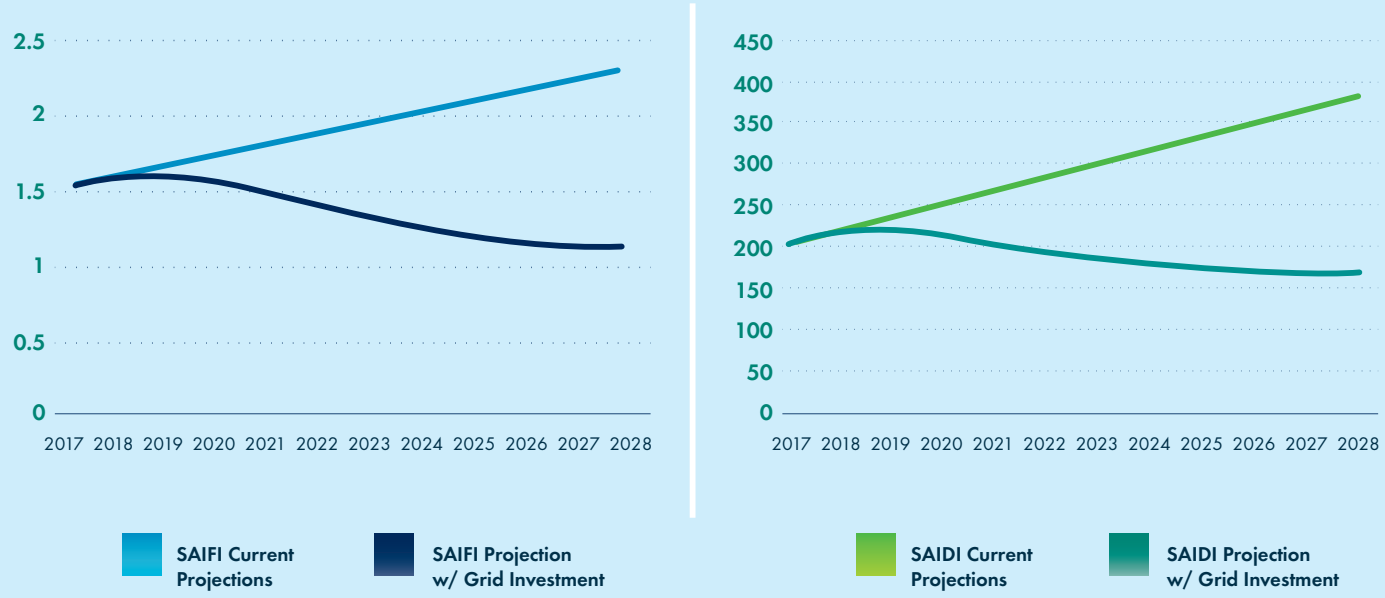
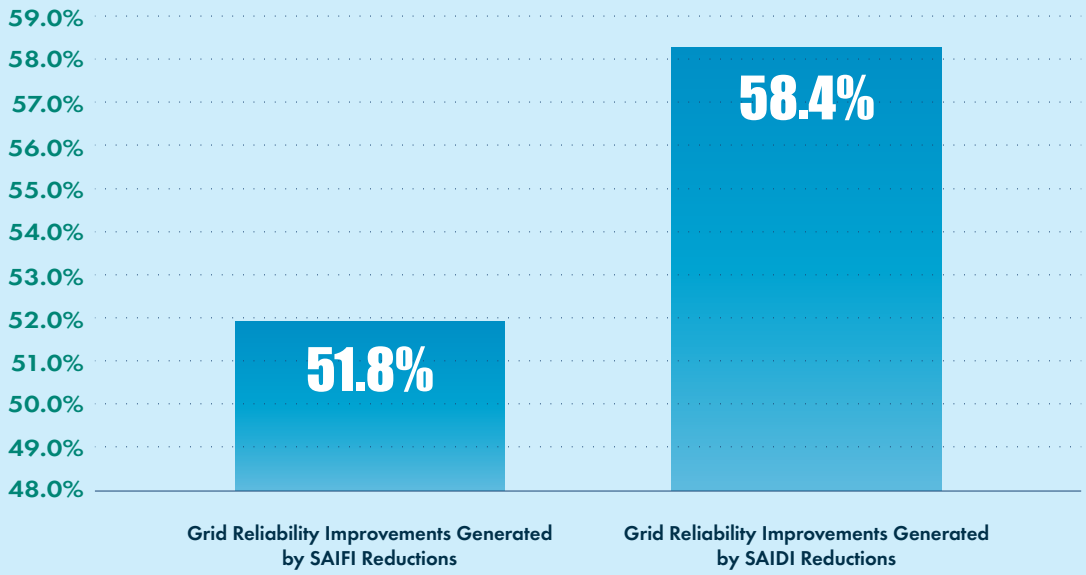


Figure 12 - Percentage Grid Reliability Improvement Resulting from Anticipated SAIFI and SAIDI Reductions



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Major Event Disruptions

The SAIFI and SAIDI projections in Figures 11 and 12 do not consider the potential benefits related to avoided or shortened outages during major events. Clearly hurricanes, such as Matthew in 2016, are included in the impacts of major events, but there are many other smaller scale multi-day events such as ice, severe thunderstorms, and severe wind storms that also qualify as major events and result in outages experienced by Duke's customers and are included in the major event data. In 2016, Duke customers that experienced an MED outage event (or events) in South Carolina were out of power for an average of 15 hours. While MEDs are less common, the impacts to customers, businesses, and communities are more severe. Based on an analysis provided by Duke Energy, the grid investment plan is projected to reduce the minutes of interruption time associated with these major event outages by 30 percent on average, as Table 6 denotes.

Table 6 – Current Reliability Associated with MEDs in South Carolina

	Customer Interrupted	Customer Minutes Interrupted
10-Year Historical Average, S.C.	232,271	209,705,028
Estimated Reduction (%)	33%	30%
Hypothetical MED, after project completion	154,847	146,793,520

This method only partially captures the value from the most severe events like Hurricane Fran, Floyd, and Matthew as well as severe winter icing events like the December 2002 Ice Storm. Models do not effectively capture the community impacts from these most severe events where widespread infrastructure damage may mean limited access to basic needs such as fuel, food, and shelter. In many cases (particularly in South Carolina's most rural areas) these critical services being available are directly tied to electric infrastructure repairs making material progress. An effective example to illustrate these broader benefits comes from looking at a specific analysis applied to Hurricane Matthew events and projects the outcomes that would have occurred if the proposed grid investments had already been completed.

A projected outage event reduction of 33 percent and a 28 percent reduction in duration from Matthew for the combined DEC/DEP South Carolina would have the potential to move Hurricane Matthew restoration completion from 6 days to approximately 4 days (excluding areas where flood waters prevented access). In addition, customers impacted from the event would have dropped by 26 percent. DEC South Carolina impacted regions would have experienced 28 percent fewer events, which would help to speed restoration in the more lightly hit areas and freeing those resources for re-allocation into harder hit areas once restoration was completed.

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Measuring the Economic Impact of All Unplanned Power Outages

In order to determine the economic impact resulting from reductions in unplanned power outages due to grid improvements over the next decade, this study began by taking SAIFI and SAIDI projections developed by Duke Energy (listed in Figures 11 and 12) for non-major events along with data on the number and type of Duke customers (i.e., residential, business, and commercial) and used these as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers for a given SAIFI/SAIDI data pair using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.[12] By estimating the interruption costs associated with current SAIFI/SAIDI projections vs. SAIFI/SAIDI projections that take into account grid improvements and then subtracting the latter from the former, the annual direct cost savings resulting from reliability improvements can be determined.

These direct cost savings, however, do not represent the full economic impact of reliability improvements. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. Both sets of activities represent new economic activity that is the result of the direct cost savings due to reliability improvements. To specifically estimate the additional economic activity that businesses undertake as a result of these cost savings, the IMPLAN model was used.[13]

To estimate cost savings for businesses and households associated with reductions in unplanned power outages during Major Event Days (MEDs), Duke Energy took the 10-year historical values described in Table 6 to define an annual average for MED events (including typical customers interrupted (CI) and customer minutes interrupted (CMI) from major events annually). Duke Energy applied this annual average to project estimates of the avoided CI (customers interrupted or impacted) and CMI (customers minutes of interruption or duration) reductions that would be realized as a result of proposed Power Forward grid investments. These data, in turn, were then used as inputs into the ICE tool to estimate the direct cost savings of reliability improvements as the improved infrastructure comes on line over the investment period. Once again, these direct cost savings estimates were then translated into total economic impacts through use of the IMPLAN model.

[12]Additional detailed methodology on the ICE model can be found at http://icecalculator.com

[13]Cost savings estimates derived from the ICE model serve as inputs into the South Carolina IMPLAN model. Because IMPLAN does not provide elasticity measurements that document how dynamic changes in production costs will affect industrial purchasing activity over time, this study used existing elasticity measurements for the major industrial sectors from external sources.

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Primary Results

The positive economic impacts that result from the Power/Forward Carolinas Initiative can be represented by examining the "four corners" of the initiative – that is – by examining the multiple ways in which value is provided to customers and communities in South Carolina and the broader Carolinas region. Consider each of the following benefits of grid improvement as summarized in the figure below:

- Core Reliability Improvements
- Statewide economic benefits resulting from all capital investments associated with building new infrastructure
- Loss avoidance among businesses and households
- Reduction of impacts associated with major event days

Each of these benefits can be quantified for the state of South Carolina.

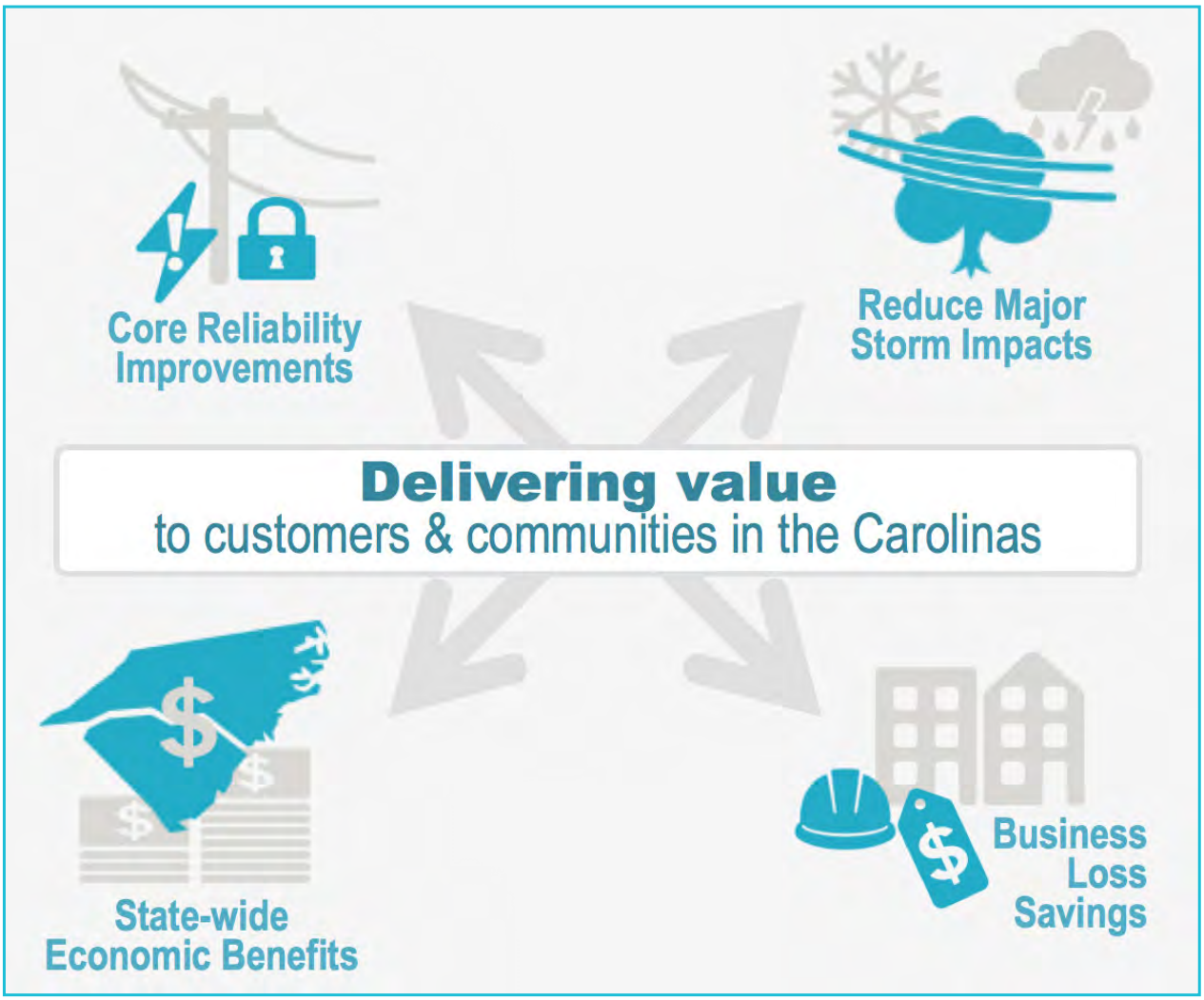
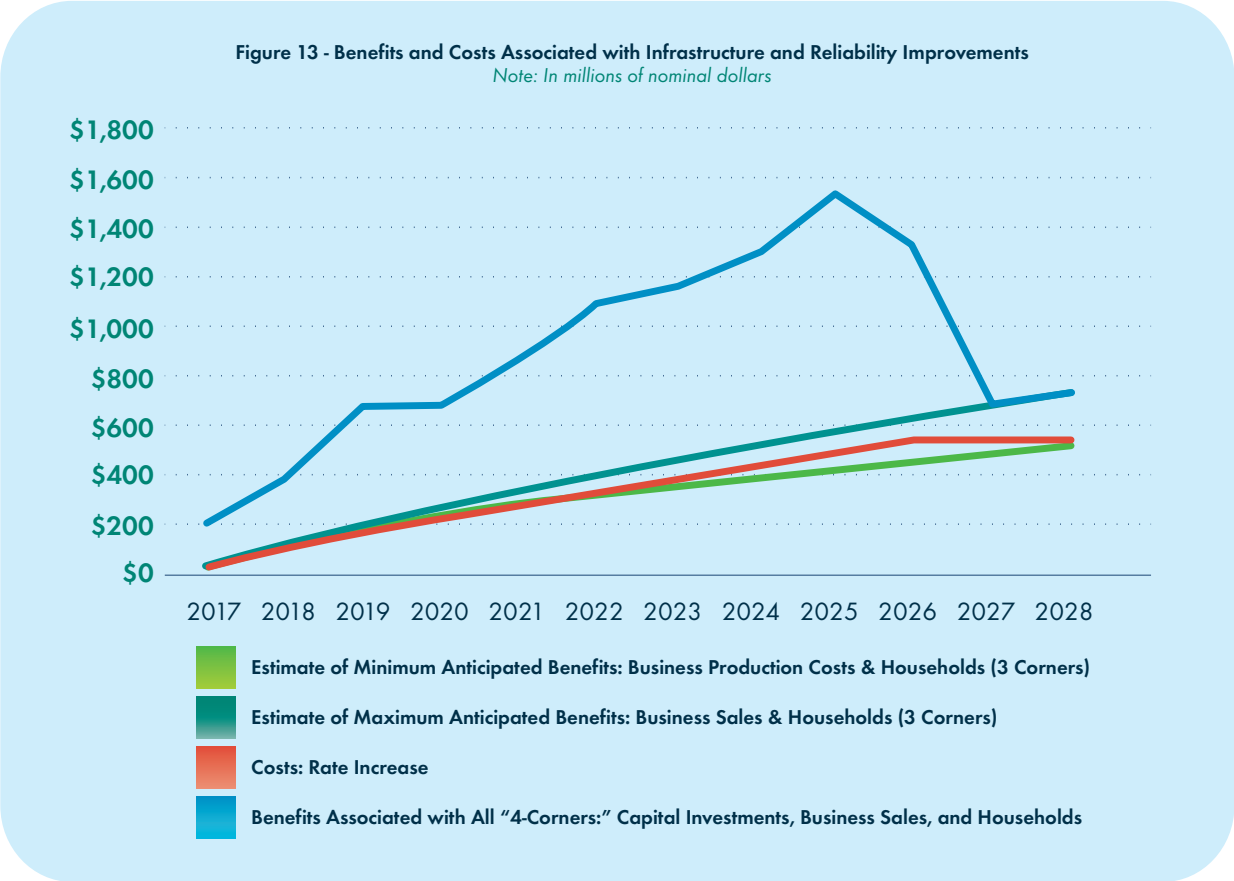


Figure 13 summarizes the total benefits and costs associated with infrastructure construction and reliability improvements between 2017 and 2028. Note that the benefits increase over time as new infrastructure comes on line. Rate increases grow along with the grid investment and generally track closely with business and household reliability benefits.



Consider first the costs (annual rate increases) associated with grid improvements in Figure 13. Note that annual rate increases are expected to continue until all capital investments are completed in 2026, at which time rate increases will terminate and costs will remain relatively constant moving forward. Total annual costs (rate increases) will range from $84 million in 2018 to $530 million by 2028 in South Carolina.

The anticipated gross benefit of reliability improvements (business production costs and households) will range from approximately $79 million in 2018 to $503 million by the end of 2028. If these avoided costs were then translated into new sales activity by businesses, this sales volume would total $724 million by 2028. Thus, the long-run annual benefit for businesses and households in South Carolina (by 2028) associated with all reliability improvements will likely range between $503 million and $724 million depending upon the extent to which businesses are able to translate cost savings into new sales activity. This "benefits range" thus includes three of the four corners addressed above: core reliability improvements, loss avoidance among businesses and households, reduction of impacts associated with major event days.

Combining the maximum anticipated economic benefits associated with the three corners with the all capital investments associated with grid improvement ("corner 4") yields a total economic impact ranging from $184 million in 2017 to $1.5 billion in 2025 (the peak year of capital investment). This final set of estimates fully integrates the combined effects of the "four corners" of the grid improvement project.

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Appendix I – Economic Impact of Duke Energy in South Carolina by County

Counties Ranked by Total Economic Output

County	Total Employment	Total Labor Income	Total Economic Output
York	3,039	$223,312,948	$1,138,015,632
Oconee	3,267	$257,040,059	$1,120,564,389
Greenville	1,766	$97,331,311	$838,324,508
Darlington	2,076	$152,112,583	$756,809,003
Spartanburg	1,199	$53,569,623	$686,359,339
Charleston	1,027	$42,345,515	$619,256,003
Richland	360	$15,485,301	$214,477,249
Anderson	469	$28,270,241	$208,480,445
Florence	323	$20,358,054	$128,834,310
Cherokee	200	$8,588,012	$117,846,760
Sumter	191	$9,187,002	$103,432,097
Lexington	120	$4,943,199	$72,288,777
Berkeley	101	$4,170,490	$60,988,768
Pickens	114	$5,958,040	$56,590,709
Lancaster	131	$8,028,786	$55,539,190
Greenwood	116	$6,589,736	$53,303,783
Chester	93	$4,956,042	$45,837,341
Orangeburg	62	$2,553,287	$37,338,975
Horry	62	$2,548,357	$37,266,876
Chesterfield	49	$2,402,273	$25,620,774
Union	40	$1,664,088	$24,335,436
Marion	54	$3,238,313	$22,719,668
Kershaw	30	$1,230,303	$17,991,808
Williamsburg	40	$2,393,339	$16,007,199
Hampton	24	$975,351	$14,263,429
Laurens	18	$754,652	$11,035,940
Dillon	16	$669,678	$9,793,296
Newberry	18	$861,367	$9,458,215
Georgetown	15	$631,429	$9,233,940
Clarendon	12	$500,189	$7,314,712
Colleton	51	$2,097,760	$6,709,179
Lee	11	$455,974	$6,668,108
Marlboro	11	$454,529	$6,646,985
Fairfield	11	$573,577	$5,292,586
Jasper	36	$1,490,853	$4,768,133
Abbeville	6	$253,675	$3,709,721
Edgefield	3	$137,772	$2,014,757
Bamberg	15	$619,346	$1,980,827
Beaufort	2	$102,358	$1,496,868
Dorchester	2	$88,179	$1,289,518
Barnwell	2	$72,459	$1,059,631
Allendale	8	$315,168	$1,007,990
McCormick	1	$30,651	$448,236
Aiken	1	$26,842	$392,532
Saluda	0	$770	$11,253
Calhoun	0	$35	$513

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