

Carolinas' Nuclear Cluster CELDi Project Report 2012-2013

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Executive Summary

The nuclear industry provides a significant economic impact in North and South Carolina. Of the 100 operating reactors in the United States regulated by the Nuclear Regulatory Commission, 12 are located in the two-state Carolinas region, with two new reactors currently under construction and two more under construction near the South Carolina-Georgia border. In addition, the Savannah River Site in Aiken, South Carolina is a major federal installation housing many different companies providing a variety of nuclear industry-related services. This report provides an estimate of the economic impact of the nuclear industry based on the contributions of the currently operating plants, the construction of new nuclear plants, the Savannah River Site, and the nuclear industry's suppliers, subcontractors, and institutions that support all of these entities. The analysis also presents the economic contribution of both induced and indirect effects, such as grocery stores and hair salons that organically grow in communities to support the employees of the nuclear industry.

The analysis was conducted by partitioning nuclear industry entities into seven categories: 1) original equipment manufacturers and producers of nuclear fuel (OEM/Fuel); 2) engineering procurement and construction companies (EPC); 3) operating nuclear plants (Nuclear Plants); 4) the entire nuclear complex in Aiken, South Carolina, including the Savannah River Site (Aiken); 5) new nuclear plant construction (New Construction); 6) organizations supported by state and/or federal governments (excluding the Savannah River Site) and post-secondary educational institutions (Govt/Post-Secondary); and 7) suppliers and subcontractors that support these entities (Suppliers).

In terms of the economic impact of the nuclear industry in both North and South Carolina as reflected in a previous 2009 study and this report, we find the following results:

Direct Effects	\$5.6B in 2009, now estimated to be \$15.9B in 2012
Indirect/Induced Effects	\$2.8B in 2009, now estimated to be \$11.8B in 2012
Total Economic Impact	\$8.4B in 2009, now estimated to be \$27.7B in 2012

Based on these numbers, the total economic impact of the nuclear industry has risen by over \$19 billion over the past four years. Clearly, part of this is attributable to new construction, the influx of nuclear-related companies to the region, and the growth in community businesses to support the population increase associated with nuclear industry employees relocating to the Carolinas. *Using a conservative approach to mitigate potential double-counting of revenues, the nuclear industry provides a total economic impact of \$20-\$25 Billion per year to the two-state Carolinas region.*

However, it is important to note that the 2009 economic impact report did not provide any details of the assumptions or calculations used to produce estimates of economic impact. Therefore, care should be taken when making side-by-side comparisons between the 2009 and 2012 results—the exact economic factors included in the 2009 report are not known. In this report, we carefully delineate all assumptions and calculations so that the source of our results can be scrutinized and discussed independent of the 2009 report's findings.

1 Introduction

From the day in 1950 when President Truman contacted DuPont asking for assistance in designing what would later be called the Savannah River Plant, the nuclear industry has had a significant economic impact on both North and South Carolina. With the introduction of nuclear plants as a viable source of electrical power generation in the 1960s, the economic impact of nuclear industry in the two-state Carolinas region dramatically increased and has grown considerably through the years. Further, this growth is projected to be strong well into the future.

The Savannah River Plant has grown into the Savannah River Site which now houses a large number of supporting and ancillary companies in the Aiken, South Carolina area. Nationally, 100 operating reactors in the United States are regulated by the Nuclear Regulatory Commission in 31 states. Of these reactors, five are located on three sites in North Carolina and seven are located on four sites in South Carolina. Based on national averages, it is estimated that each reactor supports a payroll of \$40 million by employing between 400 and 700 individuals. The macro-economic impact of each reactor is estimated to be \$470 million to the local economy.

Internationally, 13 countries relied on nuclear power generation for at least 25% of their energy needs in 2011. However, the United States was not one of these countries. There are 71 nuclear reactors under construction in the world today, five of which are in the United States. Of the five new reactors, four are considered in this report due to their economic impact on the Carolinas: reactors 2 and 3 at V.C. Summer and reactors 3 and 4 at Vogtle. Given Plant Vogtle's close proximity to South Carolina, it is included within the scope of this report.

The total economic impact of the nuclear industry in any area, however, is much larger than just the direct contribution of the nuclear plants. While the plants are certainly important, there are small, medium, and large enterprises that support nuclear operations, site planning and construction, and the indirect and induced impacts associated with businesses in the communities that support the population increase associated with employees relocating/locating in an area due to nuclear industry-related opportunities.

This report develops an estimate of the economic impact of the nuclear industry in North and South Carolina. It contains all pertinent details regarding the research team's assumptions, methodology, and calculations for each finding. Based on this research, the nuclear industry provides a total economic impact of \$20-\$25 Billion to the two-state Carolinas region.

2 The 2009 Economic Impact Report

2.1 Summary

An earlier report, "The Economic Impact of the Nuclear Cluster in the Carolinas," was completed in August 2009. The report summarized the current state of the nuclear industry in

the Carolinas and estimated the economic impact of the industry at that time. The scope of the 2009 analyses was limited to North Carolina and South Carolina.

The 2009 report had five major components. First, it overviewed the Carolinas’ Nuclear Cluster (CNC) and identified the members of the cluster (the cluster is described in Section 3 of this report). Second, survey data from CNC members was supplemented by data from other sources to identify various elements of the direct impact that CNC members had on the two-state economy. Third, inter-industry impacts in relation to the nuclear industry were evaluated using Impact Model for Planning (<http://www.implan.com>) software program. Next, the growth of the nuclear industry was estimated by projecting the economic impacts of future new construction plans. Finally, the report components were aggregated to summarize the nuclear industry’s economic impact.

The key findings of the 2009 report are summarized in Tables 1 and 2 as aggregated North Carolina and South Carolina results. The 2009 report also stated the following projection related to Table 1: “... [The] added impacts over the next 20 years from new nuclear plant operations would result in a 46% increase in jobs and a 34% increase in total income in the nuclear cluster in the two states.”

Table 1: 2009 Report Results Summary—Current Conditions

	Direct	Total
Current Jobs	18,808	37,330
Current Labor Income	\$1.65 Billion	\$2.30 Billion
Current Other Property Income	\$2.06 Billion	\$2.36 Billion
State and Local Tax Revenues		\$0.75 Billion

Table 2: 2009 Report Results Summary—Future Projections

	Construction Peak	Operations Phase
Projected New Jobs	54,300	17,200
Projected New Income	\$4.1 Billion	\$1.7 Billion

2.2 Methodology

This research effort was established to update the overall findings of the 2009 report by providing a transparent analysis of the current state of and the projected growth of the nuclear industry in North and South Carolina. To accomplish these goals, the 2009 report and the methodologies it employed were reviewed. While some elements of the 2009 methodology are the same as those we employed in our research efforts, there are a number that are different; we now discuss the most significant departures from the 2009 study in our research efforts.

In 2009, the individual impact on North and South Carolina were analyzed separately; our research analyzes them in aggregate as we examine the total impact across both states. One

reason for this change is that the latest version of the IMPLAN software used in both analyses has changed to become better suited for aggregate analysis. Additionally, although nuclear plants reside in one state or the other and the Aiken complex is in South Carolina, the rest of the entities that contribute to the economic impact of the nuclear industry in the Carolinas are much harder to classify as being in a single location. As the CNC also spans two states, a fundamental assumption of this research effort was to aggregate the economic impact findings across both states.

To analyze current operations, we employ a segmented breakdown of nuclear industry segments in our research:

- Original equipment manufacturers and producers of nuclear fuel production (“OEM/Fuel”)
- Engineering procurement and construction companies (“EPC”)
- Operating nuclear plants (“Nuclear Plants”)
- The entire nuclear complex (including the Savannah River Site) in Aiken (“Aiken”)
- New nuclear plant construction (“New Construction”)
- Organizations supported by state and/or federal governments (excluding the Savannah River Site) and post-secondary educational institutions (“Gov’t/Post-Secondary”)
- Suppliers and subcontractors that support these entities (“Suppliers”).

In 2009, cost data for new construction of nuclear power plants in the United States was unavailable to the research team. In an effort to include this significant contributor to the state economy, an analysis of the BMW manufacturing facility in Greer, SC was performed. This was scaled in some manner so as to estimate the impact of new nuclear construction. Currently, there are four reactors under construction in the two-state area: two at the V.C. Summer power station and two at Plant Vogtle. Hence, this 2012 analysis uses information and data from these projects and well as others being planned in the United States (e.g., Plant Lee) for estimating direct impacts and supplying inputs to IMPLAN for growth projection calculations.

Our analyses include the units at Plant Vogtle, which is located east of Waynesboro, Georgia (<http://www.southerncompany.com/nuclearenergy/vogtle.aspx>). Due to its close proximity to the Georgia-South Carolina border, it was deemed inappropriate to exclude these new units from the analysis. However, it seems inaccurate to include them in the 2012 study on the same scale as plants located within the borders of North and South Carolina. Hence, in this report, Plant Vogtle’s influence is assumed to be 25% of a plant located within the Carolinas.

3 The Carolinas’ Nuclear Cluster

The Carolinas’ Nuclear Cluster is one of a number of cluster organizations created under the umbrella of New Carolinas (South Carolina Council on Competitiveness). Members of the CNC include companies in the private sector, companies in the public sector, government agencies, and educational institutions (for a complete listing of the CNC, please see Appendix A). The members of the CNC exist in a dynamic industry and share a mutual understanding of the cluster’s mission with respect to industry norms and growth projections. The collaboration of the CNC is an effort to coordinate the capabilities of the nuclear industry in terms of

workforce, services, products, and policies. A collective, well-informed, and coordinated effort is more effective than individual efforts; therefore, the cluster seeks to improve North Carolina's and South Carolina's competitiveness in the nuclear industry.

The southeastern region of the United States, and specifically North Carolina and South Carolina, are leaders in domestic nuclear energy generation. Figure 1 and Table 3 display the geographic locations of nuclear power plants in the two states. In North Carolina, nuclear power generation accounts for 32% of the state's electricity usage and there are five operational reactors in North Carolina. These include two reactors at the Brunswick power station in Southport, two reactors at the McGuire power station in Huntersville, and one reactor at the Shearon Harris power station in New Hill. In South Carolina, nuclear power generation provides 52% of the state's electricity usage. The seven operational reactors in South Carolina include one reactor at the V.C. Summer power station in Jenkinsville, two reactors at the Catawba power station in Clover, a single reactor at the H. B. Robinson power station in Hartsville, and three reactors at the Oconee power station in Seneca. As stated above, although Plant Vogtle is located in Georgia, its close proximity to the South Carolina border led the research team to include it in the analysis with its impact being a fraction of the plants located within the two-state region. The Vogtle Electric Generating Plant currently operates two reactors near Waynesboro, Georgia.

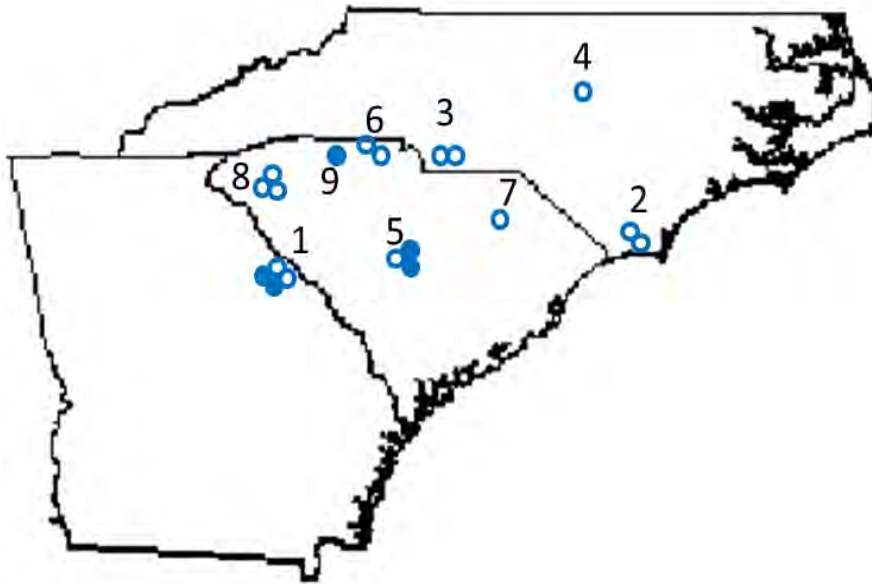


Figure 1: Location of Nuclear Plants in the Carolinas

An important component of the nuclear industry's economic impact in the Carolinas is that of the construction and operation of new reactors. "New Construction" in South Carolina includes two reactors at the V.C. Summer power station in Jenkinsville. At the time of this report, construction is in progress and the two reactors are expected to be operational in 2018. Additionally, Plant Vogtle is currently in the construction phase of on-boarding two additional reactors at its plant location near Waynesboro, Georgia. Construction progress is slightly behind that of the reactors at the V.C. Summer power station, as the two Vogtle reactors are expected to

be operational in 2019. Finally, a single reactor at the Lee power station in Gaffney, South Carolina is planned to start construction in 2014 and become operational in 2024.

Table 3: Current and Future Nuclear Plants

State	Key*	Operating Plant	New Plant**	Location	Operated By
NC	2	Brunswick I		Southport	Duke Energy
		Brunswick II		Southport	Duke Energy
	3	McGuire I		Huntersville	Duke Energy
		McGuire II		Huntersville	Duke Energy
4	Shearon Harris I		New Hill	Duke Energy	
SC	5	V.C. Summer I		Jenkinsville	SCANA
			V.C. Summer II	Jenkinsville	SCANA
			V.C. Summer III	Jenkinsville	SCANA
	6	Catawba I		Clover	Duke Energy
			Catawba II	Clover	Duke Energy
	7	H. B. Robinson II		Hartsville	Duke Energy
	8	Oconee I		Seneca	Duke Energy
			Oconee II	Seneca	Duke Energy
			Oconee III	Seneca	Duke Energy
9		Lee I	Gaffney	Duke Energy	
GA	1	Vogtle I		Waynesboro	Southern Company
		Vogtle II		Waynesboro	Southern Company
		Vogtle III		Waynesboro	Southern Company
		Vogtle IV		Waynesboro	Southern Company

* Key relates Table 3 to markings in Figure 1

** Under construction or planned

4 Industry Survey

A survey was used to elicit data from nuclear industry entities pertaining to financial, personnel, and tax information. The basic information collected in this survey was the same as that which was collected in the survey for the 2009 report. The key differences between the 2009 and the 2012 studies were that the 2009 survey was paper-based (the 2012 survey was deployed online) and that some of the 2009 survey's instructions were modified to improve clarity for the participants in 2012 (see Appendices B, C, and D for survey details). The survey was sent to over 125 companies in August 2012, 53 of whom were members of the CNC. The survey was sent out again in mid-September 2012 in the hopes of increased response rate. The research team analyzed the responses with the intention of only reporting results in aggregate form to ensure response anonymity. In the end, 14 survey responses were received that contained valid, useful data, resulting in a response rate of 11.2%.

A review of the literature discussing response rates to surveys reveals that the variation in response rate typically is large and unpredictable. Some studies segregate the surveyed audience and, as expected, short internal surveys sent to a nearly homogeneous populations often have the highest response rate (>75%). However, longer surveys sent to the public at large often have a <2% response rate. One source noted that surveys sent to members of an organization, like the Carolinas Nuclear Cluster, typically have a response rate of between 5% and 30%, depending on the length and complexity of the survey. We believe that the survey used in this study was at the high end of the complexity scale because of the number of different places (departments) in the member organizations that had to be involved to complete all of the survey's questions. As such, we submit that achieving our response rate of >11% is very good and that this adequately represents the population as a whole, especially when scaled up as we have done in our analyses.

5 Data Analysis

5.1 Methodology

Once the survey data was collected, it was necessary to assess the reasonableness of the responses and to develop a mechanism for scaling up raw survey results from the subset of industries that responded to account for the entire population in the two-state area. As mentioned previously, the nuclear industries that contribute to the economic impact in North and South Carolina were partitioned into seven categories to provide a data organization structure and an appropriate means for data scale up: OEM/Fuel, EPC, Nuclear Plants, Aiken, New Construction, Gov't/Post-Secondary, and Suppliers.

As the survey results only represented a portion of the total North and South Carolina population, the direct survey results were used as the basis for assessing the economic impacts on the nuclear industry in the Carolinas. The responses were first scrutinized by the research team for consistency. Then, the anonymous, aggregate data was then vetted with and supplemented by subject matter experts, such as employees of both Shaw and Southern Company who were very knowledgeable about the new construction projects at Plant Vogtle, and by discussions with CNC representatives. Based on the raw survey results, the data vetting process, and the research team's supplemental efforts, several segments that contributed to the economic impact of the nuclear industry were identified for each of the seven categories:

- Average salary of an employee (“average salary”)
- Revenue generated from nuclear businesses (“nuclear revenue”)
- Expenditures for procurement associated with nuclear business (“procurement”)
- Taxes paid (“taxes”)
- Expenditures associated with new plant construction (“new construction”)
- All other expenditures associated with the nuclear business but not identified elsewhere (“other”)

To convert the enhanced survey data into total economic impact, the data was normalized and then scaled up via two methods. For categories in which all companies located in the Carolinas were known fully by name (e.g., EPC), normalization was done on a per employee basis from the survey results, then scaled up according to the estimated number of employees employed by that category of the nuclear industry. Alternately, for categories in which the

number of entities was not known with certainty (e.g., Suppliers), normalization was performed on a per firm or entity basis from the survey results. This normalized amount was then scaled up by the estimated number of firms that comprised the associated segment of the nuclear industry.

Once the total direct economic impact of the companies or entities comprising each of the seven categories was computed via normalization and scaling, this data was input into the IMPLAN software. In turn, IMPLAN generated both the indirect and induced economic impacts for each category as a function of the direct impacts. The sum total of the three effects (direct, indirect, and induced) therefore represents the total economic impact of the nuclear industry in the Carolinas.

As two important pieces of data, the number of employees associated with new nuclear plant construction and the revenue generated by a nuclear plant, could not be gleaned from survey data, they were determined differently. Given that the number of employees required for new construction varies through time, a consensus estimate was obtained through contact with members of the project management team at both Shaw and the owners of the two plants currently under construction. An estimate of the total number of employees per year per reactor for the 10 year construction time was developed: 250 (year 1), 475 (year 2), 700, 925, 1150, 1775, 2400, 3000, 3000, and 1700 (year 10). To obtain the average number of employees per year, the sum of these numbers is divided by 10 yielding an estimate of 1535 employees per reactor under construction per year. To estimate the revenue for a nuclear reactor, it was assumed that each reactor produces 900 MW of output. Given a retail price for electricity of \$0.055/kWh, this produces an estimate of over \$400M revenue per reactor per year.

5.2 Direct Impacts

We now present the results of the analyses estimating the direct economic impact for each of the seven categories in the nuclear industry. Each of the results tables in this subsection are constructed using the same format. Necessary assumptions are given in the first block. These assumptions are estimates of the average salary per employee in the associated category, as well as the number of firms or employees as needed. In our analysis, average salary is assumed to be a fully burdened estimate for all job classifications in the category (e.g., managers, engineering, discipline leads, journeymen craft labor, helpers, etc.). The second block contains normalized data in the economic segments described above that correspond to the survey's queries. Finally, the third block gives an estimate of the total impact attributed to the category.

5.2.1 Government and Post-Secondary

Government and Post-Secondary includes agencies partially or fully funded by federal, state, and/or local governments, with the exception of the Aiken complex and university or technical schools that support the nuclear industry through educational initiatives. It is estimated that there are 10 such firms in the two-state region with an average burdened salary of \$70,000 per person. After normalization and scaling, the direct economic impact attributed to the Gov't/Post-Secondary category is approximately \$22.5 Million (Table 4).

Table 4: Direct Effects of Government and Post-Secondary

<i>Assumptions</i>		
Average salary	\$	70,000
Number of firms/entities		10
<i>Normalize data: per firm</i>		
<i>Source: Survey data</i>		
# employees		5
Nuclear Revenue	\$	55,740
Other	\$	-
Procurement	\$	28,400
Taxes	\$	31,782
New Construction	\$	1,800,000
<i>Total Impact</i>		
Salary	\$	3,500,000
Nuclear Revenue	\$	557,398
Other	\$	-
Procurement	\$	284,000
Taxes	\$	317,816
New Construction	\$	18,000,000
Total	\$	22,659,214

5.2.2 Suppliers

The category “Suppliers” includes firms that design, make, and provide technology, equipment, hardware, services and/or components to nuclear facilities. This category was normalized according to the number of firms because the exact number in the two-state area could not be determined with sufficient accuracy. It is estimated that there are approximately 75 firms in the region with an average burdened salary of \$85,000 per employee. Based on these estimates, Suppliers contribute approximately \$192.5 Million in direct economic impact to the nuclear industry (Table 5).

Table 5: Direct Effects of Suppliers

<i>Assumptions</i>		
Average salary	\$	85,000
Number of firms/entities		75
<i>Normalize data: per firm</i>		
<i>Source: Survey data</i>		
# employees		33
Nuclear Revenue	\$	7,250,425
Other	\$	-
Procurement	\$	906,667
Taxes	\$	5,221,825
New Construction	\$	2,700,000
<i>Total Impact</i>		
Salary	\$	210,375,000
Nuclear Revenue	\$	543,781,900
Other	\$	-
Procurement	\$	68,000,000
Taxes	\$	391,636,900
New Construction	\$	202,500,000
Total	\$	1,416,293,800

5.2.3 OEM/Fuel

This category includes the original equipment manufacturers that provide safe and reliable nuclear energy technologies, services, fuel, and design solutions for nuclear plants. There are five firms in the region that employ a total of approximately 2,000 employees. The average burdened salary for this category was assumed to be \$100,000, as the workforce is predominantly managers and engineers. Because the number of firms is known with precision, the survey data was normalized on a per employee basis. In total, OEM/Fuel directly contributes approximately \$1.15 Billion to the nuclear industry in the Carolinas (Table 6).

Table 6: Direct Effects of OEM/Fuel

<i>Assumptions</i>		
Average salary	\$	100,000
Number of employees		2000
<i>Normalize data: per employee</i>		
<i>Source: Survey data</i>		
Nuclear Revenue		314,699
Other	\$	121,022
Procurement	\$	34,741
Taxes	\$	6,175
New Construction	\$	-
<i>Total Impact</i>		
Salary	\$	200,000,000
Nuclear Revenue	\$	629,398,000
Other	\$	242,044,000
Procurement	\$	69,482,000
Taxes	\$	12,350,000
New Construction	\$	-
Total	\$	1,153,274,000

5.2.4 EPC

EPC represents the contractors of nuclear systems integration. These contractors typically define, design, supply, and construct elements of new nuclear facilities. The number of such firms in the Carolinas is known with precision; therefore, the data for EPC is normalized on a per employee basis. Unfortunately, no useful survey data was reported by any EPC firm. It was assumed that the business models of EPC companies were closer to the OEM/Fuel category than any other category in the survey. Therefore, the normalized data (on a per employee basis) for OEM/Fuels was used to characterize the economic impact of the EPC category. With these assumptions, Table 7 shows that EPC firms' estimated direct economic impact on the Carolinas' nuclear industry is approximately \$750 Million.

Table 7: Direct Effects of EPC's

<i>Assumptions</i>		
Average salary	\$	100,000
Number of employees		1300
<i>Normalize data: per employee</i>		
<i>Source: Survey data</i>		
Nuclear Revenue		314,699
Other	\$	121,022
Procurement	\$	34,741
Taxes	\$	6,175
New Construction	\$	-
<i>Total Impact</i>		
Salary	\$	130,000,000
Nuclear Revenue	\$	409,108,700
Other	\$	157,328,600
Procurement	\$	45,163,300
Taxes	\$	8,027,500
New Construction	\$	-
Total	\$	749,628,100

5.2.5 Nuclear Plants

The “Nuclear Plants” category encompasses the commercial nuclear plants that are currently operational and generating electricity. At the time of this report, 12 reactors at eight sites were operational and are included in this analysis. Additionally, the influence of the two reactors at Plant Vogtle was included in the analysis. However, as they are located in Georgia but near the South Carolina border, the economic impact of each reactor is valued at 25% of a plant located in the Carolinas. Therefore, our analysis assumes that “Nuclear Plants” consists of 12.5 plants, which in turn are responsible for approximately \$7.3 Billion in direct economic impact (Table 8).

Table 8: Direct Effects of Nuclear Plants

<i>Assumptions</i>		
Average salary	\$	90,000
Number of employees		8125
<i>Normalize data: per plant</i>		
<i>Source: Survey data</i>		
Nuclear Revenue		403,920,000
Other	\$	25,812,083
Procurement	\$	50,490,500
Taxes	\$	38,243,884
New Construction	\$	-
<i>Total Impact</i>		
<i>(12 plants + 2@Vogtle*.25 = 12.5)</i>		
Salary	\$	731,250,000
Nuclear Revenue	\$	5,049,000,000
Other	\$	322,651,042
Procurement	\$	631,125,000
Taxes	\$	478,048,550
New Construction	\$	-
Total	\$	7,212,074,592

5.2.6 Aiken

Our aggregate category “Aiken” includes the plethora of nuclear companies that are affiliated directly and indirectly with the Savannah River Site in Aiken, South Carolina. As the data for this category was reported for all companies in aggregate, no normalization calculations were required (Table 9). The nuclear-related firms in the Aiken area contribute approximately \$3 Billion to the direct economic impact of the nuclear industry in the Carolinas.

Table 9: Direct Effects of Aiken

<i>Assumptions</i>		
Average salary	\$	(Intentionally left blank)
Number of employees		10,968
<i>Data reported in total</i>		
<i>Source: Survey data</i>		
<i>Total Impact (as reported)</i>		
Salary	\$	1,153,000,000
Nuclear Revenue	\$	
Other	\$	
Procurement	\$	1,200,000,000
Taxes	\$	60,200,000
New Construction	\$	345,000,000
Total	\$	2,758,200,000

5.2.7 New Construction

New nuclear power plant construction has a significant impact in the economy in the region where the plant is being built. The “New Construction” captures the direct economic impact both of nuclear reactors currently under construction and of those planned to be built in the next decade in the Carolinas. Currently, there are two new reactors under construction at the V.C. Summer power station near Jenkinsville, South Carolina that were begun in 2008 and are scheduled to be completed by 2018. Similarly, there are two units under construction at Plant Vogtle near Waynesboro, Georgia that began construction in 2009 and are expected to be completed by 2019. Finally, construction is planned to begin in 2014 for a single reactor at the Lee power station in Gaffney, South Carolina. As before, the direct economic impact associated with the new reactors at Plant Vogtle are valued to be 25% of a reactor being built within the Carolinas.

To estimate the per plant impact, a number of conversations were held with CNC members and project personnel at several new construction sites. The consensus was that build time will be about 10 years, expenditures will average ~\$1 Billion per year per plant, and on-site personnel will ramp up to ~5500 in year 5, and then ramp down to ~1000 personnel by the end of construction. From this, the average number of employees per plant per year was computed based on the total number of personnel over the 10 year build horizon, divided by 10. Per our calculations, the direct economic impact of New Construction is estimated to be \$2.75Billion (Table 10).

Table 10: Direct Effects of New Construction

<i>Assumptions</i>		
Average salary	\$	75,000
Number of employees		4221
<i>Normalize data: per plant</i>		
<i>Source: CNC members, project personnel</i>		
Nuclear Revenue		-
Other	\$	-
Procurement	\$	-
Taxes	\$	-
New Construction	\$	1,000,000,000
<i>Total Impact</i>		
<i>(2@Summer + 2@Vogtle*.25 + 1@Lee*.25)</i>		
Salary	\$	-
Nuclear Revenue	\$	-
Other	\$	-
Procurement	\$	-
Taxes	\$	-
New Construction	\$	2,750,000,000
Total	\$	2,750,000,000

5.2.8 Summary of Direct Effects

History suggests that construction of new nuclear power plants is subject to unanticipated interruptions and that these projects will obviously terminate at some point in the future. As such, the summary of the direct impacts of the nuclear industry in the Carolinas is presented both with and without the inclusion of the impact of new construction. When interpreting this data, it is important to understand that after the new plants are completed, the entire workforce will not leave; rather, several hundred will remain as permanent employees as the plant becomes operational. In other words, as a plant is removed from the New Construction category (5.2.7) upon completion, it will add to the number of plants in the Nuclear Plants category (5.2.5).

Summary of Direct Impacts without New Construction of Nuclear Plants

Table 11 summarizes the total economic impact for each category of the nuclear industry by segment and category excluding any new construction of commercial nuclear power plants. Other new construction projects like that in Aiken or new office building for government/post-secondary education is included in this analysis. This is an aggregation of the information contained in Tables 4 through 9. *We conclude that the total estimated direct economic impact that the nuclear industry has on the economy of the Carolinas, not including the impact of constructing new nuclear plants, is approximately \$13.1B.* Figures 2 and 3 illustrate the relationship among categories and among segments, respectively.

Table 11: Details of Direct Impacts Without New Construction of Nuclear Plants (in \$K)

SEGMENT	CATEGORY					
	Nuclear Plants	Aiken	OEM/ Fuel	EPC	Suppliers	Gov't/Post Secondary
Salary	731,250	1,153,000	200,000	130,000	210,375	3,500
Nuclear Revenues	5,049,000		629,398	409,109	543,782	557
Other	322,651		242,044	157,329		
Procurement	631,125	1,200,000	69,482	45,163	68,000	284
Taxes	478,048	60,200	12,350	8,027	391,637	318
New Construction		345,000			202,500	18,000
Totals	7,212,074	2,758,200	1,153,274	749,628	1,416,294	22,659
Employees	8,125	10,968	2,000	1,300	2,475	50

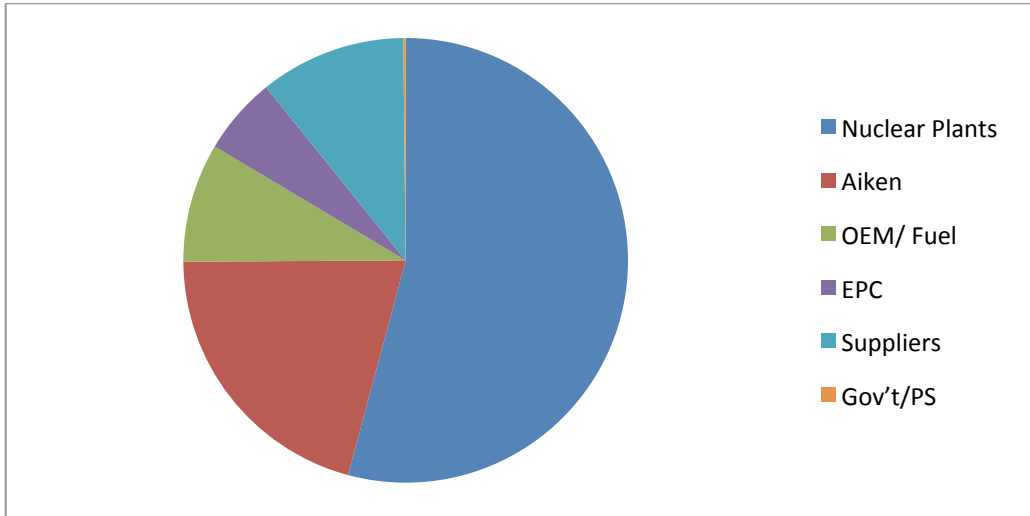


Figure 2: Breakdown of Direct Economic Impact by Category –
Without New Nuclear Plant Construction

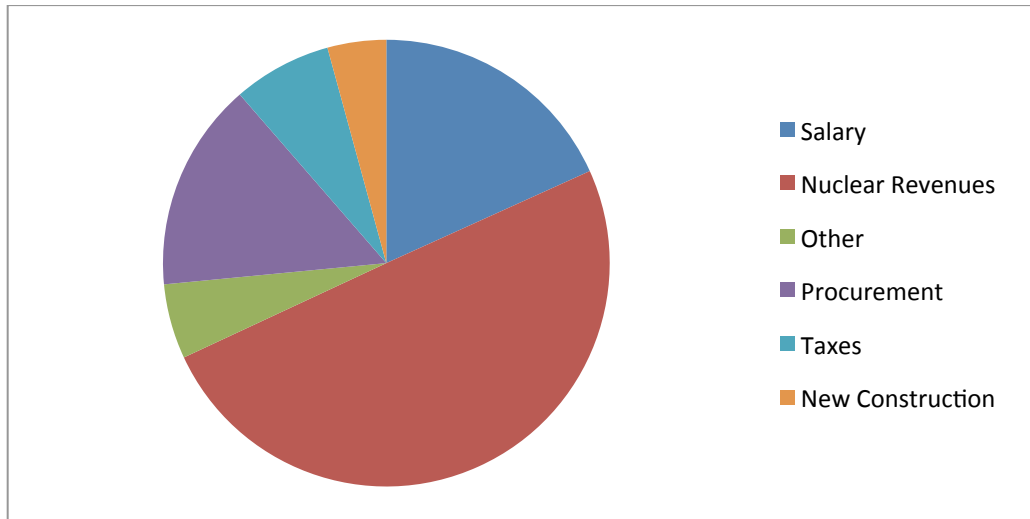


Figure 3: Breakdown of Direct Economic Impact by Segment -
Without New Nuclear Plant Construction

Summary of Direct Impacts With New Construction Included

Table 12 summarizes the total economic impact for each category by segment and category as did Table 11 *except* that Table 12 includes the impact of new nuclear plant construction. The data is an aggregation of that in Tables 4 through 10. *We conclude that the total estimated direct economic impact that the nuclear industry has on the economy of the Carolinas is over \$15.9B.* Figures 4 and 5 graphically depict the relationship among categories and among segments, respectively.

Table 12: Details of Direct Impacts with All Categories (in \$K)

SEGMENT	CATEGORY						
	Nuclear Plants	Aiken	OEM/ Fuel	EPC	Suppliers	Gov't/Post Secondary	New Construct
Salary	731,250	1,153,000	200,000	130,000	210,375	3,500	
Nuclear Revenues	5,049,000		629,398	409,109	543,782	557	
Other	322,651		242,044	157,329			
Procurement	631,125	1,200,000	69,482	45,163	68,000	284	
Taxes	478,048	60,200	12,350	8,027	391,637	318	
New Construction		345,000			202,500	18,000	2,750,000
Totals	7,212,074	2,758,200	1,153,274	749,628	1,416,294	22,659	2,750,000
Employees	8,125	10,968	2,000	1,300	2,475	50	4,221

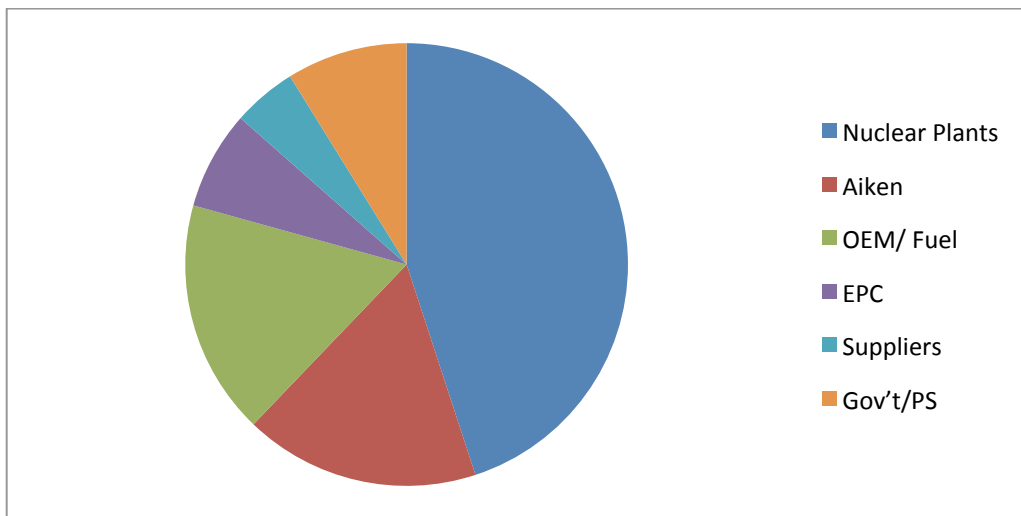


Figure 4: Breakdown of Direct Economic Impact by Category

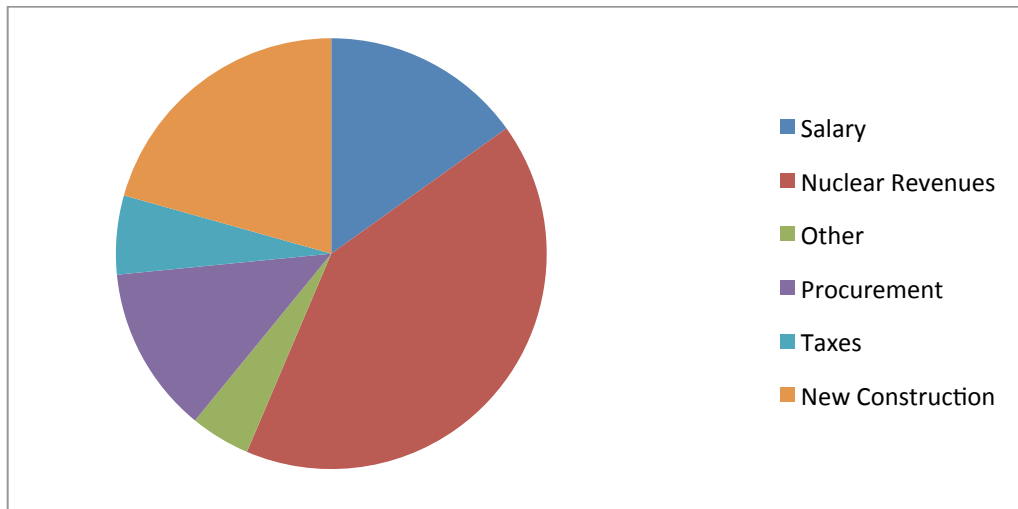


Figure 5: Breakdown of Direct Economic Impact by Segment

Two important points need to be made when interpreting this data:

1) A conservative approach was consciously taken when estimating the direct impact of each category so the direct impacts would in each category would underestimate the actual number. Subject matter experts employed in the nuclear industry scrutinized each of the aggregate inputs from the survey responses to ensure that all data was on the conservative end of a “reasonable” range. Also, for the categories in which an actual count could not be made, a reasonable lower estimate was used.

2) When all of the impacts are summed, the total amount likely overestimates the total direct impact of the nuclear industry on the economy of the Carolinas as interactions in the data are not removed. For example, consider that money an operating plant spends with an EPC company during refueling is counted twice: once as revenue by the EPC company and once as a procurement cost by the operating plant. The data upon which this analysis is based was insufficient to accurately remove this double counting; hence, the sum is reported even though it overestimates the actual total direct impact.

So how should one interpret this data given that the individual category estimates underrepresent the true impact and the sum overestimates it? A “worst case” view can help. Assume that all of the revenues for EPC, OEM/Fuel, and Suppliers are removed. That is, assume all of the revenue from companies in these categories come from operating plants and new construction in the Carolinas and have been accounted for as their procurement costs. Making this change reduces the total direct impact from \$15.9B to approximately \$14.3B (a reduction of about 10%).

5.3 Indirect and Induced Impacts

The IMPLAN (IMPact analysis for PLANning) model utilizes direct impacts as inputs to determine the indirect and induced effects that a project would have on the local economy. It is a

software package that was developed at the University of Minnesota that has become the standard tool for estimating indirect and induced impacts of projects. Even a very cursory web search reveals hundreds of reports that use IMPLAN to estimate the economic impact of a potential project. For example, the following were found on the first two pages of a Google search using the search term “IMPLAN”:

- “Impact Analysis of LA-LB [*Los Angeles – Long Beach*] Dual Ports Disruption”
- A website of the United States Department of Agriculture - Natural Resources Conservation Service with over 50 reports that use IMPLAN
- The website of The Ohio Small Business Development Centers Network with separate reports using IMPLAN on their impact in 12 regions in the State plus a state-wide report.
- “IMPLAN Methodology for the Study of the Impact of Tourism on the Vermont Economy”
- “2012 IMPLAN Summary of Fiscal Reductions to Hospitals Within the State of Tennessee”

IMPLAN is clearly a common tool used to support analyses similar to this nuclear industry study. Therefore, we submit that it is an appropriate tool to estimate the indirect and induced impact of the nuclear industry in the Carolinas.

In order to estimate the indirect and induced economic impacts of the nuclear industry on the economies of North and South Carolina, data from the segment-based analysis was redistributed into four types of economic impact. This was done in order to follow the format used in the 2009 report for comparison purposes and because it aligned with both the direct impacts model described above and the IMPLAN tool’s methodology. The four types of economic impact to be summarized are Employment, Revenue, Procurement, and Taxes—the categories that were the basis for the survey questions. Each type of impact was modeled in IMPLAN as an “activity.” As the data was appropriately scaled prior to being input into IMPLAN, the activities used to classified industry spending patterns were given an activity level of 1.00 in IMPLAN (i.e., the nominal or base level).

In order to separate the indirect and induced impacts of the construction of new nuclear plants from the impacts of all other categories combined, IMPLAN first was executed using the direct impact for all categories combined. Then, IMPLAN was executed for the new nuclear construction case alone. In this way, the impact of the nuclear industry on the economy of the Carolinas could be determined if no new construction existed. This approach was used to be consistent with the conservative approach taken in this analysis. For example, assume that IMPLAN reports the indirect and induced impact as \$1M for a particular set of inputs that contain the addition of one facility in a region. If the inputs are doubled to reflect the addition of two plants in the same area, IMPLAN’s results would be less than \$2M (i.e., not simply doubled) due to interaction effects. By allowing IMPLAN to account for all interactions first, then subtracting the indirect and induced impacts associated with building a new nuclear plant, the most conservative value is obtained for the impact of the other categories on the economy.

The IMPLAN model estimates the total impact of the indirect and induced effects caused by the nuclear industry’s presence in the Carolinas to exceed \$10 Billion (Table 13). However, as discussed previously the relationships between some categories of industries suggests that some double counting of direct impacts occurred. For example, we speculate that some of the procurement costs reported by the operating plants are for services at an OEM/Fuel company that

they reported as revenue. Therefore, we submit that the total indirect and induced impacts of the nuclear industry are in fact somewhat less than the \$10.9B estimated by IMPLAN.

Table 13: IMPLAN Outputs for Indirect and Induced Effects of the Nuclear Industry

Impact Type	Employment	Labor Income (\$K)	Value Added (\$K)	Labor + Value Added (\$K)
Indirect Effect	5,220	\$523,328	\$1,865,278	\$2,388,606
Induced Effect	81,358	\$3,022,917	\$5,521,367	\$8,544,284
Total Effect	86,578	\$3,546,245	\$7,386,645	\$10,932,890

5.4 Indirect and Induced Impacts Associated with New Nuclear Plant Construction

Data from Section 5.2.7 was used as input to IMPLAN to estimate the indirect and induced economic impacts of new nuclear plant construction. Table 14 displays the results from IMPLAN associated with building a single new nuclear power plant in the Carolinas. The employment number represents new jobs that will be created in all types of supporting functions. It seems reasonable that constructing two new units would not double this number because of overlap and interactions; however, even if the impact of the second new unit is only 50% of the first, nearly 6,500 new jobs will be created that have a total indirect and induced impact of over \$650 Million on the surrounding economy. If the impact of the new construction at Plant Vogtle on the Carolinas is 25% for plants physically located with the boundaries of North and South Carolina, the total impact of new construction of VC Summer and Plant Vogtle is estimated to be over \$850 Million.

Table 14: IMPLAN Outputs for Indirect and Induced Effects for 2012 Construction of *One* New Nuclear Power Plant in the Carolinas

Impact Type	Employment	Labor Income (\$K)	Value Added (\$K)	Labor + Value Added (\$K)
Indirect Effect	461	\$19,668	\$31,194	\$50,862
Induced Effect	3,833	\$143,968	\$262,191	\$406,159
Total Effect	4,294	\$163,636	\$293,385	\$457,021

6 Other Impacts

There are other economic impacts associated with the concentration of nuclear-related industries in the Carolinas that are hard to quantify in the same spirit as the numbers in this report; however, they should be mentioned. One is that the concentration of nuclear-related companies in this area attracts other companies. The Aiken area is an example of how a diverse mix of nuclear-related companies is attracted to an area because of the anchor provided by the Savannah River Site (SRS) and other similar industries. Clearly, many if not most of these

companies moved to Aiken because of SRS operations; however, the business has grown and expanded far beyond this initial thrust.

The combination of the number of operating plants and the number of new plants under construction with the density of nuclear-related industries makes the Carolinas an attractive place to conduct business with proper government support. For example, recently Areva began moving much of their operations into the region. Continuing to attract nuclear-related businesses to the region is important to grow the economy and create jobs that pay solid wages. Suppliers move into the region to improve accessibility to their customers. These “suppliers” include manufacturing facilities and research & development centers that, if established, would promote both North and South Carolina to the forefront of progressive organizational efforts and technology development. An area’s civility is also improved by economic growth and creates an alluring relocation option for families and young professionals. From the perspective of the nuclear industry and its supporters, this is an important consideration in combating the aging workforce that currently challenges the industry.

A second effect that impacts both the area’s economy and its visibility is the increase in conventions. Larger cities in the Carolinas like Charlotte, Columbia, Greenville, and Raleigh have become desirable locations to host meetings and conventions related to the nuclear industry—this trend will continue. While the exact estimate of the total economic impact of a convention varies widely in the literature, there is universal agreement that the total includes the direct expenditures of attendees, the indirect effects similar to those described above that include creating jobs for support employees, and induced impacts that, for example, include support employees spending their salary for goods and services. Just to get a feel for the order of magnitude associated with this number, several sources suggest the total impact is in the \$400-\$500 per person, per day range. Hence, a two-day convention with 500 people could have an economic impact of \$0.5M. The population growth in the Carolinas suggests that the region is already an attractive place to relocate—the increased visibility that comes with conventions certainly supports efforts to have companies relocate.

Therefore, there are additional economic impacts that the nuclear industry has on the Carolinas that have not been included in the economic analyses above that are very important. They not only provide actual dollar impact today but also support sustained growth in the future which is critical to the economic health of the two-state area.

7 Conclusions

An analysis of the nuclear industry’s economic impact in North and South Carolina was completed in 2009. Since the completion of the 2009 report, the industry has enjoyed significant growth. This study updates the previous report by evaluating the nuclear industry’s current economic impact and recalibrating growth projections now that the construction of new reactors is underway. The analysis was completed via a survey instrument, subject matter expert interviews, a detailed industrial engineering-based scaling methodology, and use of IMPLAN, benchmark economic software that estimates indirect and induced economic impacts on a region.

The analysis suggests that the nuclear industry in the Carolinas contributes \$15.9B in direct impact and \$11.8B in indirect/induced impact for a total of \$27.7B (Table 15). Even if this is overstated by 10% as discussed before, the total impact still approximately \$25B. Figures 6 and 7 illustrate the percentage of the total impact from both a category and a segment view, respectively.

Table 15: Summary of Total Impact (in \$M)

Impact Type	All Categories except New Nuclear Construction	New Nuclear Construction	Total
Direct	\$13,312	\$2,750	\$16,062
Indirect & Induced	\$10,933	856	\$11,789
Total	\$24,245	\$3,606	\$27,851

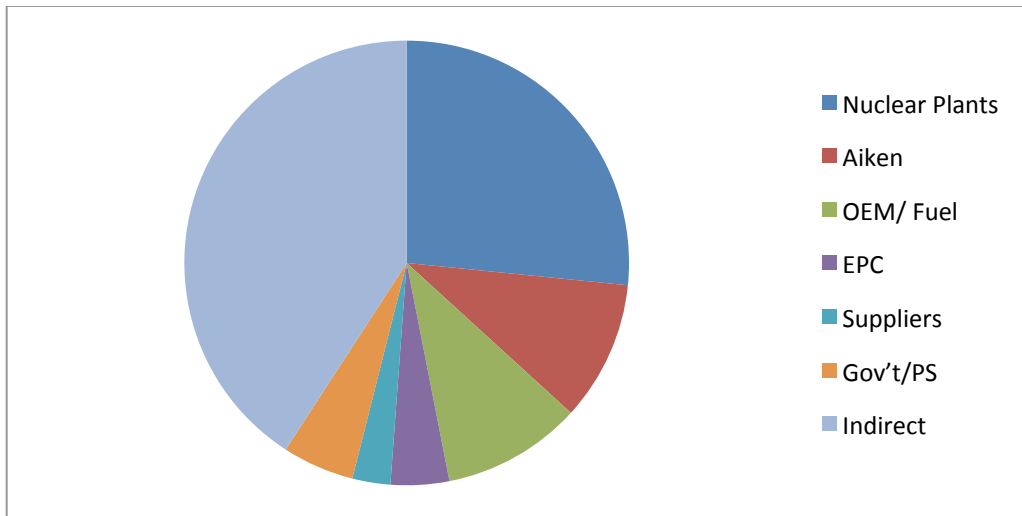


Figure 6: Total Economic Impact by Category

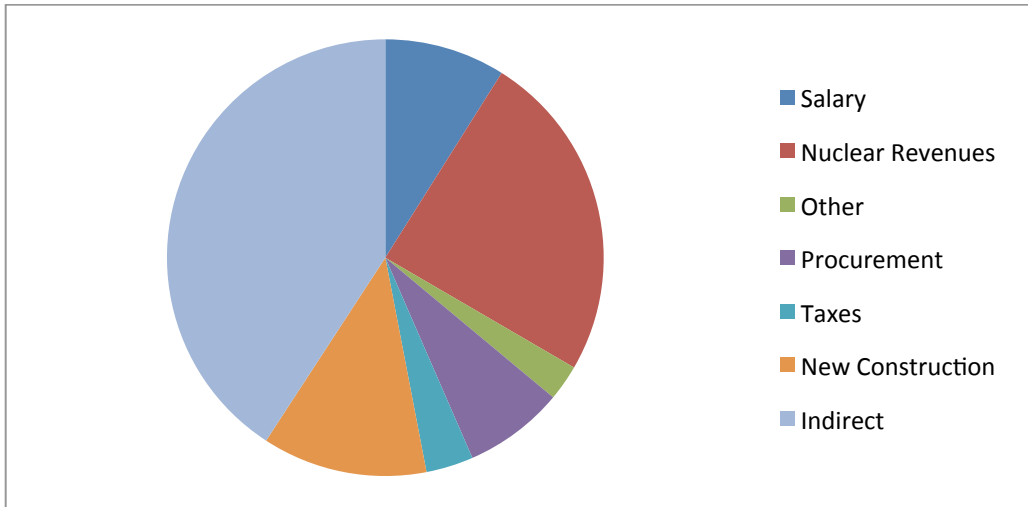


Figure 7: Total Economic Impact by Segment

Specific to the Carolinas' Nuclear Cluster, the results of this study offer a cumulative, quantitative analysis of the nuclear industry's economic impact in the two-state region. Our results provide a collective understanding of current planning, construction, and operations activities in the nuclear industry. We believe that industry growth has compounding economic impacts to the immediate industry and the regional economies in the area. The analysis suggests the total economic impact of the nuclear industry in North and South Carolina is at least \$20B and is quite possibly higher.

References

- Duke Energy. *Brunswick Nuclear Plant*. <http://www.duke-energy.com/power-plants/nuclear/brunswick.asp>
- Duke Energy. *Catawba Nuclear Station*. <http://www.duke-energy.com/power-plants/nuclear/catawba.asp>
- Duke Energy. *Harris Nuclear Plant*. <http://www.duke-energy.com/power-plants/nuclear/harris.asp>
- Duke Energy. *McGuire Nuclear Station*. <http://www.duke-energy.com/power-plants/nuclear/mcguire.asp>
- Duke Energy. *Oconee Nuclear Station*. <http://www.duke-energy.com/power-plants/nuclear/oconee.asp>
- Duke Energy. *Project Overview*. <http://www.duke-energy.com/about-us/nuclear-overview.asp>
- Duke Energy. *Robinson Nuclear Plant*. <http://www.duke-energy.com/power-plants/nuclear/catawba.asp>
- Impact Model for Planning (IMPLAN). www.implan.com
- International Atomic Energy Agency, Power Reactor Information System (IAEA, PRIS 2013) <http://www.iaea.org/pris/>
- International Atomic Energy Agency. (2012). *Nuclear Power Reactors in the World*. Reference Data Series, No. 2. ed. 2012. http://www-pub.iaea.org/MTCD/Publications/PDF/RDS2-32_web.pdf
- New Carolina, South Carolina's Council on Competitiveness. (2013). *Nuclear*. <http://www.newcarolina.org/clusters/nuclear.aspx>
- Nuclear Energy Institute (NEI). (2004). *Economic Benefits of the Duke Power-Operated Nuclear Power Plants, An Economic Impact Study by the Nuclear Energy Institute*. http://www.nei.org/filefolder/economic_benefits_dukepower.pdf
- Nuclear Energy Institute (NEI). *Resources and Stats*. http://www.nei.org/resourcesandstats/documentlibrary/protectingtheenvironment/graphic_sandcharts/emissionsavoidedbytheusnuclearindustrystatebystate/
- Southern Company. (2013). *Nuclear Energy*. <http://www.southerncompany.com/what-doing/energy-innovation/nuclear-energy/home.cshtml#>

Appendix A: Carolinas' Nuclear Cluster Members
(As of the time when this study completed)

Aiken Technical College
AREVA
ASCO Valve/Emerson
Carotek
Central Piedmont Community College
Citizens For Nuclear Technology Awareness
Clemson University
Columbiana Hi Tech
Duke Energy
Economic Development Partnership of Aiken and Edgefield County
Electric Power Research Institute
Engenuity
EnergySolutions
Fluor
Francis Marion University
Gaston College
Generation mPower LLC
Global Quality Assurance
Hendrick Construction
J-E-T-S Nuclear Consultants
K&L Gates
Kontek Industries
Midlands Technical College
Mitsubishi Nuclear Energy Systems
NC Dept. of Commerce
NC State University
Orangeburg Technical College
Pegasus Nuclear
Qualitech Solutions
RCS Nuclear
Savannah River National Lab
SC Dept. of Commerce
SC State University
SC Technical College System
SCANA/ SCE&G
SCRA
SC Universities Research & Education Foundation – SE Universities Nuclear Reactors Institute
for Science /Education

CB&I's Power Group
Siemens Energy – I&C
Spartanburg Community College
SRS– Community Re-Use Organization
Tetra Tech
Tindall Corporation
Toshiba America Nuclear Energy
UNC Charlotte
University of South Carolina
URS Corporation
WACHS Services
WEC Welding / Machining
Weirich Engineering
Westinghouse
York Technical College
Zachry Nuclear Engineering

Appendix B: Survey CNC Member Cover Letter

Your Carolinas Nuclear Cluster (CNC) has asked Clemson University to update THE ECONOMIC IMPACT OF THE NUCLEAR CLUSTER IN THE CAROLINAS, a report originally generated in 2009 that has advanced the conversation about the nuclear industry in the Carolinas. This report quantified the economic benefits of the nuclear industry in North and South Carolina and helped politicians, educators, and policy makers understand the importance of this industry to the region so that they could take appropriate actions to promote it – and they have in a demonstrable way.

We need your help in updating this report by providing information about your company's expenditures related to the nuclear industry *in the Carolinas*. An online survey tool has been provided to make data transfer to Clemson as easy as possible; however, we understand that gathering the data may be easier for some companies versus others. As you will soon find out, the requested data will likely reside in many places like Purchasing, Accounting, and/or Human Resources but we desperately need your help to dig it out and send it to us. Even if you can only fill out the survey partially or provide your best estimate for some responses, this will be beneficial to the research team. As in 2009, survey results will be compiled and reported in aggregate so complete anonymity will be maintained.

The survey is at the following URL: <http://www.surveymonkey.com/s/CarolinasNuclearSurvey>. After starting the survey, you have the option of saving your work and returning to the survey at a later time. Please note that selecting "DONE" on the last page of the survey submits your inputs and ends your participation. We request that you please complete the survey no later than November 30, 2012 so data analysis can take place and the report assembled and distributed by early 2013. Any questions should be directed to Dr. Scott Mason, Professor of Industrial Engineering at mason@clemson.edu who is heading the research effort, or Scott Carlberg with the Carolinas Nuclear Cluster (carlpsc@carolina.rr.com).

According to Clemson's Institutional Review Board policy and procedures, we are required to disclose the following to you:

Risks and Discomforts: We do not know of any risks or discomforts to you in this research study.

Possible Benefits: We do not know of any way you would benefit directly from taking part in this study. However, this research will help us to understand the economic impact of the nuclear sector in the Carolinas and identify opportunities for future growth in this important sector of the economy. In addition, survey results will help foster improved communications of the industry's importance to both internal and external stakeholders.

Protection of Privacy and Confidentiality: We will do everything we can to protect your privacy and confidentiality. We will not tell anybody outside of the research team that you were in this study or what information we collected about your company in particular. All company information will be kept confidential and only summary statistics and trends will be discussed and/or presented. In exchange for your participation in the survey, you will receive a copy of our summary report that will be an anonymous compilation of all responses.

Choosing to Be in the Study: Your company does not have to participate in this study. Your company may choose not to take part and may choose to stop taking part at any time. Your company will not be punished in any way if you decide not to be in the study or to stop taking part in the study.

Contact Information: If you have any questions or concerns about this study or if any problems arise, please contact Dr. Mason at 864-656-5645.

If you have any questions or concerns about your rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-6460 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC's toll-free number, 866-297-3071.

Thank you for your consideration!
The Clemson Research Team

Appendix C: Survey Non-CNC Member Cover Letter

This is an email to organizations that work in the nuclear energy industry that have a Carolinas presence. This is sent on behalf of a nonprofit industry association -- the *Carolinas Nuclear Cluster* (CNC). Since 2008 the CNC has represented organizations such as AREVA, Duke, Progress, SCANA, Shaw, SRS, URS and Westinghouse ... and more than 45 others as we build the nuclear industry in the Carolinas to serve our states and a multi-national market.

One activity the CNC did in 2009 was the first-ever measure of the economic impact of our industry in our states. This report quantified the economic benefits of the nuclear industry in North and South Carolina and helped politicians, educators, and policymakers understand the importance of this industry to the region so that they could take appropriate actions to promote it - and they have in a demonstrable way.

We are updating the economic impact study and ask for your help, please. Clemson University will handle the update. We ask for your help by providing information about your company's expenditures related to the nuclear industry in the Carolinas. **NOTE:** Your information is confidential—no one outside the immediate Clemson research team will see any individual company data. As in 2009, survey results will be compiled and reported in aggregate so complete anonymity will be maintained.

An online survey tool has been provided to make data transfer to Clemson as easy as possible; however, we understand that gathering the data may be easier for some companies versus others. As you will soon find out, the requested data will likely reside in many places like Purchasing, Accounting, and/or Human Resources but we need your help to dig it out and send it to us. Even if you can only fill out the survey partially or provide your best estimate for some responses, this will be beneficial to the research team.

The survey is at <http://www.surveymonkey.com/s/CarolinasNuclearSurvey>. After starting the survey, you have the option of saving your work and returning to the survey at a later time. Please note that selecting DONE on the last page of the survey submits your inputs and ends your participation. We request that you please complete the survey no later than November 30, 2012, so data analysis can take place and the report assembled and distributed by early 2013.

Any questions should be directed to Dr. Scott Mason, Professor of Industrial Engineering at mason@clemsion.edu who is heading the research effort. If you have questions about the Carolinas Nuclear Cluster, contact its manager, Scott Carlberg at carlpsc@carolina.rr.com. We hope we can include you in this survey and provide you with the summary of results.

Thank you for your consideration!

The Clemson Research Team

Appendix D: Survey

The following screen captures depict the survey questions presented to the nuclear industry members. The appearance of a North or South Carolina in the survey response box depended on how the respondent first indicated their firm's affiliation in the Carolinas. For the sake of brevity, while each survey question is shown, not all North and South Carolina response options are depicted.

Introduction

Your Carolinas Nuclear Cluster (CNC) has asked Clemson University to update THE ECONOMIC IMPACT OF THE NUCLEAR CLUSTER IN THE CAROLINAS, a report originally generated in 2009 that has advanced the conversation about the nuclear industry in the Carolinas. This report quantified the economic benefits of the nuclear industry in North and South Carolina and helped politicians, educators, and policy makers understand the importance of this industry to the region so that they could take appropriate actions to promote it – and they have in a demonstrable way.

We need your help in updating this report by providing information about your company's expenditures related to the nuclear industry in the Carolinas. An online survey tool has been provided to make data transfer to Clemson as easy as possible; however, we understand that gathering the data may be easier for some companies versus others. As you will soon find out, the requested data will likely reside in many places like Purchasing, Accounting, and/or Human Resources but we desperately need your help to dig it out and send it to us. Even if you can only fill out the survey partially or provide your best estimate for some responses, this will be beneficial to the research team. As in 2009, survey results will be compiled and reported in aggregate so complete anonymity will be maintained.

After starting the survey, you have the option of saving your work and returning to the survey at a later time. Please note that selecting "DONE" on the last page of the survey submits your inputs and ends your participation. We request that you please complete the survey no later than November 30, 2012 so data analysis can take place and the report assembled and distributed by early 2013. Any questions should be directed to Dr. Scott Mason, Professor of Industrial Engineering at mason@clemson.edu who is heading the research effort, or Scott Carlberg with the Carolinas Nuclear Cluster (carlpsc@carolina.rr.com).

Thank you for your consideration!
The Clemson Research Team

Data Needed for Survey

The following list describes the types of information that we will be requesting about your company during the survey.

1. Employment and Payroll

* Employment and payroll data for your staff who are affiliated with nuclear-related activities

2. Procurement Expenses

* Ongoing Operations: An estimate of the total dollar value of purchases made for nuclear-related operations and maintenance for either calendar year 2010 or fiscal year 2011, categorized according to the state in which the vendor is primarily affiliated.

* New Construction: An estimate of your firm's total average annual expenditures on new nuclear construction over the next decade.

3. State and Local Taxes

* South/North Carolina property taxes paid in 2010

* South/North Carolina (state or local) taxes paid in 2010

* South/North Carolina (state or local) income taxes paid in 2010

* Other South/North Carolina business taxes and fees paid in 2010

4. Gross Revenues from Nuclear Related Activities

* An estimate of your company's gross revenues from nuclear-related activities

Respondent Demographics

* 1. In which state(s) does your company have a physical business location?

South Carolina

North Carolina

Both Carolinas

Employment and Payroll

Employment and payroll data for your staff who are affiliated with nuclear-related activities

10. Enter the number of full-time equivalent employees in each annual salary range (i.e., without fringe benefits) based in South Carolina as of July 1, 2011.

Less than \$10,000	<input type="text"/>
\$10,001 to \$15,000	<input type="text"/>
\$15,001 to \$25,000	<input type="text"/>
\$25,001 to \$35,000	<input type="text"/>
\$35,001 to \$50,000	<input type="text"/>
\$50,001 to \$75,000	<input type="text"/>
\$75,001 to \$100,000	<input type="text"/>
\$100,001 to \$150,000	<input type="text"/>
\$150,001 and above	<input type="text"/>

11. Enter the number of full-time equivalent employees in each annual salary range (i.e., without fringe benefits) based in North Carolina as of July 1, 2011.

Less than \$10,000	<input type="text"/>
\$10,001 to \$15,000	<input type="text"/>
\$15,001 to \$25,000	<input type="text"/>
\$25,001 to \$35,000	<input type="text"/>
\$35,001 to \$50,000	<input type="text"/>
\$50,001 to \$75,000	<input type="text"/>
\$75,001 to \$100,000	<input type="text"/>
\$100,001 to \$150,000	<input type="text"/>
\$150,001 and above	<input type="text"/>

12. Enter the number of full-time equivalent employees in each total compensation range (i.e., with fringe benefits) based in South Carolina as of July 1, 2011.

Less than \$10,000	<input type="text"/>
\$10,001 to \$15,000	<input type="text"/>
\$15,001 to \$25,000	<input type="text"/>
\$25,001 to \$35,000	<input type="text"/>
\$35,001 to \$50,000	<input type="text"/>
\$50,001 to \$75,000	<input type="text"/>
\$75,001 to \$100,000	<input type="text"/>
\$100,001 to \$150,000	<input type="text"/>
\$150,001 and above	<input type="text"/>

13. Enter the number of full-time equivalent employees in each total compensation range (i.e., with fringe benefits) based in North Carolina as of July 1, 2011.

Less than \$10,000	<input type="text"/>
\$10,001 to \$15,000	<input type="text"/>
\$15,001 to \$25,000	<input type="text"/>
\$25,001 to \$35,000	<input type="text"/>
\$35,001 to \$50,000	<input type="text"/>
\$50,001 to \$75,000	<input type="text"/>
\$75,001 to \$100,000	<input type="text"/>
\$100,001 to \$150,000	<input type="text"/>
\$150,001 and above	<input type="text"/>

14. If income ranges are not available, please provide the number of full-time equivalent employees by state as of July 2011.

South Carolina	<input type="text"/>
North Carolina	<input type="text"/>
Other	<input type="text"/>

15. If income ranges are not available, please provide total compensation by state as of July 2011.

South Carolina	<input type="text"/>
North Carolina	<input type="text"/>
Other	<input type="text"/>

Procurement Expenses

Please estimate the total dollar value of purchases made for nuclear-related operations and maintenance for either calendar year 2010 or fiscal year 2011. Categorize purchases according to the state in which the vendor is primarily affiliated.

22. South Carolina:

Inorganic chemicals	<input type="text"/>
Engineering services	<input type="text"/>
Personnel supply services	<input type="text"/>
Transformers	<input type="text"/>
Wholesale trade	<input type="text"/>
Maintenance and repair services	<input type="text"/>
Non clay refractories	<input type="text"/>
Federal Government	<input type="text"/>
Business Associations	<input type="text"/>
Insurance carriers	<input type="text"/>
Others:	<input type="text"/>

23. North Carolina:

Inorganic chemicals	<input type="text"/>
Engineering services	<input type="text"/>
Personnel supply services	<input type="text"/>
Transformers	<input type="text"/>
Wholesale trade	<input type="text"/>
Maintenance and repair services	<input type="text"/>
Non clay refractories	<input type="text"/>
Federal Government	<input type="text"/>
Business Associations	<input type="text"/>
Insurance carriers	<input type="text"/>
Others:	<input type="text"/>

24. New Construction: Estimate your firm's total average annual expenditures on new nuclear construction over the next decade.

South Carolina	<input type="text"/>
North Carolina	<input type="text"/>

State and Local Taxes

27. Please specify state and local taxes paid:

South Carolina property taxes paid in 2010:

North Carolina property taxes paid in 2010:

South Carolina (state or local) taxes paid in 2010:

North Carolina (state or local) taxes paid in 2010:

South Carolina (state or local) income taxes paid in 2010:

North Carolina (state or local) income taxes paid in 2010:

Other South Carolina business taxes and fees paid in 2010:

Other North Carolina business taxes and fees paid in 2010:

Gross Revenues from Nuclear Related Activities

28. Please estimate your company's gross revenues from nuclear-related activities. For some plants, this can be estimated by multiplying kilowatt hours sold and the average wholesale price for electricity for the calendar year 2010 or fiscal year 2011.

Company Information

This is the last page of the survey. If you are completely finished with the survey, you may click the "Done" button below. However, if you wish to return to it later, please click the "Exit this survey" button at the top right of the screen.

29. Please enter the company with which you are affiliated. (Note: Optional)

30. If you wish to receive a copy of the results from this survey, please enter your email address below: