

The Economic Benefits of Texas' Nuclear Power Plants

An Analysis by the Nuclear Energy Institute

December 2015



NUCLEAR ENERGY INSTITUTE

www.nei.org

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Executive Summary

The Texas nuclear plants support more than 9,000 jobs in Texas.

Operating the four Texas nuclear plants generates \$4.4 billion of annual economic output in their local communities and statewide.

There are two nuclear power facilities in Texas, with two reactors each:

- Comanche Peak Nuclear Power Plant in Somervell County (Comanche Peak 1 and 2)
- South Texas Project Electric Generating Station in Matagorda County (South Texas Project 1 and 2)

Comanche Peak is operated by Luminant, a subsidiary of Dallas-based Energy Future Holdings. South Texas Project is operated by STP Nuclear Operating Company (STPNOC) and owned jointly by NRG Energy (44 percent), CPS Energy (40 percent) and Austin Energy (16 percent). CPS Energy is the municipal utility owned by the city of San Antonio, and Austin Energy is the municipal utility owned by the city of Austin.

The four nuclear reactors have been an integral part of the state's clean energy portfolio and economic fabric since they began operating in the 1980s and 1990s. In addition to the reliable, emission-free electricity that the plants generate and the jobs and economic stimulus they provide, the companies' involvement in their local communities makes them significant economic contributors to their surrounding counties and the state of Texas.

Based on data provided by Luminant and STPNOC on employment and operating expenditures, the Nuclear Energy Institute (NEI) conducted an analysis of the employment and economic impact of these facilities. The analysis used a nationally recognized model to estimate the facilities' economic impacts on the economy in their local counties and the state of Texas. Regional Economic Models, Inc. (REMI) developed the Policy Insight Plus (PI+) economic impact modeling system, the methodology employed in this analysis. (See Section 5 for more information on the REMI methodology.)

Key Findings

The Texas nuclear power operations support:

Thousands of high-skilled jobs. About 2,800 people work at the Luminant and STPNOC nuclear energy facilities in Texas. The operation of the Texas nuclear plants also supports about 7,000 additional jobs in other industries in the state, so operating these facilities results in more than 9,000 jobs in Texas.

Economic stimulus. Operating the four Texas nuclear reactors generates \$4.4 billion of annual economic output in their local communities and statewide. Over the next 25 years, from 2015 to 2040, they are estimated to generate nearly \$140 billion in economic output in the state of Texas. For every dol-

The operations of the Texas nuclear plants result in a total tax impact of approximately \$685 million in revenue to the local, state and federal governments each year.

Without the carbon-free electricity produced by these nuclear plants, an additional 28 million metric tons of carbon dioxide would be released annually, the equivalent of the emissions from more than 6 million cars.

lar of output from these plants, the state economy produces \$1.91. Further, the operation of these plants contributes \$2.9 billion to Texas's gross state product each year.

Tax impacts. Comanche Peak is the largest taxpayer in Somervell County, and South Texas Project is one of the largest taxpayers in Matagorda County. Each plant pays about \$70 million a year in state and local taxes. When calculating the total tax impact of their operations and secondary economic effects, the Texas nuclear plants result in approximately \$685 million in tax revenue to the local, state and federal governments each year.

Clean electricity for Texas. The four nuclear reactors generate 9 percent of Texas' electricity and 50 percent of the state's carbon-free electricity. Without the carbon-free electricity produced by these nuclear plants, an additional 28 million metric tons of carbon dioxide would be released annually, the equivalent of the emissions from more than 6 million cars. For perspective, Texas' electric sector emits more than 258 million metric tons of carbon dioxide annually. Without the nuclear plants, the Texas electric sector's CO₂ emissions would increase nearly 10 percent.

Reliability leaders. During full-power operations, the four reactors provide 4,960 megawatts of around-the-clock electricity for Texas homes and businesses. Over the last 10 years, the facilities have operated at an average 93 percent of capacity, which is above the industry average and significantly higher than all other forms of electric generation. This reliable production helps offset the potentially severe price volatility of other energy sources (e.g., natural gas) and the intermittency of renewable electricity sources. Nuclear power plants provide reliable electricity to businesses and consumers, and help prevent power disruptions that could lead to lost economic output, higher business costs, potential loss of jobs and losses to consumers.

Balanced portfolio of electricity options. Nuclear energy produces 9 percent of Texas' electricity, and the four nuclear reactors play an important role in maintaining a balanced electric portfolio in the state.

Community and environmental leadership. Luminant and STPNOC are corporate leaders in Texas and their communities, supporting education initiatives, environmental and conservation projects, and numerous charitable organizations.



Comanche Peak Nuclear Power Plant

First dates of operation

Comanche Peak 1 - 1990
 Comanche Peak 2 - 1993

Location

Glen Rose, Texas, 60 miles southwest of Fort Worth

License Expiration Years

Comanche Peak 1 - 2030
 Comanche Peak 2 - 2033

Reactor Types

Pressurized water

Total Electrical Capacity (Megawatts)

Comanche Peak 1 - 1,205
 Comanche Peak 2 - 1,195



South Texas Project Electric Generating Station

First dates of operation

STP 1 - 1988
 STP 2 - 1989

Location

Bay City, Texas, 90 miles southwest of Houston

License Expiration Years

STP 1 - 2027
 STP 2 - 2028

Reactor Types

Pressurized water

Total Electrical Capacity (Megawatts)

STP 1 - 1,280
 STP 2 - 1,280

Section 1 Background and Generation History

Reliable Electricity Generation

The performance of the four nuclear reactors in Texas (Comanche Peak 1 and 2; South Texas Project 1 and 2) over the last decade has exceeded the industry’s average capacity factor for the same period. In 2014, these four reactors operated at an average capacity factor of 90.4 percent. Capacity factor is the ratio of actual electricity generated to the maximum possible electric generation during the year, and serves as a measure of a power plant’s efficiency.

The nuclear plants in Texas generated 39 billion kilowatt-hours of electricity in 2014—about 9 percent of the electricity generated in the state. South Texas Project unit 2 produced 11.6 billion kilowatt-hours last year, the highest in site history and the highest net output for a U.S. nuclear power reactor in 2014. The four reactors together provide enough electricity for about three million people year-round, or 2.9 million households if all of the electricity went to the residential sector.

Texas ranks seventh in the nation in both generating capacity and net electricity generation from nuclear power. Generation from the state’s nuclear power plants accounts for five percent of the nation’s nuclear power.

In addition to providing abundant electricity, the four reactors generate low-cost electricity, which helps keep retail prices for customers lower than the U.S. average. In 2014, Texas customers paid 11.8 cents per kilowatt-hour for electricity compared to the U.S. average of 12.5 cents per kilowatt-hour.¹

Thousands of High-Skilled, Well-Paying Local Jobs

The Texas nuclear plants provide affordable electricity to the state and a large number of well-paying jobs in their own and neighboring counties. Approximately 2,800 people work at the nuclear plants in Texas.

Most jobs at nuclear power plants require technical training and are typically among the highest-paying jobs in the area. Nationwide, nuclear energy jobs pay 36 percent more than average salaries in a plant’s local area.

¹ Energy Information Administration

Safe and Clean for the Environment

Nuclear facilities generate large amounts of electricity without emitting greenhouse gases. State and federal policymakers recognize nuclear energy as an essential source of safe, reliable electricity that meets both our environmental needs and the state's demand for electricity.

In 2014, the four reactors prevented the release of 28 million metric tons of carbon dioxide,² about the same amount released by 6 million cars each year. Overall, Texas' electric sector emits more than 258 million tons of carbon dioxide annually. The four reactors also prevent the emission of more than 13,000 tons of nitrogen oxide—equivalent to that released by nearly half a million cars—as well as 43,000 tons of sulfur dioxide. Sulfur dioxide and nitrogen oxide are precursors to acid rain and urban smog.

² Emissions prevented are calculated using regional fossil fuel emission rates from the U.S. Environmental Protection Agency and plant generation data from the U.S. Energy Information Administration.

Section 2

Economic Impacts on Local and Texas Economies

NEI used the REMI PI+ model to analyze economic and expenditure data provided by the plants to develop estimates of their economic benefits (more information on REMI can be found in Section 5).

The economic impacts of the Comanche Peak and South Texas Project nuclear plants consist of direct and secondary impacts. The main variables used to analyze these impacts are:

Output

The direct output is the value of power the facilities produce. The secondary output is the result of how this production alters subsequent outputs among other industries and how those employed at the facilities influence the demand for goods and services within the community.

Labor Income

The direct labor income is the workers' earnings at the Texas facilities. The secondary labor income is the workers' earnings in the other industries as a result of the nuclear facilities.

Employment

The direct employment is the number of jobs at the Texas nuclear plants. Secondary employment is the number of jobs in the other industries as a result of the nuclear facilities.

Gross State Product

Gross state product is the value of goods and services produced by labor and property at the Texas facilities—e.g., sales minus intermediate goods. In the REMI model, electricity is the final good from a nuclear plant. Intermediate goods are the components purchased to make that electricity.

Substantial Economic Drivers

The direct output value in 2015 of the Texas nuclear facilities is estimated to total \$2.29 billion (the value of the electricity produced at the plants), with a total economic impact on the Texas economy of \$4.4 billion. For every dollar of output from operating these plants, the Texas economy produced \$1.91.

Further, these plants' output in Texas is estimated to contribute \$2.9 billion to Texas' gross state product (GSP) every year and, by 2040, their annual GSP

contribution reaches \$4.4 billion.

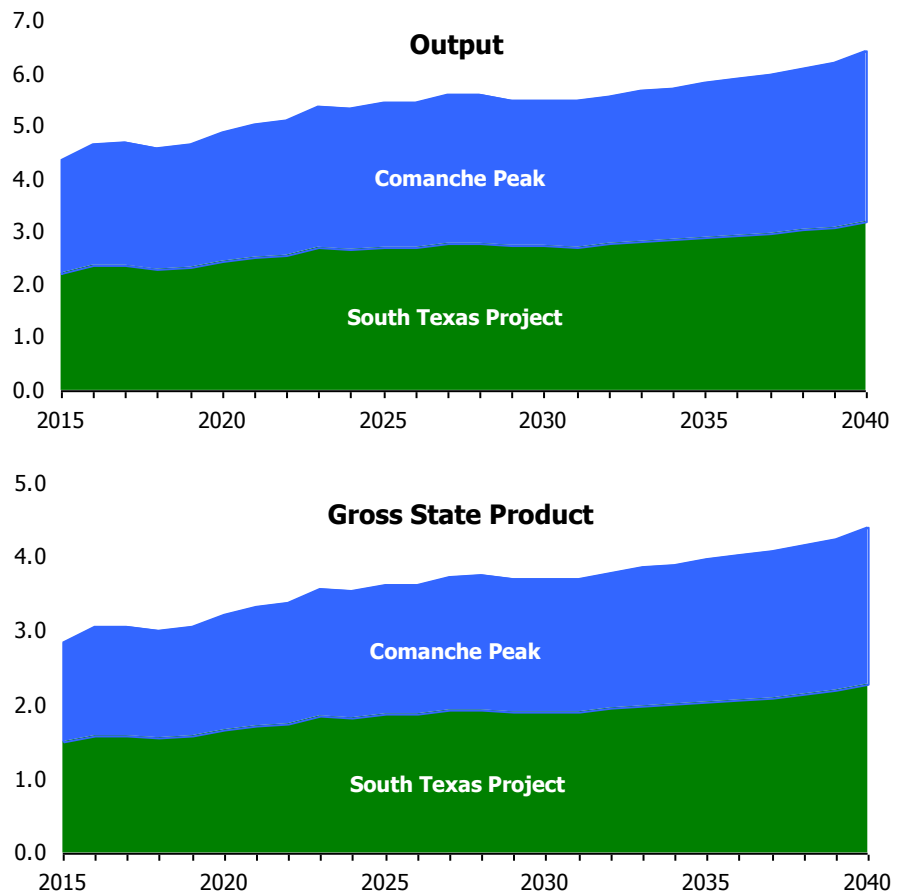
Figure 2.0 shows the value of the Texas nuclear plants' total output and contributions to the gross state product of the state of Texas through 2040, using electricity price forecast data from the Energy Information Administration.

The plants' largest impacts are on the utilities sector. Their next greatest impact in Texas is on the manufacturing sector followed by the professional/scientific/technical services sector. Other sectors that benefit from the plants' operations in Texas include mining, finance and insurance, and real estate. The plants also have a substantial economic benefit on the public sector—state and local governments—from the taxes they pay directly, the taxes their employees and contractors pay, and from taxes paid by the thousands of businesses and people who benefit from the operation of these facilities.

A fuller depiction of the sectors in Texas that benefit from the facilities is in

The Texas nuclear plants are estimated to contribute \$2.9 billion to Texas' gross state product (GSP) and, by 2040, their annual GSP contribution reaches \$4.4 billion.

Figure 2.0
Texas Nuclear Plants' Total Output and Gross State Product Contribution to Texas (dollars in 2015 billions)*



* Regional electricity price forecasts based on the Energy Information Administration's Annual Energy Outlook 2015.

Table 2.0 below.

Job Diversity and Creation

The Texas nuclear plants' output also stimulates the state's labor income and employment. The Texas nuclear plants employ about 2,800 people in full-time jobs. These jobs stimulate nearly 7,000 additional jobs in other sectors in the state.

Table 2.1 (next page) details the numbers and types of jobs that Comanche Peak and South Texas Project are estimated to support in 2015. The plants' own workers are included in the occupation categories in the table. About 30 percent of the jobs are in sales, jobs related to sales, and office workers and administrative support jobs. About 12 percent of the jobs are management,

Table 2.0
Texas' Nuclear Plants' Estimated Total Output on Texas' Economic Sectors in 2015
(in millions of 2015 dollars)

Sector Description	Comanche Peak	South Texas Project	Total
Utilities	1,554	1,670	3,225
Manufacturing	66	100	166
Professional, Scientific, and Technical Services	97	68	165
Mining	65	43	108
Finance and Insurance	45	47	92
Real Estate and Rental and Leasing	41	46	88
Retail Trade	37	45	82
State and Local Government	50	31	82
Health Care and Social Assistance	31	40	71
Administrative and Waste Management Services	36	22	58
Wholesale Trade	21	29	50
Information	21	21	42
Other Services, except Public Administration	21	18	39
Transportation and Warehousing	17	15	31
Accommodation and Food Services	14	16	30
Construction	7	8	15
Arts, Entertainment, and Recreation	5	5	10
Educational Services	3	4	7
Management of Companies and Enterprises	3	4	6
Forestry, Fishing, and Related Activities	<1	<1	<1
Total	2,137	2,230	4,368

business or financial jobs. Nine percent of the jobs supported are in occupations related to installation, maintenance, and repair. Another 8 percent are production jobs, 6 percent in health care, while 7 percent are in computer, mathematical, architecture, and engineering occupations.

Economic Stimulus Through Taxes

The operation of the four reactors results in a total annual tax impact of about \$685 million to the local, state and federal governments. This includes the direct impact and secondary impacts, because plant expenditures increase economic activity, leading to additional income and value creation and, therefore, to additional tax revenue from other sectors.

The plants' impacts on their local and state economies are substantial. In addi-

Table 2.1
Texas Nuclear Plants' Estimated Support of Direct and Secondary Jobs in Texas in 2015

Occupation	Comanche Peak	South Texas Project	Total
Sales and Related; Office and Administrative	1,341	1,207	2,548
Management, Business, and Financial	601	446	1,047
Installation, Maintenance, and Repair	393	440	833
Production	343	370	713
Computer, Mathematical, Architecture, Engineering	383	268	651
Building and Grounds; Cleaning and Maintenance; Personal Care and Services	296	286	582
Health Care	251	272	523
Transportation and Material Moving	276	215	491
Food Preparation and Service	231	232	463
Education, Training, Library	204	140	344
Construction and Extraction	139	104	243
Protective Service	120	81	201
Arts, Design, Entertainment, Sports, Media	74	49	123
Life, Physical, and Social Science	61	41	102
Legal	64	28	92
Community and Social Service	49	38	87
Farming, Fishing, and Forestry	5	5	10
Total	4,831	4,222	9,053

tion to the \$2.9 billion in gross state product, the companies are estimated to generate \$143 million in taxes from the plants and their activities for Texas and local governments every year (see Table 2.2).

Large Multiplier Effects

By producing affordable, reliable electricity, Luminant's and South Texas Project's nuclear operations are hubs of economic activity in Texas as well as a boost to the national economy. Table 2.3 shows the multipliers and summarizes the total effects from each plant. The multipliers show that for every dollar of output generated, the plants stimulate another \$1.91 in economic output in the state.

Table 2.2
Estimated Total Tax Impacts of the Texas Nuclear Plants in 2015
*(in 2015 millions of dollars)**

Facility	State and Local	Federal	Total
Comanche Peak	68	258	327
South Texas Project	74	283	358
Total Taxes	143	542	685

* Calculated based on a percentage of gross state product.

Table 2.3
Texas Nuclear Plants' Impacts on the Texas Economy in 2015 *(dollars in 2015 billions)*

Facility / Description	Direct	Secondary	Total	Multiplier
Comanche Peak				
Output	\$1.11	\$1.03	\$2.14	1.93
Employment	908	3,923	4,831	5.32
Gross State Product			\$1.36	
South Texas Project				
Output	\$1.18	\$1.05	\$2.23	1.89
Employment	1,153	3,069	4,222	3.66
Gross State Product			\$1.49	
Total				
Output	\$2.29	\$2.08	\$4.37	1.91
Employment	2,061	6,992	9,053	4.39
Gross State Product			\$2.86	

The plants also stimulate a large number of jobs. For every direct job, four additional jobs are supported in a wide variety of occupations and industries throughout the state of Texas.

Economic Impact Differences Between the Plants

The analysis shows that the South Texas Project nuclear plant has a slightly higher economic output and gross-state-product impact on its neighboring counties and the state of Texas than the Comanche Peak nuclear plant, while Comanche Peak has a slightly higher impact on the number of jobs supported in its local counties and across the state.

Some of these differences can be attributed to the locations of the plants, their employees and suppliers; however, most of the differences should be attributed to the differences in electricity production capacity, numbers of direct and contractor employees, the types of goods and services that the plants purchase in order to operate, and the types of jobs supported in the community.

The combined net summer electrical capacity of the South Texas Project reactors is 2,560 MW, and the combined net summer electrical capacity of the Comanche Peak reactors is 2,400 MW, a 160 MW difference. For perspective, a 160-MW power plant can serve approximately 107,000 people, or a city about the size of College Station, Texas.

South Texas Project employs about 1,153 people directly in full-time jobs, slightly more than Comanche Peak, but this analysis shows that Comanche Peak's impact on the number of jobs supported in its local counties and across the state is slightly higher than STP's. Much of this difference can be attributed to the different nature of the areas in Texas where the two plants operate, and the plants' secondary effects on distant communities (like El Paso and Amarillo).

Refueling and Maintenance Outages

Every 18 months, in either the spring or the fall when electricity demand is lowest, each nuclear reactor in Texas is shut down to be refueled. During these outages, which typically last about one to two months, plant operators replace one-third of the reactor's uranium fuel with new, fresh fuel.

At the same time, they conduct inspections and specialized maintenance to repair or replace equipment, valves, electrical circuitry, other components and structures. Much of this maintenance and construction cannot be performed while the reactors are operating. These outages require that the plants supplement their workforces with an additional 800 to 2,000 skilled craft workers—such as welders, pipefitters and construction workers. Some of these technicians arrive from elsewhere in Texas and some from all over the country.

These contractors are a source of substantial, additional economic energy for hotels, restaurants and related businesses in the towns that host them.

Depending on the scope of the maintenance, including construction, required in a particular outage, outage expenditures can range from \$20 million to several hundred million dollars. In addition to the nuclear fuel itself—and substantial labor costs—the plants purchase equipment, special nuclear components and construction materials from suppliers in their communities, elsewhere in Texas and other parts of the country.

License Renewal

Nuclear energy facilities in the United States are initially licensed to operate for 40 years. The term reflects the amortization period generally used by electric utility companies for large capital investments. The Atomic Energy Act of 1954 permits nuclear plants to renew their operating licenses.

The U.S. Nuclear Regulatory Commission (NRC) subjects all nuclear power reactors to a rigorous program of inspection, preventive and corrective maintenance, equipment replacement, and extensive equipment testing. These programs ensure that equipment continues to meet safety standards, no matter how long the plant has been operating.

NRC regulations allow for a license renewal period of up to an additional 20 years of operation. The NRC's review of an application for license renewal has four elements: safety review, environmental review, inspections, and an independent review by the Advisory Committee on Reactor Safeguards (ACRS).

Nuclear plant owners must prepare an application that demonstrates safe operation and protection of the environment can be assured during the additional license period. The application can range from 500 to 2,000 pages, takes approximately two years to prepare, and costs approximately \$20 million for preparation and NRC review. The NRC's comprehensive, two-year review includes numerous on-site inspections and analysis of technical data. This results in the issuance of environmental impact and safety evaluations.

In deciding whether to pursue license renewal, a company will consider the economic situation of its plant, which can include location, capital costs, competition and regional electricity needs.

At the end of a power reactor's 40-year license, initial capital costs for the plant will have been fully recovered and the decommissioning costs will have been fully funded. Any incremental cost incurred over the original license period could be amortized over a longer period of time because of license renewal, further reducing the cost of electricity. For many nuclear energy facilities, license renewal represents the most inexpensive option for future electricity generation.

In October 2010, South Texas Project applied to the NRC to renew the operating licenses of its two reactors for an additional 20 years. If the NRC approves the applications, STP's renewed licenses will expire in 2047 (unit 1) and 2048 (unit 2). Comanche Peak also plans to apply to renew the licenses of its two reactors. If the NRC approves the applications, its renewed licenses would expire in 2050 (unit 1) and 2053 (unit 2).

When a nuclear reactor operates for an additional 20 years, it continues for that same period to contribute to its local and state economies (and tax base) with a cumulative economic impact of many billions of dollars.

Section 3

Community Leadership and Environmental Protection

In addition to the economic benefits that South Texas Project and Comanche Peak contribute to their local communities, the state of Texas and the United States in the form of jobs, income and taxes, the companies and their employees contribute to their communities in other ways.

Both STP and Comanche Peak have a strong tradition of community involvement that helps to strengthen and enrich the communities in which they operate. Each Texas nuclear plant has a community outreach program designed to build trust, support and goodwill with plant neighbors, community leaders and elected officials.

STPNOC and Luminant also strengthen Texas communities through charitable contributions for community organizations and initiatives, educational programs that teach and promote the benefits of nuclear energy, environmental programs that improve the quality of the environment, and civic engagement activities that build trust and goodwill.

Contributions and Sponsorships

Employees of both nuclear energy facilities are leading corporate citizens in their home and neighboring counties. They serve their communities as volunteer firefighters, scout leaders, emergency medical technicians, and board members of chambers, school boards and community organizations. They contribute thousands of hours to civic and community organizations and make significant donations to charities each year.

At the South Texas Project nuclear plant, employees serve on school boards, city councils, chambers, navigation districts and charitable organizations. This investment by employees, supported by the company, has resulted in strong community support for STP which, in turn, has championed more than 60 different charitable agencies, schools, organizations and fundraising activities.

STP is the largest contributor annually—approximately \$200,000—to the Matagorda County United Way, which supports 22 non-profit agencies. The United Way is the largest source of non-governmental funding of social services for area non-profit organizations:

- STP President and CEO Dennis Koehl serves on the United Way Board of Directors.
- STP sponsors the Annual United Way Day of Caring, in which volunteers work on projects throughout the local community. More than 120 volunteers participated in the most recent event, many from STP.

STP was a founding member of the Boys & Girls Club of Bay City and Matagor-

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da County. Celebrating its fourth anniversary in November 2014, the Boys & Girls Club averages nearly 300 attendees per day. Programs focus on academics, the arts, leadership and character. Several STP employees have children who attend the Boys & Girls Club regularly.

STP is the largest contributor to the annual Matagorda County American Cancer Society Relay for Life event, which raised more than \$110,000 in 2014. STP employees form teams and participate in the annual volunteer-driven event with many fundraisers held throughout the year.

STP's engineering organization hosts an annual fundraiser on-site to support local charitable organizations, including the Matagorda County Women's Crisis Center. This employee-led and supported event raises more than \$10,000 annually for local charities.

STP's Women in Nuclear chapter mentors local high school students and also awards annual scholarships to students. The chapter raises funds throughout the year and last year awarded more than \$13,000 in scholarships to local students.

STP is one of the largest contributors to the annual Matagorda County Fair and Livestock Association. The company supports local youth—members of Future Farmers of America and 4-H—who participate in the fair. STP has invested more than \$60,000 in sponsorships in the past three years.

STP is the leading sponsor for the Matagorda County Annual Household Hazardous Waste Collection Day. Many employees from STP dedicate their time to collect household hazardous waste from the community for proper disposal.

Luminant and its Comanche Peak employees engage in similar work in their communities. To support emergency preparedness and planning in the area, Luminant's Comanche Peak has provided additional funding and grant-writing assistance to both Hood and Somervell counties for their emergency operations activities. Luminant participates in the local emergency preparedness committee activities and works closely with local, state and federal emergency responders during emergency preparedness exercises and drills throughout the year.

To promote community involvement and civic leadership, Comanche Peak employees support and participate in local chambers and civic organizations. Economic development efforts include annual support of the Hood County Economic Development Conference and participation in Envision Somervell County's development efforts.

Comanche Peak also sponsors fundraising events for local organizations and, over the past decade, the company has contributed thousands of dollars to various charitable groups and non-profit organizations in Somervell and Hood counties.

Luminant is the largest United Fund contributor in Somervell County and the largest United Way contributor in Hood County. Comanche Peak sponsors fund-raising events for local organizations and, over the past decade, the company has contributed thousands of dollars to various charitable groups and non-profit organizations in Somervell and Hood counties.

For example, Comanche Peak employees' and Luminant's matching contributions average over \$130,000 in annual gifts to area United Way agencies. The plant's annual bake sale has become a popular, local tradition in which a single treat can sell for more than \$1,000. The bake sale raises thousands of dollars each year in direct support for the United Fund in Somervell County and the United Way of Hood County. Employees also serve as directors on the boards of these organizations.

Comanche Peak is a longtime supporter of Ruth's Place, a free/low-cost medical clinic for citizens of Hood County. During a 2015 event, the plant helped the clinic raise over \$80,000. The company and its employees maintain a long and ongoing sponsorship of LDL Educational Resources Foundation, a Somervell County-based organization providing health, educational and medical resources.

Comanche Peak also supports Mission Granbury, a community support agency providing basic needs services to families in Hood County. In early 2014, the organization moved into a much-needed larger building by raising \$150,000, which qualified it for a philanthropic grant of \$450,000. Glen Rose Lions Club is another organization that is a longtime recipient of Luminant support. The company sponsors the Lions Club winter basketball tournament, which provides scholarships to local students.

Comanche Peak celebrated its 24th annual "Kid Fish," with more than 120 children attending at Squaw Creek Park. Company and community volunteers provide lunch, t-shirts and a day at the lake for local children. Squaw Creek Park also hosts a twice-a-year community volunteer-supported fish day outing for more than 200 U.S. veterans. The veterans are thanked for their service and enjoy lunch, music and a day out with friends and the fish.

The plant is also an annual contributor to youth fairs in Hood and Somervell counties. Several hundred students participate with livestock, home living and workshop projects through Future Farmers of America (FFA) or 4-H projects.

Pursuit of Education

Both STPNOC and Luminant employees believe that quality education and career development opportunities are among the most important tools to help communities prosper.

At South Texas Project, the company has over the last six years trained 25 science and math teachers, a handful of school counselors, and a vice principal on nuclear safety, nuclear safety culture and how operating companies protect the workforce and the public. The educators learn about radiation protection, emer-

Comanche Peak is a five-year partner with the Granbury Independent School District’s “Project Lead the Way” for pre-engineering students. These students participate in hands-on activities with plant employees and learn about career opportunities in chemistry, operations and mechanical and electrical maintenance.

gency preparedness, and all the technical disciplines, including mechanical, electrical and instrumentation control. They also learn about refueling outages and what happens with the spent fuel, as well as past events at Three Mile Island, Chernobyl and Fukushima. Briefings on plant operations, quality, engineering and security, and the business side of the company help them understand the investments the company makes in people and equipment. These educators take their experiences back to the classroom and challenge their students with math and science lesson plans related to energy generation.

STP also reaches young students in the community through its Powerset and Workforce Industry Training (WIT). Powerset—or Powerful Opportunities for Women Eager and Ready for Science, Engineering and Technology—is a program designed to provide women high school students the tools, academic support and mentoring needed to pursue education and career opportunities in science, technology, engineering and math. The program began six years ago in Matagorda County and has since spread to 11 independent school districts across Texas and been introduced to other countries, including the Czech Republic, Austria and Italy. Women in Nuclear members mentor the students, and STP also has partnered with other industries allowing Powerset to expand outside the nuclear sector.

WIT, a program based on POWERSET that includes young men and women from local high schools, has also been expanded since its inception a few years ago. The state of Texas made an initial investment in WIT of \$173,000 to help the program expand.

STP has invested in 150 scholarships through its Educational Incentive Program (EIP), a program that pays tuition, books and fees for accepted candidates interested in energy careers. The company has hired 95 of the program’s graduates. The scholarship program has become a sustainable pipeline for entry-level positions at the power plant. The NRC also awards scholarships for students to pursue degrees in nuclear technology. Some of the students completed their training at the company in under three years and are now training to become licensed operators.

STP has worked with its local community colleges to align the schools’ two-year nuclear degree programs with those of 27 colleges across the country that have the same standards and objectives so that skills are transferable. Because of these programs, STP was able to exempt some new employees from segments of the company’s entry-level training program. Students can complete the qualifications to become experienced journeymen and operators in two or fewer years, rather than the usual three years. In 2015, the company is shortening its apprentice program from three to two years.

Leveraging its membership in Energy Providers Coalition for Education, STP has worked with online colleges so that students graduating from nuclear programs with an associate’s degree from a local college are only five or six courses away from a four-year nuclear technology engineering degree.

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STP also promotes career development for incumbent employees. The company recently increased and expanded its education benefit to include graduate degrees.

Similarly, in its area, Luminant sponsors science fairs, field trips and mentorship programs in the local school systems. Employees contribute personal time to encourage student interest in math and science.

Specifically, since 2002, Luminant has partnered with the Glen Rose Independent School District (ISD) environmental classes, which teach students how to monitor the water quality of the Paluxy River watershed. With the river as their classroom, the students regularly measure the water's physical and chemical parameters. They provide the data to the Texas Stream Team, which makes information about the natural resources of Texas widely available.

Thanks to donations from Luminant and other partners, Glen Rose students are also restoring 120 acres of habitat for the bobwhite quail and eastern bluebird at Luminant's Squaw Creek Park, located at Comanche Peak's Squaw Creek Reservoir. This long-term conservation program teaches students about environmental science and how to obtain educational grants and work on community projects.

Comanche Peak is also a five-year partner with the Granbury Independent School District's "Project Lead the Way" for pre-engineering students. These students participate in hands-on activities with plant employees and learn about career opportunities in chemistry, operations and mechanical and electrical maintenance.

Every year, volunteers from Comanche Peak mentor future scientists by judging science experiments at Granbury ISD's annual science fair for secondary students. Luminant also awards a \$500 scholarship to the student who creates the top energy-themed project.

Luminant provides financial and volunteer support to Operation School Supply, an organization that provides school supplies and summer lunches to families during school-supply events in the Granbury, Tolar and Lipan school districts. Luminant is a founding member of the Granbury ISD Education Foundation and continues to support its efforts to fund teacher-requested classroom grants. The company also participates in raising funds for education foundations in Hood and Somervell counties.

Comanche Peak employees, through their individual memberships in industry-supported organizations such as Women In Nuclear and North American Young Generation in Nuclear, advise local high school pre-engineering students and support community projects surrounding Comanche Peak.

Like STP, Comanche Peak helps students through Powerset and Workforce Industry Training. Powerset aims to stimulate interest among young women in science, technology, engineering and math careers. The program is sponsored

by U.S. Women in Nuclear and Texas A&M University. WIT is based on the Powerset program and includes both young women and men from local high schools.

Luminant's Power Your Future internship program develops skills and provides experience to students pursuing a career in the fields of engineering, science, business and related technical fields. The interns have opportunities across the company, including at Comanche Peak. Each intern class is able to get hands-on experience not available in any classroom. Numerous interns return Luminant for several years during their college years, and many are offered jobs after graduation. Through this internship program, Luminant is able to usher in the next generation of energy workers.

Environmental Stewardship

Commitment to environmental protection is an integral component of the operating policy and core values of the Texas nuclear power plants. This commitment extends beyond compliance with laws and regulations by integrating sound environmental practices into daily operational and business decisions.

The South Texas Project property is 12,220 acres, which provides diverse habitat areas for birds and other wildlife, including bald eagles, peregrine falcons, deer, hogs, bobcats and white-tailed hawks. Only 65 of the 12,220 acres are occupied by the two power plants. Plant facilities include a 7,000-acre main cooling reservoir and a 47-acre essential cooling pond. Many smaller bodies of water on the property include wetlands, Kelly Lake, drainage ditches, sloughs and depressions, which provide a constant water source. Much of the land east of the main cooling reservoir is leased for cattle grazing. Approximately 1,700 acres remain in a more natural state as a lowland habitat.

The STP nuclear plant co-exists with the natural habitat and wetlands that are home to many animals, including alligators, deer and ducks. STPNOC worked with conservation groups to build and maintain a 110-acre Texas Prairie Wetland Project on the property.

STP is located on the state-sponsored Great Texas Coastal Birding Trail that spans the entire Texas Gulf Coast from Brownsville to the Louisiana border. Matagorda County, in which South Texas Project is located, consistently ranks at or near the top of the National Audubon Society's annual Christmas Bird Count for the number of species identified. Several bird species have been observed visiting the wetland habitat and elsewhere on the site. These include the bald eagle, peregrine falcon, wood stork, white-faced ibis, brown pelican and white-tailed hawk. Additional migratory and resident bird species, such as a variety of ducks, geese, turkey and pelicans (both brown and white) have been observed during informal surveys of the site's diverse natural and manmade habitats. Intensive bird nesting continues throughout the lowland habitat, particularly in a heron rookery around the perimeter of Kelly Lake. U.S. Fish and Wildlife Service biologists estimate that approximately one-third of Texas' breeding adult Gull-billed Tern population, considered to be in decline, nest on

the internal dikes of STP's main cooling reservoir. STP provides vital habitat for more than an estimated 125 different species of wintering and resident birds.

Comanche Peak works to protect the environment while meeting Texas's clean energy needs. Located on Squaw Creek Reservoir, Comanche Peak plays a key role in protecting the regional environment. In addition to meeting all regulatory requirements and having a formal environmental management system, Comanche Peak takes part in a number of other projects to protect the environment.

Bobwhite quail and eastern bluebirds once flocked to what is now Squaw Creek Park at Luminant's Squaw Creek Reservoir, which provides cooling water for Comanche Peak Nuclear Power Plant. When Luminant acquired the land, it had been overgrazed and was overgrown. In 2010, the company's desire to restore the habitat merged with a Glen Rose High School teacher's environmental grant.

With guidance from the Texas Parks and Wildlife Department, the U.S. Department of Agriculture's Natural Resource Conservation Service and Texas A&M AgriLife, Glen Rose High School's environmental-systems students cleared non-native vegetation, introduced native trees and grasses, and installed nesting boxes on 120 acres of park land Luminant had dedicated to the program.

Slowly, following natural migration patterns, both species are returning. The bluebirds have built more than a dozen nests and at least one covey of quail has been seen and heard in the park, which is considered good progress. At the same time, students learn about the effort that it takes to restore and maintain a habitat while also learning to research, make decisions about real world situations and work alongside professionals.

An adequate, dependable, long-term supply of clean water is essential for operating Luminant's power plants. The largest private owner of reservoirs in Texas, Luminant uses them to cool its generating facilities, including Comanche Peak. Although large volumes of water are cycled, only a small percentage is consumed for plant operation. Most is returned to the reservoirs for reuse. Cooling power plants in this way allows for the conservation of water and mitigation of drought, as opposed to the use of large, wet-cooling towers that consume significant quantities of water. Luminant's water management program ensures both water quality and compliance with state and federal regulations.

Luminant's reservoirs provide thousands of acres of aquatic habitat for wildlife, and the dams also have provisions to release water to sustain fish and wildlife habitats downstream. Fish love the warm water of the 3,200-acre Squaw Creek Reservoir, as do fishermen. Bassmaster named it one of the Best Bass Lakes in America in 2015.

Comanche Peak is also a founding member of both the Hood County Clean Air Coalition and the Lake Granbury Watershed Protection Plan, and is a longtime participant in the Texas Adopt-a-Highway program.

Section 4

The Texas Nuclear Plants and the U.S. Nuclear Energy Industry

Texas's nuclear power plants play a vital role in helping Texas meet its demand for affordable, reliable and sustainable energy.

In 2014, electricity production from U.S. nuclear power plants was about 797 billion kilowatt-hours—nearly 20 percent of America's electricity supply. In Texas, the four reactors generated approximately 9 percent of the state's electricity.

Over the past 20 years, America's nuclear power plants have increased output and improved performance significantly. Since 1990, the industry has increased total output equivalent to that of 26 large power plants, when in fact only five new reactors have come on line.

U.S. nuclear power plants performed at a near-record capacity factor of 91.7 percent in 2014, while producing electricity at one of the lowest costs of any fuel source used to generate electricity.

The Value of Nuclear Energy

Nuclear energy's role in the nation's electricity portfolio was especially valuable during the 2014 winter, when record-cold temperatures gripped the United States and other sources of electricity were forced off the grid. Nuclear power plants nationwide operated at an average capacity factor of 96 percent during a period of extremely cold temperatures. During that time, supply volatility drove natural gas prices in many markets to record highs and much of that gas was diverted from use in the electric sector so that it could be used for home heating.

Some of America's electricity markets, however, are structured in ways that place some nuclear energy facilities at risk of premature retirement, despite excellent operations. It is imperative that policymakers and markets appropriately recognize the full strategic value of nuclear energy to a diverse energy portfolio.

The value starts with the safe and reliable production of large quantities of electricity around the clock.

Renewable energy, while an emerging part of the energy mix, is intermittent (the sun doesn't always shine and the wind doesn't always blow when generation is needed) and therefore unreliable; natural gas-fired generation depends on fuel being available (both physically and at a reasonable price); and on-site coal piles can freeze. One of nuclear energy's key benefits is the availability of

Based on more than 50 years of experience, the nuclear industry is one of the safest industrial working environments in the nation.

low-cost fuel and the ability to produce electricity under virtually all weather conditions. Nuclear power plants also provide clean-air compliance value. In any emissions trading system, nuclear energy reduces the compliance burden that would otherwise fall on carbon-emitting generating capacity.

Nuclear plants provide voltage support to the grid, helping to maintain grid stability. They have portfolio value, contributing to fuel and technology diversity. And they provide tremendous local and regional economic development opportunities, including large numbers of high-paying jobs and significant contributions to the local and state tax base.

Affordable Energy for Consumers

In addition to increasing electricity production at existing nuclear energy facilities, power from these facilities is affordable for consumers. Compared to the cost of electricity produced using fossil fuels—which is heavily dependent on fuel prices—nuclear plant fuel prices are relatively stable, making costs to consumers more predictable. Uranium fuel is only about one-third of the production cost of nuclear energy, while fuel costs make up 78 to 88 percent of coal-fired and natural gas production costs.

Emphasis on Safety

Safety is the highest priority for the nuclear energy industry. Based on more than 50 years of experience, the industry provides one of the safest industrial working environments in the nation. Through rigorous training of plant workers and frequent communication and cooperation among nuclear plants and federal, state and local regulators, the industry is keeping the nation's 99 nuclear plants safe for their communities and the environment.

The NRC provides independent federal oversight of the industry and tracks data on the number of "significant events" at each nuclear plant. (A significant event is any occurrence that challenges a plant's safety system.) The average number of significant events per reactor declined from 0.45 per year in 1990 to 0.02 in 2013, illustrating the emphasis on safety throughout the nuclear industry.

General worker safety is also excellent at nuclear power plants—far safer than in the manufacturing sector. U.S. Bureau of Labor Statistics data show that, in 2013, nuclear energy facilities achieved an incidence rate of 0.3 per 200,000 work hours, compared to 1.8 for fossil-fuel power plants, 1.8 for electric utilities and 4.0 for the manufacturing industry.

Industry Trends: License Renewal and New Plants

The excellent economic and safety performance of U.S. nuclear power plants has demonstrated the value of nuclear energy to the electric industry, the financial community and policymakers. This is evidenced by the number of facilities seeking license renewals from the NRC.

Originally licensed to operate for 40 years, nuclear energy facilities can operate safely for longer. The NRC granted the first 20-year license renewal to the Calvert Cliffs plant in Maryland in 2000. As of August 2015, 74 reactors had received license extensions, and operators of 24 additional reactors either have submitted applications or announced that they will seek renewal. License renewal is an attractive alternative to building new electric capacity because of nuclear energy's low production costs and the return on investment provided by extending a plant's operational life.

Besides relicensing nuclear plants, energy companies also are building new, advanced-design reactors. Georgia Power and South Carolina Electric & Gas are building two advanced reactors each, near Augusta, Ga., and Columbia, S.C. These facilities are halfway through the construction program and will employ more than 5,000 workers each during the peak of construction. In addition, Tennessee Valley Authority is completing construction of the Watts Bar 2 reactor in Tennessee.

Section 5

Economic Impact Analysis Methodology

This analysis uses the REMI model to estimate the economic and fiscal impacts of the Texas nuclear power plants.

Regional Economic Models, Inc. (REMI)

REMI is a modeling firm specializing in services related to economic impacts and policy analysis, headquartered in Amherst, Mass. It provides software, support services, and issue-based expertise and consulting in almost every state, the District of Columbia, and other countries in North America, South America, Europe and Asia.

The REMI model has two main purposes: forecasting and analysis of alternatives. All models have a “baseline” forecast of the future of a regional economy at the county level. Using “policy variables,” in REMI terminology, provides scenarios based on different situations. The ability to model policy variables makes it a powerful tool for conveying the economic “story” behind policy. The model translates various considerations into understandable concepts like GDP and jobs.

REMI relies on data from public sources, including the Bureau of Economic Analysis, Bureau of Labor Statistics, Energy Information Administration and the Census Bureau. Forecasts for future macroeconomic conditions in REMI come from a combination of resources, including the Research Seminar in Quantitative Economics at the University of Michigan and the Bureau of Labor Statistics. These sources serve as the main framework for the software model needed to perform simulations.

Policy Insight Plus (PI+)

REMI’s PI+ is a computerized, multiregional, dynamic model of the states or other sub-national units of the United States economy. PI+ relies on four quantitative methodologies to guide its approach to economic modeling:

1. Input/output tabulation (IO)—IO models, sometimes called “social accounting matrices” (SAM), quantify the interrelation of industries and households in a computational sense. It models the flow of goods between firms in supply-chains, wages paid to households, and final consumption by households, government and the international market. These channels create the “multiplier” effect of \$1 going farther when its “echo” is accounted for.
2. Computable general equilibrium (CGE)—CGE modeling adds market concepts to the IO structure. This includes how those structures evolve over time and how they respond to alternative policies. CGE incorporates concepts on markets for labor, housing, consumer goods, imports and the importance of competitiveness to fostering economic growth over time.

3. Changing one of these will influence the others—for instance, a new knife factory would improve the labor market and then bring it to a head by increasing migration into the area, driving housing and rent prices higher, and inducing the market to create a new subdivision to return to “market clearing” conditions.
4. Econometrics—REMI uses statistical parameters and historical data to populate the numbers inside the IO and CGE portions. The estimation of the different parameters, elasticity terms and figures gives the strength of various responses. It also gives the “time-lags” from the beginning of a policy to the point where markets have had a chance to clear.
5. New economic geography—Economic geography provides REMI a sense of economies of scale and agglomeration. This is the quantification of the strength of clusters in an area and their influence on productivity. One example would include the technology and research industries in Seattle. The labor in the area specializes to serve firms like Amazon and Microsoft and, thus, their long-term productivity grows more quickly than that of smaller regions with no proclivity towards software development (such as Helena, Mont.). The same is true on the manufacturing side with physical inputs, such as with the supply-chain for Boeing and Paccar in Washington in the production of transportation equipment. Final assembly will have a close relationship and a high degree of proximity to its suppliers of parts, repairs, transportation and other professional services, which show up in clusters in the state.

Figure 5.0

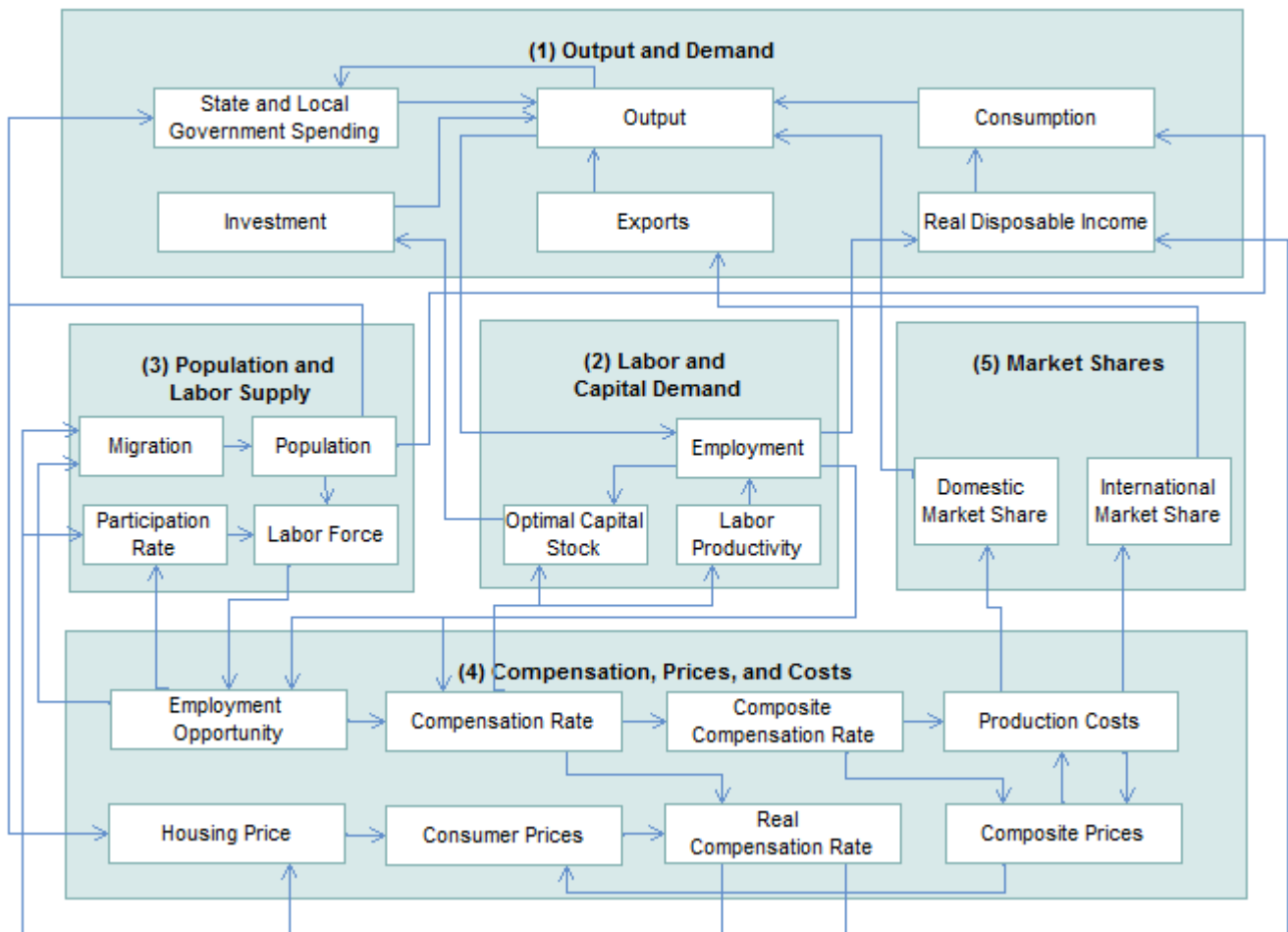


Figure 5.0 represents the structure and linkages of the regional economy in PI+. Each rectangle is a discrete, quantifiable concept or rate, and each arrow represents an equation linking the two of them. Some are complex econometric relationships, such as the one for migrant, while some are rather simple, such as the one for labor force, which is the population times the participation rate. The change of one relationship causes a change throughout the rest of the structure because different parts move and react to incentives at different points. At the top, Block 1 represents the macroeconomic whole of a region with final demand and final production concepts behind GDP, such as consumption, investments, net exports and government spending. Block 2 forms the “business perspective”: An amount of sales orders arrive from Block 1, and firms maximize profits by minimizing costs when making optimal decisions about hiring (labor) and investment (capital). Block 3 is a full demographic model. It has births and deaths, migration within the United States to labor market conditions, and international immigration. It interacts with Block 1 through consumer and government spending levels and Block 4 through labor supply. Block 4 is the CGE portion of the model, where markets for housing, consumer goods, labor and business inputs interact. Block 5 is a quantification of competitiveness. It is literally regional purchase coefficients (RPCs) in modeling and proportional terms, which show the ability of a region to keep imports away while exporting its goods to other places and nations.

Conclusion

In 2015, the total economic impact (direct and secondary) to Texas from its nuclear power plants is estimated to be \$4.4 billion in output and more than 9,000 jobs. The plants' economic benefits—on taxes and through wages and purchases of supplies and services—are considerable. In addition, plant employees stimulate the local economies by purchasing goods and services from businesses in the area, which supports many small businesses throughout the region.

The facilities generated 39 million megawatt-hours of electricity in 2014—about 9 percent of the electricity generated in the state. The four reactors provide enough electricity for about three million people year-round, or 2.9 million households if all of the electricity went to the residential sector. This low-cost, reliable electricity helps keep retail electricity prices in Texas lower than the U.S. average.

In addition to quantifying the positive economic impacts of the Texas nuclear plants, this analysis shows that the Luminant and South Texas Project plants are integral to the local and state economies. The loss of these nuclear power plants would have lasting, negative economic ramifications. Losses would reverberate for decades after the plants shut down, and host communities may never fully recover.

Texas' nuclear energy facilities are economic, fiscal, environmental and social leaders and have far-reaching, positive economic impacts in their home and neighboring counties, as well as across the state of Texas.



