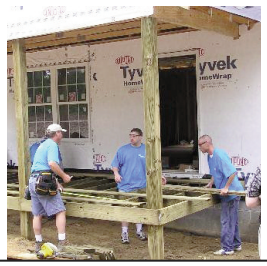

Economic Benefits of North Anna Power Station

An Economic Impact Study by the Nuclear Energy Institute In Cooperation With Dominion

NUCLEAR ENERGY INSTITUTE

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Contents

Executive Summary

North Anna Power Station in Louisa County, Va., is an integral part of the local economy. The plant, owned by Virginia Electric and Power Co. (88.4 percent) and the Old Dominion Electric Cooperative (11.6 percent), makes purchases that stimulate the local economy in Louisa, Orange and Spotsylvania counties, both directly and indirectly. Besides its economic output, the plant provides jobs, labor income, local property tax revenues and community services. And there are other intangible benefits, such as clean air; environmental stewardship; and low, stable electricity costs. North Anna's economic impact reaches beyond the local community to the state and nation.

In 2006, the latest year for which data is available, operation of the North Anna plant increased Virginia's economic output by $111.1 million, including $12.2 million in Louisa, Orange and Spotsylvania counties, the local area studied in this report. If the direct value of plant output is included, state and county output attributable to North Anna was $711.1 million in Virginia, including $612.2 million in the local area.

The operation of North Anna, and the increased economic output associated with it, accounts for 2,105 jobs in Virginia, including 696 jobs in Louisa, Orange and Spotsylvania counties. These jobs generate $152.9 million in earnings for workers in Virginia, including $61.2 million for local employees.

The North Anna plant employs about 960 people, with 31 percent living in Louisa County, 17 percent living in Spotsylvania County and 14 percent living in Orange County. These jobs pay as much as 7 percent more than the average salaries for Louisa County. Further, economic activity generated by North Anna creates another 112 jobs in the three local counties.

The plant's primary expenditure in the local area is employee compensation. In 2006, North Anna paid $57.9 million to employees living in Louisa, Orange and Spotsylvania counties, and an additional $56.4 million to employees residing elsewhere in Virginia. The economic activity of the North Anna plant resulted in the generation of an additional $3.3 million in labor income within the local area and an additional $35.2 million in other areas of the state. Together, the direct and indirect compensation from the plant resulted in $61.2 million in labor income in Louisa, Orange and Spotsylvania counties, and an additional $91.7 million in other areas of Virginia.

North Anna makes substantial purchases in the local area. In 2006, the plant made $91.9 million in purchases. Of this, $23.6 million were made in Virginia, including $670,000 in Louisa, Orange and Spotsylvania counties.

The North Anna plant pays an estimated $11 million in property taxes annually. Additionally, the economic activity generated by North Anna contributes $6.4 million in state and local taxes through increased income, property and sales taxes.

Besides the economic benefits provided by North Anna, the plant generated more than 15 billion kilowatt-hours of electricity in 2006, approximately 21 percent of Virginia's electricity generation. This low-cost electricity helps keep energy prices lower in Virginia. In 2006, North Anna's production cost was 1.38 cents/kilowatt-hour, compared to an average production cost of 2.74 cents/kilowatt-hour for the rest of the Virginia Carolinas Reliability Agreement subregional market (VACAR is a subregion of the Southeastern Electric Reliability Council). North Anna did all of this without producing the air pollution typical of some other power generation sources.

Section 1: Introduction

This economic impact study by the Nuclear Energy Institute[1] (NEI) examines the economic, fiscal and other benefits provided to the community by the North Anna Power Station, operated by Virginia Electric and Power Co. (subsidiary of Dominion). The report estimates the economic and other benefits that North Anna provides to the local area of Louisa, Orange and Spotsylvania counties, as well as Virginia and the United States. The study uses detailed data from the North Anna plant and various government databases to assess the plant's benefits to the community.

Economic benefits from North Anna include direct impacts—such as people employed at North Anna, plant expenditures within the community and tax payments—as well as indirect impacts, such as jobs created by plant expenditures in the local economy. This study also includes other benefits provided by the plant, such as reliable, low-cost electricity; a clean-air source of electricity; and environmental stewardship.

Dominion and NEI cooperated in developing this study. Dominion provided data on employment, operating expenditures and tax payments for the existing units. Dominion also provided guidance on details specific to Louisa, Orange and Spotsylvania counties and the plant.

NEI coordinated the project and applied a nationally recognized model to estimate the direct and indirect impacts of the existing plant on the local community. RTI International, a nonprofit research organization in Research Triangle Park, N.C., developed the methodology employed in this analysis, the 12th such study conducted by NEI.

The remainder of this report is presented in five sections:

- Section 2 provides background on North Anna, including costs, employment, plant history and performance, and taxes. It also discusses local area details such as total employment and earnings, and regional electricity prices.
- Section 3 examines the economic and fiscal impacts of the plant at the local, state and national levels.
- Section 4 provides data on benefits not captured by the model, such as the plant's contributions to the community and the environment.
- Section 5 outlines recent trends in the nuclear industry as a whole, including cost, performance and safety.
- Section 6 discusses the methodology used to complete the study and Impact Analysis for Planning, the economic modeling software employed as part of this effort.

[1] The Nuclear Energy Institute is the policy organization of the nuclear energy and technologies industry and participates in both the national and global policymaking process.

Section 2: The North Anna Power Station

This section provides background information on the North Anna plant and the local area of Louisa, Orange and Spotsylvania counties to frame the results of this report. Included is a brief history of North Anna, as well as information on the plant's costs, employment, performance and taxes. This section also provides information about Louisa, Orange and Spotsylvania counties; their cities and towns; and the state of Virginia, including earnings, local tax collections, regional electricity cost and total employment.

2.1 History and Information

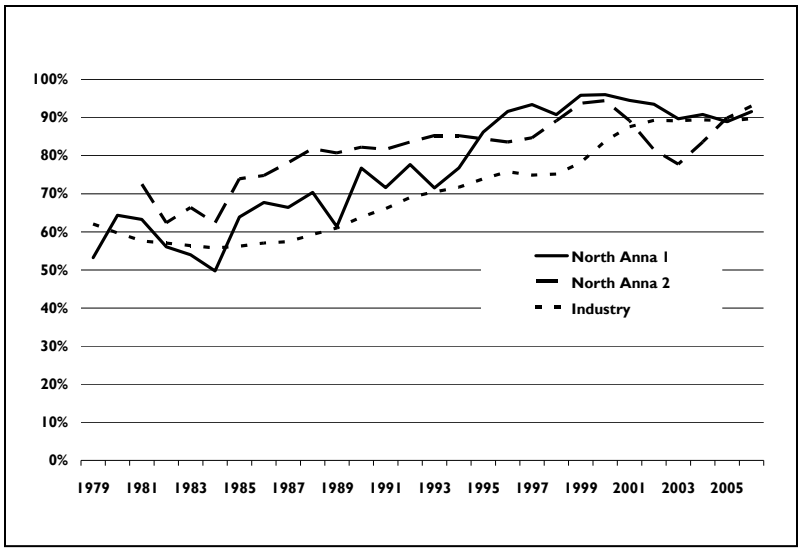
The North Anna Power Station comprises about 19,000 acres near Mineral, Va., a town of about 400 residents. The plant is situated approximately 40 miles northwest of Richmond and lies in Louisa County, which has a population of about 25,600.

Table 2-1. North Anna Nuclear Power Plant: At a Glance

Reactor	Capacity (Megawatts)	Commercial Operation Year	License Expiration Year	Reactor Type
1	903	1978	2038	Pressurized water
2	903	1980	2040	Pressurized water

The North Anna Power Station comprises two pressurized water reactors with a total electrical capacity of 1,806 megawatts. The plant is owned by Virginia Electric and Power Co. (88.4 percent) and Old Dominion Electric Cooperative (11.6 percent).

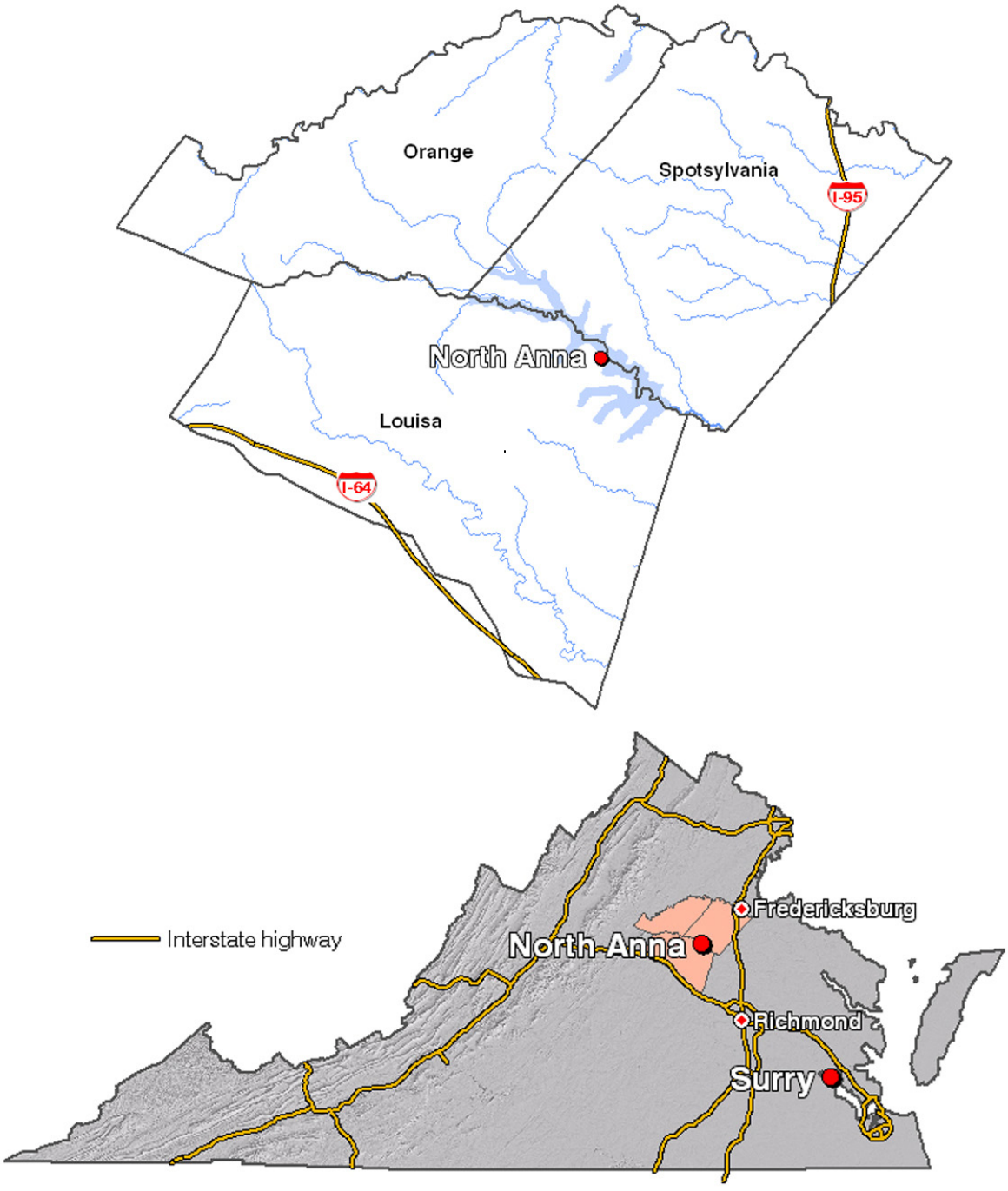
Figure 2-1. Three-Year Average Capacity Factors



Sources: Energy Information Administration, Nuclear Regulatory Commission

Throughout most of its operation, North Anna has been competitive in the nuclear energy industry. Since 1985, North Anna 1 has maintained capacity factors at or above the industry average. Capacity factor, a measure of efficiency, is the ratio of actual electricity generated compared with the maximum possible generation if the plant were to operate at full capacity for one year. In 1999, North Anna 1 had its best year, with a capacity factor of 104 percent. The 100 percent level was exceeded because the plant generated slightly more than its rating for a portion of the year. With the exception of 2001 and 2002, North Anna 2 has maintained capacity factors at or above the industry average.

Figure 2-2. The North Anna Plant and Surrounding Area



2.2 Generation

North Anna provides about 21 percent of the electricity generated in Virginia each year. The plant generated more than 15 billion kilowatt-hours of electricity in 2006. Plant output was driven by high capacity factors. North Anna 1 operated at a 92 percent capacity factor and North Anna 2 operated at a 93 percent capacity factor in 2006.

North Anna provides power for the Virginia Carolinas Reliability Agreement (VACAR) subregion in the Southeastern Electric Reliability Council (SERC) power area. Efficient performance has made the North Anna power plant cost-competitive in the region. North Anna had an average production cost in 2006 of 1.38 cents/kilowatt-hour. By comparison, the average production cost for electricity generators in the region was 2.74 cents/kilowatt-hour. Production costs represent the operations, maintenance and fuel costs of the plant.

Table 2-2. SERC VACAR Subregion Production Cost and Generation in 2006

	Average Production Cost (in cents per kilowatt-hour)	Generation (in million megawatt-hours)
North Anna	1.38	15.1
Other Nuclear	1.62	103.3
Coal	2.99	150.1
Natural Gas	7.89	16.2
Oil	12.72	0.3
Renewables	4.37	7.9
SERC VACAR Total (Including North Anna)	**2.74**	**292.9**

Source: Global Energy Decisions

North Anna's low production costs help keep electricity prices down in Virginia. Although North Anna's exact contribution is difficult to measure, it can be estimated by determining how much average production costs in the VACAR sub-region would increase if North Anna were replaced by a combined-cycle natural gas plant (the plant of choice for new generation). Substituting a combined-cycle natural gas plant for North Anna would have resulted in an increase in average generation costs for the VACAR subregion from 2.74 cents/kilowatt-hour to 3.08 cents/kilowatt-hour.

2.3 Employment

Besides helping to stabilize electricity costs to Virginia, North Anna is a substantial employer in Louisa, Spotsylvania and Orange counties. The plant employs about 960 full-time workers, 295 of whom reside within Louisa County, 159 within Spotsylvania County and 130 in Orange County.

Table 2-3. North Anna Employment by County

	North Anna			City/County Total[a]	
County	Permanent Employees	% Employed Work Force	Average Earnings	Employed Work Force	Average Earnings[b]
Louisa	295	1.5	$60,443	19,953	$56,411
Spotsylvania	159	0.2	$69,367	66,138	$73,790
Orange	130	0.6	$64,658	20,562	$58,510
Henrico	100	0.1	$78,989	138,815	$71,234
Hanover	82	0.1	$69,408	65,651	$78,745
Goochland	16	0.1	$81,529	13,717	$84,125

[a] *Census 2000, adjusted to 2006 dollars.*

[b] *Earnings, defined as the sum of wage and salary income, represent the amount of income received regularly before deductions for personal income taxes, Social Security, Medicare, etc.*

The jobs provided by the North Anna plant are also typically higher-paying than most jobs in the area. Full-time North Anna employees who live in Louisa County earn, on average, about $60,400 a year. This is 7 percent higher than the average earnings of workers in the county—about $56,400 a year.

2.4 Property Taxes

In addition to employment and direct purchases in the area, the plant also makes large tax payments. In 2006, North Anna made property tax payments of about $11 million.

2.5 Summary

North Anna provides low-cost electricity, high employment and a large tax base to Louisa, Orange and Spotsylvania counties and Virginia. However, these are only the direct economic benefits of the plant. As illustrated in the next section, the secondary benefits are as significant as the direct benefits.

Section 3: Economic and Fiscal Impacts

North Anna's spending boosts activity throughout the local and state economies. The effects of the plant's large wage and salary payments are evident throughout the local and state economies—in the private sector through increased sales and employment, and in the public sector through increased tax revenues to support public services.

Estimates of these effects were developed by applying the Impact Analysis for Planning (IMPLAN) model to expenditure data provided by Dominion, the holding company of the North Anna plant. (For more information on IMPLAN, see Section 6.)

3.1 Plant Expenditures in Louisa, Orange and Spotsylvania Counties

North Anna's expenditures for products and services (including labor) in the local area totaled $58.6 million in 2006. Expenditures within Louisa, Orange and Spotsylvania counties represent approximately 42 percent of the plant's total spending of $138 million in Virginia, and approximately 28 percent of the plant's total spending of $206.6 million.

Table 3-1. North Anna Expenditures in Louisa, Orange and Spotsylvania Counties

Description	Amount (Thousands)
Facilities support services	$237
Special tool, die, jig and fixture manufacturing	$138
Food and beverage stores	$87
Automobile and light truck manufacturing	$48
Accessories and other apparel manufacturing	$37
Petroleum lubricating oil and grease manufacturing	$22
Cement manufacturing	$21
Building material and garden supply stores	$19
Overhead cranes, hoists and monorail systems	$15
General merchandise stores	$14
Other	$34
Subtotal	**$670**
Total Compensation[a]	$57,883
Total	**$58,553**

[a] *Total compensation includes wages, salaries and fringe benefits based on data provided by Dominion.*

Dominion provided the expenditure totals for Louisa, Orange and Spotsylvania counties that appear in Table 3-1. Several categories that represent major local contracts are identified in the table to show the types of expenditures North Anna makes in the local area. The categories were chosen from among a total of 509 IMPLAN sectors and are listed largely according to the IMPLAN description for each. Total compensation, which includes benefits, salaries and wages, is listed separately.

Total compensation for labor is $57.9 million and represents almost 99 percent of North Anna's expenditures in the local area. This reflects the fact that most of North Anna's expenditures for labor (employee benefits, salaries and wages) stay "home" in Louisa, Orange and Spotsylvania counties. Naturally, the share of compensation within the local area is much larger than the share of compensation within Virginia and the United States.

The largest non-labor expenditure is for facilities support services, at $237,000. This category includes services to the plant's site, such as road paving, plumbing, janitorial services and pest control.

The next-largest non-labor expenditures identified in the local area totaled $138,000 for special tools such as welding supplies, and $87,000 for food and beverage stores.

Many of the top sectors in Table 3-1 involve expenditures for services and plant supplies. This illustrates the reliance on local vendors to provide facility maintenance services and to meet day-to-day materials requirements at the plant.

3.2 Plant Expenditures in Virginia

In 2006, North Anna's expenditures for products and services (including labor) in Virginia totaled $138 million. This total includes $57.2 million in the local area and $80.8 million in other areas of Virginia. Spending within the state represents two-thirds of the plant's total expenditures of $206.6 million.

Table 3-2 provides details on the plant's total spending within the state. Total compensation is the largest category, at $114.3 million, and represents about 83 percent of the total. This is less than the share of total compensation for spending in Louisa, Orange and Spotsylvania counties. Instead, more money is spent on products and non-labor services in the rest of Virginia.

The largest non-labor expenditure is for maintenance and repair construction at $14.2 million. This sector includes mechanical services, craft support and electric motor repair services.

The next-largest expenditures in Virginia are for professional and technical services, at $1.7 million. These expenditures are for specialized and highly technical contracted services that are generally unique to the industry, such as nuclear engineering.

The next two sectors are business and facilities support services at $1.25 million and $1.21 million, respectively. Business support services include travel and relocation for employees. Services for plant upkeep and maintenance continue to be a large part of plant spending at the state level. These include plant building, landscaping and janitorial services.

Table 3-2. North Anna Expenditures in Virginia

Description	Amount (Thousands)
Maintenance and repair construction	$14,223
Professional and technical services	$1,720
Business support services	$1,246
Facilities support services	$1,210
State and local government enterprises	$722
Motor vehicle and parts dealers	$531
Special tool, die, jig and fixture manufacturing	$354
Maintenance and repair of nonresidential buildings	$345
Legal services	$320
Miscellaneous electrical equipment manufacturing	$246
Other	$2,723
Subtotal	**$23,640**
Total Compensation[a]	$114,346
Total	**$137,986**

[a] *Total compensation includes wages, salaries and fringe benefits based on data provided by Dominion.*

3.3 Plant Expenditures in the United States

North Anna expenditures for products and services (including labor) purchased in the United States totaled $206.6 million in 2006. Besides expenditures of $138 million in Virginia, the plant spent $68.6 million elsewhere in the United States, largely for specialized products and services unique to the nuclear industry.

National expenditures are detailed in Table 3-3. Total compensation ($114.7 million) remains the largest category, representing 56 percent of the total. Total compensation as a share of the U.S. total is lower because most plant employees live in Virginia (and particularly in Louisa, Orange and Spotsylvania counties), while spending on products and non-labor services is concentrated outside the state.

The largest non-labor expenditure is for maintenance and repair construction, at $21.2 million. The next-largest expenditure is for basic inorganic chemical manufacturing, at $12.5 million. This category represents expenses for the plant's fuel, which typically is purchased outside the state or region where the plant is located. North Anna purchased nuclear fuel for about $50 million; however, only 25 percent ($12.5 million) was purchased inside the United States.

Payments to the federal government ($8.9 million) represent fees paid by the plant to government organizations such as the U.S. Nuclear Regulatory Commission and the Federal Emergency Management Agency. NRC fees paid by U.S. nuclear plants are used to cover the cost of nuclear plant regulation.

Expenditures for the metal can, box and other container manufacturing sector are unique to the nuclear industry. At $7.1 million, this sector encompasses the manufacturing of dry casks for used nuclear fuel.

After uranium fuel is burned in a reactor core, it is transferred to a used fuel storage pool to sufficiently cool down. Once the used fuel is adequately cooled, it is transferred into dry casks for on-site storage at the plant.

Table 3-3. North Anna Expenditures in the United States

Description	Amount (Millions)
Maintenance and repair construction	$21.2
Basic inorganic chemical manufacturing	$12.5
Federal government enterprises	$8.9
Metal can, box and other container manufacturing	$7.1
Professional and technical services	$5.7
Civic, social, professional and similar organizations	$2.9
Metal valve manufacturing	$2.8
Architectural and engineering services	$2.6
Miscellaneous electrical equipment manufacturing	$2.3
Pump and pumping equipment manufacturing	$2.2
Other	$23.7
Subtotal	**$91.9**
Total Compensation[a]	$114.7
Total	**$206.6**

[a] *Total compensation includes wages, salaries and fringe benefits based on data provided by Dominion.*

3.4 Taxes Paid and Accrued

In 2006, North Anna paid $11.1 million in state and local taxes. A large component of taxes paid by the plant is for property taxes paid to the county of Louisa. Additionally, the plant made tax payments to the federal government of $5.7 million.

Table 3-4. Taxes Paid by North Anna

Description	Amount (Millions)
Total Payroll	$5.7
Total Property	$11.0
Total Taxes	**$16.7**

3.5 Economic Impacts on Geographic Area

Summary economic impacts for each of the three geographic areas—Louisa, Orange and Spotsylvania counties; Virginia; and the United States—are presented in Table 3-5. The three economic impact variables are:

- output—the value of production of goods and services,
- labor income—the earnings of labor,
- employment—measured in jobs provided.

Table 3-5. Impact of North Anna on Local, State and National Economies (Output and Labor Income in Millions)

	Direct	Secondary[a]	Total
County			
Output	$600.0	$12.2	$612.2
Labor Income	$57.9	$3.3	$61.2
Employment	584	112	696
State			
Output	$600.0	$111.1	$711.1
Labor Income	$114.3	$38.5	$152.9
Employment	1,080	1,025	2,105
United States			
Output	$600.0	$333.2	$933.2
Labor Income	$114.7	$103.0	$217.7
Employment	1,085	2,478	3,563

[a] *Secondary effects include indirect and induced impacts. Indirect impacts measure the effect of input suppliers on expenditures by Dominion, while induced impacts measure the effects produced by the change in household income resulting from North Anna expenditures.*

The plant's overall economic impact is shown as either a direct or secondary effect. The direct, or "first-round," effects reflect the industry sector and geographical distribution of North Anna spending without any subsequent spending effects. The secondary, or "ripple," effects include subsequent spending effects, which can be further divided into two types: indirect and induced. Indirect effects reveal how the plant's spending patterns affect subsequent spending patterns among input suppliers. Induced effects reflect how changes in labor income affect the final demand for goods and services, which has a subsequent impact on all sectors producing basic, intermediate, and final goods and services.

The direct effects in this table are based on the estimated value of the power production from the North Anna plant of $600 million for 2006. The output value is divided among consumer benefits, investor returns, plant purchases, salaries and taxes. It reflects the total output of products and services associated directly with North Anna, which includes the expenditures for products and services (including labor) itemized in Tables 3-1, 3-2 and 3-3. The direct employment entry for the United States (960 jobs) is North Anna's employment level in 2006. The majority of these jobs (about 54 percent) are filled by

workers who reside in Louisa, Orange and Spotsylvania counties. The direct labor income entries reflect the geographic distribution pattern of North Anna employment.

As Table 3-5 indicates, direct effects are the largest contributor to total effects for each of the measures of economic impact for Louisa, Orange and Spotsylvania counties and Virginia. Secondary effects are a much larger contributor to total effects at the national level.

These results reveal the multiplier effects of North Anna spending. Multipliers show the ratio of the plant's "total economic impact" to its "direct economic impact" and can be measured for each geographical region. The most interesting multipliers are for the total effects, which is the ratio between the total and direct effects.

The total output multiplier reveals how much spending results in a geographic area of interest from each dollar of direct spending. The total output multiplier for the local area is 1.02 (or $612.2 million divided by $600 million). This indicates that for every dollar of output from the North Anna plant, the local economy produces $1.02. Using the same formula, the output multiplier is 1.19 for Virginia and 1.56 for the United States.

3.6 Economic Impacts on Local Industry

North Anna's economic impacts are spread over virtually every economic sector. The direct effects are concentrated in a few sectors, but the secondary effects—and especially the induced effects—increase the dispersion of total effects across other sectors, which vary by geographic area. Table 3-6 presents the 10 sectors most affected by the plant in Louisa, Orange and Spotsylvania counties, based on total output. Since North Anna's spending is dominated by local salaries, the impacts are most notable in local areas that cater to the plant's employment base.

The sector most affected by total output is power generation and supply, which includes the value of electricity produced by the plant. Thus, all direct effects are included in this sector. It is the largest sector, based on total output, in the Virginia and U.S. economies, as shown in Tables 3-7 and 3-8, respectively.

The second-most-affected sector is housing values. This is not a traditional business/industry sector, so it has no impact on labor income or employment. Instead, it is a special sector developed by the U.S. Department of Commerce's Bureau of Economic Analysis. It estimates what homeowners would pay in rent if they rented, rather than owned, their homes. In essence, it creates an industry from owning a home. The sole product (or output) of this industry is home ownership, purchased entirely by personal consumption expenditures from household income. In effect, this sector captures increases in housing values caused by increased labor resulting from the plant.

The other sectors most affected by the North Anna plant are related to providing goods and services to the plant's large employment base, including restaurants, real estate services, banks, and car dealership and repair services. Spending by plant employees indirectly boosts the sales and employment of these industries, which typically are operated by local small-business owners.

Table 3-6. Impact of North Anna on the Most-Affected Industries in Louisa, Orange and Spotsylvania Counties

Description	Output (Thousands)	Labor Income (Thousands)	Employment
Power generation and supply	$600,482	$57,981	585
Owner-occupied dwellings	$2,769	N/A	N/A
Real estate	$777	$135	4
Wholesale trade	$666	$250	4
Food services and drinking places	$661	$209	14
Motor vehicle and parts dealers	$469	$217	4
Automotive repair and maintenance	$351	$136	4
Food and beverage stores	$333	$141	6
General merchandise stores	$324	$133	6
Monetary authorities and depository credit intermediaries	$309	$71	1
Other	$5,083	$1,949	68
Total	**$612,225**	**$61,222**	**696**

3.7 Economic Impacts on State Industry

Table 3-7 uses the same sectors applied in Table 3-6 to illustrate the plant's economic impact on the state of Virginia. Again, the power generation and supply sector is most affected, in terms of total output. The other entries in Table 3-7 are similar to those in the local area.

Table 3-7. Impact of North Anna on the Most-Affected Industries in Virginia

Description	Output (Millions)	Labor Income (Millions)	Employment
Power generation and supply	$601.9	$114.7	1,082
Owner-occupied dwellings	$12.6	N/A	N/A
Maintenance and repair construction	$11.0	$6.5	132
Food services and drinking places	$5.1	$1.7	103
Offices of physicians, dentists and other health care providers	$4.7	$2.9	42
Real estate	$4.6	$0.8	24
Hospitals	$3.8	$1.7	37
Wholesale trade	$3.7	$1.4	20
Motor vehicle and parts dealers	$2.8	$1.3	25
Monetary authorities and depository credit intermediaries	$2.4	$0.6	10
Other	$58.5	$21.3	630
Total	**$711.1**	**$152.9**	**2,105**

3.8 Economic Impacts on U.S. Industry

Table 3-8, similar to Tables 3-6 and 3-7, illustrates the impact on the United States. Again, the most-affected sector in terms of total output is power generation and supply, followed by owner-occupied dwellings. The 10 most-affected sectors (on the basis of output) in the United States are very similar to the 10 most-affected sectors in the local area and in Virginia.

Table 3-8. Impact of North Anna on the Most-Affected Industries in the United States

Description	Output (Millions)	Labor Income (Millions)	Employment
Power generation and supply	$605.0	$115.8	1,092
Owner-occupied dwellings	$24.7	N/A	N/A
Real estate	$16.6	$2.9	94
Wholesale trade	$15.1	$5.7	84
Food services and drinking places	$12.3	$4.1	244
Offices of physicians, dentists and other health care providers	$10.8	$6.6	97
Hospitals	$10.7	$5.1	96
Insurance carriers	$9.3	$2.6	37
Monetary authorities and depository credit intermediaries	$8.8	$2.1	35
Telecommunications	$8.1	$1.7	19
Other	$211.9	$71.1	1,765
Total	**$933.2**	**$217.7**	**3,563**

3.9 Tax Impacts

North Anna's spending has effects on tax payments that extend beyond the taxes paid directly on the plant. This spending has direct impacts on income and value creation, which affect taxes paid on that income and value. Similarly, the ripple effects of North Anna purchases on other spending and economic activity lead to additional income and value creation, resulting in the payment of additional taxes.

These additional or "induced" effects on tax payments are much larger than the taxes paid directly. These results are presented in Table 3-9.

North Anna is responsible for more than $17 million in state and local tax revenue, either directly or indirectly. Much of the indirect expenditures come through additional property tax revenue created by the large number of employees at the North Anna plant. In addition, the plant is responsible for generating more than $31 million in federal tax revenue.

Table 3-9. Tax Impacts[a] of Economic Activity Induced by North Anna (Millions)

	Taxes Paid by Plant	Taxes Induced by Plant Expenditures	Total Tax Impact[a]
Federal Government	$5.7	$25.4	$31.1
State and Local Government	$11.0	$6.4	$17.5
Total Taxes	**$16.7**	**$31.9**	**$48.6**

[a] *The total tax impact includes taxes paid by North Anna and other entities as a result of the economic activity created by plant expenditures.*

3.10 Summary

The economic and fiscal impacts of North Anna are substantial. These impacts are greater at the national level than at the state level, where they, in turn, are greater than at the county level. When compared with their respective economies, those relative impacts are reversed: relative impacts are highest for Louisa, Orange and Spotsylvania counties; next-highest for Virginia; and lowest for the United States.

As is the case with other nuclear plants, North Anna buys many specialized products and services not available in local and state economies. National and international markets typically provide these products and services.

The state and local economic and fiscal effects are great, in large part because of the buying power that is created by North Anna's high wages, salaries and benefits. In turn, plant employees buy goods and services provided locally. This spending supports many small businesses in the area.

Section 4: Additional Benefits Provided by North Anna

The North Anna Power Station is an active corporate citizen in the surrounding region. In addition to the economic and fiscal benefits described in Section 3, North Anna contributes to the local community in important ways that are difficult to quantify, but have resulted in many expressions of appreciation from local officials, civic groups and station neighbors.

4.1 Introduction

North Anna has a long tradition of community involvement. This tradition is manifested in the plant management's strong commitment to sharing financial resources and intellectual talent in Louisa and the surrounding counties. Company leaders support volunteerism with measures such as a plant volunteer council and paid time off for employees who perform community-based volunteer service. Station employees have given tens of thousands of dollars to local United Way charities, and Dominion donates to worthy nonprofit organizations through the corporate Community Investment Board and the Dominion Foundation.

4.2 Education

Educating members of the public about nuclear energy, radiation, electricity, forms of energy and magnetism is a long-standing goal at Dominion's two nuclear plants in Virginia, North Anna and Surry. The company operates Nuclear Information Centers at both plants to inform the public about the company's nuclear operations and to support educational outreach to area teachers and students. Since they opened their doors in 1988, the Nuclear Information Centers have interfaced with more than 230,000 people, including teachers, students, journalists, civic and professional groups, community leaders, and representatives of the nuclear industry and its regulators.

Teachers can bring their students to the information centers for free programs that meet the Virginia Standards of Learning teaching requirements for nuclear energy, sources of energy, circuits and magnetism. The centers' staffs also provide similar programs at area schools upon request.

The Nuclear Information Centers have partnered with members of professional societies such as the American Nuclear Society, the Health Physics Society, Women in Nuclear and North American Young Generation in Nuclear to conduct teacher workshops on nuclear science and energy. The information centers also offer programs during the summer months to help area Boy Scouts obtain the Nuclear Science Merit Badge.

Dominion also participates in teacher workshops and training programs in partnership with the National Energy Education Development Project, a nonprofit organization dedicated to helping the nation's teachers and students understand the role of energy in the United States.

Dominion accepts grant applications (up to $10,000) to encourage the development of new programs to strengthen math and science education in kindergarten through grade 12. Since the grant program was established, nearly $2 million has been allocated to nearby schools. In 2006, Dominion provided $3,500 in educational grants to Louisa County schools and $5,000 to Spotsylvania County schools.

4.3 Environment

Dominion is committed not only to operating its stations safely, but in an environmentally responsible manner. The company has embraced policies and technologies that help protect and enhance its plants' surrounding natural resources.

In 1971, Dominion became one of the first energy companies in the United States to establish a permanent environmental department to monitor the environmental impacts of its operations. The department employs environmental professionals (engineers, chemists, biologists, meteorologists and technicians) who focus on clean air, water, land and waste management. These professionals constantly monitor the environment around Dominion facilities looking for changes or problems and providing solutions.

The company's conservation efforts focus on protecting and enhancing fish populations. At North Anna, special structures of brush and cinderblocks have been constructed and sunk in Lake Anna to improve fish habitat.

The plant was designed so that the water used for cooling the steam for electricity generation discharges into innovative systems of lagoons at a warmer temperature. By the time that water returns to Lake Anna, it is near normal temperatures.

Because of the warmer water, the life cycles of some of the large introduced game fish—such as striped bass and walleye—have changed seasons, so that they grow during the winter instead of the summer. Also, Lake Anna is the only body of water in Virginia in which threadfin shad, an introduced forage fish species, can survive during the winter. Typically, threadfin shad must be reintroduced to Virginia lakes annually because they cannot survive winter's low water temperatures.

Dominion biologists monitor the health of fish populations by sampling adult fish in Lake Anna on a quarterly basis to compare fish population data to past years. The data also are compared to pre-operational lake data. These comparisons consistently have shown that North Anna is not harming the fish population; in fact, Lake Anna supports a healthy, growing population of fish.

4.4 Corporate Citizenship

For more than 20 years North Anna Power Station has endeavored to be a good corporate citizen in Central Virginia. Many of the station's more than 900 employees contribute in meaningful ways to help make their communities better places to live.

North Anna Power Station employees demonstrate their commitment to their communities by participating in an Adopt-a-Highway program to keep Virginia Route 700 free of litter, supporting local Habitat for Humanity projects, providing Thanksgiving baskets for the needy, conducting blood drives and sending mentally and physically challenged children to summer camps. They also support area Boy Scouts by providing opportunities to stay overnight at the station and earn merit badges.

Over the past decade Dominion has donated more than $100,000 to Louisa County organizations and activities such as the Louisa County Library, LinkAges of Louisa, after-prom school parties, the 4-H Council, Crime Solvers and the Lake Anna Civic Association.

Recently, Dominion was recognized as the Corporate Philanthropist of the Year by the Central Virginia Chapter of the National Society of Fund Raising Executives. The company also was honored with the Virginia governor's Community Service and Volunteerism Award in recognition of its volunteer programs supporting local schools.

North Anna Power Station has a history of partnering with Virginia state parks. Volunteers have built a nature pavilion and assisted in creating a ball field at the Bumpass-Beaverdam Park in Louisa County. They also have constructed nature trails, fishing piers and a nature pavilion at the Lake Anna State Park in Spotsylvania County.

Section 5: Nuclear Industry Trends

The U.S. nuclear energy industry steadily has improved performance and cost, while also becoming a model of industrial safety.

Total electricity production for U.S. nuclear power plants reached a near-record 787 billion kilowatt-hours in 2006, or about 20 percent of America's electricity production. In Virginia, nuclear power generates 38 percent of the state's electricity.

Power plant performance is measured by capacity factor, which compares the amount of electricity actually produced by a plant with the maximum production achievable. U.S. nuclear power plants achieved an average capacity factor of 89.8 percent in 2006. At the same time, production costs for those plants have been among the lowest of any baseload fuel source.

5.1 Nuclear Industry Performance

U.S. nuclear power plants have increased their output and improved their performance significantly over the past 10 years. Since 1990, the industry has increased total output equivalent to that of 27 new, large nuclear plants, while only five plants have come on line.

Overall capacity factors for U.S. nuclear power plants have increased dramatically over the past decade, reaching 89.8 percent in 2006. By contrast, the industry's average capacity factor was 60 percent in the late 1980s. One of the key reasons for the increased capacity factor has been the shortening of refueling outage times.

Figure 5-1. U.S. Nuclear Industry Net Electricity Generation
(36% increase from 1990 to 2006)

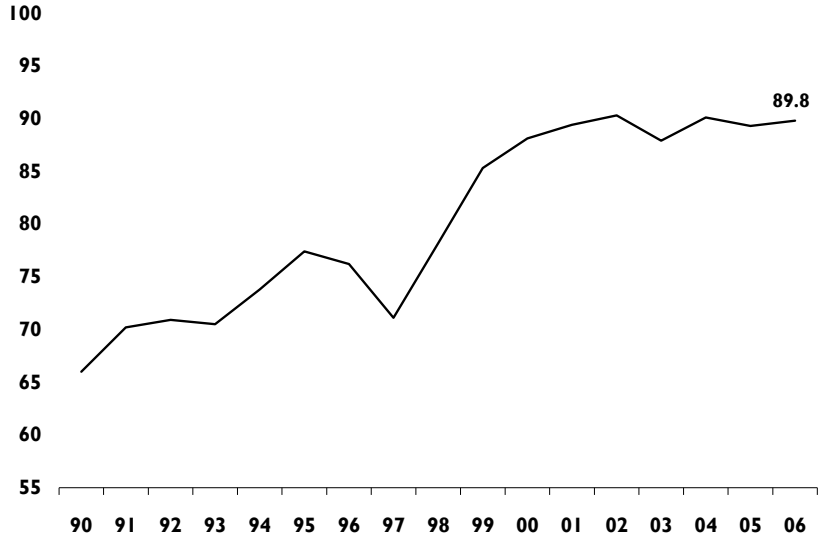
Sources: Global Energy Decisions, Energy Information Administration

Nuclear plants need to shut down to refuel approximately every 18 to 24 months. Refueling represents one of the major determinants of nuclear plant availability.

In the past 10 years, the durations of refueling outages have been declining. In 1990, the average refueling outage took 104 days to complete.

By 2006, this number declined to an average of 39 days, and companies continue to apply best practices to further reduce this average length of refueling. The record for the shortest outage is 14.7 days for a boiling water reactor and 15.7 days for a pressurized water reactor.

Figure 5-2. U.S. Nuclear Industry Average Capacity Factors (Percent, 1990-2006)

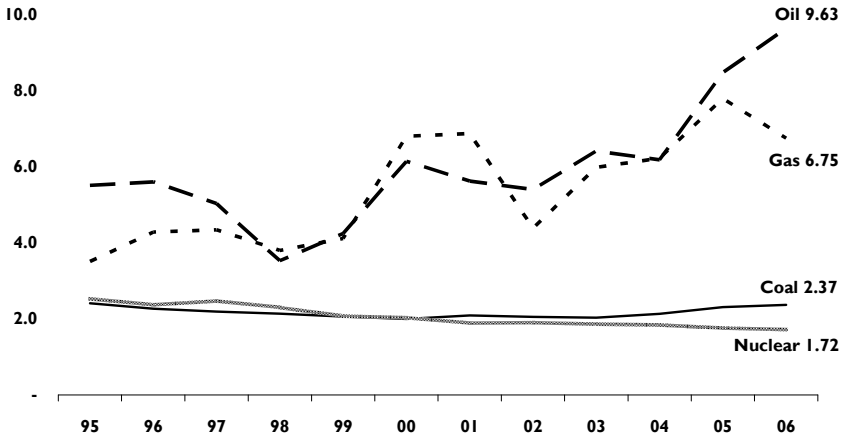


Sources: Global Energy Decisions, Energy Information Administration

5.2 Cost Competitiveness

Along with increasing output, the U.S. nuclear industry has continued to decrease the cost of its operations. In 2006, nuclear power had a production cost of 1.72 cents per kilowatt-hour. In the past decade, nuclear production costs have dropped by about one-third because of the increased capacity factor of U.S. plants. Since most nuclear plant costs are fixed, greater electricity production can be produced more economically than fossil fuels which rely primarily on fuel costs. However, nuclear plants also have taken steps to reduce their total cost through improved work processes.

Figure 5-3. U.S. Electricity Production Costs (1995-2006, in 2006 cents per kilowatt-hour)



Source: Global Energy Decisions

Table 5-1. Wholesale Electricity Prices by Region

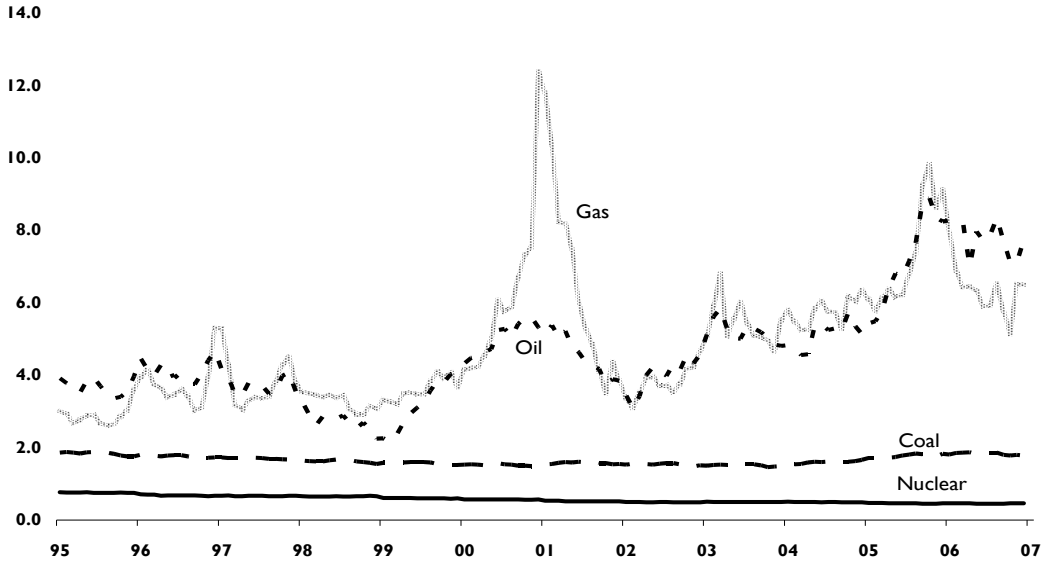
Region	2006 Average 24/7 Power Prices (in cents per kilowatt-hour)
East	6.12
Midwest	5.01
Southeast	5.56
West	5.18

Sources: Global Energy Decisions, InterContinental Exchange

Because of low production costs and excellent safety performance, nuclear plants are highly competitive in today's energy markets. Ultimately, the primary test of nuclear energy's competitiveness is how well it performs against market prices. In this respect, nuclear energy is highly competitive. The average 2006 production cost at the nation's 103 reactors of 1.72 cents per kilowatt-hour was lower than the average price in all regional markets. Nuclear energy also is competitive with futures market prices, one of the best ways to judge what prices will be in the year ahead.

Nuclear plants provide a unique degree of price stability for two reasons. First, uranium fuel represents only 26 percent of the production cost of nuclear energy, but fuel costs make up 77 percent to 92 percent of the cost of natural gas-, coal- and petroleum-fired generation. Fuel markets tend to be volatile, so the production costs of generation sources tied to fuel expenses are highly volatile, as they swing with variations in the market. Second, nuclear fuel prices are much more stable than those of fossil fuels, particularly natural gas and petroleum. Because of its stable, low production cost, nuclear energy can help mitigate large electricity price swings.

Figure 5-4. Monthly Fuel Cost to Electric Generators
(1995-2006, in 2006 cents per kilowatt-hour)



Source: Global Energy Decisions

5.3 Industry Safety

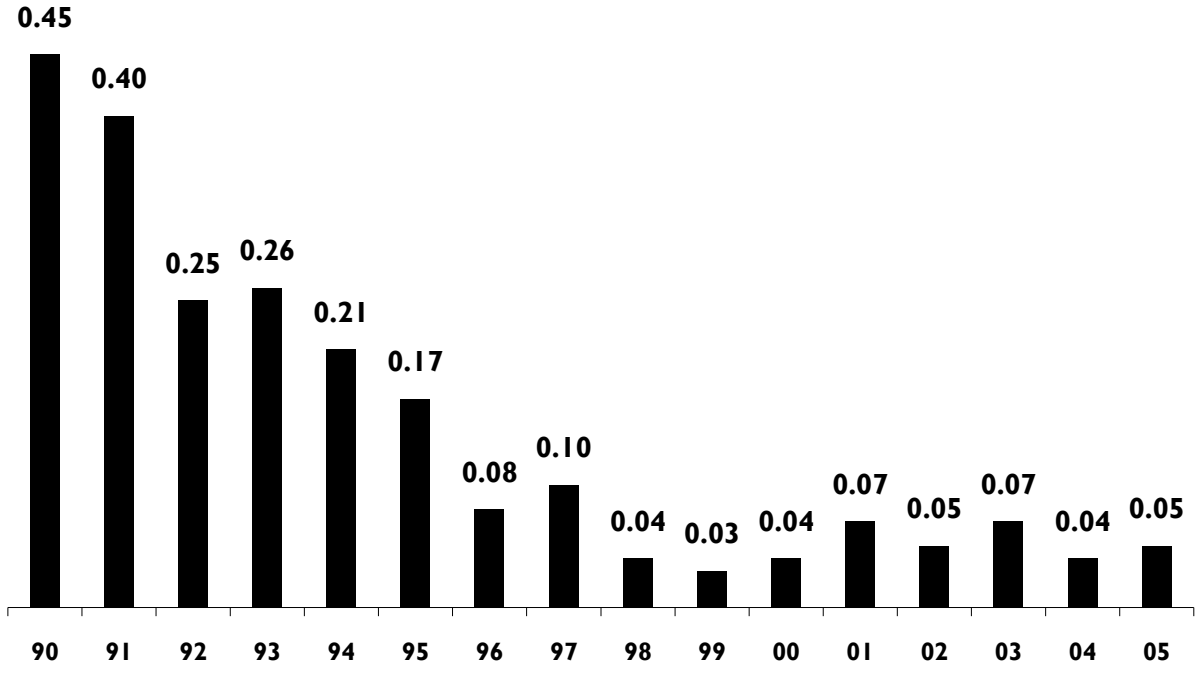
The nuclear industry's recent performance and cost achievements occurred in an era of outstanding safety at U.S. nuclear plants. In 2006, the nuclear energy industry was close (93 percent) to meeting all 2006 safety goals set by the Institute of Nuclear Power Operations (INPO) and the World Association of Nuclear Operators (WANO). These entities track safety and performance data in nine important areas.

One key indicator tracked by INPO and WANO is the number of unplanned automatic plant shutdowns. The U.S. industry has maintained a low rate in the number of unplanned automatic shutdowns, attaining a median of 0.49 shutdowns per reactor in 1997 and 0.42 in 2006.

Other safety and performance indicators tracked by the U.S. Nuclear Regulatory Commission confirm the excellent safety performance of U.S. nuclear plants. The NRC 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 0.05 in 2005.

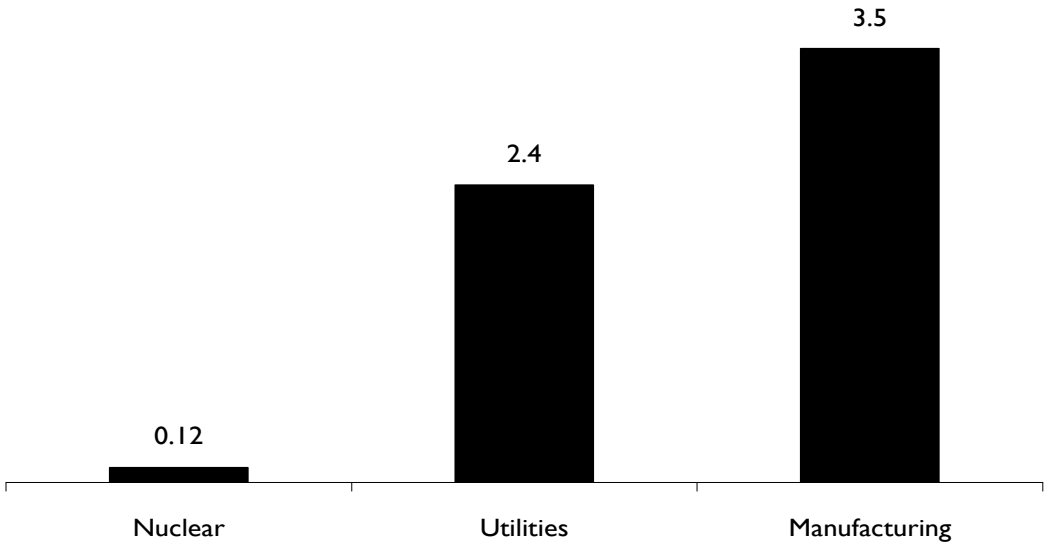
In addition to safe operations, U.S. nuclear plants continue to improve their already high levels of worker safety. According to NRC data, radiation exposure to workers (measured in rems) decreased from an average of about 1 rem per year in 1973 to 0.15 rem per year in 2005. Both the historical and current doses per employee are far below the regulatory limit of 5 rem per year.

Figure 5-5. Significant Events: Annual Industry Average
(Number of events per reactor, 1990-2005)



Source: Nuclear Regulatory Commission Information Digest

Figure 5-6. Nuclear's Superior Safety Record
(2006 Nuclear Industry's Industrial Accident Safety Rates* Compared to Other Industries)



**Number of accidents resulting in lost work, restricted work or job transfer per 200,000 worker-hours.*
Sources: Nuclear (World Association of Nuclear Operators), others (U.S. Bureau of Labor Statistics)

General worker safety also is excellent at U.S. nuclear power plants—far safer than in the U.S. manufacturing sector. WANO and the U.S. Bureau of Labor Statistics provide information on the industrial accident safety rate. This statistic measures the lost workday accidents per 200,000 worker-hours. The nuclear industry has improved its industrial safety accident rate from 0.38 in 1997 to 0.12 in 2006. By comparison, the U.S. manufacturing industry had an industrial safety accident rate of 3.5.

5.4 Current Industry Events

The excellent economic and safety performance of U.S. nuclear plants has increased interest in nuclear energy by the electric utility industry, the financial community and policymakers. This is evidenced by the increasing number of plants seeking license renewals from the NRC.

Originally licensed to operate for 40 years, nuclear plants can operate safely for longer periods. The NRC granted the first 20-year license renewal to the Calvert Cliffs plant in Maryland in 2000. As of January 2008, 48 reactors have received license extensions—including Dominion's North Anna, Surry and Millstone nuclear plants—and 33 plants either have submitted applications or formally announced that they will seek to renew their licenses. 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 current plants, interest recently has increased in building new nuclear plants. Dominion has submitted a combined construction and operating license (COL) application for a new reactor at the North Anna Power Station. NRG Energy Inc. also has submitted a COL application to the NRC to build two new reactors at the South Texas Project site in Matagorda County, Texas, while the Tennessee Valley Authority has submitted a COL application for a new reactor at the Bellefonte site in

Alabama. Additionally, UniStar Nuclear Energy LLC has submitted a partial COL application for a new reactor at the Calvert Cliffs plant in Calvert County, Md. Three companies—Entergy, Exelon and Dominion—have received from the NRC early site permits (ESPs) for potential new nuclear plants. The NRC is reviewing an ESP application for Southern Co. Several other companies and consortia have plans to file new reactor applications in the coming years.

Section 6: Economic Impact Analysis Methodology

The methodology used to estimate the economic and fiscal impacts of Dominion's North Anna nuclear power plant is commonly referred to as input/output analysis. Several operational input/output models are available in the marketplace. The market leaders are Impact Analysis for Planning (IMPLAN), Regional Economic Models Inc. and Regional Input-Output Modeling System II. The study's authors selected the IMPLAN model for use in this study, primarily because of the availability of the model and data sets. Other important factors were its relevance to the particular application, as well as its transparency and ease of use.

This section presents typical applications of input/output analysis and explains the methodology and its underpinnings. It also describes how North Anna data and the IMPLAN model were used to estimate local, state and national economic and fiscal impacts of the plant's operation.

6.1 Use of Input/Output Models

Input/output models capture input, or demand, and output, or supply, interrelationships for detailed business, industry and government sectors in a geographic region. They also capture the consumption of goods and services for final demand by these sectors and by the household sector.

The basic geographic region is a county, but model results can be developed at the multi-county, state, multi-state and national levels. These results are particularly useful in examining the total effects of an economic activity or of a change in the level of that activity.

These models are typically used when the following key questions need to be addressed:

- How much spending does an economic activity (such as a power plant) bring to a region or local area?
- How much of this spending results in sales growth by local businesses?
- How much income is generated for local businesses and households?
- How many jobs does this activity support?
- How much tax revenue is generated by this activity?

These models also are useful in addressing related questions, such as the geographic and industry distribution of economic and fiscal impacts. Typical applications of these models include facility or military base openings and closings, transport or other public infrastructure investments, industrial recruitment and relocation, and tourism.

6.2 Overview of the Input/Output Methodology

Input/output models link various sectors of the economy—e.g., agriculture, construction, government, households, manufacturing, services and trade—through their respective spending flows in a reference year. These include geographic linkages, primarily at national, state and county levels.

As a result of these linkages, the impact of an economic activity in any sector or geographic area on other sectors and areas can be modeled. These impacts can extend well beyond the sector and area in which the

original economic activity is located. They include not only the direct, or initial, effects of the economic activity, but also the secondary, or "ripple," effects that flow from this activity. Direct effects are analogous to the initial "splash" made by the economic activity, and ripple effects are analogous to the subsequent "waves" of economic activity (new employment, income, production and spending) triggered by the splash. A full accounting of the effect of the splash must include the waves as well as the splash itself.

The sum of the direct and ripple effects is called the total effect, and the ratio of the total effect to the direct effect is called the "total effect multiplier," or simply the multiplier effect. Multipliers can be developed for any of the model outputs, such as earned income, employment, industry output and total income (which includes the effect of transfers between institutions).

"Multipliers" also can be developed for any industry/business sector or geographic area in the model. Multipliers for a county are smaller than for a larger area, such as the state in which the county is located, because some spending associated with an economic activity migrates from the small area into the larger area. At the local area level, multipliers are larger if the local area tends to produce the types of goods and services that the plant requires.

Secondary effects include two components—indirect and induced effects—modeled separately within input/output models. Indirect effects are those influencing the supply chain that feeds into the business/industry sector in which the economic activity is located. For example, when North Anna buys a hammer for $5, it contributes directly to the economy.

Consequently, the company that makes the hammer also has to increase its purchases of steel and wood to maintain its inventory, increasing output in the steel and wood industries. The steel and wood industries then will have to purchase more inputs for their production processes, and so on. The result will be an economic impact that is greater than the $5 initially spent for the hammer.

The increased income of plant employees and other regional workers leads to higher spending at the household level. That increased spending is called the induced effect. To illustrate, when North Anna pays $5 for a hammer, a portion of the $5 goes to pay wages of employees at the company that makes the hammer. This portion contributes to labor income, which provides an additional contribution to the economy through its effects on household spending for goods and services.

This purchase also will affect labor income in the wood and steel industries, and the resulting household spending on goods and services. Dominion's wage and salary expenditures at the plant create induced effects as well, primarily in the plant's host and surrounding counties.

As with any model, input/output models incorporate some simplifying assumptions to make them tractable. There are several key simplifying assumptions in input/output models, including the assumption of a fixed commodity input structure. In essence, the "recipe" for producing a product or service is fixed, and there is no substitution of inputs, either of new inputs (which were not in the mix before) for old inputs, or among inputs within the mix.

Input substitution does not occur if technical improvements in some inputs make them relatively more productive. Nor does input substitution occur if there are relative price changes among inputs. Were any of these types of substitutions to be allowed, they might dampen the multiplier effects, especially for larger geographic areas.

Another key simplifying assumption is constant returns to scale. A doubling of commodity or service output requires a doubling of inputs, and a halving of commodity or service output requires a halving of

inputs. There is no opportunity for input use relative to commodity or service production levels to change, as those levels expand or contract, so there are no opportunities for either economies or diseconomies of scale. This will not dramatically alter the overall results as long as the economic activity whose effects are being modeled is not large relative to the rest of the sectors.

In other words, the models assume that for every dollar of output, the same dollar amount is required for the various input categories. Returning to the hammer example, if a $5 hammer requires $3 of steel, then two hammers would require $6 of steel.

Although that works for steel and hammers, some inputs do not vary directly with output. For instance, if an oil refinery's efficiency and output increases, a corresponding increase in personnel operating the plant is unlikely. The constant-return-to-scale assumption considers such differences and is necessary for modeling.

Input/output models assume no input supply or commodity/service production capability constraints. This simplifying assumption is related in part to the constant-returns-to-scale assumption, for if there were supply constraints, diseconomies of scale likely would result. As in the case of the constant-returns-to-scale assumption, this "no supply constraints" assumption is not a major concern as long as the economic activity of interest is not large
relative to the rest of the sectors.

To illustrate, the assumption presupposes that a hammer manufacturer would purchase all the steel for the same price. If not, doubling the number of hammers sold could mean that the dollar value of the steel might more than double if the manufacturer had to buy more steel at a higher price. This would violate the constant-returns-to-scale assumption, which simplifies modeling.

Homogeneity, another key simplifying assumption, characterizes firms and technologies within sectors as very similar. Although the model allows some editing of its sector files to characterize specialized firms, there is no ability to reflect full diversity of firms within sectors.

6.3 The IMPLAN Model and Its Application to North Anna

IMPLAN was originally developed by the U.S. Department of Agriculture's Forest Service in cooperation with the Federal Emergency Management Agency and the U.S. Department of the Interior's Bureau of Land Management to assist in land and resource management planning. IMPLAN has been used since 1979 and is supported by the Minnesota IMPLAN Group Inc.

The IMPLAN system consists of two components: the software and the database. The software performs the necessary calculations, using the study area data, to create the models. It also provides an interface for the user to change the region's economic description, create impact scenarios and introduce changes into the local model. The software is described in a user's guide provided by the Minnesota IMPLAN Group.

The IMPLAN software was designed to serve three functions: data retrieval, data reduction and model development, and impact analyses.

The IMPLAN database consists of two major parts:

- national technology matrices
- estimates of regional data for institutional demand and transfers, value added, industry output, and employment for each county in the United States, as well as state and national totals.

The model's data and account structure closely follow the accounting conventions used in the input/output studies of the U.S. economy by the Department of Commerce's Bureau of Economic Analysis. The comprehensive and detailed data coverage of the entire United States by county, and the ability to incorporate user-supplied data at each stage of the model-building process, provides a high degree of flexibility in terms of both geographic coverage and model formulation.

In applying the IMPLAN model to the plant, Dominion provided three basic types of data: purchase order expenditures by purchase order code, employee compensation expenditures and tax payment data for 2006.

The purchase order data mapped IMPLAN's 509 sector codes in two ways. First, by identifying the largest contracts at each geographic level and assigning them an industrial classification code within IMPLAN sector codes. For the remaining expenditures, the data were mapped into IMPLAN codes based on average distributions obtained through detailed studies of six nuclear reactors. The purchase order data also were mapped into IMPLAN based on the areas where these purchases were made.

The purchase order and compensation data then were augmented by an estimate of revenues from electricity sales from North Anna into the wholesale market in 2006. This augmentation was necessary because purchase orders and compensation do not reflect all the economic value of the nuclear plant, while total output (approximated by total revenues) better reflects the full economic impacts of the plant.

The estimated revenues were above the expenditure data provided by North Anna, indicating a nuclear generation profit margin that was incorporated into IMPLAN as profits associated with the operation of the plant.

These data then were incorporated into the IMPLAN model, which combined specifics of the local economy with data on economic activity of North Anna to provide estimates of the plant's total impacts. IMPLAN then developed the economic and fiscal impact estimates for this report.

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