Economic Benefits of Palo Verde Nuclear Generation Station

An Economic Impact
Study by the
Nuclear Energy Institute

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Executive Summary

The Palo Verde Nuclear Generating Station in Arizona's western Maricopa County is an integral part of the county and state economy. The plant provides jobs and makes purchases that stimulate the local economy directly and indirectly. Additional benefits to the area include higher tax revenue, increased labor income and significant charitable contributions to the local community. In addition, there are important intangible benefits, such as clean air, environmental stewardship and stable, affordable electricity prices. According to this study by the Nuclear Energy Institute, Palo Verde's economic impact reaches beyond the local community to the state and nation.

The Palo Verde plant is operated by Arizona Public Service Co. and jointly owned by Arizona Public Service Co., El Paso Electric Co., Los Angeles Department of Water and Power, PNM Resources, Salt River Project, Southern California Edison, and Southern California Public Power Authority.

In 2002, operation of the Palo Verde Power Nuclear Generating Station increased Maricopa County's economic output by $149.3 million. Adding the direct value of the plant's electricity output brings the county's economic output attributable to Palo Verde to $868.5 million.

The plant's total economic impact includes direct effects, which comprise the value of electricity produced at the plants, as well as secondary—or indirect—effects resulting from plant operation.

The operation of Palo Verde, and its secondary effects, accounts for 3,943 jobs in Maricopa County. Earnings for these jobs total $245.2 million in the county. Additionally, the plant and its related economic activity provide $62 million to state and local tax coffers.

The plant is one of the largest employers in the far Southwest Valley area of Maricopa County. The plant directly employs 2,386 people, including long-term contractors and corporate staff. The vast majority of these workers live in Maricopa County. More than one of every 100 working people in the municipalities of Avondale, Buckeye, Goodyear, Litchfield Park and Wickenburg work at Palo Verde. In addition, these jobs pay 13 percent above the average Maricopa County salary.

The economic activity generated by the Palo Verde plant creates another 1,570 jobs in the county. Given the combination of employees at the plant and indirect jobs created by Palo Verde's economic activity, the plant is responsible for 3,943 jobs in Maricopa County.

The plant's principal expenditure in Maricopa County is employee compensation. During 2002, Palo Verde paid $193.2 million in compensation to employees living in the county. Additionally, the economic activity created by Palo Verde accounted for $51.9 million in non-Palo Verde employee compensation in Maricopa County. Together, the direct and indirect compensation from the plant accounted for $245.2 million in labor income in the county.

Palo Verde makes substantial purchases in Maricopa County. In 2002, these purchases totaled $223.4 million, including $17.8 million in Maricopa County. Economic activity generated by Palo Verde also led to $149.3 million in increased output in the county.

Palo Verde pays an estimated $54.1 million in state and local taxes annually. Additionally, the economic activity generated by Palo Verde contributes another $7.8 million in state and local taxes, through increased income, property and sales taxes. By combining direct and indirect taxes, Palo Verde accounts for $62 million in state and local tax payments.

Besides the economic benefits Palo Verde provides, the plant generated 30.9 billion kilowatt-hours of electricity in 2002, approximately 35 percent of Arizona's total electricity generation. This low-cost electricity helped keep energy prices in Arizona affordable. During 2002, Palo Verde had a production cost of 1.33 cents per kilowatt-hour, compared with an average production cost of 2.53 cents per kilowatt-hour for the rest of the Southwest energy market. Palo Verde did this without producing air pollution typical of some other large power generation sources.

Palo Verde also is an integral part of the local community, as seen in charitable giving by Arizona Public Service Co. and its employees. In 2002, Palo Verde employees donated $459,564 to charitable organizations. The largest contribution supported local educational programs. Additionally, Palo Verde employees contributed more than 50,000 man-hours of volunteer time to Arizona community events.

The plant also plays a vital role in maintaining regional air quality. Without the plant, nitrous oxide emissions in the local area would increase by 93,000 tons per year and sulfur dioxide emissions would rise by 158,000 tons annually because fossil-fueled power plants would be used to offset electricity generation from nuclear energy. Additionally, carbon dioxide emissions, one of the main greenhouse gases, would increase by 29.1 million tons.

Section 1: Introduction

This economic impact study by the Nuclear Energy Institute[1] (NEI) examines the economic, fiscal and other community benefits provided by the Palo Verde Nuclear Generating Station, operated by Arizona Public Service Co. The plant is jointly owned by Arizona Public Service Co., El Paso Electric Co., Los Angeles Department of Water and Power, PNM Resources, Salt River Project, Southern California Edison, and Southern California Public Power Authority.

This study analyzes the economic and other benefits Palo Verde provides to Maricopa County, as well as the state of Arizona and the United States. The analysis uses detailed data from Palo Verde and governmental sources to assess those benefits.

Although this study focuses primarily on benefits to the local community, state and national benefits also are analyzed. These include direct impacts—such as people employed by the plant, plant expenditures within the community and corporate tax payments—and indirect impacts, such as jobs created indirectly by plant expenditures in the local economy. The study also discusses other benefits provided by the plant, such as reliable, low-cost electricity, its contributions to air quality as an emission-free source of electricity, and land stewardship.

Arizona Public Service Co. and NEI cooperated in developing this study. Arizona Public Service Co. and Palo Verde provided data on employment, operating expenditures and tax payments, as well as guidance on details specific to Maricopa County and the plant.

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

The remainder of this report contains five sections:

- Section 2 provides background on Palo Verde, including plant history, performance, cost, employment, taxes and local area details, such as total employment and earnings, as well as regional electricity prices.
- Section 3 examines the economic and fiscal impacts of the plant on 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 Palo Verde Nuclear Generating Station

This section provides background information on Palo Verde and Maricopa County to frame the results of subsequent sections, including a brief history of the plant and information on its cost, employment, performance and taxes. This section also includes information on local area details of Maricopa County, its major cities and the state of Arizona, including total employment, earnings, local tax collections and regional electricity cost.

2.1 History and Information

The Palo Verde Nuclear Generating Station, near Wintersburg, Ariz., is about 45 miles west of Phoenix (see Figure 2-2). The facility is the largest nuclear power plant in the United States and has been the top power producer of any kind in the country for 12 consecutive years. The plant lies in Maricopa County, which has a population of about 3.3 million and covers 9,203 square miles. Palo Verde, operated by Arizona Public Service Co., is owned by Arizona Public Service Co., El Paso Electric Co., Los Angeles Department of Water and Power, PNM Resources, Salt River Project, Southern California Edison, and Southern California Public Power Authority.

Table 2-1. Palo Verde Nuclear Power Plant: At a Glance

Unit	Capacity	Commercial Operation Year	License Expiration Year	Reactor Type
Unit 1	1,243 MW	1986	2024	PWR
Unit 2*	1,243 MW	1986	2025	PWR
Unit 3	1,247 MW	1988	2027	PWR

MW = megawatts; PWR = pressurized water reactor

** Unit 2's capacity is larger because of an expansion of plant capacity in 2003.*

Throughout its operation, Palo Verde has been a leader in the nuclear energy industry. During most of the 1990s, the Palo Verde reactors maintained capacity factors 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.

Since 1998, all reactors have operated at or near a 90 percent capacity factor on a three-year rolling average basis.

Figure 2-1. Three-Year Average Capacity Factors

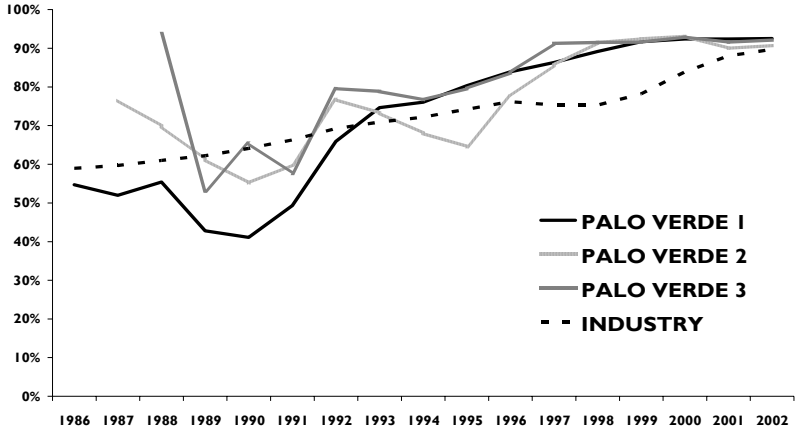


Figure 2-2. The Palo Verde Nuclear Generating Station and Surrounding Area

2.2 Generation

Palo Verde generated more than 30.9 billion kilowatt-hours of electricity in 2002—a U.S. generating record. The plant provides about 35 percent of the electricity generated in Arizona each year. Plant output was driven by a high capacity factor that reached 94.4 percent in 2002.

Palo Verde provides power primarily for the Arizona/New Mexico/Nevada Power Area, although it exports some of its power (13 percent) to utilities in California and Texas. Efficient performance has made Palo Verde very cost-competitive in the region. Palo Verde had a production cost of 1.33 cents per kilowatt-hour. By comparison, the three-year average production cost was 2.53 cents per kilowatt-hour for electricity generators in the region.

Production costs represent the operations, maintenance and fuel cost of the plant. They do not include depreciation, interest or ongoing capital cost. Contributions to the Nuclear Waste Fund, established to pay for the disposal of used nuclear fuel from commercial power plants, are contained within fuel cost. Customers of nuclear-generated electricity pay for the fund.

Table 2-2. Regional Power Production Cost and Generation

	Average Production Cost (in Cents per Kilowatt-Hour)	Generation (in Million Megawatt-Hours)
Palo Verde	1.33	30.9
Coal	2.26	68.8
Natural Gas	4.54	28.1
Hydro	0.63	10.5
Total (including Palo Verde)	**2.53**	**139.6**

Source: Resource Data International; Region includes Arizona, Nevada and New Mexico.

Palo Verde's low production costs help keep wholesale electricity prices affordable in the region. Although Palo Verde's exact contribution is difficult to measure, it can be estimated by determining how much average 2002 production costs in the region would increase if Palo Verde were replaced, for example, by a combined-cycle natural gas plant (the plant of choice for new generation). Substituting combined-cycle natural gas plants for Palo Verde in 2002 would have resulted in an increase in average generation costs for the region from 2.53 cents per kilowatt-hour to 3.13 cents per kilowatt-hour.

2.3 Employment, Spending and Taxes

Besides providing affordable electricity to the Southwest, Palo Verde is the largest employer in the far Southwest Valley. The plant employs 2,055 full-time on-site workers. Of these employees, 2,042 reside within the county. Full-time employees include 370 people from Glendale, 305 from Phoenix, 276 from Peoria, 211 from Buckeye, 197 from Goodyear, 168 from Avondale, and 153 from Litchfield Park. In a few cities almost one in 10 work at Palo Verde while in several other localities, one of every 100 employed people works at the Palo Verde Nuclear Generating Station.

Maricopa County, the fourth most populous county in the United States, has a vast employment base, and Palo Verde is responsible for one worker per 1,000 employed people. In addition to these workers, the plant also is responsible for the employment of 151 long-term contractors and 180 employees at Arizona Public Service's corporate offices in Phoenix.

Jobs provided by Palo Verde also are typically higher paying than most jobs in the area. Full-time Palo Verde employees who live in Maricopa County earned, on average, about $66,000 in 2002. This was about 13 percent higher than the average earnings of workers in the county, about $58,600 a year.

Palo Verde also spends a large amount of money in the local community. During the one-year period of this study, Palo Verde made $17.8 million in non-labor purchases in Maricopa County.

Palo Verde also made substantial tax payments to the county in 2002. The plant paid $46.1 million in county property taxes to Maricopa County, almost 12 percent of Maricopa County's $392.8 million property tax levy.

Table 2-3. Full-Time On-Site Employee and Salary Information by Top-10 Cities and Towns in Maricopa County

Location	Palo Verde			City/County Total*	
	Permanent On-Site Employees	% of Employed Work Force	Average Earnings	Employed Work Force	Average Earnings
Glendale	370	0.4%	$66,070	103,474	$54,391
Phoenix	305	0.0%	$64,448	611,019	$54,727
Peoria	276	0.6%	$68,257	49,793	$61,113
Buckeye	211	8.5%	$60,746	2,474	$50,639
Goodyear	197	2.6%	$68,319	7,651	$62,348
Avondale	168	1.1%	$68,057	15,670	$56,999
Litchfield Park	153	9.4%	$77,234	1,630	$88,323
Tonopah	74	NA	$59,816	NA	NA
Surprise	50	0.5%	$66,378	10,443	$46,902
Wickenburg	40	2.0%	$71,988	1,964	$40,530
Maricopa County Total	2,042	0.1%	$66,006	1,427,292	$58,635

** Source: Census 2000; NA = Not available*

2.4 Summary

Palo Verde provides reliable electricity generation and keeps power prices affordable in Arizona. The plant also offers well-paid employment and a large tax base to Maricopa County. However, these are only the direct economic benefits of the plant. As illustrated in the next section, the secondary effects on the local and regional economies are as substantial as the direct benefits.

Section 3: Economic and Fiscal Impacts

The economic and fiscal effects of Palo Verde's operation go well beyond what the plant spends on purchases, wages, salaries, employee benefits and taxes. They also reflect the strong stimulus that the plant's large wage and salary payments provide to key measures of economic activity—value of electricity production, employment and labor income—in the local and state economies.

Palo Verde's spending lifts economic activity throughout the local and state economies. Tax payments related to economic activity are another contributing factor. This effect is felt throughout the local and state economies—by the private sector in the form of increased sales and employment, and by the public sector through increased tax revenues to support the provision of public services.

Estimates of these effects were developed by applying the Impact Analysis for Planning (IMPLAN) model to expenditure data provided by Arizona Public Service Co., operator and part owner of Palo Verde. (For more information on IMPLAN, see Section 6.)

3.1 Plant Expenditures in Maricopa County

Palo Verde expenditures in Maricopa County totaled $211 million in 2002. Of those expenditures, labor represented $193.2 million and goods and services represented $17.8 million. The labor figure includes on-site employees as well as long-term contractors and corporate staff dedicated to Palo Verde. Spending within the county represents approximately 50 percent of the plant's total spending of $418 million and almost all of the $215.3 million of spending in Arizona.

The expenditure totals for Maricopa County, provided by Arizona Public Service Co., are shown in Table 3-1. The 10 sectors receiving the largest amount of Palo Verde spending are listed in this table. The categories, chosen from 509 IMPLAN sectors, are listed largely according to the IMPLAN description for each. Total compensation, which includes wages, salaries and benefits, is listed separately.

Similar expenditure totals for the state of Arizona and the United States are presented in Tables 3-2 and 3-3, respectively.

Table 3-1. Palo Verde Expenditures in Maricopa County

Description	Amount
Business Support Services	$4,953,156
Other Maintenance and Repair Construction	$3,574,866
Automotive Repair and Maintenance	$1,467,563
Other Computer-Related Services	$1,237,121
Fabricated Pipe and Pipefitting Manufacturing	$684,600
Commercial Machinery Repair and Maintenance	$639,940
Industrial Process Variable Instruments	$548,333
Miscellaneous Electrical Equipment Manufacturing	$473,375
Other Miscellaneous Chemical Product Manufacturing	$384,175
Other Miscellaneous Textile Product Mills	$359,635
Other	$3,454,207
Subtotal	**$17,776,971**
Total Compensation[a]	$193,235,557
TOTAL	**$211,012,528**

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

Total compensation for labor was $193.2 million—more than 90 percent of Palo Verde's expenditures in Maricopa County. Most of the plant's labor expenditures (wages and employee benefits) stay "home" in the county. As expected, the county's share is much larger than the share at the state or national level.

The largest non-labor expenditures in the county totaled nearly $5 million for business support services. This sector represents a wide range of facility services contracted by the plant, such as cafeteria, groundskeeping and janitorial services. Many of these services are purchased from local providers.

The next largest non-labor expenditure in Maricopa County was for maintenance, repair and construction at nearly $3.6 million. This sector represents general and specialized contractors, such as welders and pipe fitters, employed by the plant in order to perform necessary maintenance. This maintenance is necessary to ensure the safe and reliable operations of the plant. This includes many local contractors hired when the plant performs its semiannual refueling outages.

Five of the top six sectors in Table 3-1 involve service expenditures. The prevalence of service sectors reflects the heavy reliance of the plant on contracted labor to perform many specialized services. These labor-intensive services tend to produce a substantial number of jobs.

3.2 Plant Expenditures in Arizona

In 2002, Palo Verde spent $215.3 million for products and services (including labor) in Arizona. Labor represented $194.2 million, while goods and services represented $21.1 million. This total includes $211 million dispersed in Maricopa County, as well as expenditures of $4.3 million spent in other areas of Arizona.

Almost all of Palo Verde's spending in Arizona occurs in Maricopa County. Expenditures within the state represent approximately 51 percent of the plant's total spending of $418 million. Total spending in Arizona is presented in Table 3-2. Total compensation is the largest category at $194.2 million, representing about 90 percent of the total.

Table 3-2. Palo Verde Expenditures in Arizona

Description	Amount
Business Support Services	$7,467,347
Other Maintenance and Repair Construction	$3,612,886
Automotive Repair and Maintenance	$1,467,563
Other Computer-Related Services	$1,237,121
Fabricated Pipe and Pipefitting Manufacturing	$709,325
Commercial Machinery Repair and Maintenance	$690,921
Industrial Process Variable Instruments	$565,432
Miscellaneous Electrical Equipment Manufacturing	$533,322
Investigation and Security Services	$392,577
Other Miscellaneous Chemical Product Manufacturing	$384,175
Other	$4,014,554
Subtotal	**$21,075,223**
Total Compensation[a]	$194,230,485
TOTAL	**$215,305,708**

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

As expected, the spending distribution in Arizona closely mirrors that in Maricopa County. The business support services sector remains the largest non-labor expenditure category for the state at $7.5 million. Maintenance and repair construction is the second largest category, with $3.6 million.

Notably, $5.4 million of the $21.1 million of the plant's non-labor spending in Arizona was contracted to minority- or woman-owned businesses, a total of 45 different suppliers.

3.3 Plant Expenditures in the United States

Palo Verde expenditures for products and services (including labor) purchased in the United States totaled $418 million in 2002. Besides expenditures of $215.3 million in Arizona, $202.7 million was spent elsewhere in the United States. Much of that amount was for specialized products and services unique to the nuclear industry.

These national expenditures are detailed in Table 3-3. Total compensation ($194.6 million) remains the largest category and represents 47 percent of the total. Compensation as a share of the U.S. total is lower because plant employees live mostly in Arizona (and particularly in Maricopa County), while spending on products and non-labor services is concentrated outside the state.

Total compensation is followed closely by spending in the inorganic chemicals sector ($136.4 million). This category represents plant spending on fuel, which is typically purchased outside the county or state in which a plant is located. This category represents roughly 30 percent of Palo Verde's spending nationwide.

Business support services ($29.8 million) is one of the largest expenditure categories in the national data. This category represents a large portion of nuclear plant expenditures because of the many specialized activities required at plants. Many of these services are not required on a continual basis, so nuclear power plants outsource these activities.

Table 3-3. Palo Verde Expenditures in the United States

Description	Amount
Other Basic Inorganic Chemical Manufacturing	$136,417,617
Business Support Services	$29,775,593
Architectural and Engineering Services	$15,802,260
Other Maintenance and Repair Construction	$10,658,978
Fabricated Pipe and Pipefitting Manufacturing	$3,052,563
Other Computer-Related Services	$2,476,285
Commercial Machinery Repair and Maintenance	$2,360,699
Dry Cleaning and Laundry Services	$2,299,823
Employment Services	$2,005,000
Automotive Repair and Maintenance	$1,496,428
Other	$17,061,966
Subtotal	**$223,407,212**
Total Compensation[a]	$194,579,303
TOTAL	**$417,986,515**

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

The remaining sectors in the Top 10 are similar to the sectors for the state. The sole exception is architectural and engineering services. Purchases in this sector are primarily for specialized engineering work that is typically done by engineering firms located outside Arizona.

3.4 Taxes Paid and Accrued

Palo Verde pays a substantial amount of taxes primarily in the form of property tax payments to Maricopa County, which totaled $46.1 million in 2002. When combined with state use and payroll taxes, the plant paid $54.1 million in state and local taxes.

At the federal level, Palo Verde made tax payments of $36.5 million. These were almost entirely in the form of payroll taxes for its employees. These estimates do not include federal income taxes because these taxes are paid at the corporate level and not by the plant.

Table 3-4. Taxes Paid by Palo Verde

Description	Amount
Federal Government	
Payroll Tax	$35,631,183
Other Federal Taxes	$827,258
Total Federal Taxes	$36,458,441
State and Local Government	
Property Tax	$46,100,000
Other State Taxes	$8,010,844
Total State and Local Taxes	$54,110,844
Total Taxes Paid	**$90,569,285**

3.5 Economic Impacts by Geographic Area

Summary economic impacts for each of the three geographic areas—Maricopa County, Arizona 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 Palo Verde on Local, State and National Economies

	Direct	Indirect/ Induced[a]	Total
Maricopa County			
Output	$719,204,589	$149,330,798	$868,535,387
Labor Income	$193,235,557	$51,917,990	$245,153,547
Employment	2,373	1,570	3,943
Arizona			
Output	$719,204,589	$159,774,713	$878,979,302
Labor Income	$194,230,485	$55,118,042	$249,348,527
Employment	2,385	1,800	4,185
United States			
Output	$719,204,589	$1,004,180,170	$1,723,384,759
Labor Income	$194,579,304	$329,975,269	$524,554,573
Employment	2,386	8,594	10,980

[a] *Indirect impacts measure the effect of input suppliers on expenditures by Palo Verde. Induced impacts measure the effects produced by the change in household income that results from Palo Verde expenditures.*

These economic impacts are divided into direct and secondary effects. The direct effects reflect the industry sector and geographical distribution of Palo Verde's spending without any subsequent spending effects.

The secondary effects include subsequent spending effects, which can be further divided into two types: indirect and induced. Indirect effects reflect how the plant's spending patterns alter subsequent spending patterns among suppliers. Induced effects reflect how changes in labor income influence the final demand for goods and services, which then has an effect on all sectors producing basic, intermediate and final goods and services.

The direct effects are based on the estimated value of power production from the Palo Verde Nuclear Generating Station of $719.2 million in 2002. This output value is based on 2002 wholesale market values for the electricity from Palo Verde.

Wholesale prices are used for two reasons: They provide a market value for electricity in the region, and plant-specific rates are either unavailable or confidential. The wholesale rate used was 2.5 cents per kilowatt-hour, which reflects the average round-the-clock price for power in the region in 2002.

The revenue or output value of the plant is divided among salaries, taxes, plant purchases, investor returns and consumer benefits. It reflects the total output of products and services associated directly with Palo Verde. This total includes expenditures for products and services (including labor) itemized in Tables 3-1, 3-2 and 3-3.

The direct employment entry (2,386 jobs) for the United States is the Palo Verde employment level over this period, including corporate employees and long-term contractors. Almost all of these jobs are filled by workers in Maricopa County. The direct labor income entries reflect the geographic distribution of Palo Verde employment.

As Table 3-5 indicates, direct effects are typically the largest contributor to total effects for each measure of economic impact for Maricopa County and Arizona. Secondary effects are more important as a share of the total at the national level.

3.6 Economic Impacts by Local Industry

Palo Verde's economic impacts are spread over nearly every sector of the economy. Although the direct effects are concentrated in a few sectors, the secondary effects—and especially the induced effects—increase the dispersion of the economic impacts across other sectors. The most-affected sectors vary by geographic area. Table 3-6 presents the 10 sectors most affected by the plant in Maricopa County, based on total output.

The sector most affected in terms of total output is power generation and supply, which includes electricity produced by the plant. Thus, all direct effects are included in this sector. It is also the largest sector, based on total output, in the Arizona 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 or industry sector, and so it has no impact on labor income or employment. Instead, it is a special sector developed by the U.S. Department of Commerce that estimates what homeowners would pay if they rented rather than owned their homes. In essence, it creates an industry out of 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 in the area resulting from the plant.

The other sectors most affected by Palo Verde are related to providing goods and services to the plant's large employment base. These include enterprises such as doctor and dentist practices, restaurants, wholesalers, and automotive dealerships. Indirect spending by plant employees boosts the revenues and work forces of these industries, which are typically run by local small business owners.

Table 3-6. Impact of Palo Verde on the Most-Affected Industries in Maricopa County

Industry Description	Output	Labor Income	Employment
Power Generation and Supply	$720,572,993	$193,559,211	2,376
Housing Values	$15,515,384	$0	—
Food Services and Drinking Places	$7,974,853	$3,599,947	191
Hospitals	$7,770,240	$3,077,711	72
Wholesale Trade	$7,559,040	$2,906,091	51
Physicians, Dentists, Health Care Providers	$7,349,510	$4,575,335	78
Real Estate	$6,624,260	$773,137	39
Automotive Repair and Maintenance	$5,741,478	$1,204,778	41
Monetary Authorities/Depository Credit Intermediaries	$4,539,561	$957,113	19
Motor Vehicle and Parts Dealers	$3,301,809	$1,752,022	36
Other	$81,586,261	$32,748,202	1,041
TOTAL	**$868,535,389**	**$245,153,547**	**3,944**

3.7 Economic Impacts by State Industry

Table 3-7 uses the same sectors applied in Table 3-6 to illustrate the plant's economic impacts on the state of Arizona. Again, the power generation and supply, along with housing values, are the most-affected sectors in terms of total output.

The entries in Table 3-7 for the most-affected industries in Arizona are similar to those for Maricopa County. Most of Palo Verde's expenditures and employees in Arizona are in Maricopa County, so the impact distribution in the two regions is almost identical.

Table 3-7. Impact of Palo Verde on the Most-Affected Industries in Arizona

Industry Description	Output	Labor Income	Employment
Power Generation and Supply	$720,798,307	$194,607,430	2,389
Housing Values	$16,091,844	$0	—
Hospitals	$8,878,398	$3,411,820	83
Food Services and Drinking Places	$8,275,180	$3,640,010	207
Wholesale Trade	$8,052,268	$3,087,039	58
Physicians, Dentists, and Health Care Providers	$7,745,718	$4,813,701	86
Real Estate	$7,226,388	$843,413	50
Automotive Repair and Maintenance	$5,923,941	$1,225,263	43
Monetary Authorities/Depository Credit Intermediaries	$4,835,851	$1,019,584	23
Motor Vehicle and Parts Dealers	$3,464,554	$1,815,919	39
Other	$87,686,855	$34,884,350	1,207
TOTAL	**$878,979,304**	**$249,348,529**	**4,185**

3.8 Economic Impacts by U.S. Industry

Table 3-8 illustrates Palo Verde's economic impact on the United States. Again, the most-affected sector is power generation and supply, in terms of total output.

The second largest sector is the inorganic chemicals sector, which includes nuclear fuel-processing services. These services are performed at a few locations in the United States and around the world.

The 10 most-affected sectors (based on output) in the United States are similar to the 10 most-affected sectors in Maricopa County and Arizona. The main difference is the architectural and engineering services sector, which includes specialized engineering work often performed by national consultants.

Table 3-8. Impact of Palo Verde on the Most-Affected Industries in the United States

Industry Description	Output	Labor Income	Employment
Power Generation and Supply	$732,757,265	$197,789,230	2,414
Other Basic Inorganic Chemical Manufacturing	$107,884,496	$22,871,946	278
Wholesale Trade	$44,432,652	$17,042,076	310
Owner-Occupied Dwellings	$39,876,392	$0	—
Real Estate	$32,658,238	$3,840,114	214
Business Support Services	$31,581,250	$15,692,044	554
Hospitals	$25,731,656	$10,289,805	235
Food Services and Drinking Places	$23,626,708	$10,329,366	595
Architectural and Engineering Services	$22,457,438	$13,361,341	244
Monetary Authorities/Depository Credit Intermediaries	$21,918,612	$4,585,945	95
Other	$640,460,052	$228,752,706	6,041
TOTAL	**$1,723,384,759**	**$524,554,573**	**10,980**

3.9 Tax Impacts

The effect of Palo Verde spending extends beyond the taxes paid directly on the plant. This spending has direct impacts on income and value creation, which in turn, affects taxes paid on that income and value. Similarly, the secondary effects of plant spending on other products and services, as well as the increased economic activity itself leads to additional income and value creation—and additional tax revenues.

These additional or "induced" effects on tax payments are much larger than the taxes paid directly. These results are presented in Table 3-9. Palo Verde is responsible for approximately $62 million in state and local tax revenue, either directly or indirectly. Much of the indirect expenditures are the result of additional sales tax revenue created by the large number of employees at Palo Verde.

At the federal level, Palo Verde's operations induce $87.6 million in tax revenue. Most of that total is from income and Social Security taxes.

Table 3-9. Tax Impacts of Economic Activity Induced by Palo Verde

	Taxes Paid by Palo Verde	Taxes Induced by Palo Verde Expenditures	Total Tax Impact[a]
Federal Government			
Payroll Tax	$35,631,183	$35,462,454	$71,093,637
Corporate Tax	—	$10,406,055	$10,406,055
Personal Tax	—	$35,374,992	$35,374,992
Business Tax	$827,258	$6,391,727	$7,218,985
Total Federal Government	$36,458,441	$87,635,228	$124,093,669
State and Local Government			
Payroll Tax	$6,245,043	$33,850	$6,278,893
Corporate Tax	—	$104,768	$104,768
Personal Tax	—	$703,804	$703,804
Business Tax	$47,865,801	$7,002,439	$54,868,240
Total State and Local Government	$54,110,844	$7,844,861	$61,955,705
TOTAL	**$90,569,285**	**$95,480,089**	**$186,049,374**

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

3.10 Summary

Palo Verde has substantial economic impacts on Maricopa County and Arizona. When compared with their respective economies, the plant's relative impacts are highest for Maricopa County, next highest for Arizona and lowest for the United States. The Palo Verde job creation impact (direct and indirect) of 3,943 jobs in Maricopa County is a significant number of jobs deriving from a single enterprise.

The state and local economic effects of the plant are great, largely because of the buying power created by Palo Verde's high wages and salaries, which are spent on goods and services provided locally. This spending supports many small businesses in the area.

Section 4: Additional Benefits Provided by Palo Verde

Besides the economic benefits that Palo Verde contributes to Maricopa County in the form of jobs, incomes and taxes, the plant also contributes to the local community in ways difficult to capture with these measures. Although most businesses tend to provide contributions to their communities, nuclear power plants tend to be significant contributors to their surrounding communities because of the large numbers of well-paid and well-educated people they employ.

4.1 Introduction

Because of its rural location, Palo Verde essentially is a self-sufficient municipality with the infrastructure required by any small city. That infrastructure includes a fire department, medical facilities, security services, a Maricopa County Sheriff's substation, training facility, community outreach services and water treatment facility. Because of the size of the plant and the breadth of its resources, Palo Verde and its employees are able to provide many additional benefits to the surrounding community beyond the economic impact of the plant. Educational, environmental and community programs are the primary beneficiaries of the plant's outreach efforts.

4.2 Education

Palo Verde makes significant contributions to educational programs in western Maricopa County. Nuclear power plants like Palo Verde need employees with strong backgrounds in science, engineering, business and computer technology, so the plant's strong interest in promoting education is understandable.

Palo Verde employs a large work force, and as with many industries, the nuclear energy sector is faced with an aging worker population. Palo Verde estimates that it will need to replace approximately 10 percent of its workers over the next five years. As part of its work force planning efforts, Palo Verde has invested heavily in educational programs to help local students develop their skills, while the plant develops a potential future work force.

One such educational program at Palo Verde is Quest for Excellence (QFE)—a partnership with Central, Buckeye and Wickenburg high schools that emphasizes the development of math and science skills for juniors and seniors. Each year, 20 to 25 new students enroll in the program, with an average of about 40 students participating at any one time. The students receive a stipend of $7 an hour during the summer while participating in advanced math and physics classes.

At the conclusion of the program, students are eligible to move into Palo Verde's QFE college program, which supports students in the fields of engineering, business, supply-chain management and information technology. Participants, who receive tuition scholarships, work as interns at Palo Verde during summer breaks, allowing them to gain valuable on-the-job experience. About five new students enroll in the program each year, with approximately 15 participating in the program at any one time.

For students considering the skilled crafts, Palo Verde sponsors a maintenance intern program, which provides internships to students who want to pursue careers as electricians; heating, ventilation and air-conditioning specialists; instrumentation and control specialists; machinists; mechanics; and welders. Students gain experience at the plant during 20-hour workweeks, while attending classes at a nearby community college.

Palo Verde has several other programs aimed at improving the quality of education in western Maricopa County. Plant workers serve as substitute teachers for local schools, and Palo Verde's annual financial contributions help fund accelerated reading programs in local elementary schools. The plant also conducts programs for Arizona teachers that provide energy-related lesson plans and teaching materials. Additionally, Palo Verde makes financial and in-kind contributions to area schools to support certain athletic, music and scholastic programs.

4.3 Environment

Environmental stewardship is a core value at Palo Verde, starting with the plant's vital contribution to clean air. Palo Verde prevents significant air pollutants and greenhouse gas emissions that would be generated if the same amount of electricity were produced by fossil fuels. In 2002, Palo Verde avoided the emission of 158,000 tons of sulfur dioxide, 93,000 tons of nitrous oxide and 29.1 million tons of carbon dioxide. Sulfur dioxide can produce acid rain and nitrous oxide is a precursor to ground-level ozone. Carbon dioxide is the leading greenhouse gas.

The plant also contributes to clean air through its van pool program. The company provides commuter vans for Palo Verde employees to reduce vehicular emissions resulting from worker commutes. The plant currently maintains about 200 vans as part of its fleet, and nearly 75 percent of the plant's 2,042 employees participate in the program. Officials estimate that this alternative transportation program prevents 823,000 pounds of pollution.

Water is a precious commodity in Arizona, and Palo Verde does its part to conserve that resource. Unlike other nuclear power plants, Palo Verde sits in the desert without a large body of water nearby as its source of cooling water. Instead, treated wastewater from cities in Maricopa County is piped nearly 40 miles to Palo Verde. By using wastewater, the plant conserves natural groundwater resources, while benefiting the local economy through the annual purchase of more than 22 billion gallons of wastewater.

Once the wastewater reaches the plant, Palo Verde treats the water at its own tertiary water treatment facility and makes it available for other uses, such as cooling the nearby Redhawk power plant. Other plants typically use groundwater for their water needs. Redhawk uses water from Palo Verde and avoids the use of nearly 1 billion gallons of groundwater a year.

4.4 Community Involvement

Palo Verde is much like a small city unto itself. As such, the plant is able to make many resources available to its surrounding communities in the form of direct financial contributions, in-kind donations and volunteer time. For example, Palo Verde's warehouses store food for the regional food bank and Palo Verde employee volunteers play a major role in distributing the food to local families several times a year.

Additionally, Palo Verde and Arizona Public Service Co. are major contributors to the Valley of the Sun United Way. In 2002, Palo Verde employees contributed $764,754 to Arizona Public Service's Community Service Fund. Combined with the company's matching gift program, employees provided more than $1.1 million to local nonprofit organizations served by the United Way.

Palo Verde makes other donations to the local community. The largest are made through three formal community funds established by the company in 2001 during construction of the nearby Redhawk plant. The funds are administered by the Arizona Community Foundation and overseen

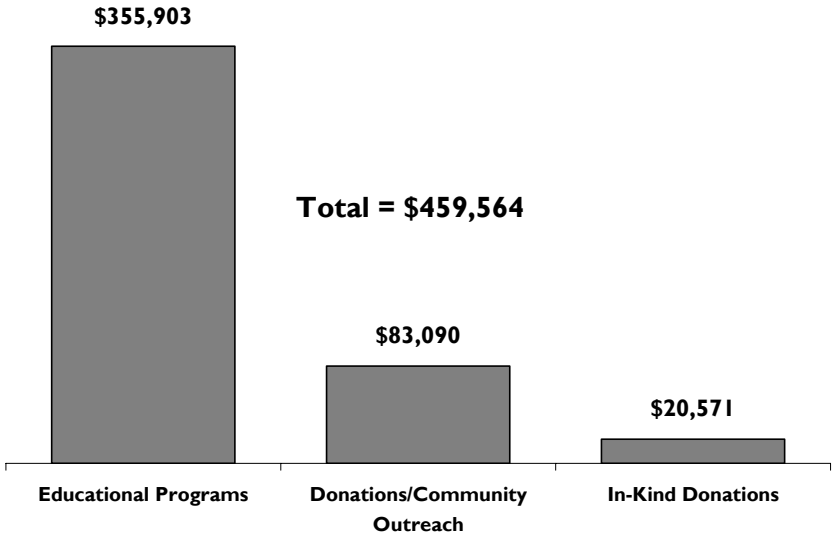
by community volunteers. Following an initial endowment of $500,000 in 2001, Palo Verde contributes $52,500 annually to these funds, which provide a permanent source of financial support for projects that benefit western Maricopa County communities near Palo Verde. The funds can be used for a wide variety of purposes, including the arts, community development, culture, education, the environment and public health.

In 2002, Palo Verde made $83,090 in contributions to nonprofit organizations in smaller, more rural communities surrounding the plant that otherwise would not have that source of support. Overall, Palo Verde's financial donations to Maricopa County community organizations totaled $438,993 in 2002.

In addition to financial support, Palo Verde makes in-kind donations to the local community. For example, the plant donated its printing services to several nonprofit organizations and neighboring schools. Recipients of Palo Verde's in-kind expenditures, which totaled $20,571 in 2002, included the Buckeye Union High School, the Tonopah Fire Department and the Wickenburg Mining Museum.

Palo Verde employees also spend their spare time volunteering for local nonprofit organizations to help improve the quality of life for their neighbors. In 2002, plant employees donated approximately 50,000 hours to Arizona community organizations and events.

Figure 4-1. Palo Verde Community Donations
(2002)



Section 5: Nuclear Industry Trends

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

Total electricity production for U.S. nuclear power plants reached 764 billion kilowatt-hours in 2003. Power plant performance is measured by capacity factor, which expresses the amount of electricity actually produced by a plant, compared with the maximum achievable. U.S. nuclear power plants achieved a capacity factor of nearly 90 percent in 2003. 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 plants have increased their output and improved their performance significantly over the past 10 years. Nuclear energy represents about 20 percent of all electricity generated in the United States. Since 1990, the industry has increased total output equivalent to 26 new, large nuclear plants. The increase in output occurred without building any new nuclear plants.

Meanwhile, overall capacity factors for the U.S. nuclear power plants increased dramatically over the past decade, reaching about 90 percent in 2003. By contrast, the average capacity factor for the industry was 60 percent in the late 1980s. One of the key reasons for these increased capacity factors has been the shortening of refueling outage times.

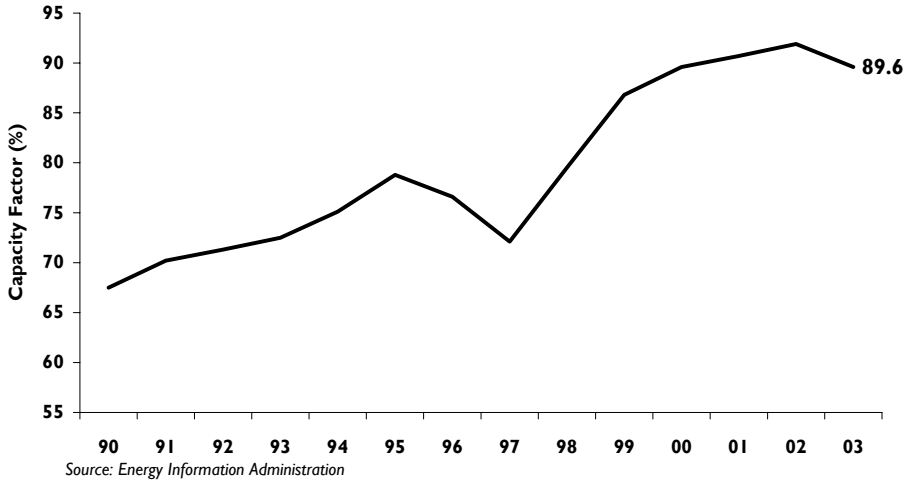
Figure 5-1. U.S. Nuclear Industry Net Electricity Generation

(32% increase from 1990 to 2003)

Source: 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 105 days to complete. By 2003, this number declined to an average of 40 days, and companies continue to apply best practices to further reduce this average. The record for the shortest refueling outage is 14.67 days for a boiling water reactor and 15.67 days for a pressurized water reactor.

Figure 5-2. Nuclear Industry Average Capacity Factors
(1990-2003)

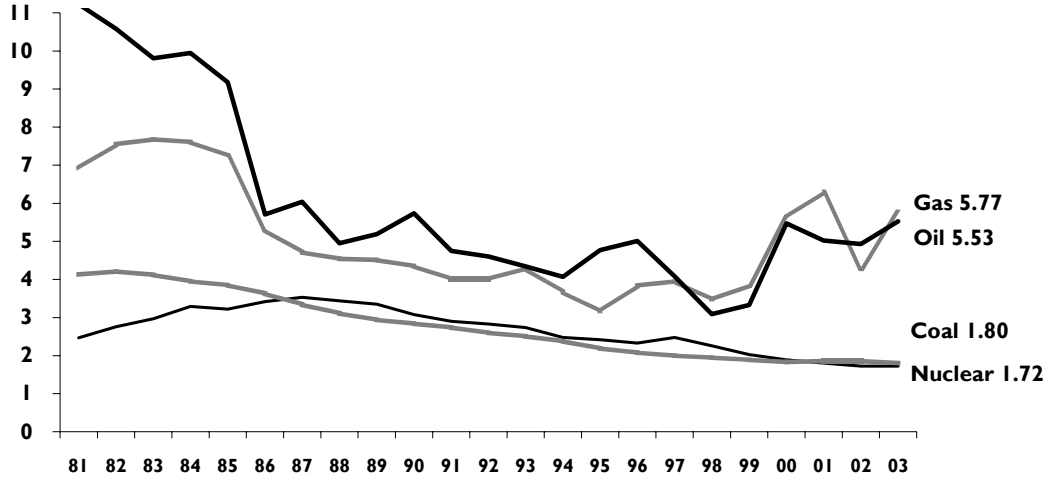


Source: Energy Information Administration

5.2 Cost Competitiveness

Along with increasing output, the U.S. nuclear industry has continued to decrease its operations costs. In 2003, nuclear power had a production cost of 1.72 cents per kilowatt-hour. This was significantly lower than the production costs of electricity generated by oil and natural gas and slightly lower than coal. In the past decade, nuclear production costs have dropped by about one-third because of the increased capacity factor of the U.S. plants. Since most nuclear plant costs are fixed, greater electricity production creates lower cost. However, nuclear plants have also taken steps to reduce their total cost through improved work processes.

Figure 5-3. U.S. Electricity Production Costs
(1981-2003 in constant 2003 cents/kWh)



Source: Pre-1995: Utility Data Institute (UDI), Post-1995: Resource Data International (RDI) Modeled Production Cost

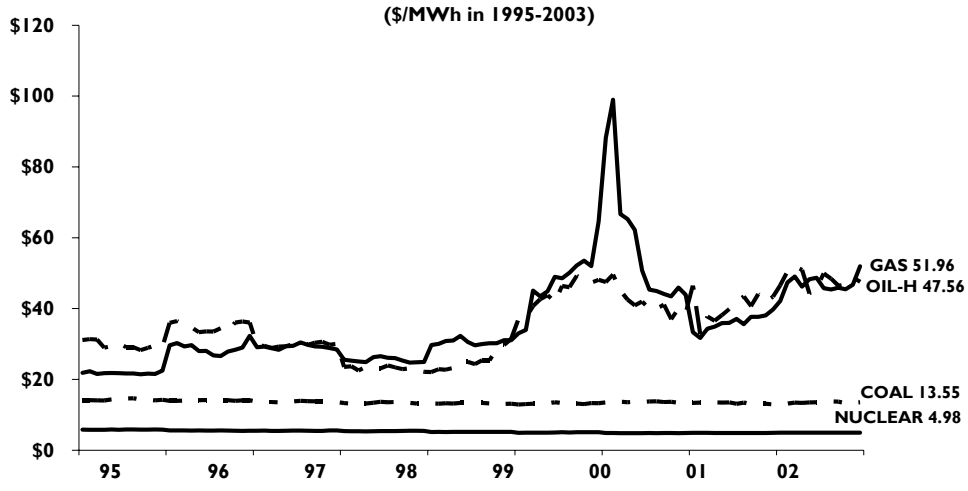
Table 5-1. Wholesale Electricity Prices by Region (cents/kilowatt-hour)

Region	2001 Average 24/7 Power Prices	2003 Average 24/7 Power Prices
New England	3.3	6.6
Mid-Atlantic	2.6	4.1
Tennessee Valley	2.0	2.9
Gulf States	2.2	3.0
Midwest	2.0	2.7
Texas	2.2	3.9
Northwest	2.2	3.8
Southwest	2.5	4.1

Because of low production costs and excellent safety performance, nuclear plants are very 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. Average production cost at the nation's 103 reactors was 1.72 cents per kilowatt-hour in 2003, lower than the average price in all regional markets. Nuclear energy is also 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, production costs for nuclear plants are comprised of costs not associated with fuel. Fuel markets tend to be very volatile, so the production costs of generation sources tied to fuel expenses are highly volatile, as they swing with variations in the markets. Fuel represents only 20 percent of the production cost of nuclear energy, but it makes up 60 percent to 80 percent of the cost of natural gas, coal and petroleum-fired generation. 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



Source: Resource Data International (RDI) and Utility Data Institute (UDI).

** Projected cost*

5.3 Current Industry Events

The excellent economic and safety performance of the U.S. nuclear power 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 Nuclear Regulatory Commission.

Nuclear plants were originally licensed to operate for 40 years, but can safely operate for longer periods of time. The NRC granted the first 20-year license renewal to the Calvert Cliffs plant in Maryland in 2000. As of December 2004, 30 plants have received license extensions, and 16 reactors have submitted an application 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 for license renewal.

Besides relicensing current plants, interest has recently increased in building new nuclear plants. Three companies—Entergy, Dominion and Exelon—have submitted early site permit applications with the NRC to test the agency's new permitting process for new reactor sites.

Three groups of energy companies are seeking to collaborate with the U.S. Department of Energy to test a new licensing process for building and operating an advanced nuclear reactor called a combined construction and operating license. The effort is part of DOE's Nuclear Power 2010 program, established to foster the development of next-generation nuclear power plants.

Section 6: Economic Impact Analysis Methodology

The methodology used to estimate the economic impacts of Palo Verde is commonly referred to as input/output methodology. Several operational input/output models are available in the marketplace, but the market leaders are Impact Analysis for Planning (IMPLAN), REMI and RIMS-II. The IMPLAN model was selected for this study primarily because of the availability of the model and data sets. Other important factors were the relevance of IMPLAN to the particular application, as well as its transparency and ease of use.

This section presents typical applications of the input/output methodology and explains the methodology and its underpinnings. It also describes how Palo Verde data and the IMPLAN model were used to estimate local, state and national economic impacts of plant 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 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 linkages include geographic linkages, primarily at national, state and county levels.

Because 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, while secondary effects are the subsequent "waves" of economic activity (new employment, income, production and spending) triggered by this splash. A full accounting of the splash's effect must include the waves, as well.

The sum of the direct and secondary 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 of the 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 produces the types of goods and services required by the plant.

Secondary effects include two components—indirect and induced effects—that are separately modeled within input/output models. Indirect effects are the effects on the supply chain that feeds into the business/industry sector in which the economic activity is located. For example, when Palo Verde buys a hammer for $5, it contributes directly to the economy by this purchase. However, 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. These industries will then 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 a nuclear power plant pays $5 for a hammer, a portion of the $5 pays the 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.

There also will be a contribution from the effect of this purchase on labor income in the wood and steel industries, and on the resulting household spending on goods and services. Palo Verde's wage and salary expenditures create induced effects as well, and they occur primarily in Maricopa County.

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.

Input/output models assume 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 previously) 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 return-to-scale assumption considers such differences and is necessary for accurate 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, this 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 similar firms and technologies within sectors. 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 Palo Verde

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

There are two components of the IMPLAN system: the software and the database. The software performs the necessary calculations, using study area data, to create the models. It also provides an interface for the user to change a 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 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-level technology matrices and 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 IMPLAN data and account structure closely follow the accounting conventions used in 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, provide a high degree of flexibility in terms of both geographic coverage and model formulation.

In applying the IMPLAN model to Palo Verde, three basic types of data were provided by Arizona Public Service Co.:

- purchase order expenditures by Palo Verde purchase order code
- employee compensation expenditures
- tax payment data.

Purchase order expenditures, employee compensation (salary data and an estimate of the value of benefits) and tax payment information were provided for the year 2002. The purchase order data were mapped to IMPLAN's 528 sector codes by comparing the descriptions of the purchase order codes provided by Arizona Public Service Co. with the standard industrial classification codes within IMPLAN's sector codes.

The purchase order and compensation data were then augmented by an estimate of revenues from sales to the wholesale market in 2002. This augmentation was necessary because purchase orders and compensation do not reflect all Palo Verde expenditures. Total expenditures (approximated by total revenues) better reflect the full economic impacts of Palo Verde. Plant revenues were estimated based on kilowatt-hours sold and wholesale prices paid at the Palo Verde hub during this time.

In tailoring the model to Palo Verde, IMPLAN's underlying data sets were reviewed to determine if any of the model's coefficients could be edited to reflect more accurately local conditions. IMPLAN coefficients are based on national relationships, and in some cases may not reflect local conditions. In this report, the coefficients within the electric services sector were edited to reflect a nuclear power plant rather than a "national average power plant of all types."

The IMPLAN model only has a general category for electric services. Since 50 percent of the country's electricity is produced by coal, the electric utility production function has in it large purchases of coal. This would be inappropriate for the impacts of a nuclear power plant.

To correct this, the model instead used actual purchase order data from Palo Verde to produce a production function for the plant. This includes the location of purchases, since many purchases by a nuclear power plant are made outside the county or state. Without regional purchase coefficient editing, the estimates of local purchases would be much higher in general.

Once the data sets were complete, IMPLAN was used to develop the economic impact estimates detailed in this report.

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