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Nuclear Energy's Economic Benefits — Current and Future

Executive Summary

The nuclear energy industry can play an important role in job creation and economic growth, providing both near-term and lasting employment and economic benefits. The 104 nuclear units in the U.S. generate substantial domestic economic value in electricity sales and revenue - $40-$50 billion each year - with over 100,000 workers contributing to production.

Worldwide, over 150 new nuclear plant projects are in the licensing and advanced planning stage, with 65 plants currently under construction. As a result, the years ahead will see a surge in demand for materials, components and services for the global nuclear industry. The Department of Commerce estimates the global market for nuclear products, services and fuel at $500-$740 billion over the next 10 years.

The U.S. Department of Energy projects that U.S. electricity demand will rise 24 percent by 2035, about 1 percent each year. That means our nation will need hundreds of new power plants to provide electricity to meet rising demand and replace aging infrastructure. Nuclear energy is the only proven technology that can provide emission-free, affordable baseload electricity.

Nuclear Plant Economic Benefits

Each year, the average 1,000 megawatt (MW) nuclear plant generates approximately $470 million in electricity sales (economic output) in the local community and more than $40 million in total labor income.[1] These figures include both direct and secondary effects. The direct

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[1] In 2010 dollars unless otherwise noted.

effects reflect the plant's expenditures for goods, services and labor. The secondary effects include subsequent spending attributable to the presence of the plant and its employees as expenditures filter through the local economy (e.g., restaurants and shops buying goods and hiring employees).

Analyses of 23 U.S. nuclear plants representing 41 units show that every dollar spent by the average unit results in the creation of $1.04 in the local community, $1.18 in the state economy and $1.87 in the U.S. economy.[2]

The average nuclear plant pays about $16 million in state and local taxes annually. These tax dollars benefit schools, roads and other state and local infrastructure. The average nuclear plant also pays federal taxes of $67 million annually.

Workforce Income Impacts

A recent analysis found that nuclear plants create some of the largest economic benefits compared to other electric generating technologies due to their size and the number of workers needed to operate the plants. Operation of a nuclear plant requires 400 to 700 direct permanent jobs. These jobs pay 36 percent more than average salaries in the local area. These opportunities will be available to new workers since 39 percent of the nuclear workforce will be eligible to retire by 2016 (about 25,000 employees).

According to one recent analysis: "[n]uclear plants create the largest workforce annual income based on both large capacity and being a labor-intensive technology."[3] The table below compares the number of jobs, average salaries and workforce income among different energy sources.

Technology[3]	Jobs/MWe	Average Size (MWe)	Direct Local Jobs	Average Salary ($/hour)	Workforce Income ($ Million/year)
Nuclear	0.50	1,000	504	$31	$32.49
Coal	0.19	1,000	187	$28	$10.99
Hydro > 500 MW	0.11	1,375	156	$33	$10.79
Hydro Pumped Storage	0.10	890	85	$38	$6.70
Hydro > 20 MW	0.19	450	86	$33	$5.79
Concentrating Solar Power	0.47	100	47	$27	$2.62
Gas Combined Cycle	0.05	630	34	$28	$2.02
Solar Photovoltaic	1.06	10	11	$15	$0.33
Micro Hydro < 20 MW	0.45	10	5	$35	$0.33
Wind	0.05	75	4	$35	$0.29

[2] A discussion of the economic model is found on pages 5 and 6.
[3] Harker, Donald, Hirschboeck, Peter Hans, "Green Job Realities—Quantifying the Economic Benefits of Generation Alternatives," March 2010, http://www.fortnightly.com/exclusive.cfm?o_id=379

Manufacturing and Service Impacts in the U.S.

The 104 nuclear units generate substantial domestic economic value in electricity sales and revenue — $40-$50 billion each year. From this revenue, nuclear companies procure over $14 billion each year in materials, fuel and services from domestic suppliers.[4] Nuclear procurement takes place in all 50 states (31 states have nuclear power plants). The average procurement per state each year is over $270 million. Materials, fuel and services are procured from over 22,500 different vendors across the country.[5]

The resurgence of nuclear energy will lead to increasing demand for skilled labor at all levels.

U.S. suppliers provide a full range of products and services for the complete lifecycle of nuclear facilities. During the construction phase, U.S. suppliers provide design, engineering, procurement, construction, and consulting services for both large and small reactors, as well as turbine islands and balance of plant systems. In addition, major components, subcomponents, fuel, commodities and consumables are available from U.S.-based manufacturers and vendors for safety-related and general commercial applications. These components include turbines, polar cranes, pumps, valves, piping, and instrumentation and control systems, safety-related batteries and reactor control rod drive mechanisms.

During the operational life of the plant, U.S. vendors provide operations, maintenance, repair and inspection services. They also manufacture replacement components and perform plant modifications and upgrades. Ongoing maintenance of existing nuclear power plants provides substantial economic benefits for American manufacturers. Over 30 million man-hours are worked by supplemental craft labor each year at the nation's 104 reactors, translating to over 14,000 full-time equivalent jobs.[6]

Impact of a 1,000 MW nuclear plant on Local, State and National Economies

Units	Region	Effect	Output	Labor Income	Employment
Multipliers		Direct	1.00	1.00	1.00
	Local	Direct + Indirect/Induced	1.04	1.22	1.66
	State	Direct + Indirect/Induced	1.18	1.49	2.36
	National	Direct + Indirect/Induced	1.87	3.75	8.26
			$ 2010 Millions		
Dollar and job values per gigawatt	Local	Direct	453	36	319
		Direct + Indirect/Induced	471	44	528
	State	Direct	453	61	505
		Direct + Indirect/Induced	533	91	1,192
	National	Direct	453	65[7]	530
		Direct + Indirect/Induced	846	244	4,372

Source of data: IMPLAN model. See detailed description on pages 5-6.

[4] Procurement numbers are based on a Nuclear Energy Institute survey of member companies. Procurement of nuclear services includes fees paid to regulatory agencies.
[5] The number of domestic vendors includes all organizations from which the industry procured over $1,000 worth of materials, services, or fuel in 2008.
[6] Extrapolation of data from Associated Maintenance Contractors, October 2007.
[7] The total direct labor income calculated in the table on page 2 is $32 million, compared to $65 million above. The labor income on page 2 does not include fringe benefits, but the data above does include them.

New Plant Construction

A new nuclear plant represents an investment of $6-8 billion (depending on plant size), including interest during construction. New plant construction creates demand for skilled labor such as welders, pipefitters, masons, carpenters, millwrights, sheet metal workers, electricians, ironworkers, heavy equipment operators and insulators, as well as engineers, project managers and construction supervisors.

In anticipation of new nuclear plant construction, U.S. companies have created in excess of 15,000 new U.S. jobs since 2005. Manufacturing and technical service jobs have been created in Virginia, North and South Carolina, Tennessee, Pennsylvania, Louisiana and Indiana. These jobs include engineering services and the manufacture of components including pumps, valves, piping, tubing, insulation, reactor pressure vessels, pressurizers, heat exchangers and moisture separators.

American companies have already booked export orders for billions of dollars in equipment and services, including generators, reactor coolant pumps and instrumentation and control systems.

Construction of a new nuclear power plant requires up to 3,500 workers at peak construction. Construction will also provide a substantial boost to suppliers of commodities like concrete and steel, and manufacturers of hundreds of plant components. A single new nuclear power plant requires approximately 400,000 cubic yards of concrete, 66,000 tons of steel, 44 miles of piping, 300 miles of electric wiring, and 130,000 electrical components.

New U.S. Nuclear Plant Procurement of U.S. Equipment and Services

Since 1980, the U.S. nuclear supply chain has contracted because of the lack of new nuclear plant construction in the U.S. and abroad. Thanks to nuclear energy expansion in the U.S. and around the world, the U.S. has a unique opportunity to rejuvenate its nuclear manufacturing sector through investment in state-of-the-art factories and processes to supply the high-precision, high-quality components necessary for nuclear technologies. The demand for these commodities, components and services provides an export opportunity for U.S. manufacturers.

Over the past few years, the U.S. has seen a significant increase in the number of domestic nuclear suppliers. Suppliers of nuclear equipment are qualified and quality controlled through an accreditation known as N-stamp (also known as American Society of Mechanical Engineers' Section III Nuclear Certificates). This means that the supplier is authorized to produce the commercial nuclear-grade components in accordance with the AMSE's Boiler and Pressure Vessel Nuclear Codes and Standards. The number of N-stamps held in the U.S. has increased 70 percent since 2007.

NEI has gathered information from companies managing the lead projects in the U.S. Some supply chain and strategic sourcing information is closely held for competitive reasons, but our survey found that:

- The lead projects will obtain between 60 percent and 80 percent of components, commodities and services from U.S. firms.
- Over $2 billion of equipment and services has already been procured from U.S. companies in 17 states.

Commercial Nuclear Exports = More U.S. Jobs

U.S. companies and workers also benefit from the expansion of nuclear energy underway worldwide. American companies have already booked export orders for billions of dollars in equipment and services, including generators, reactor coolant pumps and instrumentation and control systems. U.S. workers in 25 states – including Illinois, Ohio, Pennsylvania, South Carolina, Virginia and Tennessee – are beginning to reap the benefits of reinvestment in the U.S. nuclear supply chain.

According to the Department of Commerce, every $1 billion of exports by U.S. companies represents 5,000 to 10,000 jobs. The four Westinghouse AP1000 projects underway in China support over 15,000 U.S. jobs. The direct jobs generated from these exports had an average salary of $84,000. These jobs include design and engineering, manufacturing, information technology and transportation.

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IMPLAN Model Reveals Significant Economic Benefits

Using IMPLAN's input/output model, widely used by U.S. government agencies, NEI has conducted 13 economic benefits studies on 23 nuclear plants (comprising 41 reactors). The data collected for these studies provides a snapshot of the economic impact of an average nuclear power plant.

Input/output models link various sectors of the economy—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.

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.

A nuclear 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 plant spending without any subsequent spending effects. The direct effects shown in the table on page 3 are based on the estimated value (revenue) of operating a nuclear facility each year, which is $453 million.

Direct effects are the largest contributor to total effects in the local and state areas. Secondary effects (indirect/induced) are a much larger contributor to total effects at the national level. Indirect effects reveal how the facility'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.

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Multipliers
"Multipliers" 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.

Multipliers show the ratio of the facility'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 given area from each dollar of direct spending. The total output multiplier for the local area during one year of operation is 1.04 (or $471 million divided by $453 million). This indicates that for every dollar of output from the nuclear facility, the local economy produces $1.04. Using the same formula, the output multiplier during one year of operation is 1.18 for the state and 1.87 for the United States.

The output value is divided among consumer benefits, investor returns, facility purchases, salaries and taxes. It reflects the total output of products and services associated directly with a nuclear plant, which includes the expenditures for products and services (including labor).

Employment
The average direct employment for a nuclear plant during operation is 530. About 60 percent of these jobs (319) are filled by workers who reside in the local area. Typically, 95 percent of the direct jobs at the plant (505) reside within the state. Nuclear plants are often found near the borders of neighboring states, so the remaining percentage of direct workers usually live outside the state.

The total employment multiplier reveals how many jobs are created in a geographic area from each direct job. The total output employment for the local area during one year of operation is 1.66 (or 528 direct and secondary jobs divided by 319 direct jobs). This indicates that for every 100 direct jobs from the nuclear facility, the local economy produces an additional 66 indirect and induced jobs. Using the same formula, the employment multiplier for the state is 2.36 and for the nation is 8.26. Thus, for every 100 direct jobs at a nuclear plant, another 726 indirect and induced jobs are created throughout the nation.

Economic Modeling Description
Estimates are based on normalized averages from analyses of the economic and employment impact of 23 U.S. nuclear power plants representing 41 units (Braidwood, Byron, Catawba, Clinton, Diablo Canyon, Dresden, Grand Gulf, Hope Creek, Indian Point, LaSalle, Limerick, McGuire, Millstone, Oconee, Oyster Creek, Palo Verde, Peach Bottom, Quad Cities, Salem, Susquehanna, Three Mile Island, Wolf Creek). The figures are calculated per megawatt of installed capacity and reflect a nominal 1,000-megawatt plant size. In practice, new nuclear plants are larger than 1,000 megawatts, so the economic benefits listed in the table on page 3 understate the benefits that new nuclear plants will produce.