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Volume 1

U.S. Job Creation Due to Nuclear Power Resurgence in The United States — Volume 1

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Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

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Abstract

The recent revival of interest in nuclear power is causing a reexamination of the role of nuclear power in the United States. This renewed interest has led to questions regarding the capability and capacity of current U.S. industries to support a renewal of nuclear power plant deployment. This study was conducted to provide an initial estimate of jobs to be gained in the U.S. through the repatriation of the nuclear manufacturing industry. In the course of the study, related job categories were also modeled to provide an additional estimate of the potential expansion of existing industries (i.e., plant construction and operations) in conjunction with the repatriation of manufacturing jobs.

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Executive Summary

Over 200 nuclear power units were ordered in the United States during the late 1960s and 1970s[1], causing a significant expansion of employment and manufacturing capability in the nation. Architect-engineers, constructors, nuclear steam system suppliers, component suppliers, and nuclear fuel production all rapidly expanded to meet the needs.

Starting in the mid-70s, several factors contributed to the changing nature of the nuclear industry. These factors included incidents such as the Brown's Ferry fire in 1975, the Three Mile Island Accident in 1979, and the Chernobyl accident in 1986, were one of those contribution factors. In addition, the oil embargo in force during the same period (a time when the electrical demand had been growing at a rate 7% - 8% a year) forced the country to rethink energy usage policies. After the embargo, a growth rate of 2% per year was the norm. Reduced electrical demands and projections, eroded public confidence, growing regulatory uncertainty, delayed plant start-ups, and ballooning plant costs all contributed to a lack of orders for new plants.

In response, companies supplying goods and services to the U.S. nuclear industry worked off the backlog of U.S. orders for nuclear power units and either transitioned to support new foreign orders or dropped out of the industry all together. The lack of domestic orders and relatively small numbers of foreign orders caused the U.S. nuclear supply industry to undergo a drastic contraction in the late 1980s and 1990s. There were no new orders in the U.S.; work slowed on the existing orders, causing some of the existing orders to be cancelled; and some existing plants were abandoned or scheduled for decommissioning (e.g., Zimmer, Marble Hill, Bellafonte, Yankee Rowe, Rancho Seco, etc.).

The recent revival of interest in nuclear power is causing a reexamination of the role of nuclear power in this country. This renewed interest has led to questions regarding the capability and capacity of current U.S. industries to support a renewal of nuclear power plant deployment. This study was conducted to provide an initial estimate of jobs to be gained in the U.S. through the repatriation of the nuclear manufacturing industry. In the course of the study, related job categories were also modeled to provide an additional estimate of the potential expansion of existing industries (i.e., plant construction and operations) in conjunction with the repatriation of manufacturing jobs.

The framework adopted for this initial study can be summarized as follows:

> Deploying 33 to 41 new Generation III units, ranging in capacity from 1200 to 1500 megawatts (MWe), will meet an estimated demand of 50,000 MWe of new generating capacity by 2020. Construction of the first unit is assumed to begin in 2009.

The results from the model show that approximately 610,000 jobs would be added to the U.S. economy by

- Repatriating 37,000 to 38,000 nuclear manufacturing jobs
- Adding 72,000 to 79,000 plant construction and operations jobs
- Adding another 181,000 to 250,000 Indirect Jobs in the nuclear power industry
- Inducing an additional 218,000 to 242,000 jobs in the non-nuclear industries throughout the country.

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[1] "The Changing Structure of the Electric Power Industry: An Update," Energy Information Administration (EIA), Dec 1996, Appendix A, p. 109 and 110.

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Study Summary

1. INTRODUCTION

This study was requested by the U.S. Department of Energy to evaluate the potential for job creation through resurgence of the commercial nuclear industry in the United States. The Idaho National Engineering and Environmental Laboratory (INEEL) and Bechtel Power Corporation collaborated to produce the enclosed information. This study provides an initial estimate of the potential numbers of new jobs that could be created in the United States, including those that could be repatriated from overseas, due to a resurgence of the nuclear power industry.

This Study Summary Volume (Volume 1) is accompanied by a larger, more detailed volume. Volume 2 contains three major appendices: Bechtel Power Corporation's report, *Study of the Impact on Domestic Manufacturing and Supply Infrastructure Resulting from New Nuclear Plant Deployment*; INEEL's data analysis and curve fitting methodologies for both the Bechtel and Nuclear Energy Institute (NEI) data used to drive the job creation model; and a description of the relationships and operations of the resultant Macroeconomic model. Broader-level descriptive information is provided below to support the conclusions and recommendations made in this volume of the report.

2. STUDY APPROACH

Purpose of Study. This study is focused on defining the potential new jobs created or repatriated to the United States directly attributable to a large-scale deployment of new nuclear power plants across the nation.

Input Data. Three key sources of input data were used to develop the underlying relationships used to model job repatriation and new job creation in a revitalized nuclear industry. The first input source was developed by Bechtel Power Corporation of Frederick, Maryland, directly for this study. Bechtel Power surveyed previous and potential U.S. suppliers of nuclear power plant components to identify the number of jobs they would add to meet a series of new plant orders (shown in Figure 1). Bechtel also supplied the estimate of construction jobs needed to build the new plants. The complete Bechtel Power report, *Study of the Impact on Domestic Manufacturing and Supply Infrastructure Resulting from New Nuclear Plant Deployment* can be found in Volume 2 of this study.

The second source of input data was from NEI. Projections of the Energy Information Administration (EIA) estimate the United States will need an additional 355,000 MWe of electricity within the next two decades to meet growing demand in this country. Based on these projections, NEI developed a vision for the nuclear power industry entitled, *Nuclear Energy and the Nation's Future Prosperity*, which assumes that 60,000 MWe of this new demand will be provided by nuclear sources: 10,000 MWe through extension and efficiencies in the current plants and 50,000 MWe through new generation capacity. This report is the foundation of NEI's Vision 2020 initiative and represents the views of over 260 nuclear energy and technology firms.

The third source of data was the Dominion Energy 'Constructability Study' formally titled, *Study of Construction Technologies and Schedules, O&M Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactors*. The specific advance reactor staffing figures were used to augment NEI data to create an Operations Jobs estimation function for this study.

In addition to the Vision 2020 framework, this study also used a compendium of NEI economic impact studies of existing nuclear power plants and their effects on the regional economies in terms of permanent plant operations jobs, subcontracted Indirect Jobs, and non-nuclear jobs induced into the U.S.

economy. These data provided the critical link between jobs repatriated in the nuclear manufacturing sector and new job expansion in existing industries due to the deployment of new nuclear power plants.

Results. The results of this study are reported in five job categories: repatriated manufacturing jobs, power plant construction jobs, plant operations jobs, indirect plant jobs, and non-nuclear jobs induced into the economy. Each of these categories is defined in Section 3.1. To allow for ease of comparison between this study's results and other job prediction reports, these five job categories are combined into three common families: Direct Jobs, Indirect Jobs, and Induced jobs. The Direct Job family is the sum of construction, manufacturing, and operations jobs. In addition to showing results grouped in these three categories, the manufacturing jobs are also reported separately to highlight the difference between repatriating the lost manufacturing jobs versus expanding the existing construction and operations sectors.

2.1 Key Assumptions

Timeframe of Study. The timeframe for this study is from 2009, with the first order for a new plant, to 2024, when a steady state of plant orders has been reached and the 50,000 MWe of electricity assumed in Vision 2020 have been achieved. A five-year construction period is also assumed. Consequently, a new plant ordered in 2009 becomes operational in 2014.

Types and Numbers of Plants. To establish a conservative job creation scenario, two alternatives were used to bound this study and meet the 50,000 MWe goal: (1) 33 single-unit, 1500-megawatt plants, and (2) 41 single-unit, 1200-megawatt plants, as shown in the Table 1. This is consistent with NEI's Vision 2020 scenario shown in Figure 1.

Table 1. New Nuclear Plant Deployment by Year

Year	# of 1200 MW units deployed	# of 1500 MW units deployed
2014	1	1
2015	2	2
2016	3	2
2017	3	2
2018	4	3
2019	4	3
2020	4	4
2021	5	4
2022	5	4
2023	5	4
2024	5	4
TOTAL	**41**	**33**

It is recognized that other combinations of unit capacity and number of units could also be deployed to meet the 50,000 MWe demand (50 units of 1,000 MW each, or 125 units of 400 MW each). For simplicity, two generic units of 1200 and 1500 MWe, respectively, and deployed as single unit plants were used in this study. In keeping with the conservative nature of this study, the higher capacity units meant fewer plants being built and lower numbers of jobs being created.

The NEI economic impact data from recent studies of operational plants were combined with Dominion Energy's *Study of Construction Technologies and Schedules, O&M Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactors* O&M staffing projections to

develop the Operations Jobs function for a generic plant. Once completed, a good correlation was observed between the composite function and the Dominion Energy data. For instance, the Dominion Energy Study projected that a new single-unit AP1000 plant would require 647 total plant staff. The model in this study estimated that 677 permanent workers would be needed for a similar generic, single-unit, 1100MWe plant. Volume 2, Appendix B, has more detailed information on all of the job estimation functions.

Life Cycle Stages Considered. The enclosed study starts with the assumption that new power plant orders have been placed and considers those jobs that are part of the construction, equipment manufacturing, operations, and servicing of the new plants. The study also looks at the non-nuclear power jobs induced into the economy to support the nuclear jobs. Notably missing are the jobs that could be created and/or repatriated for the design, siting, licensing, oversight, waste management, decontamination and decommissioning, and other related endeavors. Instead, given the time permitted, this initial study focused on the growth impacts on the most immediate categories of jobs due to repatriation or creation. An expanded study that takes into account these other job categories is recommended to further refine the results reported here.

Number of New Nuclear Power Plants. In the report, *Nuclear Energy and the Nation's Future Prosperity* (Vision 2020), NEI assumes that 50,000 MWe of electrical power generated by new nuclear sources will be needed, in addition to growing fossil and renewable sources, to meet the power demands of the year 2020. For the purposes of this study, the demand stated in Vision 2020 was translated to start in 2014, coinciding with the latest thinking on the licensing and approvals required for new nuclear plants, and extend for 20 years. The types of advanced reactors expected to provide this additional electricity are capable of 1200 MWe to 1500 MWe per generic unit. That equates to a need for 33 to 41 new nuclear power units by the year 2020. Beyond 2020, it is estimated that four to five new plants will have to be added to the inventory every year to keep pace with continued growth in the demand for electricity. The deployment of new plants to meet these needs through 2024 is shown in Figure 1. The estimate of new plants was not based on any particular design but, instead, represents a potential range of power generation capabilities.

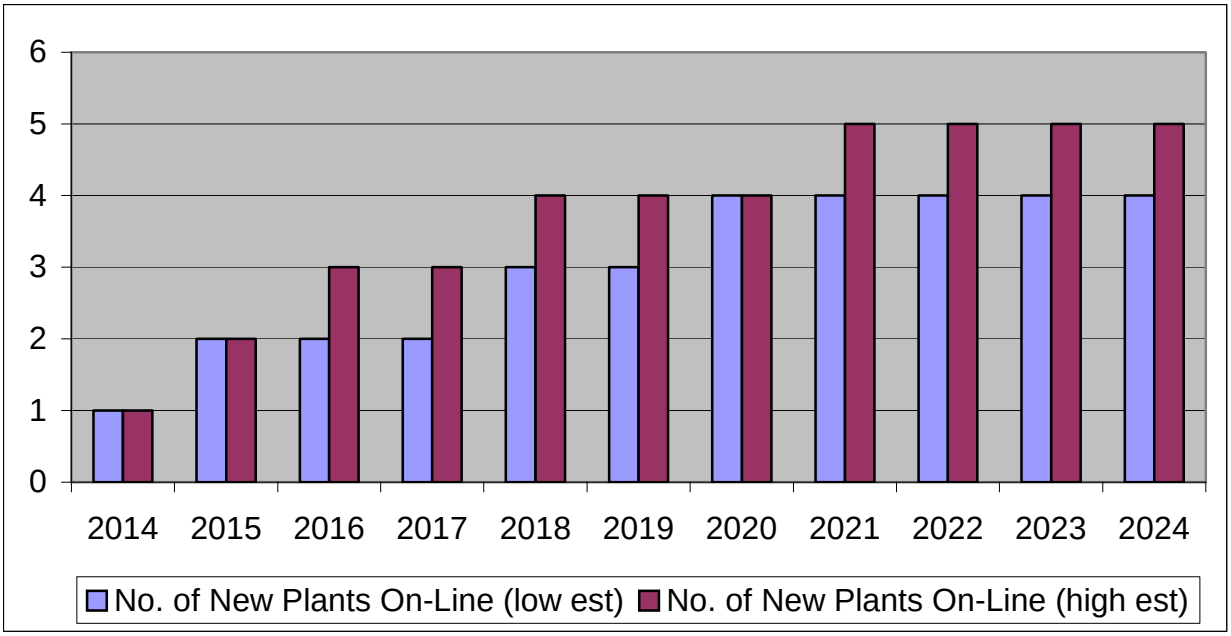


Figure 1. Estimate of New Operational Plants by Year

Repatriated Manufacturing Jobs. This job category refers to those jobs previously lost to either offshore companies or industry attrition due to the lack of nuclear plant orders in the United States. It was assumed that job repatriation would first occur in the manufacturing sector under the Vision 2020 scenario. Bechtel Power Corporation conducted a study of potential suppliers for nuclear plant equipment to determine how many jobs those first tier suppliers might add *if* new nuclear plant orders were received. These suppliers were given the chart shown in Figure 1 and were asked to provide a table of new jobs per year from 2009 through 2024. The Bechtel Power Corporation report is included in Appendix A in Volume 2 of this study.

It is important to note that data from major suppliers of all needed equipment could not be collected in the short duration of this initial study. No suppliers of cabling, compressors, vacuum pumps, dampers/louvers, and cooling towers responded to the Bechtel Power survey. Additionally, manufacturers of large components, such as reactor vessels and steam generators, postulated they could fill the orders for what they perceived as a relatively few large components with their existing offshore capabilities and/or subcontracting relationships. To estimate a repatriation of jobs, suppliers were asked about their market share in the commodity or equipment. The market share data were used to estimate an entirely 100% U.S. production of the equipment under consideration. Appendix A in Volume 2 describes the transformation of the Bechtel survey data points into continuous functions for the modeling work. As a result of some missing data, the number of Repatriated Jobs reported in this study is considered to be very conservative.

Construction Jobs. The Bechtel Power Corporation Study also included an estimate of the labor needed to construct a new nuclear power plant. Their data were used to analyze the Direct construction jobs added due to new plant deployment. These jobs were considered to be an expansion of the construction industry.

Operations Jobs. These jobs include the higher-paying permanent plant operators, technicians, plant engineers, and managers involved in the day-to-day-operations of a nuclear power plant. The NEI has conducted several economic impact studies of existing nuclear power plants over the past several years. The NEI study data were used to formulate the number of Plant Operations jobs to be added per new plant per year. These jobs were considered to be new jobs in the existing Plant Operations sector. In addition, no consideration was given to the operations jobs running the current fleet of reactors. This assumption is based on the current plants' license being extended beyond the time frame considered in this study.

Indirect Jobs. These jobs were calculated using formulas derived from the NEI economic impact studies. For the NEI studies, the indirect employment effects for each plant were based on actual operations expenditures for all outside goods, services, and taxes. Examples of indirect expenditures include nuclear fuel; maintenance and repair services; personnel supply services; management and consulting services; industrial machinery; pipes, valves, and pipe fittings; research and testing services; engineering-architectural services; steam supply and sewage services; computer and data processing services: insurance premiums; and state and local taxes. The potential new jobs created by these expenditures are an expansion of higher paying, family-wage employment in the United States.

Induced Jobs. This job category contains the initial estimate of the new jobs created in the non-nuclear industry due to the new jobs added in the categories above and using formulas derived from the NEI studies. These jobs represent a significant impact on the employment and economy of those locales in which the new plants may be built and on the U.S. economy as a whole. (For instance, the Indian Point study reported local Induced Jobs at 918, Induced Jobs throughout New York State at 1,132, and Induced Jobs across the United States at 5,125). These types of jobs include the additional grocery store checkers, elementary school teachers, home construction craft workers, postal carriers, etc. that are added to the community as a result of new nuclear power plant employment.

Data from NEI studies were used for the Operations, Indirect, and Induced Jobs calculations. The NEI data were developed utilizing the IMPLAN modeling tool running on U.S. Census data to determine the economic impact of operating nuclear plants at both the regional and national levels. The IMPLAN data and account structure closely follow the accounting conventions used in studies of the U.S. economy by the Department of Commerce Bureau of Economic Analysis. Data of this caliber were needed to complement the supplier data collected by the Bechtel survey and the construction data supplied by Bechtel for this study.

2.2 Collection and Evaluation of Existing Data

The first element of the study was the collection and analysis of existing industry and expert data from a total system perspective. Many industry-specific and labor-related studies and experiences were available as data sources; however, the complex problem stated above required integration across the various energy, manufacturing, and employment sectors to identify solutions and their respective impacts. This initial step provided a basic understanding of the relationship between the number of new plants built and number of new jobs created. The data collected by Bechtel Power Corporation during this phase of the study can be found in its entirety in the *Study of the Impact on Domestic Manufacturing and Supply Infrastructure Resulting from New Nuclear Plant Deployment* report included in Volume 2 of this report.

The data collected by Bechtel Power were used to define the relationships between jobs in the manufacturing and construction sectors and the number of new plants deployed. NEI data were used to develop relationships between jobs created and plants deployed in the Operations, Indirect, and Induced Jobs sectors.

2.3 Development of the Macroeconomic Model

The second phase of the study was the development of a macroeconomic model that incorporated the industry data uncovered in the first step. The industry data were further enhanced by information from economic impact studies performed by NEI for individual plant sites. Statistical methods for fitting a curve through the data points translated the raw data into a set of equations, which could then be used to generate graphical representations of the relationships in the construction, manufacturing, operations, and indirect sectors with respect to the jobs created in each of those areas. The input used for all of these functions within the model is the number of new nuclear power plants built and brought on line at the rate shown in Figure 1.

2.4 Job Creation Analysis

Based on the new nuclear plant deployment timeline shown above and using the formulas and graphical functions from the collected data, analyses were performed to estimate the numbers of new jobs created through the construction, equipment manufacturing, operations, and servicing of these new plants.

The analyses considered the upper and lower bounds for the number of new plants, as shown in Figure 1, based on the assumptions that generic 1200 or 1500 megawatt units are used to meet the 50,000 megawatt target. The upper and lower bounds of jobs created are shown in Figures 3 – 6 based on the number of new plants being built. More detailed uncertainty analyses regarding both the survey data and the NEI studies should be performed. Initial uncertainty bands were created to drive a Monte Carlo simulation technique in the event uncertainty analyses are desired. Additional information on the curve fitting and other statistical methods applied to the collected data can be found in Appendix B of Volume 2 of this study.

3. JOBS CREATED

A substantial number of new jobs would be created if the nuclear power industry were reinvigorated to ensure it would continue to provide a vital role in meeting the electrical demand in this country. Jobs repatriated are but a fraction of all the new jobs that would proceed from building new nuclear plants in the United States.

Figure 2 shows the maximum number of new jobs created during the 2009 – 2024 timeframe for the five job categories in this study. The jobs shown here include operations jobs for the 44 plants operating in 2024 plus the 25 plants under construction in 2024, which hire and train workers three years prior to beginning operations. An estimated 38,000 repatriated manufacturing jobs would be generated. However, a cascading effect was noted whereby 79,000 new construction and operations jobs plus the 38,000 manufacturing jobs would create an additional 250,000 Indirect Jobs. The impact from these Indirect Jobs would ripple through the U.S. economy and create an additional 242,000 jobs for a total of nearly 610,000 new jobs added over the 15-year timeframe. The result is that for each Direct construction, manufacturing, or operations job in a new nuclear power plant, four[2] new jobs will be created to provide indirect goods and services to that plant or as induced non-nuclear jobs in the economy.

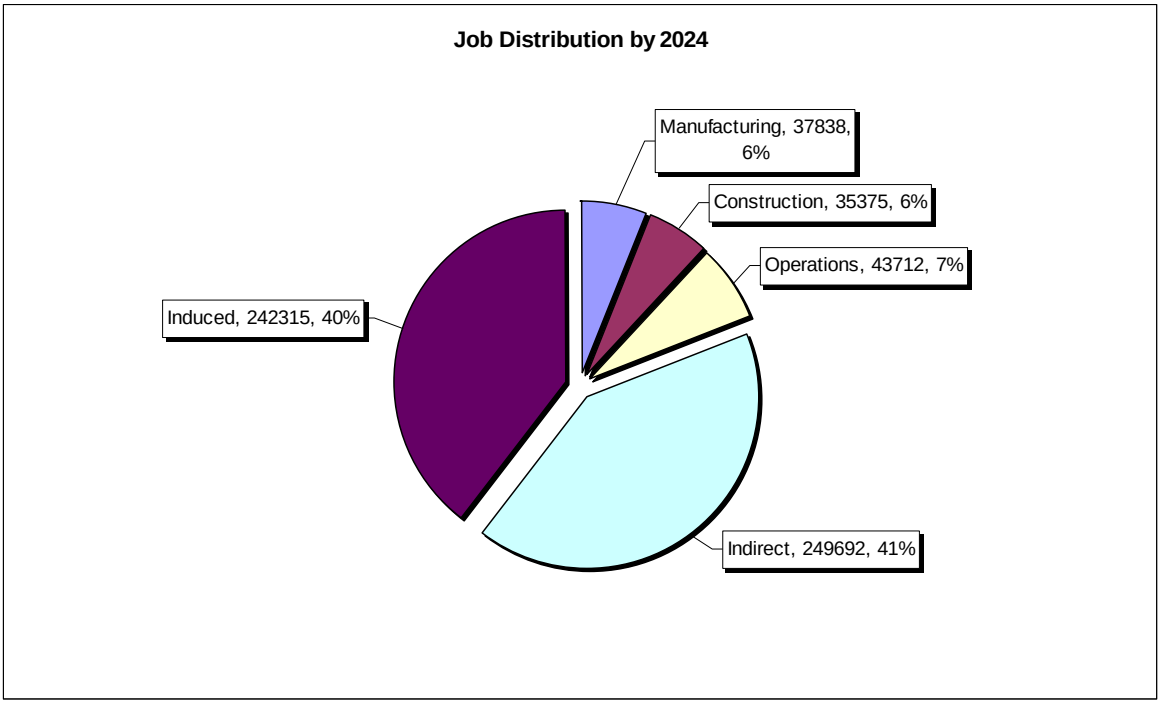


Figure 2. Maximum Job Creation Totals by Job Category

Standard economic impact prediction models for utilities were consulted to validate the results shown above. In particular, the State of Washington's Office of Financial Management recently revamped and published their 1997 Washington Input-Output Model (see www.ofm.wa.gov/economy/ for the complete study). In the Washington model, the total indirect plus induced employment per Direct construction, manufacturing, or operations job was determined. The Washington data for related

[2] It is recommended the NEI data used to generate this multiplier effect be validated to ensure appropriate scaling factors are used when a new unit is added to an existing site, as compared to a unit being built at a new site.

industries corroborate this study's results and are shown in Table 2. The 4-to-1 multiplier of Direct to Indirect/Induced Jobs seems to match well with other power utility figures. Another way to view the impact of new nuclear power plants on jobs is shown in Figures 3 and 4. Figure 3 shows the growth in Direct Jobs (construction + manufacturing + operations) over time while Figure 4 shows the growth in Indirect plus Induced Jobs over the same timeframe.

Table 2. Washington Input-Output Model Data Comparison to Study Results

Industry	Indirect plus Induced Employment Per Direct Job
Chemicals and Products	4.631
Electric Utilities	4.948
Gas Utilities	3.834
Other Utilities	3.372
This Study's Nuclear Utilities	4.208

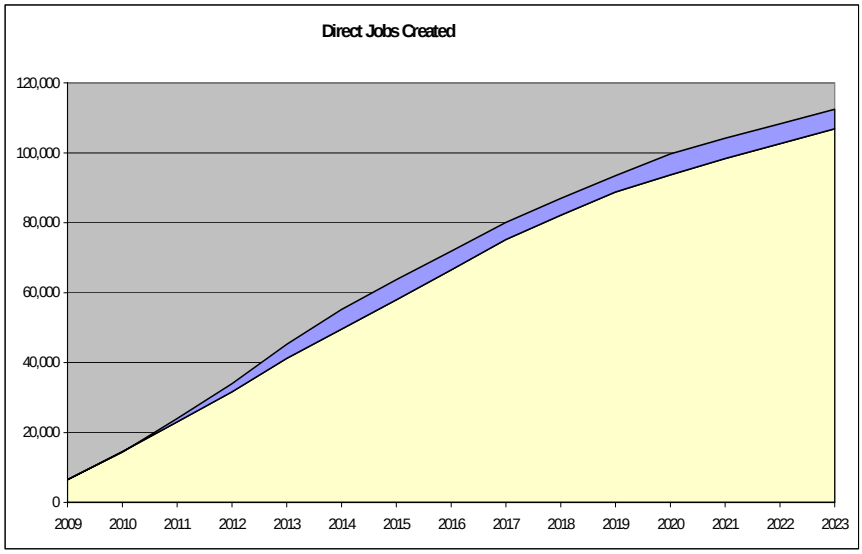
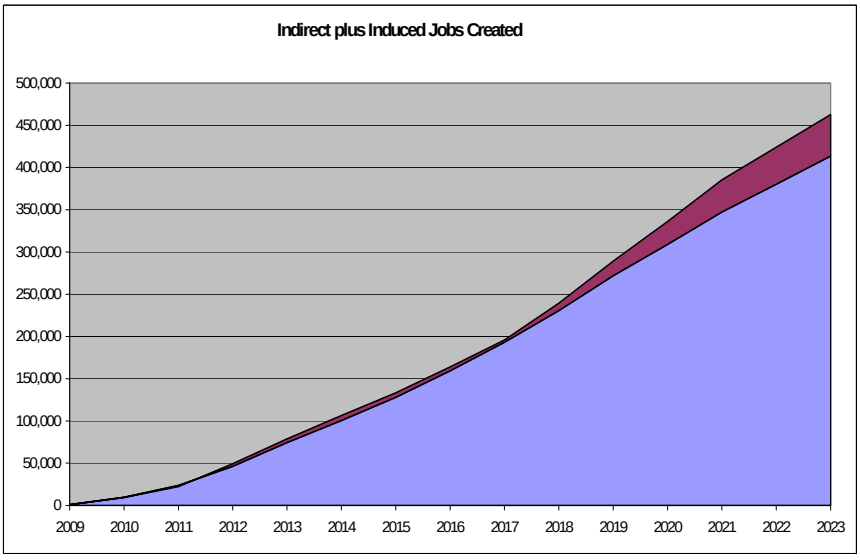


Figure 3. Growth of Direct Jobs over Study Timeframe



In both Figures 3 and 4, the lower curve represents the cumulative number of jobs added due to the lower estimate of 33 plants of 1500 MWe each. The small wedge above the basic curve represents the additional jobs from deploying the higher number, 41 units, of 1200-megawatt capacity each.

Figure 3 combines the construction, manufacturing, and operations into the 'Direct Jobs' category.

Figure 4 adds the Indirect and Induced Jobs together. These figures clearly show the approximately 4 to 1 ratio of Indirect (plus Induced) to Direct Jobs.

Figure 4. Growth of Indirect plus Induced Jobs over Study Timeframe

Bechtel Power's survey of suppliers was conducted via structured phone calls to the suppliers of interest. Many of these companies commented on the general disbelief that nuclear power would return to the United States in sufficient quantities to make it economically feasible. Clearly, a strong commitment by the Federal Government is needed for most of the jobs discussed in this report to be realized.

3.1 Direct Job Comparison

Figures 5 and 6 compare the construction, manufacturing, and operations jobs directly created through new nuclear power plants orders. Figure 5 is based on a lower number (33) of higher-capacity (1500MWe), single-unit plants while Figure 6 is based on 41 1200-MWe plants.

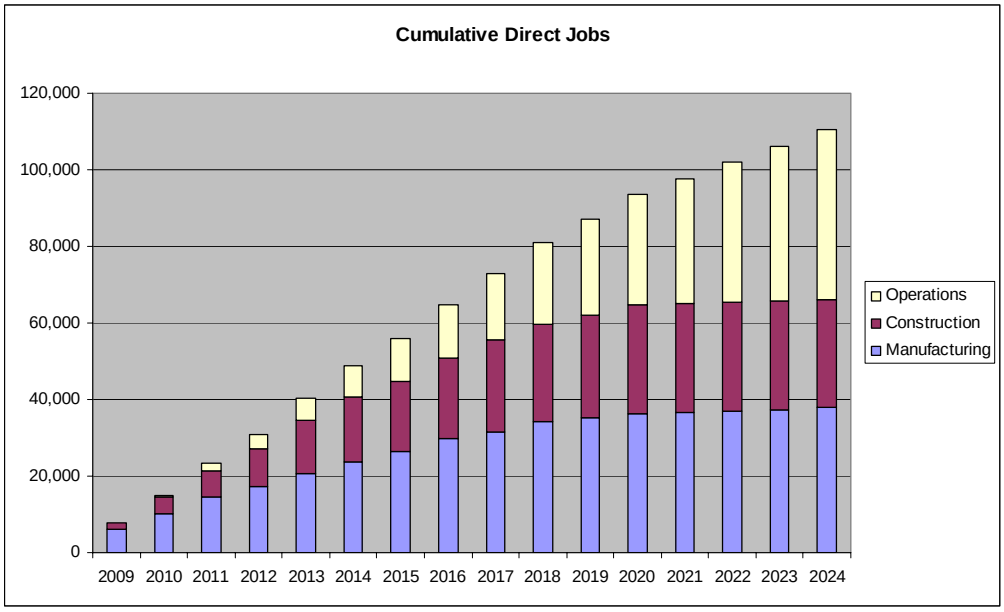


Figure 5. Direct Jobs Due to 33 1500-MWe Units over 15 Years

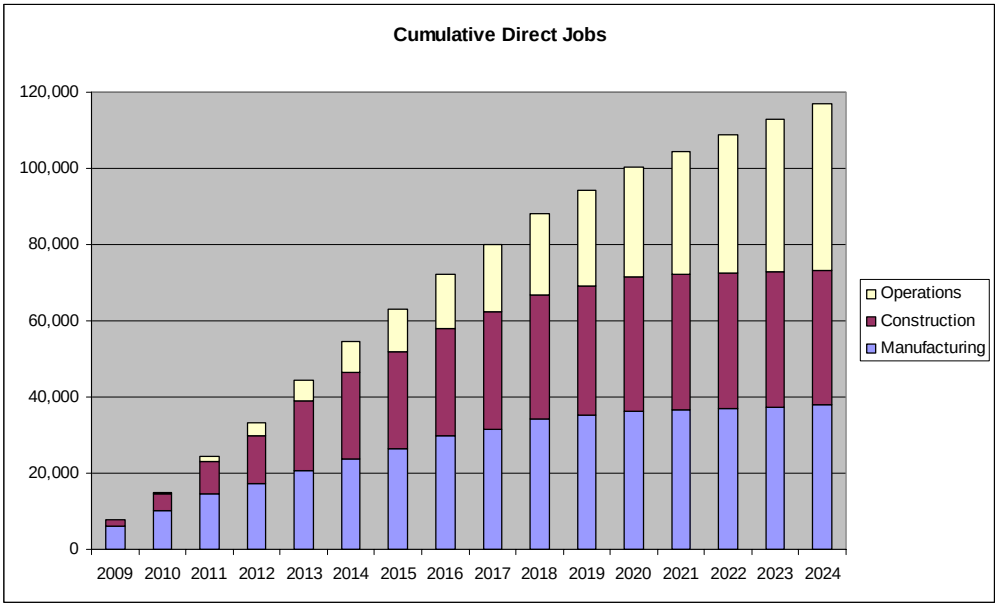


Figure 6. Direct Jobs Due To 41 1200-MWe Plants Over 15 Years

3.2 Direct, Indirect, and Induced Job Comparison

Figures 7 and 8 compare the Direct Jobs (from Figures 5 and 6) with the Indirect and Induced non-nuclear jobs. Once again, Figure 7 represents 33 1500-megawatt units while Figure 8 represents 41 1200-MWe units.

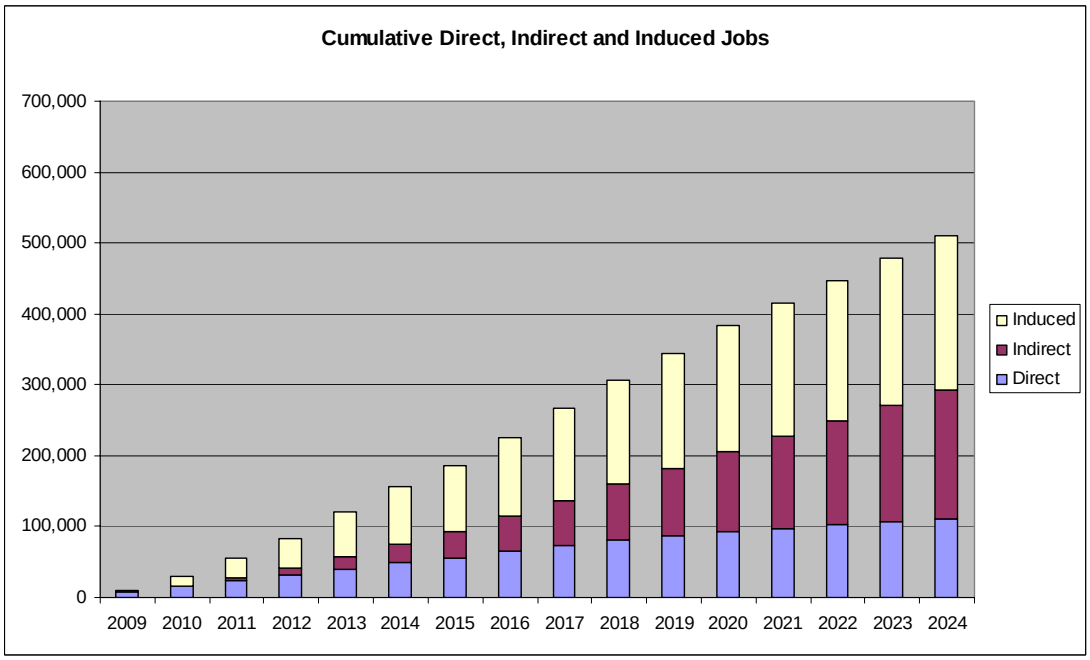


Figure 7. Direct vs. Indirect vs. Induced Jobs by Year for 1500MWe Units

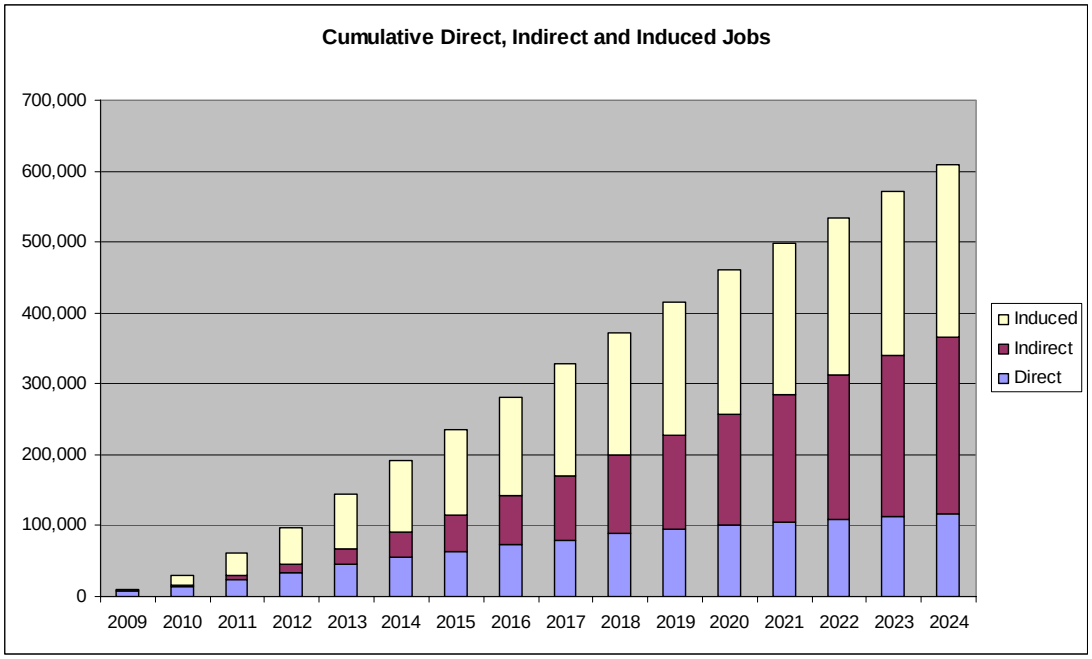


Figure 8. Direct vs. Indirect vs. Induced Jobs by Year for 1200-MWe Units

The ripple-down effect leading to the creation of indirect and induced jobs quickly surpasses the number of repatriated manufacturing jobs. While a portion of the Induced Jobs are lower-wage service industry positions, the majority of these new U.S. jobs employ trained and educated personnel earning a family wage.

4. COMPARISON OF COAL VERSUS NUCLEAR JOBS

On October 12, 2004, a study status presentation was made to the SEAB Task Group indicating that there would be 117,000 additional direct jobs added to the domestic economy as a result of new nuclear plants deployed in the U.S. through 2024. During their discussion, the Task Group posed the following question:

> How does this compare to the number of jobs created if the same MWe were generated using coal technology?

The baseline scenario for comparing coal versus nuclear jobs follows the Vision 2020 proposal of 50,000 MWe of new electrical generating capacity. Rather than abruptly stopping new plant orders once the 50,000 MWe is met, the model assumes new plants continue to be ordered beyond 2020. These additional orders increased the jobs created in all job categories.

Data was generated for this scenario using the Westinghouse 1150-MWe AP1000 nuclear plant design. To determine the difference in job creation between coal and nuclear plant, the AP1000 plants were compared to 1500-MWe coal plants that employ two 750-MWe conventional pulverized coal-fired generators, used by Peabody Energy and other owner-operators. The coal plants were deployed to maintain the same total electrical generating capacity as the 1150-MWe nuclear plants. The coal plants, however, were modeled as needing only 3 years to construct instead of the 5 years for nuclear plants.

Additionally, no new manufacturing jobs were modeled for the coal plants. Discussions with industry experts suggested that the coal plant equipment manufacturers are still strong in the U.S. and will utilize excess capacity to fill most—if not all—of the new equipment demand.

Results of the analysis are displayed in Table 3. From the results of this analysis, the job creation potential for nuclear power plants is clearly greater than that for coal plants. The jobs reported in this section, however, have slightly different results from previous sections, which present results of the initial modeling effort that provided a parametric analysis of nuclear plants with capacities ranging from 1200 to 1500 MWe.

Table 3. Job Comparison Between Nuclear and Coal

Life-Cycle Stage	Nuclear AP 1000	Coal Pulverized Coal-Fired Generators
Construction Jobs	35,000	25,600
Operator Jobs	45,600	7,800
Manufacturing Jobs	38,000	0
Indirect/Induced Jobs	530,000	175,000
Total Jobs	**648,600**	**207,800**

5. EXPANDED STUDY TOPIC AREAS

The question this study has tried to answer is complex and dependent upon many factors. As answers were found, they often led to more questions. The following study areas are suggested for follow-on investigation to help refine, expand, and validate the information provided in this initial report.

Additional Economic Benefits. This initial study looked at the potential for the creation of jobs in the United States given resurgence in the nuclear power industry. However, more than just jobs will be impacted by such a decision. Location of plants, other related industry impacts, diversity of energy supply, and other types of benefits will also be accrued with the deployment of new nuclear generating capacity. Looking into the additional benefits can help develop strategies to facilitate such deployment.

Favorable Factors. This study assumes that new Generation III/III+ plants would be used to generate 50,000 MWe of new electrical power by 2020. However, many factors will influence the decision to deploy new plants. While many suppliers replied that they were capable of responding to a new rollout, they also cited the need for a solid commitment and deployment schedule. Financial incentives, Government-Industry partnerships, new permitting and licensing processes, liability issues, etc. will all play a factor in determining if, when, where, how, and which new nuclear power plants are built in the United States. Further analysis of these dynamic and interrelated issues may provide additional insight that facilitates job growth and repatriation.

Second Tier Suppliers. Bechtel Power Corporation noted in their survey that the first-tier suppliers were concerned that *their* suppliers might not have sufficient capability to support a revitalization of the nuclear industry. In particular, these first-tier suppliers expressed concern regarding raw material supply and foundry and pipe mill capabilities. By continuing the Bechtel survey to include second and third-tier suppliers, additional avenues of job repatriation and growth can be identified and additional barriers or opportunities can be uncovered. More detail on this issue can be found in the *Study of the Impact on Domestic Manufacturing and Supply Infrastructure Resulting from New Nuclear Plant Deployment* contained in Appendix A of Volume 2.

The Global Perspective. Reflecting on the few large component suppliers discussed above also leads to a natural follow-on of looking at the *global* nuclear power industry. While the surveyed companies are supportive of a resurgence of nuclear power in the United States, is the industry as a whole capable of supplying the goods and materials needed on a global scale? Is the timing of Vision 2020 such that the global industry is swamped with new orders? What are the projected power needs across the globe, and how much demand is required to be filled by nuclear sources? The answers to these and other similar questions may impact U.S. decisions regarding nuclear energy.

Fossil vs. Nuclear. This study has provided preliminary answers to the questions, "What if 50,000 MWe were supplied by new fossil plants instead of nuclear?" and "What types and numbers of jobs are provided by deploying the nuclear plants compared to fossil plant deployment?". A more thorough analysis is necessary for the relative merits of nuclear power (when compared to coal and/or gas power) to be determined.

Complete Plant and Life Cycle Coverage. Relatively few large component suppliers exist today. Consequently, those suppliers chose to provide limited feedback in the Bechtel survey out of concern that strategic plans could be inferred from the results, thus giving their competitors a potential advantage. Historical data, however, could be used to derive employment needs for these large components. By adding this capability to the analysis, a more accurate picture of domestic job creation would be available. In addition, looking at the full life cycle of the plants and estimating the upstream

(i.e., design and licensing) and downstream (i.e., decontamination and waste management) jobs would further enhance the analyses and provide even greater refinement of the reported numbers.

Trade Association Involvement. The Bechtel supplier survey yielded results from over 40 companies. Mathematical curve fitting was used to take these disparate data points from the surveys and create a representation of the entire field of companies. Through industry trade association involvement, actual data could be obtained to take the place of statistical approximations and, with all interested parties providing input; current data gaps could be more easily filled. Additionally, the modeling technique used in this study is a powerful tool for exploring and defining dynamic and chaotic relationships surrounding an issue. Workshops with the trade associations, union organizations, technology providers, educational institutions, and others could more quickly provide the information needed in modeling these complex and interrelated relationships. These workshops can also help to build strong partnerships and a growing industry consensus on the matters of nuclear energy. This represents a more proactive use for modeling and decision analysis tools along the lines of the successful Decision Makers Forums sponsored by Senator Domenici.