

VIRGINIA'S NUCLEAR WORKFORCE NEEDS

SECOND PHASE



Prepared for



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About Mangum Economics, LLC

Mangum Economics was founded in 2003 and since then, we have become known as a leader in industry analysis, economic impact assessment, policy and program evaluation, and economic and workforce strategy development. The Mangum Team specializes in producing objective and actionable quantitative economic research that our clients use for strategic decision making in a variety of industries and environments. We know that our clients are unique, and that one size does not fit all. As a result, we have a well-earned reputation for tailoring our analyses to meet the specific needs of specific clients, with a specific audience.

Most of our research falls into four general categories:

- **Energy:** The Mangum Team has produced analyses of the economic and fiscal impact of over 50 GW of proposed solar, wind, battery energy storage, and hydro projects spanning more than thirty states ranging from 1 MW to over 800 MW in capacity, including small-scale distributed facilities. Among those projects was Dominion's 2.6 GW Coastal Virginia Offshore Wind project off of Virginia Beach. In addition, the Mangum Team has also performed economic and fiscal impact analyses for the natural gas, nuclear, oil, and pipeline industries.
- **Economic Development and Special Projects:** The Mangum Team has performed hundreds of analyses of proposed economic development projects and existing entities including museums and tourist attractions, hospital systems, industrial development and mixed-use projects, and economic development regions. The Mangum Team has also authored multiple economic development plans and assessed the impacts of international trade and an overseas trade office.
- **Advanced Applied Technology:** The Mangum Team specializes in analyzing how advanced technology developments (like data centers, fiber networks, and advanced manufacturing plants) contribute to the state and local economies. We have worked with local governments, trade associations, developers, and operating firms across the country to show how investments in advanced critical infrastructure transform local economies across the country.
- **Policy Analysis:** The Mangum Team also has extensive experience in identifying and quantifying the intended and unintended economic consequences of proposed legislative and regulatory initiatives.

The Project Team

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Executive Summary

In this revised report, we update the estimates from our June 2025 report of the workforce required to support an expansion of the nuclear power industry in Virginia. The updates were aided by input from organizations actively involved in the deployment of new commercial nuclear projects. The most salient findings from that analysis are:

1) Virginia's demand for electricity is outpacing supply.

- An independent forecast commissioned by Virginia's Joint Legislative and Review Commission recently found that demand for electric power in Virginia could double within the next ten years.
- In February 2023, PJM reported that region-wide the pace at which new generation resources were being brought online would soon be insufficient to keep up with expected retirements and projected demand growth.

2) Nuclear energy, in combination with renewable and more traditional energy sources, is uniquely positioned to be a key part of the solution to that problem.

- Nuclear energy is carbon-free and a baseload power source capable of reliably producing electricity 24 hours a day, seven days a week, regardless of weather conditions or the time of day.
- Expansion of nuclear power in Virginia will most likely be accomplished through the deployment of Small Modular Reactors (SMRs). SMRs are advanced nuclear reactors that can vary in size from tens of megawatts up to hundreds of megawatts.
- SMRs have a relatively small physical footprint compared to alternative generation facilities, which means they can be sited in a wide range of locations.
- SMRs are modular, which means that they can be prefabricated and then shipped to and installed on site.
- SMRs also provide enhanced safety performance because they rely on passive safety systems where no human intervention or external power is required to shut down the system.

3) The Nuclear Power Industry already has a significant footprint in Virginia.

- BWXT, located in Lynchburg, builds the systems that power the U.S. Navy's nuclear-powered submarine and aircraft carrier fleets, and also supplies components and fuel for commercial reactors around the world.
- Framatome, also located in Lynchburg, specializes in the design, manufacture, construction, and maintenance of nuclear power systems within the U.S. and internationally.

- Bechtel, located in Reston, was responsible for constructing Vogtle Units 3 and 4, the first two new nuclear reactors built in the U.S. in over 30 years.
- Newport News Shipbuilding, located in Newport News, is the sole designer, builder, and fueler of nuclear aircraft carriers in the U.S. and one of only two U.S. shipyards capable of designing and building nuclear submarines.

4) Virginia's capacity to expand its Nuclear Power Industry is contingent on the state's ability to provide the necessary workforce.

- According to a report by the U.S. Department of Energy, between 2023 and 2050, nationwide 200 GW of coal-powered baseload generation units are expected to retire and "as utilities begin to retire these fossil assets, advanced nuclear is uniquely positioned to replace [those] assets with a similar electricity profile."
- The report also estimates that expanding the nuclear power industry to fill that nationwide void will require 275,000 nuclear power workers by 2050 in addition to the 100,000 that are already employed in the industry. That means that nationwide the industry's workforce would need to almost quadruple.

5) Nuclear Workforce GAP analysis.

- In this updated report, we estimate that deployment of one representative 300 MW SMR in Virginia would:
 - Support approximately 2,000 full-time equivalent jobs over a six year construction period, with an average wage of approximately \$96,150 a year.
 - Support approximately 150 full-time equivalent jobs annually to operate the SMR, with an average wage of approximately \$107,550 a year.
- Both Dominion Energy and Appalachian Power have publicly announced plans to construct SMRs in Virginia. To assess Virginia's likely nuclear workforce needs, we build on those two announced SMR projects to assume a total of six 300 MW SMR units could be built in Virginia over a 21-year period. We consider six to be a conservative estimate and the actual total could be higher.
- Comparing the annual demand for workers necessary to support the deployment of those units, to the pipeline of graduates from Virginia's public and private colleges and universities in programs associated with those occupations, shows that the state could experience several workforce gaps.
- Among those are shortfalls in trained workers to fill the following occupations:
 - Chemical Technicians.
 - Civil Engineers.
 - Civil Engineering Technologists and Technicians.



- Computer Network Support Specialists.
- Electrical Engineers.
- Electricians.
- Environmental Engineers.
- Heating, Air Conditioning, and Refrigeration Mechanics and Installers.
- Information Security Analysts.
- Mechanical Engineers.
- Network and Computer Systems Administrators.
- Nuclear Engineers.
- Nuclear Technicians.
- Occupational Health and Safety Specialists.
- Welders.



Introduction

In this report, we provided updated estimates of the workforce required to support an expansion of the nuclear power industry in Virginia. The updates reflect input from interviews with organizations actively involved in the deployment of new commercial nuclear projects. This report was commissioned by the Virginia Innovative Nuclear Hub (VIN-Hub) and produced by Mangum Economics.

The Issue

Nuclear energy is a clean, baseload energy source, which means that it is carbon-free and is capable of reliably producing electricity 24 hours a day, seven days a week, regardless of weather conditions or the time of day. Virginia is currently facing a combination of trends that are causing its projected demand for electric power to outpace supply. Nuclear energy, in combination with renewable and more traditional energy sources, is uniquely positioned to be a key part of the solution to that problem. However, nuclear energy's ability to play that role is in no small way contingent on Virginia's ability to supply the workforce necessary to support the industry.

Virginia's Demand for Electricity is Outpacing Supply

According to Virginia Electric and Power Company's (Dominion Power's) 2024 Integrated Resource Plan, driven by electrification (*e.g.*, electric vehicles) and construction of new data centers to meet the needs of AI (*e.g.*, ChatGPT) and rapidly expanding consumer services (*e.g.*, self-driving cars, streaming, and GPS), peak electricity demand is growing faster in Dominion's territory than in any other part of the PJM regional transmission organization.¹ An independent forecast commissioned by Virginia's Joint Legislative and Review Commission provided additional support for that assessment, finding that demand for electric power in Virginia could double within the next ten years.²

Unfortunately, generation capacity is not keeping pace with that increased demand. In February 2023, PJM reported that region-wide the pace at which new generation resources were being brought online would soon be insufficient to keep up with expected retirements and projected demand growth.³ And in Virginia specifically, where natural gas powered facilities currently account for approximately 60 percent of the state's generation capacity, the total retirement of those facilities by 2045, as mandated by the 2020 Virginia Clean Energy Act, is also likely to cause available generation capacity to fall behind growing demand.⁴

¹ Virginia Electric and Power Company, "2024 Integrated Resource Plan," filed with the Virginia State Corporation Commission, October 15, 2024. PJM is the regional transmission organization that coordinates the movement of electricity through all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

² Joint Legislative and Review Commission, "Data Centers in Virginia," December 9, 2024.

³ Virginia Electric and Power Company, "2024 Integrated Resource Plan," filed with the Virginia State Corporation Commission, October 15, 2024.

⁴ Virginia Department of Energy, "The Commonwealth of Virginia's 2022 Energy Plan," October 3, 2022.

In addition, that looming supply shortage is being further exacerbated by changes in the composition of Virginia's electric generation portfolio. Where intermittent renewable energy facilities such as wind and solar currently account for approximately 5 percent of Virginia's generation capacity, by 2045 they are expected to account for 72 percent.⁵ Because the availability of renewable energy is dependent on weather conditions and the time of day, it is not reliably dispatchable. That means it cannot be relied upon to address daily or weather-related spikes in the demand for electricity.

For that reason, absent significant advancements in technology, the integration of such a large volume of intermittent generation capacity will likely be problematic for grid reliability. Although evolving technologies such as battery storage may partly mitigate this issue, the more probable outcome is that Virginia will become more reliant on importing baseload electric power from other states in PJM, many of which will be experiencing their own capacity shortfalls and may not be in a position to supply the additional power.

Advantages of Nuclear Power

As discussed earlier, nuclear energy is carbon-free and a baseload power source capable of reliably producing electricity 24 hours a day, seven days a week, regardless of weather conditions or the time of day. Four of the nation's 94 commercial nuclear reactors are located in Virginia where they have been in operation for over half a century.⁶ Nuclear power currently accounts for approximately 30 percent of Virginia's electric power generation.

Expansion of nuclear power in Virginia will most likely be accomplished through the deployment of Small Modular Reactors (SMRs). SMRs are advanced nuclear reactors that can vary in size from tens of megawatts up to hundreds of megawatts. As the name implies, their most salient characteristics are that: 1) they have a relatively small physical footprint compared to alternative generation facilities, which means they can be sited in a wide range of locations, and 2) they are modular, which means that they can be prefabricated and then shipped to and installed on site.

In addition to these advantages, SMRs also provide enhanced safety performance because they rely on passive safety systems where no human intervention or external power is required to shut down the system. Furthermore, because SMRs are factory-built as opposed to constructed on site, construction schedules and costs are minimized, while the accumulated experience gained from standardization ensures that quality is improved.

Finally, it is important to realize that by providing a zero-emission baseload power source to complement intermittent and non-dispatchable sources such as wind and solar, SMRs can play a key role in the transition to clean energy while still maintaining grid reliability – a key consideration given the current trend toward electrification of cars and many other components of modern life. That is why

⁵ Virginia Department of Energy, "The Commonwealth of Virginia's 2022 Energy Plan," October 3, 2022.

⁶ Data Source: Nuclear Energy Institute. The quadrennial Virginia Energy Plan is the official document that addresses statewide energy needs and planning. A revised version of this plan should be issued in late 2026.

both the U.S. and Virginia Departments of Energy have identified SMRs as a key part of their goal to develop safe, clean, and affordable nuclear options.

The Nuclear Power Industry Already has a Significant Footprint in Virginia

It is also important to realize that Virginia is already home to several global leaders in the nuclear power industry:

- BWXT, located in Lynchburg, builds the systems that power the U.S. Navy’s nuclear-powered submarine and aircraft carrier fleets, and also supplies components and fuel for commercial reactors around the world.
- Framatome, also located in Lynchburg, specializes in the design, manufacture, construction, and maintenance of nuclear power systems within the U.S. and internationally.
- Bechtel, located in Reston, was responsible for constructing Vogtle Units 3 and 4, the first two new nuclear reactors built in the U.S. in over 30 years.
- Newport News Shipbuilding (Huntington Ingalls Industries), located in Newport News, is the sole designer, builder, and fueler of nuclear aircraft carriers in the U.S. and one of only two U.S. shipyards capable of designing and building nuclear submarines (including the nation’s newest class of attack submarines, the Virginia class).

In addition, Virginia is also home to two federal facilities – NASA Langley and the Norfolk Naval Shipyard – that are actively engaged in nuclear research and development.

Moreover, as a sample of recent headlines demonstrates, Virginia’s nuclear power sector is growing:

- *BWXT team lands \$30B federal nuclear contract*, Kate Andrews, Virginia Business, June 14, 2024.
- *Dominion Energy Virginia announced today it is accepting proposals for a first-in-the nation small nuclear reactor at North Anna Power Station in Louisa County*, Virginia Public Media, Patrick Larsen, July 10, 2024.
- *Navy considers four Virginia sites for nuclear energy expansion*, Virginia Department of Energy news release, October 11, 2024.
- *Dominion files energy plan that includes more wind, nuclear*, Virginia Business, Kate Andrews, October 15, 2024.
- *Amazon, Dominion agree to explore nuclear development*, Virginia Business, Courtney Mabeus-Brown, October 30, 2024.
- *Appalachian Power plans small nuclear reactor in Campbell*, Virginia Business, Beth JoJack, November 29, 2024.
- *BWXT wins \$2.1B in U.S. Naval Nuclear Propulsion Program contracts*, Virginia Business, Beth JoJack, February 20, 2025.



- *Roanoke/New River Big Deal: Framatome expands for a small modular future*, Virginia Business, Mike Gangloff, February 27, 2025.
- *Lynchburg's BWXT unveils Innovation Campus*, Virginia Business, Beth JoJack, March 26, 2025.

Nuclear Workforce

There is a growing realization that renewable energy alone will be insufficient to provide a carbon-free solution to our exponentially increasing demand for electricity caused by the rapid transition to electrification and our ever-growing dependence on data. That realization is driving an increased interest in nuclear power as our only available carbon-free baseload power source. However, expansion of nuclear power in the U.S. and Virginia is contingent on meeting the industry's need for additional workers.

According to a report by the U.S. Department of Energy, between 2023 and 2050 200 GW of coal-powered baseload generation units are expected to retire.⁷ The report further states that, "as utilities begin to retire these fossil assets, advanced nuclear is uniquely positioned to replace [those] assets with a similar electricity profile."⁸ But, the report also estimates that doing so will require 275,000 nuclear power workers by 2050 in addition to the 100,000 that are already employed in the industry. Which means the industry's workforce will need to almost quadruple.

To make matters worse, the nuclear power industry is already facing headwinds in meeting its workforce needs. According to the U.S. Department of Energy's 2024 energy employment report, "the nuclear [electric power generation] workforce trends older than the energy workforce average," with a larger proportion of workers at or nearing retirement age.⁹ Moreover, the pipeline of recent graduates necessary to replace those retirees is declining. As reported in a recent Wall Street Journal report entitled *Shortfall in Young Engineers Threatens Nuclear Renaissance*, "between 2012 and 2022, the number of students graduating with bachelor's degrees in nuclear engineering in the U.S. fell by 25 percent."¹⁰

In short, to realistically meet our goals for carbon reduction, the U.S. and Virginia need nuclear power and the nuclear power industry needs trained workers.

Estimated Workforce Needs

In this section, we provide a high-level estimate of the trained workers that will be needed to facilitate the expansion of Virginia's nuclear power industry. We then compare that estimate to the current pipeline of students graduating from associated educational programs to identify potential "gaps"

⁷ U.S. Department of Energy, "Pathways to Commercial Liftoff: Advanced Nuclear," March 2023.

⁸ "Pathways to Commercial Liftoff," p.27.

⁹ U.S. Department of Energy, "United States Energy and Employment Report 2024," October 1, 2024, p.39.

¹⁰ Wall Street Journal, "Shortfall in Young Engineers Threatens Nuclear Renaissance," Yusuf Kahn, September 11, 2024.

between demand and supply. The method used to accomplish this analysis is not new and has been successfully employed in multiple other studies.¹¹

Demand for Nuclear Workers

Our analysis starts with the development of a detailed staffing matrix for both the construction and operations of a representative 300 MW SMR. Those staffing matrices are based on an extensive review of the existing literature and a list of pertinent references is provided at the end of this report.

Each staffing matrix included data on the specific occupations involved by U.S. Bureau of Labor Statistics (BLS) Standard Occupation Code (SOC) and the estimated number of workers required in each occupation. In the next step of the process, we mapped those occupations into data from BLS on existing employment and average wages in 2024, and data from the Virginia Department of Workforce Development and Advancement on statewide projected annual openings in each occupation between 2020 and 2030.

In addition, as part of the process of updating our June 2025 report, we conducted interviews with several organizations actively involved in the deployment of new commercial nuclear projects to verify and improve the matrices. Through those interviews, we gained valuable information that allowed us to refine and enhance the precision of our initial staffing matrix.

For example, we learned through the interviews that occupations pertaining to non-destructive evaluation were not included in our original staffing matrix. Those occupations have been added in this report under their associated BLS SOC titles. In the data presented in Table 1 for construction occupations they appear as Construction Inspectors and in the data presented in Table 2 for operations occupations they appear as Inspectors, Testers, Sorters, Samplers, and Weighers.

Based on this analysis, we estimate that:

- Construction of a representative 300 MW SMR will support approximately 2,000 full time equivalent (FTE) jobs, over a period of approximately six years, with approximately 160 FTEs in the first year, 540 FTEs in the peak year, and 210 FTEs in the sixth year. The average wage for those jobs will be approximately \$96,150 a year. However, it is important to realize that different SMR designs have different staffing requirements and actual construction employment could range from as few as 1,200 FTEs to as many as 2,800 FTEs.
- Operation of a representative 300 MW SMR will support approximately 150 FTE jobs annually and the average wage for those jobs will be approximately \$107,550 a year. Another 300 MW SMR on the same site as an existing SMR will support approximately 100 FTE jobs annually. Here

¹¹ For an excellent exposition of this method see, William J. Drummond and Jan L. Youtie, "Occupational Employment, Demand for College Graduates, and Migration: A Statewide View," a report to the Board of Regents, University System of Georgia, 1999. For an example of how this method has been used previously in Virginia see, A. Fletcher Mangum, "System-Wide Needs Assessment for Virginia Education," State Council of Higher Education for Virginia, March 28, 2002, p.90.

again however, it is important to realize that different SMR designs have different staffing requirements and actual operations employment could range from as few as 130 FTEs to as many as 170 FTEs, with additional SMRs on the same site requiring between 80 FTEs to 120 FTEs.

As shown in the headlines presented earlier, both Dominion Energy and Appalachian Power have announced plans to construct SMRs in Virginia.

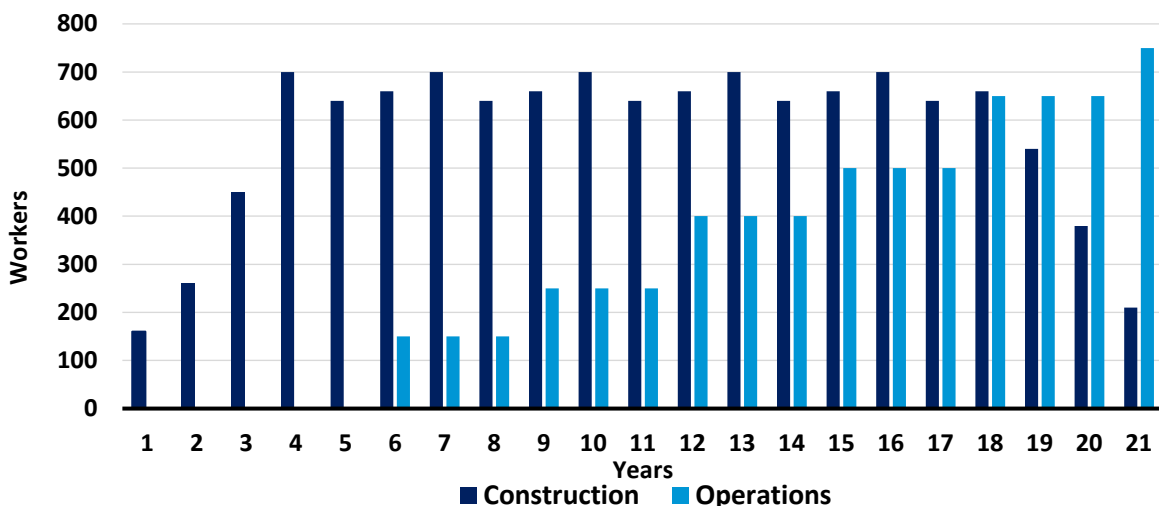
Building on those two announced SMR projects, if we assume that:

- An additional four SMR projects could be initiated for a total of six over 21 years, with,
- One project initiated every three years,
- The construction period for each project lasting six years, and
- The last of the six SMR projects initiated in year 16 and completed in year 21.

Then, as depicted in Figure 1:

- The demand for nuclear construction workers would peak at approximately 700 in years four, seven, ten, thirteen, and sixteen of the construction period due to the overlapping projects. Construction employment would decline after year 19 if no additional projects were initiated.
- The demand for nuclear operations workers would start at approximately 150 in the sixth year of construction as the SMR is completed. A second SMR on the same site as the first one would require approximately 100 additional operations staff, because some office and support positions do not need to be duplicated. SMR operations employment growth is modeled as alternating first and second phases of approximately 150 and 100 jobs every three years, reaching approximately 750 workers in year 21, when the last of the six SMRs is completed.

Figure 1: Additional Nuclear Workers Necessary to Support Deployment of Six 300 MW SMRs



Supply of Trained Graduates

To estimate the likely supply of trained graduates in Virginia, we use data from the State Council of Higher Education for Virginia (SCHEV) on completions by detailed program area for academic year 2023-2024 for all public and private colleges and universities in Virginia. Those data identify program areas by U.S. Department of Education Classification of Instructional Programs (CIP) Codes and provide detail on the number of students graduating statewide in those programs that year by award level (*e.g.*, certificates, Associate's degrees, Bachelor's degrees, Master's degrees, and Doctoral degrees).

Gap Analysis

In the next step of the analysis, we use a SOC-CIP crosswalk developed jointly by BLS and the U.S. Department of Education to identify the prerequisite education and training programs necessary for entry into each occupation included in the staffing matrices. We then compare the overall annual demand for trained workers in those occupations (*i.e.*, **the combined total demand for nuclear workers and workers in all other industries hiring that occupation**) to the annual supply of associated graduates from Virginia public and private colleges and universities to identify potential gaps between the two.

The results of that analysis are presented in Tables 1 and 2 for Nuclear Construction Workers and Nuclear Operations Workers respectively. It is important to note that there are some occupations listed in these tables for which it was not possible to identify a "gap". Typically, the reason for this is the occupation is not associated with a specific post-secondary education program and, as a result, there is no supply of trained graduates to compare to the occupational demand in terms of average annual openings. In most cases, this is because the typical education level required for entry into the occupation is a high school diploma or equivalent and a post-secondary degree or certificate is generally not required.

In Tables 1 and 2:

- **Occupation** is the Standard Occupation Code (SOC) title for the occupation being assessed.
- **Estimated Salary** is the 90th percentile U.S. salary for that occupation in calendar year 2024.¹²
- **Entry Education** is the typical educational attainment level required for entry into that occupation.¹³
- **Avg. Annual Openings** are the projected average annual openings in that occupation statewide in Virginia for 2020 through 2030, **plus** the average annual additional nuclear workers need to support deployment of six 300 MW SMRs.¹⁴

¹² Data Source: U.S. Bureau of Labor Statistics.

¹³ Data Source: U.S. Bureau of Labor Statistics.

¹⁴ Data Source: Virginia Department of Workforce Development and Advancement.

- **Certificate, Associates, Bachelors, Masters, Doctorate, and Total** are the degree and non-degree completions associated with that occupation reported by Virginia private and public, four-year and two-year colleges and universities, in academic year 2023-2024.¹⁵
- **GAP** is the difference between the pipeline of annual graduates associated with each occupation and the projected average annual openings for that occupation, where a negative number indicates a shortfall of needed graduates.

Table 1 details the results of the gap analysis for the nuclear construction workers that would be required to build one 300 MW SMR as identified in our nuclear construction staffing matrix. Recall that the gap analysis compares the overall annual statewide demand for trained workers in each of those occupations to the annual supply of graduates from Virginia public and private colleges and universities in programs that prepare graduates for that occupation. Also, it is important to note that some of these estimated gaps may be more apparent than real. As detailed in the **Educational Req.** column, not all of the occupations listed necessarily require a post-secondary degree or certificate and some may be supported by apprenticeship or other workforce training programs.

As the data in Table 1 show, the potential shortfalls in the supply of workers in those occupations required in nuclear construction are estimated to be in:

- Electricians (a shortfall of 2,327 graduates).
- First-Line Supervisors of Construction Trades and Extraction Workers (a shortfall of 2,213 graduates).
- Heating, Air Conditioning, and Refrigeration Mechanics and Installers (a shortfall of 926 graduates).
- Welders (a shortfall of 540 graduates).
- Civil Engineers (a shortfall of 531 graduates).
- Construction Managers (a shortfall of 358 graduates).
- Civil Engineering Technologists and Technicians (a shortfall of 157 graduates).

Table 2 details the results of the gap analysis for the supply of workers in those occupations required to operate one 300 MW SMR as identified in our nuclear operations staffing matrix. Again, it is important to note that some of these estimated gaps may be more apparent than real, because not all of the occupations listed necessarily require a post-secondary degree or certificate.

As the data in Table 2 show, the shortfalls in the supply of trained nuclear operations workers are estimated to be in:

- Accountants and Auditors (a shortfall of 3,884 graduates).

¹⁵ Data Source: State Council of Higher Education for Virginia.



- Project management Specialists (a shortfall of 2,136 graduates).
- General and Operations Managers (a shortfall of 1,762 graduates).
- First-Line Supervisors of Mechanics, Installers, and Repairers (a shortfall of 1,507 graduates).
- Training and Development Specialists (a shortfall of 1,458 graduates).
- Information Security Analysts (a shortfall of 643 graduates).
- Compliance Officers (a shortfall of 627 graduates).
- Logisticians (a shortfall of 625 graduates).
- Electrical Engineers (a shortfall of 316 graduates).
- Computer Network Support Specialists (a shortfall of 312 graduates).
- First-Line Supervisors of Security Workers (a shortage of 270 graduates).
- Mechanical Engineers (a shortfall of 269 graduates).
- Network and Computer Systems Administrators (a shortfall of 263 graduates).
- Occupational Health and Safety Specialists (a shortfall of 251 graduates).
- Chemical Technicians (a shortfall of 113 graduates).
- Environmental Engineers (a shortfall of 113 graduates).
- Nuclear Engineers (a shortfall of 150 graduates).
- Nuclear Technicians (a shortfall of 96 graduates).



Table 1: Gap Analysis for Nuclear Construction Occupations (combined total demand for nuclear construction workers and all other construction workers)

Occupation	Estimated Salary	Entry Education	Avg. Annual Openings	Certificate	Associates	Bachelors	Masters	Doctorate	Total Grads	GAP
Boilermakers	\$107,600	High school diploma or equivalent	38							N/A
Brick masons and Block masons	\$95,560	High school diploma or equivalent	282							N/A
Carpenters	\$98,370	High school diploma or equivalent	2,704							N/A
Cement Masons and Concrete Finishers	\$87,620	No formal educational credential	393							N/A
Civil Engineering Technologists and Technicians	\$97,840	Associate's degree	193	14	20	1	0	0	36	-157
Civil Engineers	\$160,990	Bachelor's degree	971	0	0	302	113	25	440	-531
Construction Inspectors (NDE)	\$112,320	High school diploma or equivalent	537							N/A
Construction Laborers	\$77,530	No formal educational credential	3,469							N/A
Construction Managers	\$176,990	Bachelor's degree	868	21	51	305	127	6	510	-358
Control and Valve Installers and Repairers, Except Mechanical Door	\$109,050	High school diploma or equivalent	90							N/A
Electrical Power-Line Installers and Repairers	\$126,610	High school diploma or equivalent	314							N/A
Electricians	\$106,030	High school diploma or equivalent	2,522	170	25	0	0	0	195	-2,327



Table 1: Gap Analysis for Nuclear Construction Occupations (combined total demand for nuclear construction workers and all other construction workers)

Occupation	Estimated Salary	Entry Education	Avg. Annual Openings	Certificate	Associates	Bachelors	Masters	Doctorate	Total Grads	GAP
First-Line Supervisors of Construction Trades and Extraction Workers	\$126,690	High school diploma or equivalent	2,523	245	65	0	0	0	310	-2,213
Floor Layers, Except Carpet, Wood, and Hard Tiles	\$97,180	No formal educational credential	59							N/A
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	\$91,020	Post-secondary nondegree award	1,295	310	59	0	0	0	369	-926
Helpers--Brick masons, Block masons, Stonemasons, and Tile and Marble Setters	\$68,330	No formal educational credential	155							N/A
Helpers--Electricians	\$56,770	High school diploma or equivalent	362							N/A
Helpers--Installation, Maintenance, and Repair Workers	\$54,650	High school diploma or equivalent	533							N/A
Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	\$54,860	High school diploma or equivalent	358							N/A
Helpers--Roofers	\$55,310	No formal educational credential	88							N/A
Industrial Machinery Mechanics	\$92,730	High school diploma or equivalent	1,275							N/A
Inspectors, Testers, Sorters, Samplers, and Weighers (NDE)	\$75,510	High school diploma or equivalent	1,020							N/A



Table 1: Gap Analysis for Nuclear Construction Occupations (combined total demand for nuclear construction workers and all other construction workers)

Occupation	Estimated Salary	Entry Education	Avg. Annual Openings	Certificate	Associates	Bachelors	Masters	Doctorate	Total Grads	GAP
Insulation Workers, Mechanical	\$94,110	High school diploma or equivalent	241							N/A
Millwrights	\$93,740	High school diploma or equivalent	104							N/A
Operating Engineers and Other Construction Equipment Operators	\$100,690	High school diploma or equivalent	1,188							N/A
Paving, Surfacing, and Tamping Equipment Operators	\$90,110	High school diploma or equivalent	280							N/A
Plumbers, Pipefitters, and Steamfitters	\$105,150	High school diploma or equivalent	1,819							N/A
Reinforcing Iron and Rebar Workers	\$95,530	High school diploma or equivalent	131							N/A
Roofers	\$80,780	No formal educational credential	402							N/A
Sheet Metal Workers	\$102,680	High school diploma or equivalent	482							N/A
Structural Iron and Steel Workers	\$107,520	High school diploma or equivalent	221							N/A
Surveyors	\$116,330	Bachelor's degree	142	2	0	0	0	0	2	-140
Welders, cutters, solderers, and brazers	\$75,850	High school diploma or equivalent	1,127	587	0	0	0	0	587	-540



Table 2: Gap Analysis for Nuclear Operations Occupations (combined total demand for nuclear operations workers and all other operations workers)

Occupation ¹⁶	Estimated Salary	Entry Education	Avg. Annual Openings	Certificate	Associates	Bachelors	Masters	Doctorate	Total Grads	Gap
Accountants and Auditors	\$106,450	Bachelor's degree	4,868	123	29	589	243	0	984	-3,884
Calibration Technologists and Technicians	\$105,440	Associate's degree	364	326	17	1	0	0	344	-20
Chemical Technicians	\$90,990	Associate's degree	153	0	0	33	3	4	40	-113
Compliance Officers	\$130,030	Bachelor's degree	919	2	0	220	58	12	292	-627
Computer Network Support Specialists	\$95,710	Associate's degree	649	34	168	108	24	3	337	-312
Electrical and Electronic Engineering Technologists and Technicians	\$111,790	Associate's degree	537	513	96	154	0	0	763	226
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	\$127,970	Post-secondary nondegree award	78	68	4	0	0	0	72	-6
Electrical Engineers	\$175,460	Bachelor's degree	461	0	0	92	32	21	145	-316
Electro-Mechanical and Mechatronics Technologists and Technicians	\$109,580	Associate's degree	53	50	15	30	0	0	95	42
Environmental Engineering Technologists and Technicians	\$92,280	Associate's degree	91	0	0	0	0	0	0	-91
Environmental Engineers	\$161,910	Bachelor's degree	115	0	0	0	2	0	2	-113
Facilities Managers	\$173,080	Bachelor's degree	444	35	26	128	75	9	272	-172

¹⁶ Occupations with an asterisk (*) have salaries at the 75th percentile for the U.S.



Table 2: Gap Analysis for Nuclear Operations Occupations (combined total demand for nuclear operations workers and all other operations workers)

Occupation ¹⁶	Estimated Salary	Entry Education	Avg. Annual Openings	Certificate	Associates	Bachelors	Masters	Doctorate	Total Grads	Gap
First-Line Supervisors of Mechanics, Installers, and Repairers	\$124,280	High school diploma or equivalent	1,530	12	4	7	0	0	23	-1,507
First-Line Supervisors of Security Workers	\$93,930	High school diploma or equivalent	287	18	0	0	0	0	18	-270
First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	\$94,830	High school diploma or equivalent	1,620							N/A
General and Operations Managers	\$202,441	Bachelor's degree	5,698	232	334	2,086	1,219	65	3,935	-1,762
Hazardous Materials Removal Workers	\$82,480	High school diploma or equivalent	199							N/A
Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	\$166,670	Bachelor's degree	34	1	0	0	6	1	8	-26
Helpers--Installation, Maintenance, and Repair Workers	\$54,650	High school diploma or equivalent	526							N/A
Human Resources Managers	\$234,300	Bachelor's degree	400	24	21	87	67	20	219	-182
Human Resources Specialists	\$97,270	Bachelor's degree	2,690	59	144	517	428	96	1,244	1,446
Industrial Production Managers	\$197,310	Bachelor's degree	200	9	12	86	46	5	157	-43
Information Security Analysts	\$159,600	Bachelor's degree	1,969	53	574	551	134	13	1,326	-643



Table 2: Gap Analysis for Nuclear Operations Occupations (combined total demand for nuclear operations workers and all other operations workers)

Occupation ¹⁶	Estimated Salary	Entry Education	Avg. Annual Openings	Certificate	Associates	Bachelors	Masters	Doctorate	Total Grads	Gap
Instructional Coordinators	\$115,410	Master's degree	564	46	0	0	462	362	869	305
Laborers and Freight, Stock, and Material Movers, Hand	\$53,180	No formal educational credential	7,950							N/A
Logisticians	\$104,330	Bachelor's degree	1,025	25	55	169	144	6	400	-625
Mechanical Engineers	\$161,240	Bachelor's degree	506	0	0	208	20	9	237	-269
Network and Computer Systems Administrators	\$123,390	Bachelor's degree	1,369	84	285	499	217	20	1,106	-263
Nuclear Engineers	\$187,430	Bachelor's degree	152	0	0	0	1	1	2	-150
Nuclear Technicians	\$126,890	Associate's degree	102	0	6	0	0	0	6	-96
Occupational Health and Safety Specialists	\$130,460	Bachelor's degree	252	0	0	0	1	0	1	-251
Occupational Health and Safety Technicians	\$94,670	High school diploma or equivalent	55							N/A
Plumbers, Pipefitters, and Steamfitters	\$105,150	High school diploma or equivalent	1,796							N/A
Power Plant Operators	\$128,760	High school diploma or equivalent	42							N/A
Production, Planning, and Expediting Clerks	\$71,480	High school diploma or equivalent	930							N/A
Project Management Specialists	\$165,790	Bachelor's degree	4,105	131	240	956	613	28	1,969	-2,136
Security Guards	\$59,580	High school diploma or equivalent	4,452							N/A



Table 2: Gap Analysis for Nuclear Operations Occupations (combined total demand for nuclear operations workers and all other operations workers)

Occupation ¹⁶	Estimated Salary	Entry Education	Avg. Annual Openings	Certificate	Associates	Bachelors	Masters	Doctorate	Total Grads	Gap
Shipping, Receiving, and Inventory Clerks	\$60,300	High school diploma or equivalent	1,525							N/A
Stationary Engineers and Boiler Operators	\$121,200	High school diploma or equivalent	83							N/A
Training and Development Specialists	\$120,190	Bachelor's degree	1,586	34	0	30	63	1	128	-1,458

Opportunities for Virginia

In this section, we describe opportunities for Virginia that were identified by SMR-related companies interviewed by Mangum Economics.

SMR Workforce

To guarantee an adequate workforce for constructing and operating SMRs, Virginia needs to expand its educational and training programs. Specific areas that deserve attention include:

- Addressing the workforce gaps identified in this report.
- Preparing electricians and welders to pass nuclear certification tests. Potential workers need opportunities to practice the methods used in the tests to master those methods. Because the SMR-related construction and manufacturing companies typically administer those certification tests themselves, this will require collaboration between Virginia's community colleges and those firms.
- Preparing former military personnel for SMR jobs to take advantage of their existing security clearances. Workers in nuclear environments require security clearances and military personnel often have those.
- Establishing more programs like the collaboration between Dominion Energy and the College of William and Mary on education, workforce development, and research for general energy jobs, but focused on the workforce pipeline for SMR jobs.¹⁷
- Additional nuclear reactor control room simulations like the ones at George Mason University, Virginia Commonwealth University, and the University of Virginia's College at Wise.
- Develop new programs to prepare service technicians and engineers to refuel and maintain SMRs specifically.

SMR Supply Chain

Virginia's existing nuclear sector includes Dominion Energy's four operating nuclear reactors, along with major companies in the industry (e.g., BWXT, Framatome, Huntington Ingalls, AECOM, Bechtel, Day and Zimmerman, Kiewit, Aeorfin, AMR PEMCO, NovaTech, and Virginia Transformer,). Virginia could expand its nuclear sector if the state is one of the early locations for SMRs. As an early adopter of SMR technology, Virginia would have a first-mover advantage in developing a SMR construction and maintenance workforce and SMR supply chain. More specifically:

- If Virginia prepares its construction workers to handle the construction of some of the first SMRs in the U.S., those workers could later be available for SMR construction sites in other states. Large construction projects often employ significant numbers of out-of-state workers because

¹⁷ "How universities and corporations can build a veteran talent Pipeline", Richmond Times-Dispatch, November 11, 2025

the construction company's standing workforce has done the same work on previous projects elsewhere.

- SMR installations are expected to house multiple units built in succession on the same site. Maintenance of the SMRs will generally be a service provided by the SMR manufacturer. As an early SMR adopter, Virginia could be the home base for the teams of service technicians who would travel around the U.S. ensuring their company's SMRs are operating optimally.
- Virginia's existing nuclear equipment manufacturers provide proof that nuclear equipment can be made in Virginia. Additional opportunities for SMR suppliers include:
 - Reactor vessels
 - Nuclear fuel
 - Specialty metals
 - Metal fabrication
 - Small components
 - Electronics
 - Transformers
 - Turbines

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