OXFORD ECONOMICS

NUCLEAR POWER PAYS

ASSESSING THE TRENDS IN ELECTRIC POWER GENERATION EMPLOYMENT AND WAGES

April 2019

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1. INTRODUCTION

1.1 BACKGROUND

For more than 50 years the nuclear power generation industry has helped to produce electricity for millions of people and has supported thousands of jobs in the US. Nuclear power produces 20 percent of the electricity needs in the US, and accounts for 56 percent of emission-free electricity. Providing 100 percent carbon-free electricity, nuclear power is uniquely situated in the power generation industry as a highly efficient yet complex source of electricity. As such, the workers employed in the nuclear power generation industry must be highly educated and skilled in order to safely operate nuclear plants.

To better understand the relationship between industry pay and the knowledge, skills, and training demanded to work in the nuclear power generation industry, we examined fundamental labor market data to understand better and explain the variations in pay found within the broader power generation industry. We looked at industry employment and wage trends, occupational staffing patterns and pay, as well as indicators of knowledge and skills such as educational attainment, veteran status, and O*NET Job Zones. Throughout the report we attempted to examine these differences, where possible, using the detailed industry groups identified below in Figure 1. These groupings allow for comparisons between the different types of power generation, including nuclear, fossil fuel, solar and wind, and other renewables.

Fig. 1. The electric power generation industry

Industry Title	NAICS
Electric Power Generation	**22111**
Fossil Fuel	221112
Nuclear	221113
Solar and Wind, includes:	
Solar	221114
Wind	221115
Other Renewables, includes:	
Hydroelectric	221111
Geothermal	221116
Biomass	221117
Other	221118

Source: US Census, Oxford Economics

1.2 EMPLOYMENT AND WAGE ESTIMATES COVERED

This wage and workforce analysis is based upon a large, but not a complete sample of all nuclear employment in the US. The nuclear power generation employment estimate in this report reflects permanent workforce employed directly by commercial nuclear power plants. The temporary or contracting workforce at the plants are typically not included by the Bureau of Labor Statistics Quarterly Census

of Employment and Wages. The employment estimate also does not include workforce employed by US Department of Energy National Labs, research and development firms, engineering consulting firms, other industry firms, or the federal government.

1.3 PURPOSE OF THIS REPORT

This report seeks to illustrate and articulate the US nuclear power industry as a driver of highly educated, high-skilled workers who earn premium wages. In addition, it provides an analysis of workforce characteristics to highlight noteworthy qualities about the people who work within the industry. The following sections present the respective findings for each component of the research and provide comparisons to the broader electric power generation industry as well as the US workforce overall.

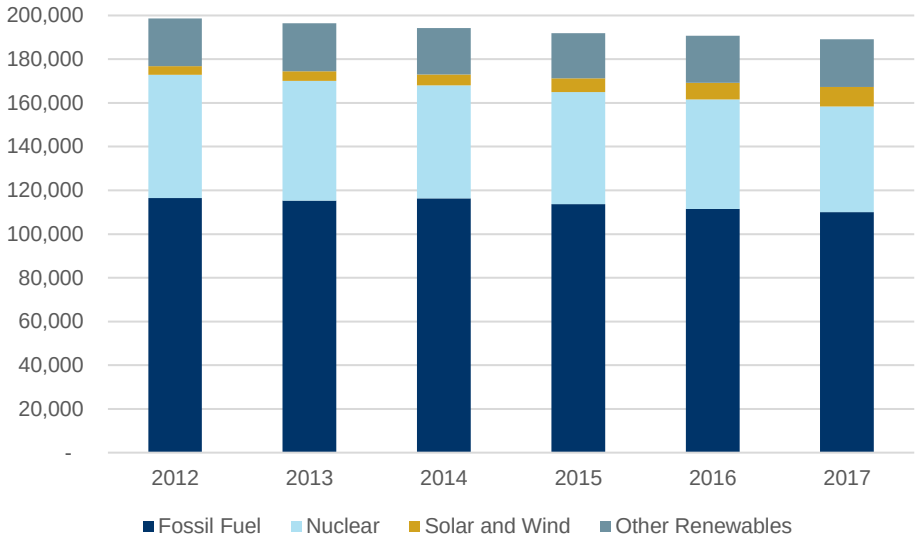
2. EMPLOYMENT AND WAGES IN THE ELECTRIC POWER GENERATION INDUSTRY

In 2017, the electric power generation industry employed approximately 189,200 people in the US. On average, these workers earned $118,000 in that period. However, a closer inspection of the industry reveals significant differences between the skills, education, and pay depending on the source of power (i.e., the industry in which workers are employed). To better understand the relationship between industry and pay we examine the trends over time to determine which electric power generation industry pays the highest average wages.

2.1 INDUSTRY EMPLOYMENT

Annual employment in the electric power generation industry was 189,200 in 2017, a slight decline from 198,700 in 2012. Fossil fuel made up the largest share of employment in the industry, with 110,000 workers, followed by nuclear with employment of 48,400 workers, other renewables with 21,900 workers, and solar and wind with 8,900 workers. Employment in both renewable segments increased, however, not enough to offset the decline in the broader industry. Although the nuclear employment share of electric power generation declined to 26 percent in 2017 from 28 percent in 2012, it still ranked as the second largest power employer in the US. Figure 2 displays the annual employment trends of the electric power generation industry from 2012 to 2017.

Fig. 2. Electric power industry employment trends, 2012-2017

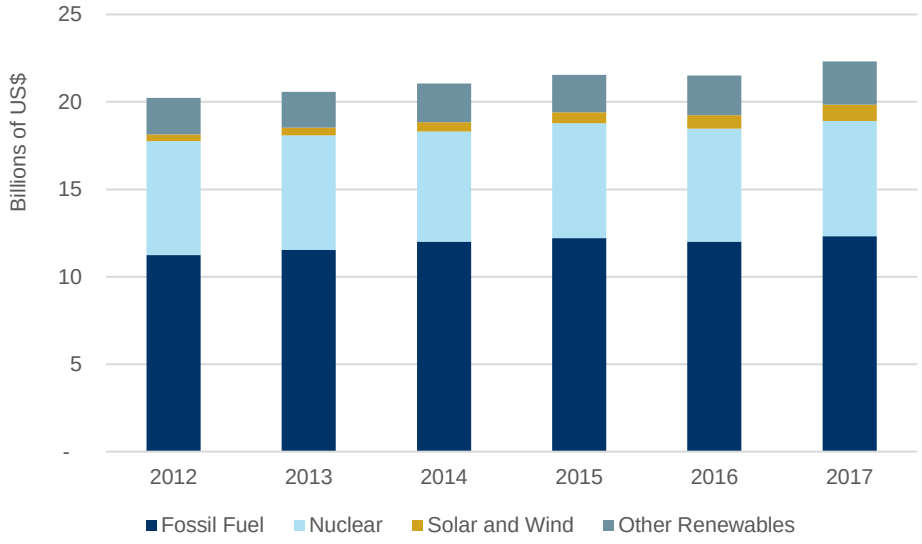


Source: BLS Quarterly Census of Employment and Wages, Oxford Economics

2.2 INDUSTRY WAGES

In contrast to declining employment, the electric power industry paid approximately $22.3 billion in wages in 2017, which was an increase from $20.2 billion paid in 2012. Similar to employment, fossil fuel accounted for the largest share, paying $12.3 billion in wages in 2017, followed by nuclear with $6.6 billion, other renewables with $2.5 billion, and solar and wind with $922 million. Although the nuclear wage share of electric power generation declined to 30 percent in 2017 from 32 percent in 2012, it still ranked as the second largest power in terms of wages in the US. It is important to note the outsized share of wages in the nuclear industry compared to employment, as this translate into higher average wages, which we explore in the following section. Figure 3 displays the annual wage trends of the electric power generation industry from 2012 to 2017.

Fig. 3: Electric Power Industry Wage Trends, 2012-2017



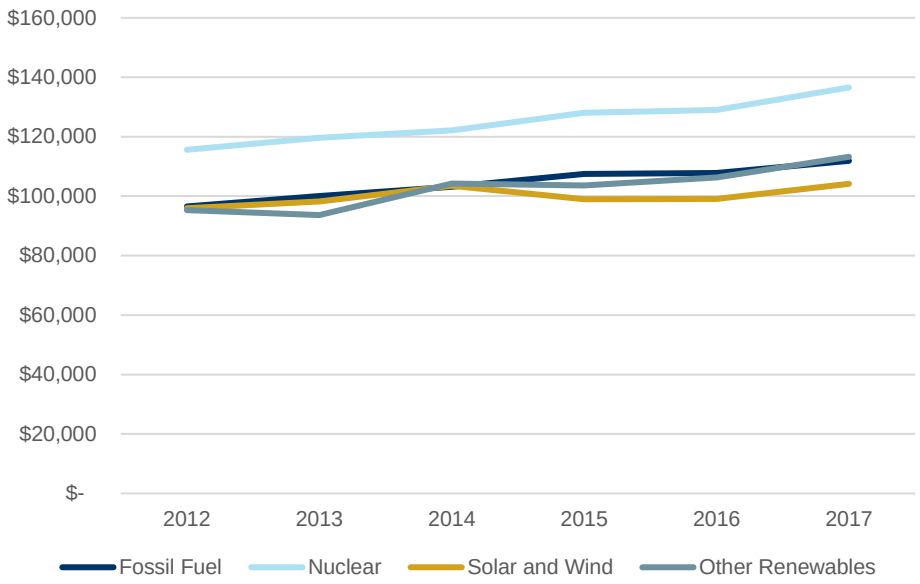
Source: BLS Quarterly Census of Employment and Wages, Oxford Economics

2.3 AVERAGE INDUSTRY PAY

Combining the employment and wage trends provides a perspective of average worker pay within the power generation industry. As noted above, the average pay in the electric power industry overall was nearly $118,000 in 2017. This represented an increase of 16 percent from 2012 average pay.

Notably, average wages in the nuclear power industry average pay increased by 18 percent between 2012 and 2017, with the average nuclear power worker earning nearly $136,600 in 2017. This ranked as the highest average pay within the electric power industry and is followed by other renewables with $113,200 average pay, fossil fuel with $111,900 average pay, and solar and wind with $104,200 average pay. Figure 4 displays the average annual wage trends of the electric power generation industry from 2012 to 2017. The nuclear industry stands out as exceeding the average pay of all other industries by about 20 percent.

Fig. 4: Average Annual Wage Trends, 2012-2017



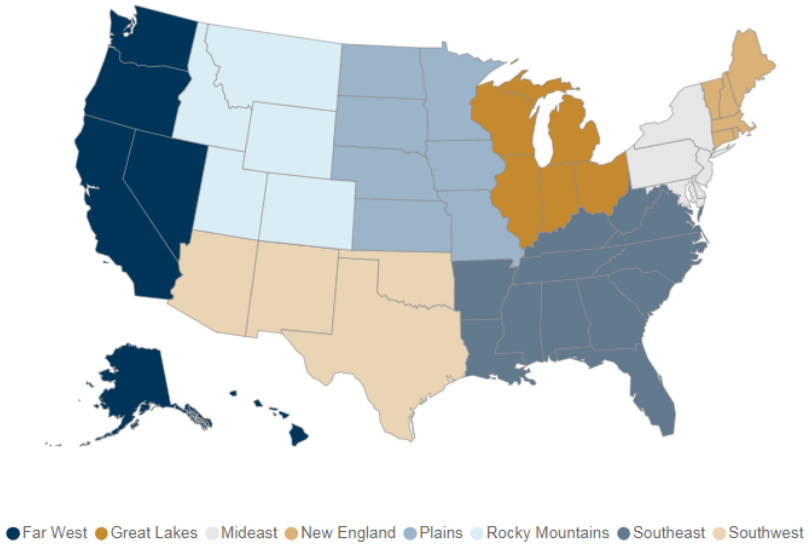
Source: BLS Quarterly Census of Employment and Wages, Oxford Economics

This average way premium is indicative of the high-caliber employees needed to utilize, manage, and develop the technologies found in the nuclear energy industry. As such workers in the nuclear industry demonstrate high levels of knowledge, skills, and training which are necessary to work in nuclear power generation. As we will see in subsequent sections, the variation in average industry pay can be attributed to the types of jobs found within the industry, the premium paid across all job functions due to specialized skills, and the education and training required for employment within the nuclear power industry. But first, we examine the regional variations in pay found within the nuclear power industry in Section 3.

3. STATE AND REGIONAL VARIATION

While only 30 states are represented in the nuclear electric power generation industry, the average wage premium paid to workers in the industry holds true across each respective region. The regions used in this analysis come from the Bureau of Economic Analysis and are identified below in Figure 5. To highlight the variation, we calculated employment and wages in each respective geographic region to compare the average worker pay to the average pay in the nuclear power industry.[1]

Fig. 5: Bureau of Economic Analysis regions



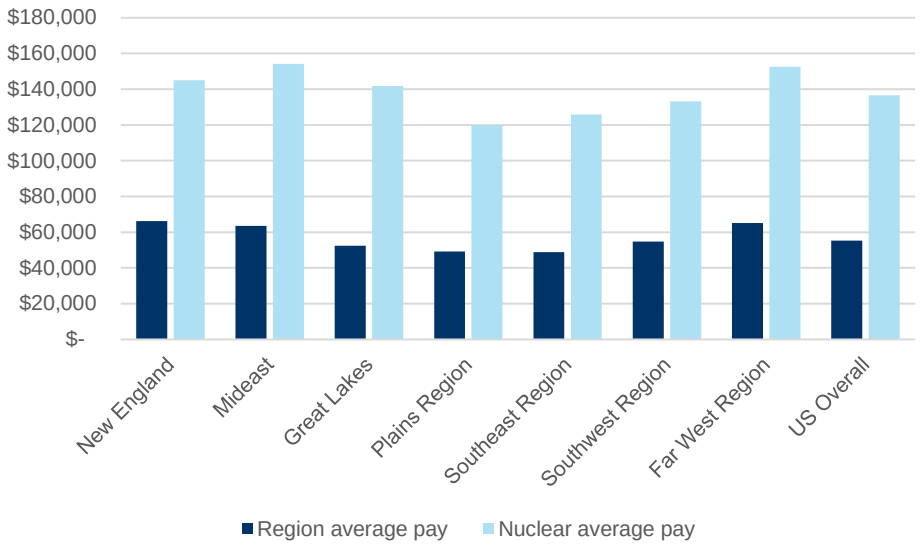
Source: BEA

3.1 REGIONAL PAY PREMIUMS

Workers in the nuclear power industry are highly productive, and wages reflect this at $136,600 annual income on average, placing them well above the average earned by workers in all regions. Overall, the $55,400 average pay earned by workers in the US was less than half of what workers in the nuclear power industry earned in 2017. The Mideast and Far West regions indicated notably higher pay compared to the industry average, at $154,200 and $152,500, respectively. The average pay in each region and the average nuclear pay in each region are identified below in Figure 4.

[1] The regions used in the analysis are the eight geographic regions used by the Bureau of Economic Analysis. The Rocky Mountain Region was excluded because there are no nuclear power plants located in that region. For a list of states in each respective region, see Appendix 1.

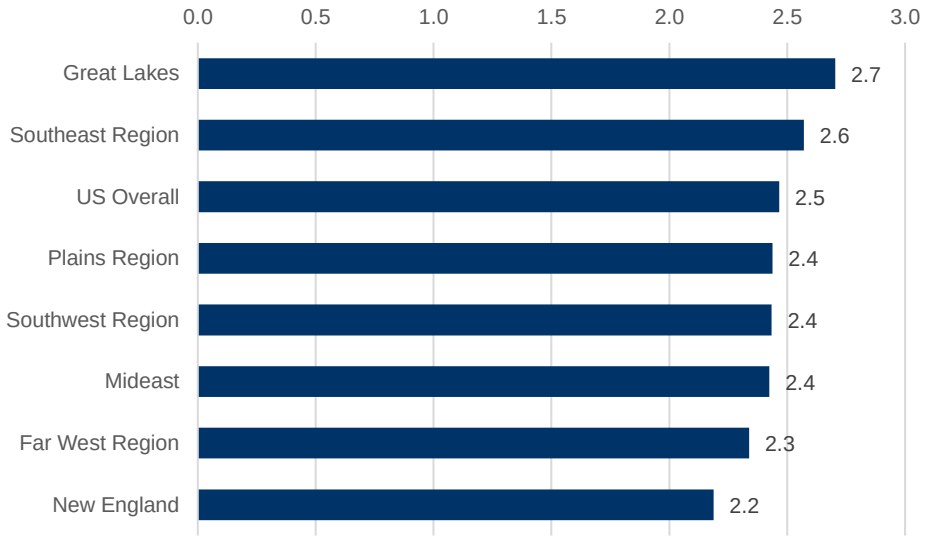
Fig. 6: Average regional wages and average nuclear power wages by region, 2017



Source: BLS Quarterly Census of Employment and Wages, Oxford Economics

Average nuclear pay was 2.5 times higher than the average pay in the US overall. When breaking down pay by region, the nuclear premium was highest in the Great Lakes region, paying 2.7 times the regional average pay, followed closely by the Southeast Region with a 2.6 premium above-average regional pay. Although the Mideast and Far West regions indicated relatively higher average wages, the regional premium in the Great Lakes and Southeast indicates that nuclear power workers living in those regions have greater purchasing power. The average nuclear pay premium in each region are identified in Figure 7.

Fig. 7: Nuclear pay premium by region, 2017



Source: BLS Quarterly Census of Employment and Wages, Oxford Economics

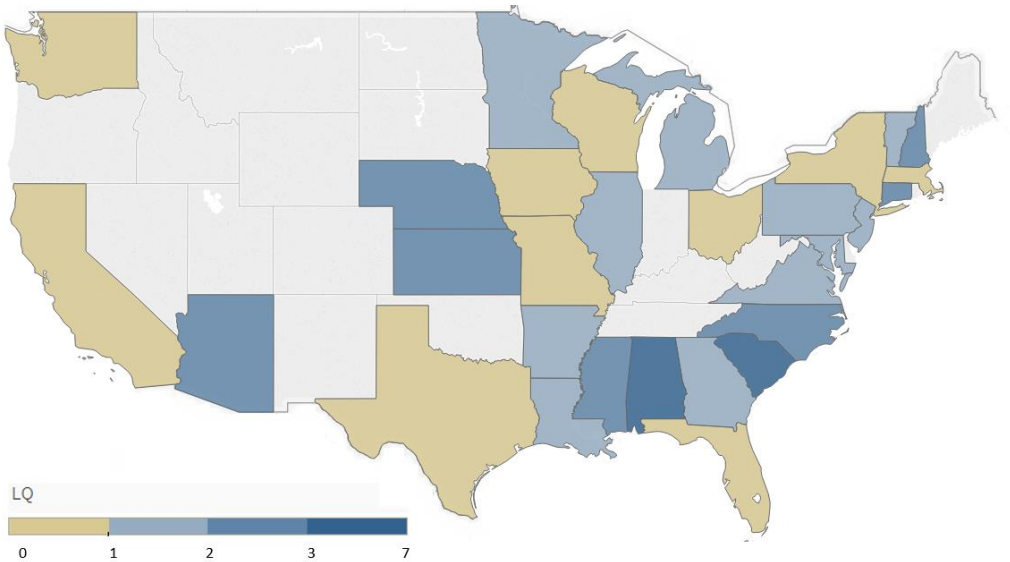
3.2 REGIONAL CONCENTRATION

A location quotient (LQ) for an industry helps to illustrate how concentrated it is in a state or region by comparison to the US overall. A location quotient equal to 1.0 indicates that the state's industry concentration is equal to the national concentration of the same industry. Industries with higher location quotients indicate that a state has a higher concentration in the production of that good or service, relative to the rest of the nation. For example, a value of 1.5 indicates that industry employment within the state is 1.5 times more concentrated than the US overall. A location quotient below 1.0 indicates that industry employment within the state is less concentrated compared to the US overall.

It is important to note that states with high industry employment do not necessarily result in high location quotients, as this statistic is relative to the national employment share. For example, if the nuclear power industry made up 0.52 percent of Pennsylvania's employment and 0.41 percent of the US employment, then Pennsylvania's LQ for the industry would be 1.3 (0.52% / 0.41%). Conversely, if the nuclear power industry makes up 0.28 percent of California's employment and 0.41 percent of the US employment, then California's LQ for the industry would be 0.7 (0.28% / 0.41%).

The states with high LQ values for the nuclear power industry include South Carolina, Alabama, New Hampshire, and Connecticut. This indicates, for example, that the economy of South Carolina is more reliant on the nuclear power industry than California and the US overall. The map in Figure 8 presents the nuclear power employment LQ for each respective state in the US that reported employment in the nuclear power generation industry.

Fig. 8: Nuclear power industry location quotient (LQ) by state, 2017



Source: BLS Quarterly Census of Employment and Wages, Oxford Economics

4. OCCUPATIONAL PROFILE OF THE POWER GENERATION INDUSTRY

While industry employment describes the type of business being conducted by a firm, occupations often provide better insights into the specific tasks employees complete while at work. In this section, we examine the occupation profile of the power generation industry to better understand the job functions within the industry as well as the types of skills and knowledge that workers need to be employed in the industry. This analysis helped to identify how staffing patterns of each respective electric power generation industry vary, the average pay of occupations across the electric power generation sector, and the differences in occupational skills, education, and training across the respective power generation industries.

4.1 STAFFING PATTERNS

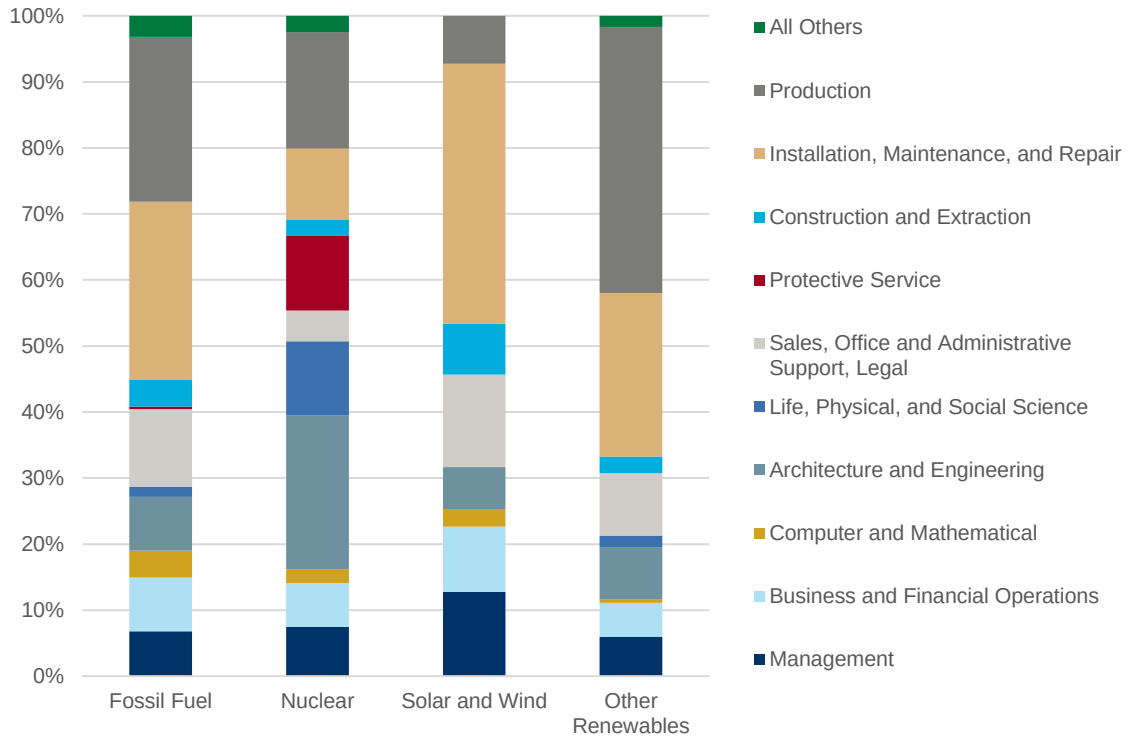
The roles of power generation industry employees are many and varied: they are electricians, operations managers, engineers, environmental scientists, power plant operators, customer service representatives, and maintenance and repair workers, among others. In fact, the major occupation group that has the largest share of employment within the power generation industry is production occupations, which accounts for about 23 percent of workers, followed closely by installation, maintenance, and repair workers at 22 percent. However, nuclear power stands out as having its highest share of employment in architecture and engineering occupations (23 percent), which are among the most highly educated, typically requiring a college degree, and highly paid jobs, with average salaries over $100,000 annually. Another notable occupational category unique to the nuclear power industry is the protective service jobs, representing about 11 percent of the nuclear power workforce.

Nuclear power plants typically operate for 50 years (and often beyond), and the locations cannot be moved. As such, the occupations found in nuclear power industry provide locally sustaining jobs and generate a significant economic contribution to many communities, as identified in reports such as “Economic Impacts of the Columbia Generating Station” or “Economic Impacts of the Cooper Nuclear Station.”[2] In contrast jobs in construction or installation, maintenance, and repair tend to be more transient and temporary in nature. The industries that employ these types of jobs are prone to providing short-term impacts in local economies that last only during the duration of a project.

Figure 9 shows the occupational profile of workers employed within the electric power generation industry, highlighting the major occupation groups.

[2] To access these reports and others, see NEI’s resource page: https://www.nei.org/resources/.

Fig. 9: Occupational staffing patterns of the power generation industry, 2017



Source: BLS Occupational Employment Statistics, Oxford Economics

4.2 JOB ZONES

There is ample evidence that at the occupational level certain training, skills, and educational attainment are necessary for employment. As a result, certain occupations demand higher wages to attract workers with the right backgrounds. To better understand the skills and education demanded in the electric power generation industry, we examined the differences in job zones across the power generation sector using O*NET's Job Zones. A Job Zone is a group of occupations that are similar in how much education people need to do the work, how much related experience people need to do the work, and how much on-the-job training people need to do the work. For this analysis, a "skilled" occupation is defined as an occupation in O*NET Job Zones Three, Four, or Five.

An important aspect to distinguish skilled occupations, in this section, is that postsecondary education is not necessarily a pre-requisite for employment. However, a high percentage of those employed in skilled occupations do indeed have a postsecondary degree. For example, individuals in the nuclear technician are not required to have a bachelor's degree to enter the occupation. However, nearly 35 percent of those employed in the occupation has a bachelor's degree or higher. This indicates that postsecondary education and degree completion is typically desired by companies that employ nuclear technicians.

O*NET'S JOB ZONES CLASSIFICATION

The O*NET program is the nation's primary source of occupational information. Central to the project is the O*NET database, containing information on hundreds of standardized and occupation-specific descriptors. The following provides a description of each respective Job Zone, ranging from One (lowest) to Five (highest):

Job Zone One: Most occupations in Job Zone One require may require a high school diploma or GED certificate and little or no previous work-related skill, knowledge, or experience.

Job Zone Two: Most occupations in Job Zone Two require a high school diploma and some previous work-related skill, knowledge, or experience.

Job Zone Three: Most occupations in Job Zone Three require training in vocational schools, related on-the-job experience, or an associate's degree.

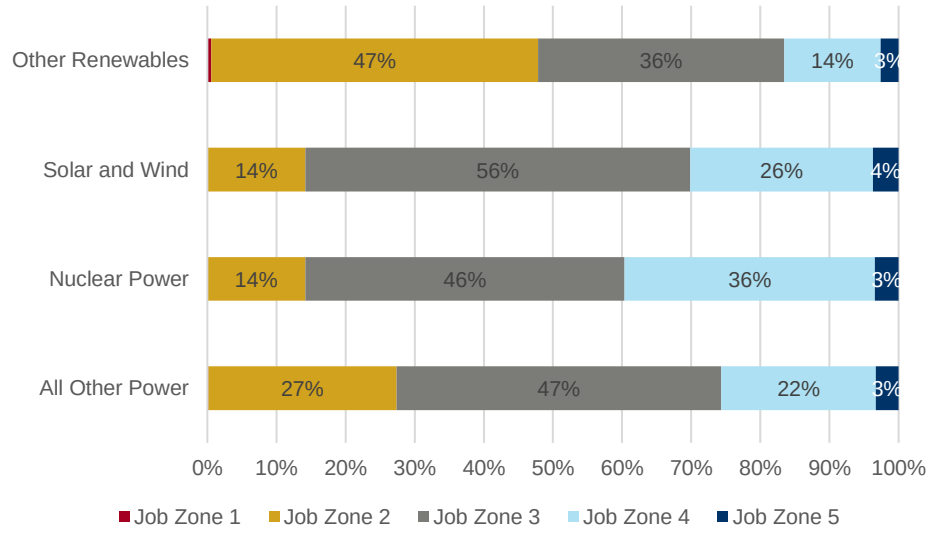
Job Zone Four: Most occupations in Job Zone Four require a four-year bachelor's degree and a considerable amount of work-related skill, knowledge, or experience.

Job Zone Five: Most occupations in Job Zone Five require graduate school as well as extensive skill, knowledge, and experience.

For a more detailed description of O*NET Job Zones and training requirements see Appendix 2.

Figure 10 shows the occupational distribution of power generation jobs. A majority of the jobs is skilled jobs. Notably, nuclear power indicates the highest share of high-skilled jobs (in Job Zones 4 and 5), at 40 percent.

Fig. 10: The share of power generation jobs by Job Zone

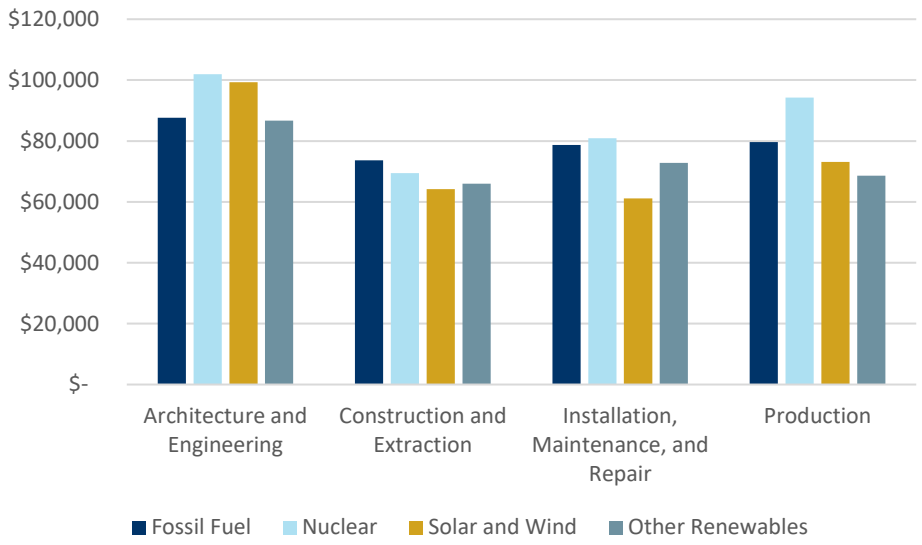


Source: O*NET, BLS Occupational Employment Statistics, Oxford Economics

4.3 OCCUPATIONAL WAGES

The occupations with the highest demands for training, skills, and educational attainment often pay higher wages compared to others. In aggregate, the nuclear power industry pays premium wages to other power generation industries. Furthermore, the nuclear power industry pays higher wages within most occupation functions. Not only does nuclear energy employ a greater share of highly paid occupations (e.g., Engineers), generally it pays the highest average wage within a given occupation group. (e.g., within Production occupations, nuclear power average wages are higher than other industry segments). Figure 11 displays average wages for each respective occupation group across the electric power generation industry.

Fig. 11: Electric power occupational wages, 2017



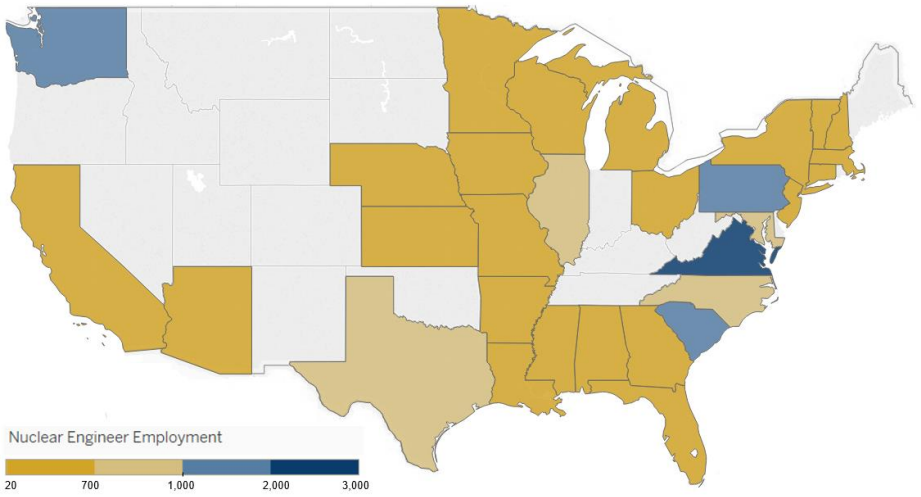
Source: BLS Occupational Employment Statistics, Oxford Economics

4.4 OTHER INDUSTRIES EMPLOYING NUCLEAR ENGINEERS

Outside of the nuclear power generation industry, nuclear engineers are employed in several other industries. In fact, over half of all nuclear engineers in the US are employed in industries other than nuclear power generation. However, these jobs are often in areas that support or oversee the nuclear power generation industry. For example, they are employed by the federal government, research and development service firms, engineering and related service firms, technical consulting firms, waste management service firms, and chemical manufacturing firms.

With the exception of federal government, all of these industries pay nuclear engineers' average salaries over $100,000 per year. This further demonstrates the value and knowledge that these workers must have in order to be employed. The map presented in Figure 12 highlights the distribution of nuclear engineers employed in each state throughout the country.

Fig. 12: Nuclear engineer employment by state, 2017



Source: BLS Occupational Employment Statistics, Oxford Economics

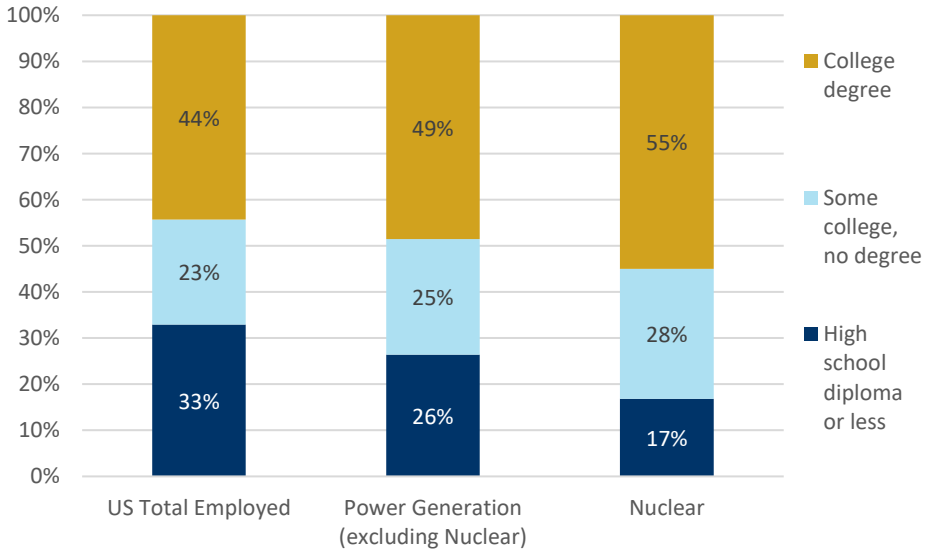
5. THE PEOPLE WHO WORK IN THE NUCLEAR POWER INDUSTRY

This section considers some demographic and socioeconomic characteristics of workers in the nuclear power industry. To estimate employee demographics within the nuclear power generation industry, data was obtained from the 2017 American Community Survey Public Use Microdata Sample. When examining the data presented in this section, the nuclear power generation workforce was identified as those people employed in NAICS "2211P" (Electric Power Generation, Transmission, and Distribution) and employed in Public Use Microdata Areas (PUMA)[3] known to have nuclear plants. In addition, we provide a comparison to all other employed workers in the power generation industry[4] as well as the US employed workforce overall.

5.1 EDUCATIONAL ATTAINMENT

The workforce of the nuclear power industry and all other power industries show a greater share of workers with college degrees compared to the US workforce overall. The nuclear power industry is particularly notable, with 55 percent of its employed workforce having a college degree. This highlights the demands of the power generation employers as needing highly knowledgeable and skilled workers.

Fig. 13: Educational attainment of the employed workforce, 2017



Source: American Community Survey, Oxford Economics

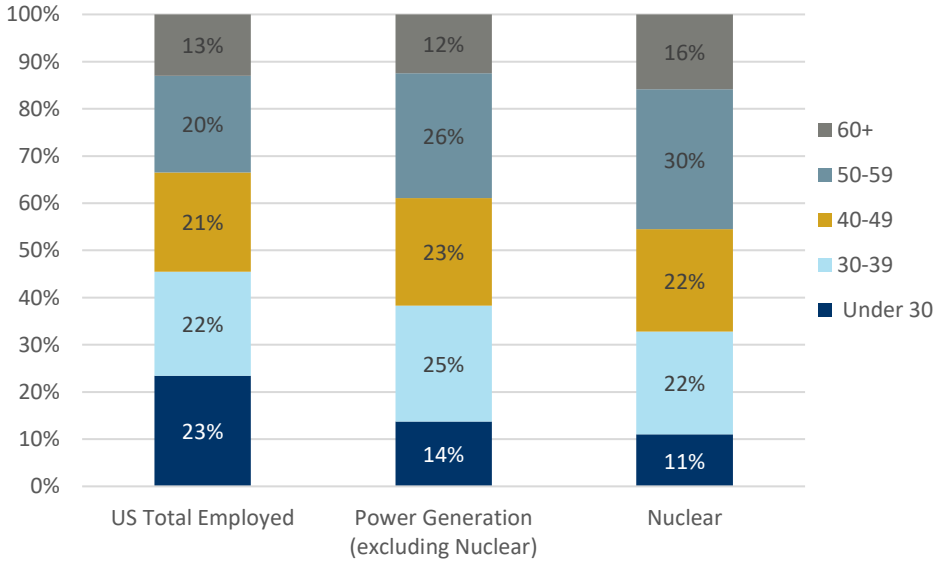
[3] Public Use Microdata Areas (PUMAs) are non-overlapping areas that partition each state into areas containing about 100,000 residents. PUMAs are the most detailed geographic area available in the PUMS.
[4] This group is represented by those workers employed in NAICS "2211P" less nuclear employment.

5.2 AGE PROFILE

Workers in the nuclear power industry are likely to be older compared to the rest of the US workforce. Indeed, nearly 46 percent of the nuclear power workforce was over the age of 50, reflecting the length of tenure within the industry as well as industry knowledge. But as the older cohort approaches retirement age, nuclear power employers will need to prepare to recruit for their future workforce.

While the mid-career age groups (30-39 and 40-49) within the nuclear power are similarly distributed to the US overall, the nuclear power industry lags in the share of workers under age 30 at 11 percent. However, this is partly explained by the number of workers that inevitably must complete college degrees while in their 20's, as demonstrated by the educational attainment, shown above, as well as the number of workers recruited from the military, as we will examine in the following section.

Fig. 14: The age profile of the employed workforce, 2017

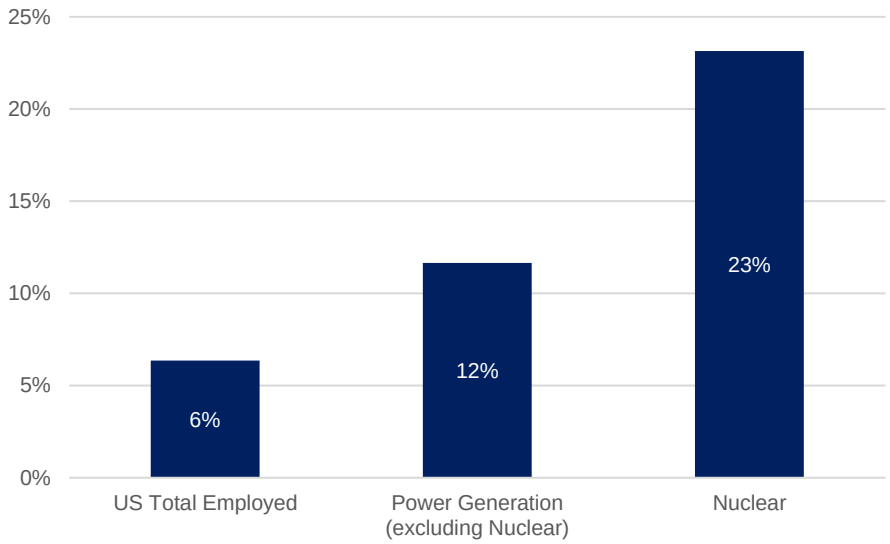


Source: American Community Survey, Oxford Economics

5.3 VETERAN STATUS

The nuclear power workforce has a greater share of veterans compared to the power generation industry and US workforce overall. This indicates that there may be a strong alignment between the skills veterans learn during military services and the skills required to work in the industry, such as teamwork and problem solving, or operating in a fast-paced or stressful environment while using highly technical equipment. As the nuclear power workforce ages, this could provide a useful pool of talent to recruit and replace retiring workers.

Fig. 15: The share of veterans in the employed workforce, 2017

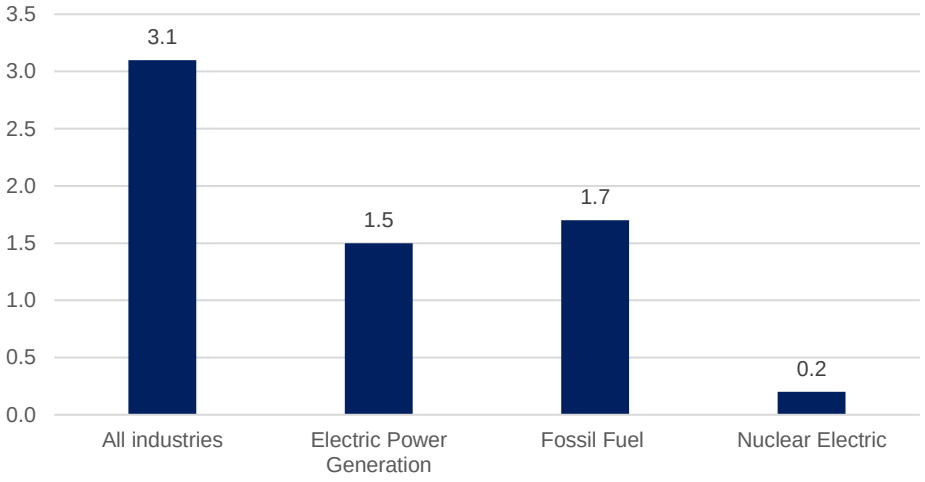


Source: American Community Survey, Oxford Economics

5.4 SAFETY CULTURE

The nuclear power industry is one of the safest industries compared the electric power generation industry and all industries overall. In fact, workers in the electric power generation industry overall are 7.5 times more likely to be injured or face illness while at work compared to the nuclear power generation industry.

Fig. 16. Incidence rates of nonfatal occupational injuries and illnesses, by industry, 2017[5]



Source: BLS Injuries, Illnesses, and Fatalities (IIF)

[5] The incidence rates represent the number of injuries and illnesses per 100 full-time workers.

6. CONCLUSION

The nuclear power generation has been and will continue to play an important role in the US economy. Not only does it provide 20 percent of the electricity needs in the US, but it also supports tens of thousands of well-paying jobs throughout the country. In total, the nuclear power generation industry employs nearly 48,400 workers in the US paying an average salary of $136,600 annually. This exceeds not only average regional wages across the country, but also exceeds the average wages paid in the broad electric power generation industry. The nuclear pay premium is greatest in the Great Lakes and Southeast states, and additionally, the industry provides locally sustaining jobs in each state with a nuclear power presence.

The roles identified in the nuclear power generation industry are indeed varied. With engineering occupations accounting for the largest share of the job functions, it's not surprising that in total, skilled occupations account for nearly 86 percent of total jobs in the industry. Other functions such as management analysts, nuclear technicians, and nuclear power reactor operators are just some of the other highly skilled occupations found within the industry.

The high wages paid in the nuclear power industry are reflective of the skills and training that employees obtain over the course of their careers. A majority of the workers employed in the industry have a college degree, and nearly a quarter of the employed workforce has served in the military. Given the relatively older workforce found in the nuclear power industry, colleges and the military provide excellent sources for the recruitment of highly skilled and knowledgeable workers for the nuclear power industry.

APPENDIX 1

DATA SOURCES

Bureau of Labor Statistics (BLS):

- QCEW – 2017 Annual Quarterly Census of Employment & Wages
- OES – May 2017 Occupational Employment Statistics

US Census Bureau (US Census):

- ACS – 2017 American Community Survey Public Use Microdata Sample (PUMS)

O*NET OnLine (O*NET):

- Job Zones

BUREAU OF ECONOMIC ANALYSIS REGIONS

BEA Regions and States		
New England Region	**Mideast Region**	**Southeast Region**
Connecticut	Delaware	Alabama
Maine	District of Columbia	Arkansas
Massachusetts	Maryland	Florida
New Hampshire	New Jersey	Georgia
Rhode Island	New York	Kentucky
Vermont	Pennsylvania	Louisiana
Great Lakes Region	**Plains Region**	Mississippi
Illinois	Iowa	North Carolina
Indiana	Kansas	South Carolina
Michigan	Minnesota	Tennessee
Ohio	Missouri	Virginia
Wisconsin	Nebraska	West Virginia
Rocky Mountain Region	North Dakota	**Far West Region**
Colorado	South Dakota	Alaska
Idaho	**Southwest Region**	California
Montana	Arizona	Hawaii
Utah	New Mexico	Nevada
Wyoming	Oklahoma	Oregon
	Texas	Washington

APPENDIX 2

AN OVERVIEW OF O*NET JOB ZONES

The O*NET program is the nation's primary source of occupational information. Central to the project is the O*NET database, containing information on hundreds of standardized and occupation-specific descriptors. The database is continually updated by surveying a broad range of workers from each occupation. The following provides a description of each respective Job Zone, ranging from One (lowest) to Five (highest).

Job Zone One: Little or No Preparation Needed

Education- Some of these occupations may require a high school diploma or GED certificate.

Related Experience- Little or no previous work-related skill, knowledge, or experience is needed for these occupations. For example, a person can become a waiter or waitress even if he/she has never worked before.

Job Training- Employees in these occupations need anywhere from a few days to a few months of training. Usually, an experienced worker could show you how to do the job.

Job Zone Examples- These occupations involve following instructions and helping others. Examples include taxi drivers, amusement and recreation attendants, counter and rental clerks, nonfarm animal caretakers, continuous mining machine operators, and waiters/waitresses.

Job Zone Two: Some Preparation Needed

Education- These occupations usually require a high school diploma.

Related Experience- Some previous work-related skill, knowledge, or experience is usually needed. For example, a teller would benefit from experience working directly with the public.

Job Training- Employees in these occupations need anywhere from a few months to one year of working with experienced employees. A recognized apprenticeship program may be associated with these occupations.

Job Zone Examples- These occupations often involve using your knowledge and skills to help others. Examples include sheet metal workers, forest fire fighters, customer service representatives, physical therapist aides, salespersons (retail), and tellers.

Job Zone Three: Medium Preparation Needed

Education- Most occupations in this zone require training in vocational schools, related on-the-job experience, or an associate's degree.

Related Experience- Previous work-related skill, knowledge, or experience is required for these occupations. For example, an electrician must have completed three or four years of apprenticeship or several years of vocational training, and often must have passed a licensing exam, in order to perform the job.

Job Training- Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers. A recognized apprenticeship program may be associated with these occupations.

Job Zone Examples- These occupations usually involve using communication and organizational skills to coordinate, supervise, manage, or train others to accomplish goals. Examples include food service managers, electricians, agricultural technicians, legal secretaries, occupational therapy assistants, and medical assistants.

Job Zone Four: Considerable Preparation Needed

Education- Most of these occupations require a four-year bachelor's degree, but some do not.

Related Experience- A considerable amount of work-related skill, knowledge, or experience is needed for these occupations. For example, an accountant must complete four years of college and work for several years in accounting to be considered qualified.

Job Training- Employees in these occupations usually need several years of work-related experience, on-the-job training, and/or vocational training.

Job Zone Examples- Many of these occupations involve coordinating, supervising, managing, or training others. Examples include accountants, sales managers, database administrators, teachers, chemists, art directors, and cost estimators.

Job Zone Five: Extensive Preparation Needed

Education- Most of these occupations require graduate school. For example, they may require a master's degree, and some require a Ph.D., M.D., or J.D. (law degree).

Related Experience- Extensive skill, knowledge, and experience are needed for these occupations. Many require more than five years of experience. For example, surgeons must complete four years of college and an additional five to seven years of specialized medical training to be able to do their job.

Job Training- Employees may need some on-the-job training, but most of these occupations assume that the person will already have the required skills, knowledge, work-related experience, and/or training.

Job Zone Examples- These occupations often involve coordinating, training, supervising, or managing the activities of others to accomplish goals. Very advanced communication and organizational skills are required. Examples include librarians, lawyers, sports medicine physicians, wildlife biologists, school psychologists, surgeons, treasurers, and controllers.

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