

SEATTLE'S ENERGY EFFICIENT BUILDING OPERATIONS AND CONSTRUCTION INDUSTRIES WORKFORCE REPORT



Elodie Marlet, PhD, and Kathleen Carson, PhD

Seattle Jobs Initiative | 1200 12th Ave St, Suite 160, Seattle, WA 98144

ACKNOWLEDGMENTS

The Seattle Jobs Initiative report on the Construction and Building Operations workforce in the Seattle area has been commissioned by Emerald Cities and Seattle City Light to assess this workforce's state.

EXECUTIVE SUMMARY

There has been a renewed emphasis on green and sustainable Construction and Building Operations activities at the state and local levels. With the new federal administration, there is also the prospect for significant investment in clean energy and related infrastructure. Strengthened regulations, investments in infrastructure, and more robust consumer demand for more sustainable buildings will continue to drive the demand for a well-trained Construction and Building Operations workforce. The COVID-19 recession has highlighted the need for educational pipelines that prepare an increasingly diverse population to meet the latest industry standards to reach state and municipal sustainability goals.

This report provides an overview of the most relevant occupations in the sustainable Construction and Building Operations sectors and the different training programs (college and non-college based) available for each occupation. Though the list of occupations is largely the same as that found in Seattle Jobs Initiative's (SJI) 2016 Clean Energy Workforce report,¹ we have made important updates. They are described in greater detail, along with statistics and projections about future employment.

“*The sectors continue to be overwhelmingly white and male.*”

Key findings:

- The sectors continue to be overwhelmingly white and male. While there have been some gains in diversity in specific occupations, overall, the industry is not diversifying as fast as the Seattle-Tacoma-Bellevue Metropolitan Statistical Area (Seattle MSA) population is.
- The COVID-19 recession has impacted Black, Indigenous, and people of color (BIPOC) working in the sectors more than white workers, reversing earlier gains in diversity in the industry.
- While the age of Construction and Trades workers has been a concern in years past, current data shows that a significant portion of students and current workers are well below retirement age. Those requiring more experience (such as Construction and Building Inspectors) skew slightly older. Those requiring a relatively new type of skills (such as Solar Photovoltaic Installers) skew younger.
- Energy-Related Construction trades have the highest baseline projected of the four sectors considered between now and 2024. Additional investment in clean energy and infrastructure adds between 0.3% and 0.7% to growth in that sector.
- There are multiple pathways for many of the occupations, including shorter-term training. These shorter-term training programs can be supported with on-ramp programs and wrap-around services for individuals who have been unemployed for six months or longer or face other barriers.
- Apprenticeship programs need to be expanded. Apprenticed occupations have a consistent undersupply, with strong projected growth, while programs have long waitlists.
- It is critical that apprenticeship programs rapidly diversify their recruitment and registration. Despite current efforts, registration of BIPOC apprentices remains well below the share of BIPOC in the Seattle MSA working-age population.
- Increasing women's participation in Construction and the Trades has been notoriously difficult. Both training programs and employers have a role to play. Training program coordinators have reported efforts to attract more students from target populations. However, they have long waitlists, which is a higher barrier to those same target populations. At the same time, employers must prioritize racial equity and inclusion and accommodate cultural differences and caretaking responsibilities

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Introduction

In the wake of the 2008 financial crisis, there was a great deal of hope that “green jobs” would emerge to simultaneously solve the employment crisis and the environmental crisis. Many policymakers understood green jobs would be newly emerging occupations. While some new occupations did develop, they have not transformed the labor market. They are not typically unionized and, consequently, have comparatively low wages with limited advancement opportunities. As such, many policymakers were disappointed with “green jobs” as a workforce development opportunity.

This framing of green jobs is counterproductive. It undermines the arguments that much of green infrastructure is both cost-effective and good for the economy in the near term and necessary for economic well-being in the medium and long terms. “Green jobs” is necessarily about transforming how existing occupations do their work. An example of the greening of existing jobs is carpenters using materials with a smaller environmental footprint and adopting methods that produce less waste to build buildings designed to operate more efficiently. Another is plumbers and electricians installing more efficient fixtures.

This report updates the work done by SJI in 2016¹ about the current state of and projections for Construction and Building Operations occupations in the Seattle-Tacoma-Bellevue Metropolitan Statistical Area (Seattle MSA, see Appendix A for map).^{*} This report begins with reassessing and recategorizing the list of occupations under consideration (see Appendix B for detailed descriptions of occupations). There are two categorizations: the occupational level and the occupational sector. For the occupational level, there are four categories of occupations (Table 1):

1. Engineering Professional
2. Managers
3. Journey Workers & Apprentices
4. Helpers

Table 1. Construction and Building Operations occupations by level

Occupational Level	
Engineering Professionals	Mechanical Engineers
	Environmental Engineering Technologists & Technicians
Managers & Supervisors	Construction Managers
	First-Line Supervisors of Construction Trades Workers
	First-Line Supervisors of Mechanics & Repairers
Journey Workers	Construction and Building Inspectors
	Electricians
	Plumbers, Pipefitters, & Steamfitters
	Sheet Metal Workers
	Boilermakers
	Heating, Air Conditioning, & Refrigeration Mechanics & Installers
	Solar Photovoltaic Installers
	Installation, Maintenance, & Repair Workers, All Other
	Maintenance & Repair Workers, General
	Stationary Engineers and Boiler Operators
	Electrical & Electronics Repairers, Commercial & Industrial Equip

^{*} The Seattle-Tacoma-Bellevue Metropolitan area corresponds to King, Pierce, and Snohomish counties. It is a single labor market with 95% or more of the counties’ workforce that lives within the MSA.²

Occupational Level	
Journey Workers	Electrical & Electronics Repairers, Powerhouse, Substation, & Relay Carpenters
	Construction Laborers
	Insulation Workers, Floor, Ceiling, & Wall
	Miscellaneous Construction & Related Workers
Helpers	Helpers—Electricians
	Helpers—Pipelayers, Plumbers, Pipefitters, & Steamfitters
	Helpers—Installation, Maintenance, & Repair Workers
	Helpers—Carpenters

For the occupational sector, there are also four categories (Table 2):

1. Managers & Engineers
2. Building Operations
3. Energy-Related Construction
4. General Construction

Table 2. Construction and Building Operations occupations by sector

Occupational Sector	
Building Operations	Maintenance & Repair Workers, General
	Stationary Engineers and Boiler Operators
	Electrical & Electronics Repairers, Commercial & Industrial Equipment
	Electrical & Electronics Repairers, Powerhouse, Substation, & Relay
	First-Line Supervisors of Mechanics & Repairers
	Helpers—Installation, Maintenance, & Repair Workers
Energy-Related Construction	Electricians
	Plumbers, Pipefitters, & Steamfitters
	Sheet Metal Workers
	Boilermakers
	Heating, Air Conditioning, & Refrigeration Mechanics & Installers
	Solar Photovoltaic Installers
	Helpers—Electricians
	Helpers—Pipelayers, Plumbers, Pipefitters, & Steamfitters
	Installation, Maintenance, & Repair Workers, All Other
General Construction	Carpenters
	Construction Laborers
	Insulation Workers, Floor, Ceiling, & Wall
	Miscellaneous Construction & Related Workers
	First-Line Supervisors of Construction Trades Workers
	Helpers—Carpenters
Managers & Engineers	Construction Managers
	Construction and Building Inspectors
	Mechanical Engineers
	Environmental Engineering Technologists & Technicians

The occupations within these categories were selected because a shift to clean energy and increased environmental standards will most likely impact their work and overall employment level. There are twenty-five occupations across these five categories. Only two typically require a bachelor’s degree. An additional nine require an apprenticeship (4) or long-term on-the-job training (5). These occupations also make up almost 3% of the Seattle MSA’s gross regional product (GRP) with the General Construction occupations producing the largest output (see Appendix C for more discussion of GRP).

Table 3. Gross regional product (GRP) by occupational sector³

Occupational Sector	Occupational Sector GRP	Occupational Sector GRP as % of Seattle-MSA GRP	Jobs in 2020
Managers & Engineers	\$1,915,631,693	0.5%	14,583
Energy-Related Construction	\$2,540,768,536	0.7%	28,150
Building Operations	\$2,584,589,382	0.7%	33,002
General Construction	\$4,192,068,261	1.1%	55,009

The primary questions addressed in this report are:

1. What is the current sectoral employment?
2. Who is employed in those jobs?
3. Are these currently “good jobs”?
4. What is the projected employment for these occupations given today’s baseline, and if proposed policies are implemented?
5. What does the training pipeline look like? And what is needed to support and increase diversity and representation in these training pipelines?

To answer these questions, we have drawn quantitative data from Emsi,³ the American Community Survey,^{4,5} Current Population Survey,⁶ Washington State Department of Labor and Industry,^{7,8} and the City of Seattle.⁹ We also held a focus group with training program coordinators (see Appendix D: List of Stakeholders and Appendix E: Data and Methodology for information).

Current Workforce

Race & Ethnicity

The Construction and Building Operations sectors employ 130,000 people in the Seattle MSA.³ The industry is historically male and white, and, nationally, many of the trades have been struggling to attract younger workers. Unions, apprenticeship programs, and other training programs have committed to diversifying the sectors in terms of race and gender and have sought to attract younger workers. There is a great deal of variability in both the representation of racial groups across occupational levels, occupational sectors, and specific occupations. The rate of change also varies widely.

In the following sections, there are charts of the distribution of workers’ race in each occupation with the racial distribution of Seattle MSA’s working-age population (ages 19-64 years) and the population entering the workforce (ages 19-22 years) for references. The Latinx category includes Latinx workers of all races, while the other racial categories are non-Hispanic/Latinx (See Appendix F for detailed data tables).

Occupation Level

All occupational levels except helpers are at least 70% white³ (Figure 1, Seattle MSA’s working-age population is 63% white⁵). Overall, Latinx workers are overrepresented in the Construction and Building Operations workforce, accounting for 13% of the total workforce while representing only 10% of the Seattle

MSA’s working-age population. However, Latinx workers are underrepresented in engineering professional and managers and supervisor occupations. They are overrepresented in journey workers (15%) and especially helper occupations (22%). Asian workers are overrepresented in engineering professional occupations (17% vs. 15%). All other BIPOC workers are underrepresented in all occupational levels.^{3,4}

Occupational Level by Race & Ethnicity
Seattle MSA, 2020

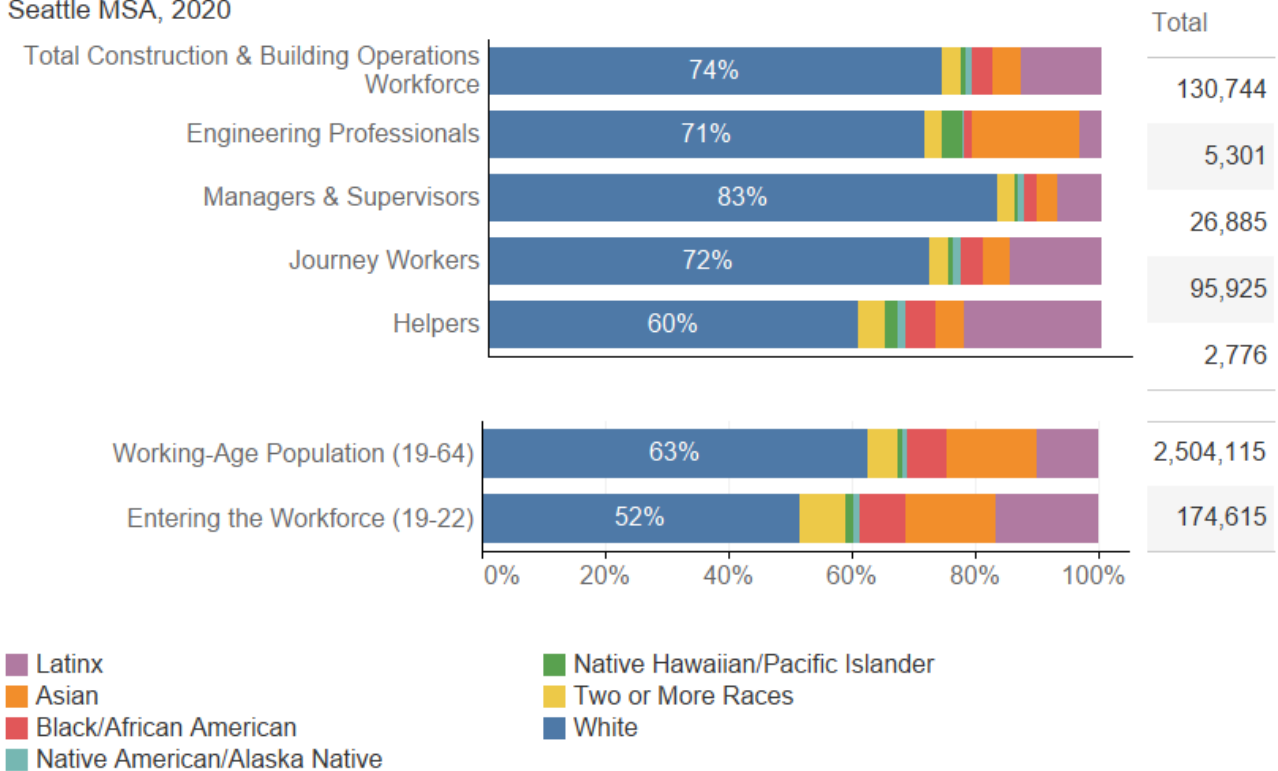


Figure 1. Occupational level by race^{3,4}

Table 4. Occupational level by race³

	Latinx	Asian	Black/African American	Native American/Alaska Native	Native Hawaiian/Pacific Islander	Two or More Races	White
Total Construction & Building Operations Workforce	13%	5%	3%	1%	1%	3%	74%
Engineering Professionals	4%	17%	1%	0%	3%	3%	71%
Managers & Supervisors	7%	3%	2%	1%	1%	3%	83%
Journey Workers	15%	4%	4%	1%	1%	3%	72%
Helpers	22%	5%	5%	1%	2%	4%	60%
Working-Age Population (19-64 years old)	10%	15%	6%	1%	1%	5%	63%
Entering the Workforce (19-22 years old)	16%	15%	7%	1%	1%	7%	52%

When compared to 2014, the Construction and Building Operations workforce has become less diverse overall. The percent of white workers has increased in occupational every level except Engineers Professionals (Figure 2). While the proportion of white workers in Helper occupations increased the most, this also accounts for the fewest workers and with the lowest barriers to entry and exit. It is the 5% increase among managers and supervisors is the most concerning both for the total number of workers this reflect and also because the lack of representation among managers and supervisors is reproduced throughout the sector's workforce and managers and supervisors tend to hire and promote people who resemble them.¹⁰

Percent White by Occupational Level in the Seattle MSA

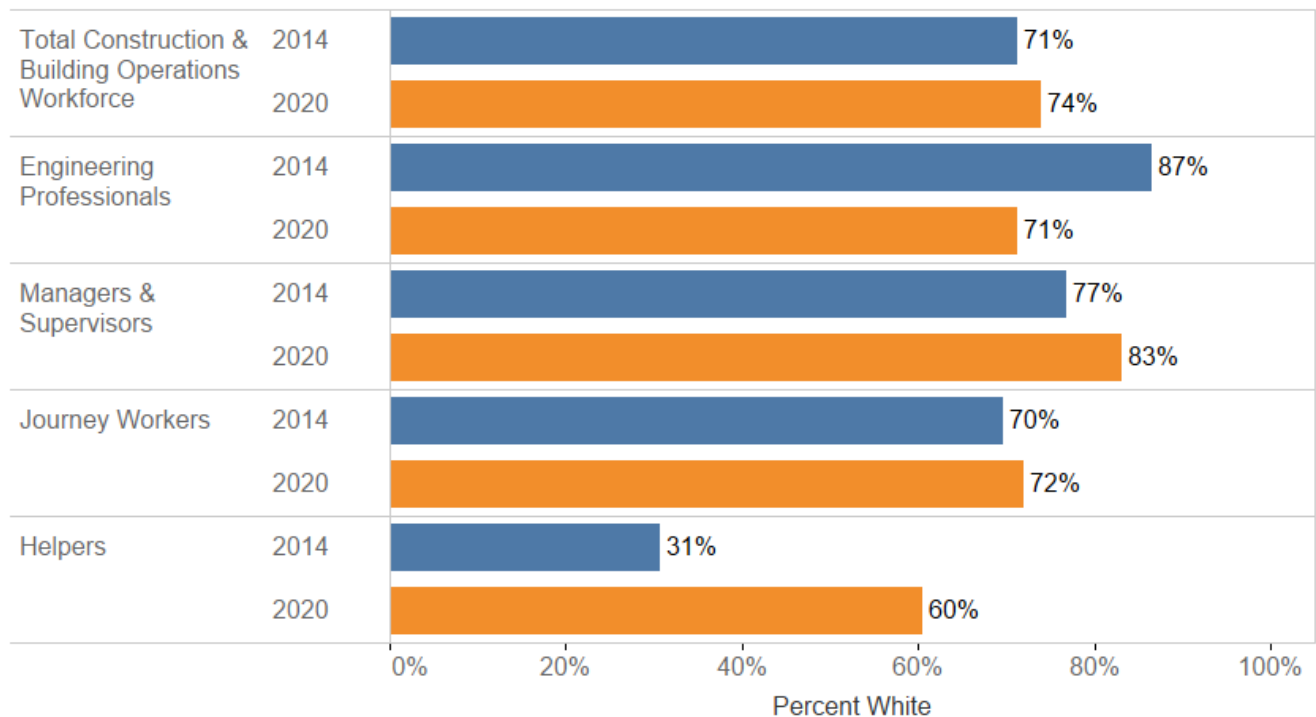


Figure 2. Percent white of occupational levels, 2014 and 2020^{3,5}

Engineering Professionals

Both Mechanical Engineers and Environmental Engineering Technicians and Technologists are substantially less diverse than both the Seattle MSA working-age population and the population entering the workforce (Figure 3).

Race: Engineering Professionals
Seattle MSA, 2020

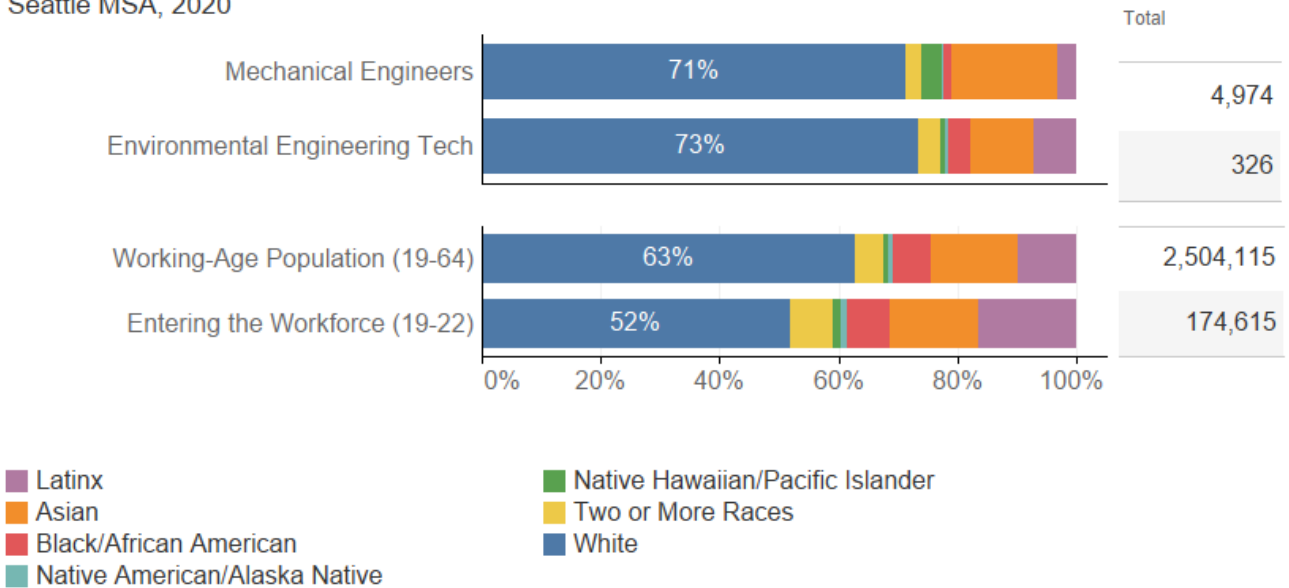


Figure 3. Engineering professional occupations by race^{3,5}

This is despite the Engineering Professional occupational category substantially increasing in diversity between 2014 and 2020 (Table 5). Even with this increase in diversity, Mechanical Engineers will never reach representation of the Seattle MSA’s demographics at the current rate.^{1,3}

SOC	Occupation	Total Number of Workers (2020)	Diversity 2007-2020	Representative of the Seattle MSA*
17-2141	Mechanical Engineers	4,974	↗	No

Table 5. Diversity of Engineering Professionals³

Managers & Supervisors

First-Line Supervisors and Construction Managers are so disproportionately white and similarly so (Figure 4). Construction Managers are the least diverse group. However, the difference between the three occupations is dwarfed by the difference between the distribution of race of the workers and the Seattle MSA’s working-age population.

* Linear trends were calculated based on percent white of each occupation from 2007 to 2020 and for the Seattle MSA from 2001 to 2020. Consistent data was not available for data not included in the 2016 report, trends for these occupations were not calculated, and occupations with fewer than 1,500 workers are not shown here. See Appendix F for more detail.

Race: Managers & Supervisors
Seattle MSA, 2020

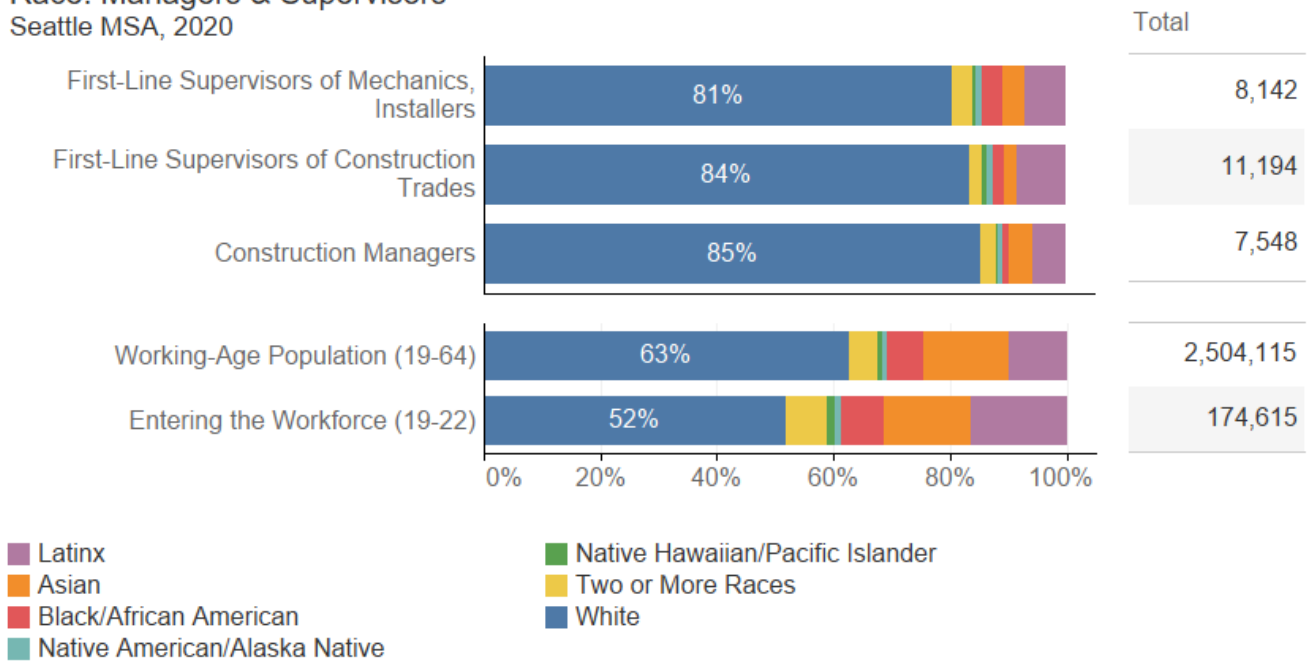


Figure 4. Manager and supervisor occupations by race^{3,5}

In the Managers and Supervisors category, there are differing trends for diversity (Table 6). Construction Managers have become more diverse, with most non-white racial categories increasing, if slightly, their share of jobs in this occupation. However, the Seattle MSA is increasing in diversity faster than construction managers. This occupation is not on track to be representative of the metropolitan area.^{1,5,8} At the same time, first-line supervisor occupations have become less diverse.^{1,3,5}

Table 6. Diversity of Managers and Supervisors³

SOC	Occupation	Total Number of Workers (2020)	Diversity 2007-2020	Representative of the Seattle MSA*
47-1011	First-Line Supervisors of Construction Workers	11,194	↘	NA
49-1011	First-Line Supervisors of Mechanics, Installers	8,142	↘	NA
11-9021	Construction Managers	7,548	↗	No

This, combined with first-line supervisors declining in diversity and construction managers' too-gradual increase, is concerning and not only for these occupations themselves. The lack of diversity impacts the occupations they supervise, as a lack of representation among managers and supervisors trickles down. White managers and supervisors hire and promote fewer BIPOC workers than BIPOC managers and supervisors.^{10,11}

* Linear trends were calculated based on percent white of each occupation for select years from 2007 to 2020 and for the Seattle MSA for select years from 2001 to 2020. Consistent data was not available for occupations not included in the 2016 report and trends were not calculated for those occupations.

“ White managers and supervisors hire and promote fewer BIPOC workers than BIPOC managers and supervisors. ”

Journey Workers

Journey workers, as seen below in Figure 5, are the largest group of workers and the second most diverse among the four levels. The largest occupation, construction laborers, is approximately representative of the MSA. However, other large occupations, like carpenters, maintenance workers, and electricians, are not representative of the Seattle MSA’s working-age population.



Race: Journey Workers
Seattle MSA, 2020

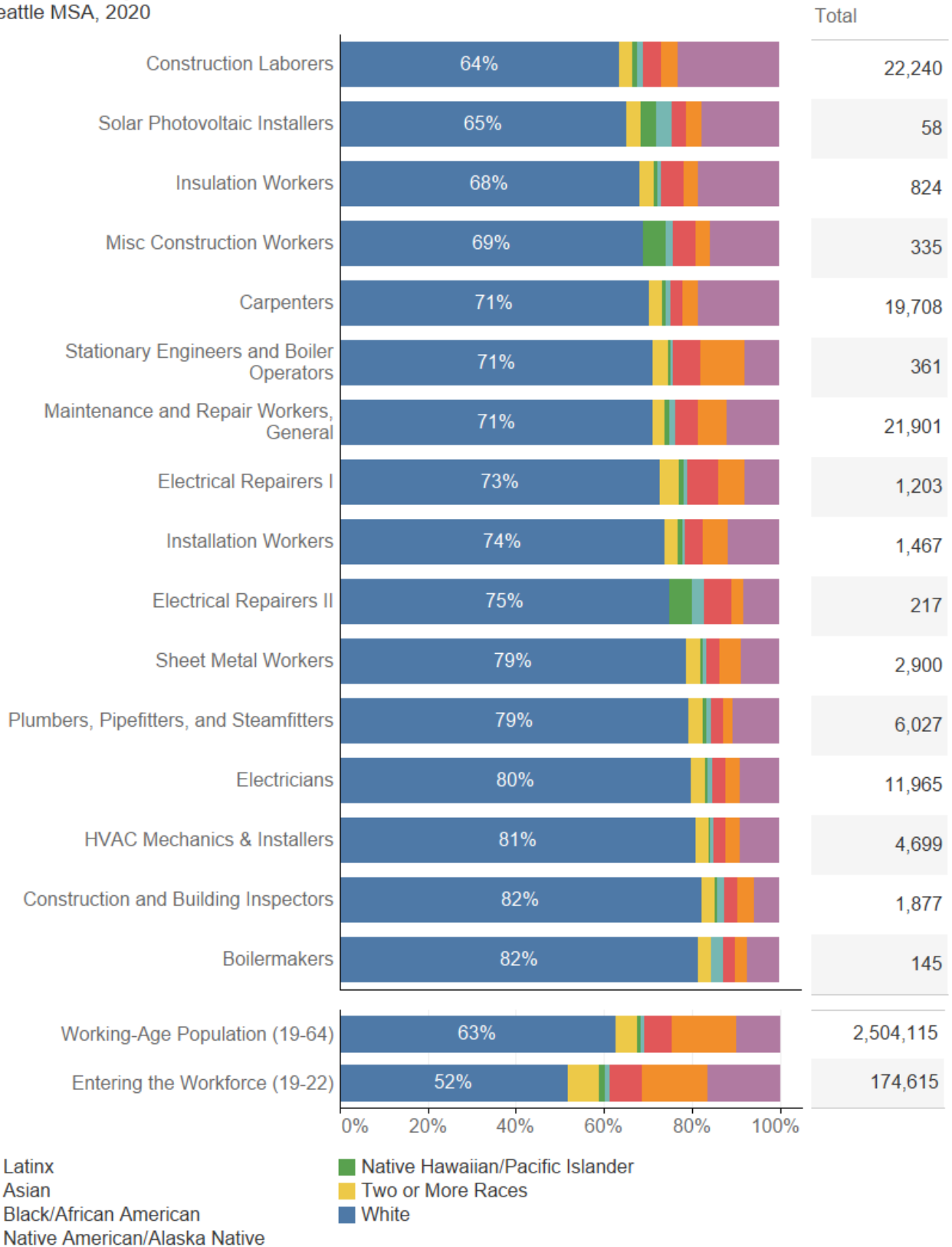


Figure 5. Journey worker occupations by race^{3,5}

There is no consistent trend in diversity across the occupations at the journey worker level (Table 7). After construction workers, the next two largest occupations, maintenance workers and carpenters, increased their diversity. However, the electricians, already among the least diverse journey worker occupations, have stayed flat while plumbers, pipefitters, and steamfitters have declined in diversity. Finally, of those occupations trending more diverse, only construction and building inspectors increased their diversity and are also on track to reach representation (although not until the 2050s).

Table 7. Diversity of Journey Workers³

SOC	Occupation	Total Number of Workers (2020)	Diversity 2007-2020	Representative of the Seattle MSA*
47-2061	Construction Laborers	22,240	=	Yes
49-9071	Maintenance and Repair Workers, General	21,901	↗	No
47-2031	Carpenters	19,708	↗	No
47-2111	Electricians	11,965	=	No
47-2152	Plumbers, Pipefitters, and Steamfitters	6,027	↘	No
49-9021	HVAC Mechanics & Installers	4,699	=	No
47-2211	Sheet Metal Workers	2,900	↗	No
47-4011	Construction and Building Inspectors	1,877	↗	By 2060

Apprenticeships

The patterns in the previous section raise the question about what the journey worker training pipeline is. There are apprenticeships for Building Operations, General Construction, and Energy-Related Construction occupations. For General Construction and Energy-Related Construction, the apprenticeship pathway is how workers enter the occupation. These two sectors have large apprenticeship programs, most located in King County (Figure 32). These programs served 12,547 apprentices in the last five years.

In contrast, the Building Operations occupations have more varied pathways, and the apprenticeships programs are small and dispersed throughout the metropolitan area. There have been fewer than 50 registered apprentices for each occupation over the last five years (Table 8). This limited capacity may be difficult to expand. The most viable pathways may continue to be through Associate of Applied Science (AAS) degree programs at community and technical colleges.

* Linear trends were calculated based on percent white of each occupation for select years from 2007 to 2020 and the for the Seattle MSA for select years from 2001 to 2020. Consistent data was not available for occupations not included in the 2016 report and trends for these occupations were not calculated. Occupations with fewer than 1,500 workers are not shown here. See Appendix F for more detail.

Table 8. Number of registered apprenticeships^{7,8}

Sector	Occupation	Number of Programs	Number of Registered Apprentices (2016-2021)
Energy-Related Construction	Electricians	7	3,289
	Plumbers, Pipefitters, & Steamfitters	4	1,140
	Sheet Metal Workers	2	1,040
	Heating, Air Conditioning, & Refrigeration Mechanics & Installers	4	282
	Boilermakers	1	45
Building Operations	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	7	46
	Stationary Engineers & Boiler Operators	2	35
	Maintenance and Repair Workers, General	1	16
	Electrical and Electronics Repairers, Commercial and Industrial Equipment	1	11
General Construction	Carpenters	2	3,300
	Construction Laborers	3	3,209
	Insulation Workers, Floor, Ceiling, and Wall	1	190
	Construction and Related Workers, All Other	1	52
Total		37	12,655

A group of apprenticeship coordinators participated in a focus group exploring the current state of their programs. They indicated that the demand for apprenticeship opportunities is high and has been for many years. They maintain long waitlists and individuals often wait six months to two years to enter an apprenticeship.

Program coordinators also indicated that the programs that have the capacity to recruit are seeking a more diverse candidate pool. However, not all programs have the capacity to recruit and have no need to recruit to fill their seats.

The coordinators who are recruiting asked BIPOC apprentices and journey workers and women apprentices and journey workers to go to recruiting events and carry recruiting materials with them. They have also discovered that it is a self-reinforcing trend: the more diverse the workplace is, the more diverse it becomes. **BIPOC workers recruit and serve as pathbreakers for family members and communities.** Some program coordinators also recruit individuals with a history of involvement in the criminal justice system, emphasizing that it does not need to be a barrier.

Apprenticeship coordinators also find that their apprentices are starting their programs slightly older than they would have done traditionally. They report that the most successful apprentices have entered the workforce or gone to college before applying to an apprenticeship in their late 20s. This may reflect renewed interest in trades and postsecondary training opportunities driven in part by the cost of a four-year degree. However, the long waitlists to register as an apprentice may contribute to younger workers' attrition.

“BIPOC workers recruit and serve as pathbreakers for family members and communities.”

Location of Apprenticeship Programs
 Number of apprentices (2016-2021)

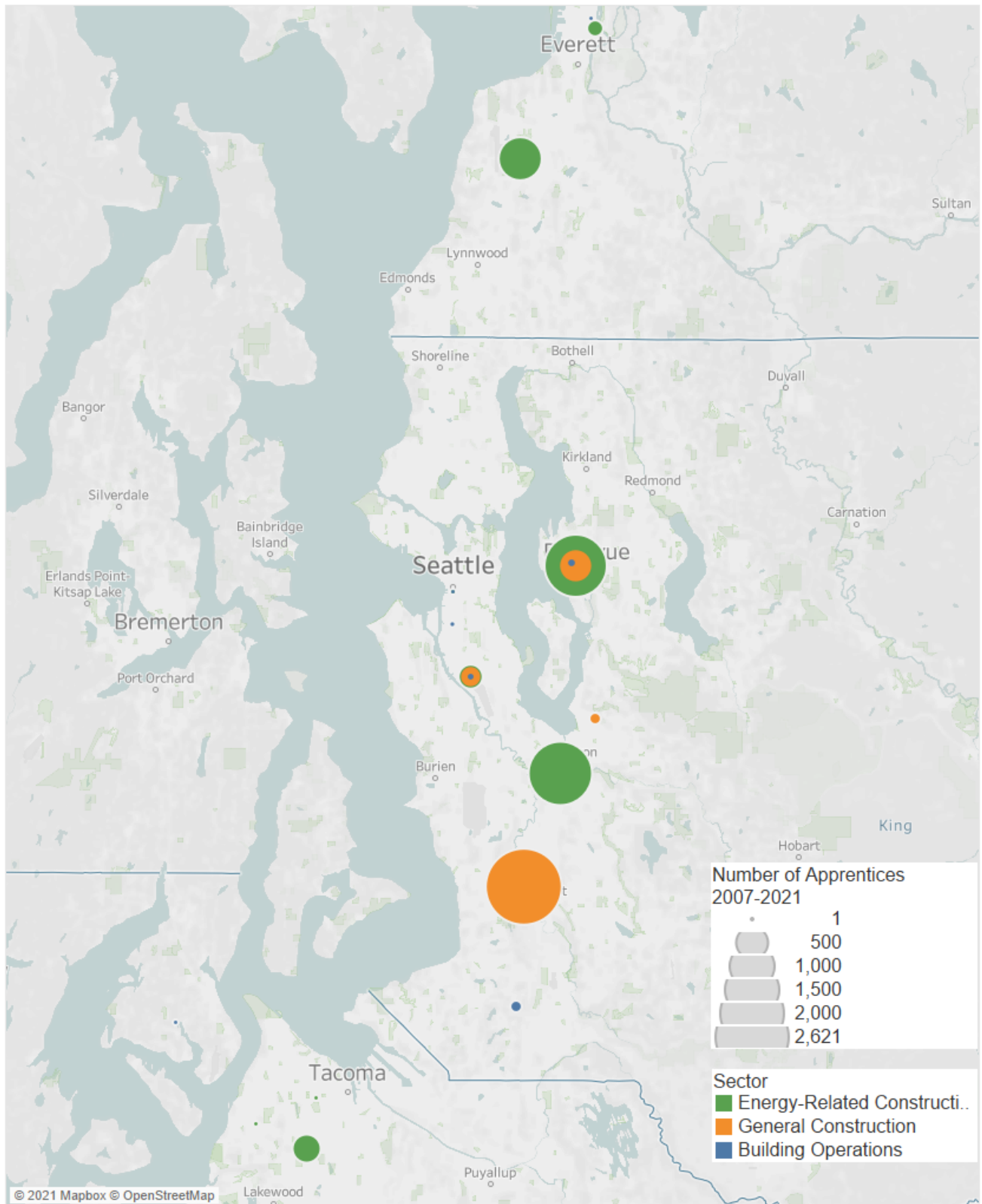


Figure 6. Number of apprenticeship programs by occupation and sector⁷

It may also contribute to the lack of diversity in registered apprentices. Despite some apprenticeship programs' efforts to attract more BIPOC apprentices, the registration patterns across apprenticeships do not show a dramatic increase in the percent or number of BIPOC apprentices. In General Construction apprenticeships, the percent of BIPOC apprentices had increased from 32% in 2016 to 37% in 2019 before ticking back down to 36% in 2020. The percent of BIPOC apprentices registered has increased across relevant apprentices from 17% in 2017 to 23% in 2020.⁸ However, except for General Construction apprenticeships in 2019 (37% BIPOC), apprenticeships have registered a smaller share than the 37% BIPOC of the Seattle MSA working-age population and the 48% BIPOC of those newly entering the working-age (19-21 years).⁵ This means that these sectors are not on track to represent Seattle MSA's current workforce and even less so of Seattle MSA's future workforce (Figures 33 and 34).

Race: General Construction Apprenticeship
2016-2020

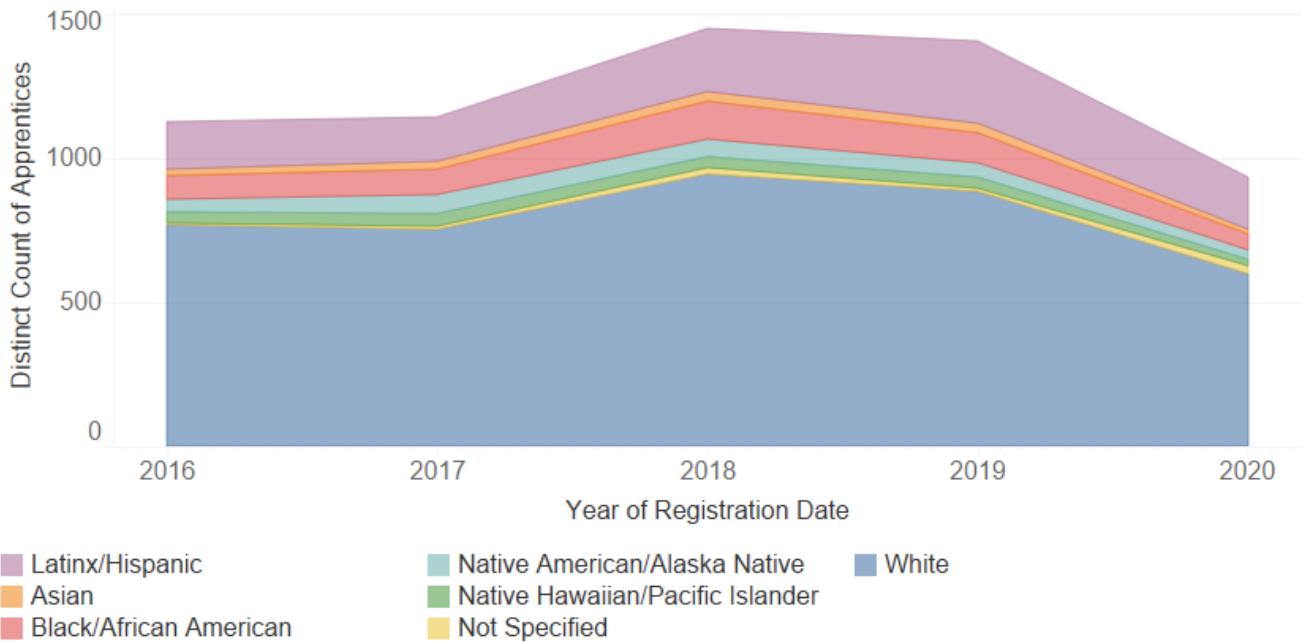


Figure 7. General Construction apprenticeship registration by race⁸

Race: Energy-Related Construction
2016-2020

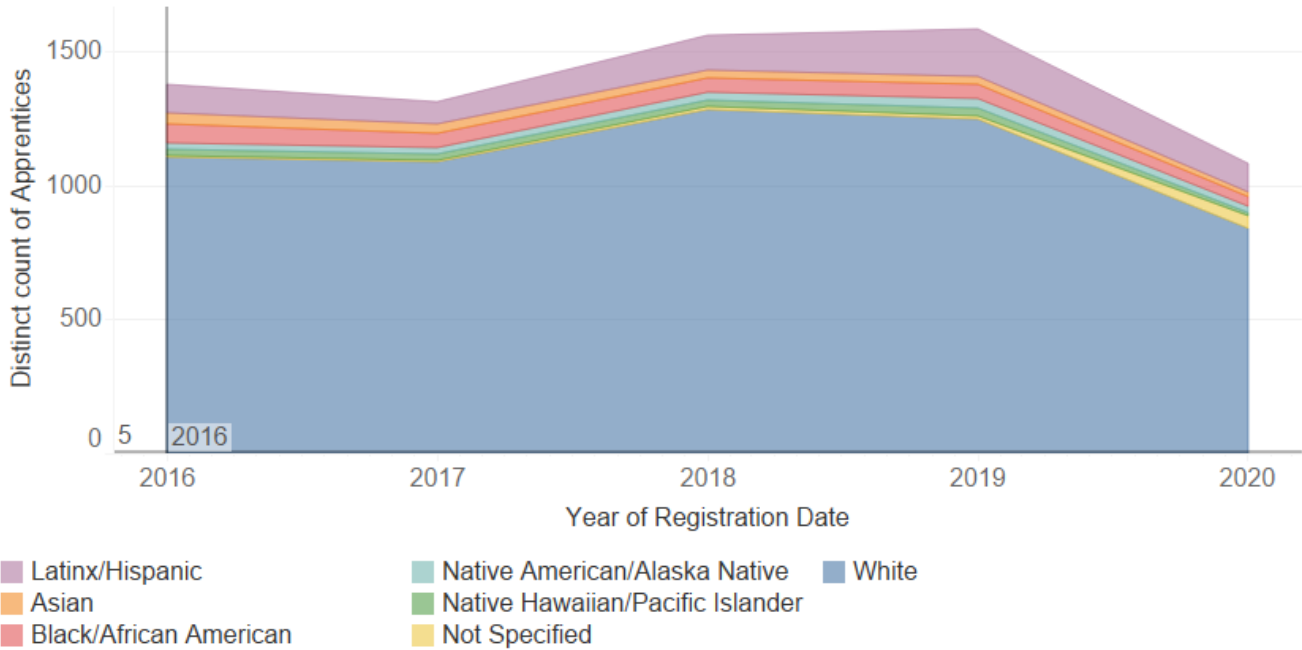


Figure 8. Energy-Related Construction apprenticeship registration by race⁸

In particular, the largest apprenticeships: electricians, carpenters, and plumbers, pipefitters, and steamfitters, have not registered BIPOC apprentices in proportion to the working-age population or the population newly entering the workforce (33%). Among General Construction and Energy-Related Construction trade apprentices, only insulation workers, construction laborers, other construction workers have registered BIPOC apprentices at percentages at or above their representation in the working-age population over the last five years (Figures 35 and 36).

**Race: General Construction Apprenticeships
(2016-2020)**

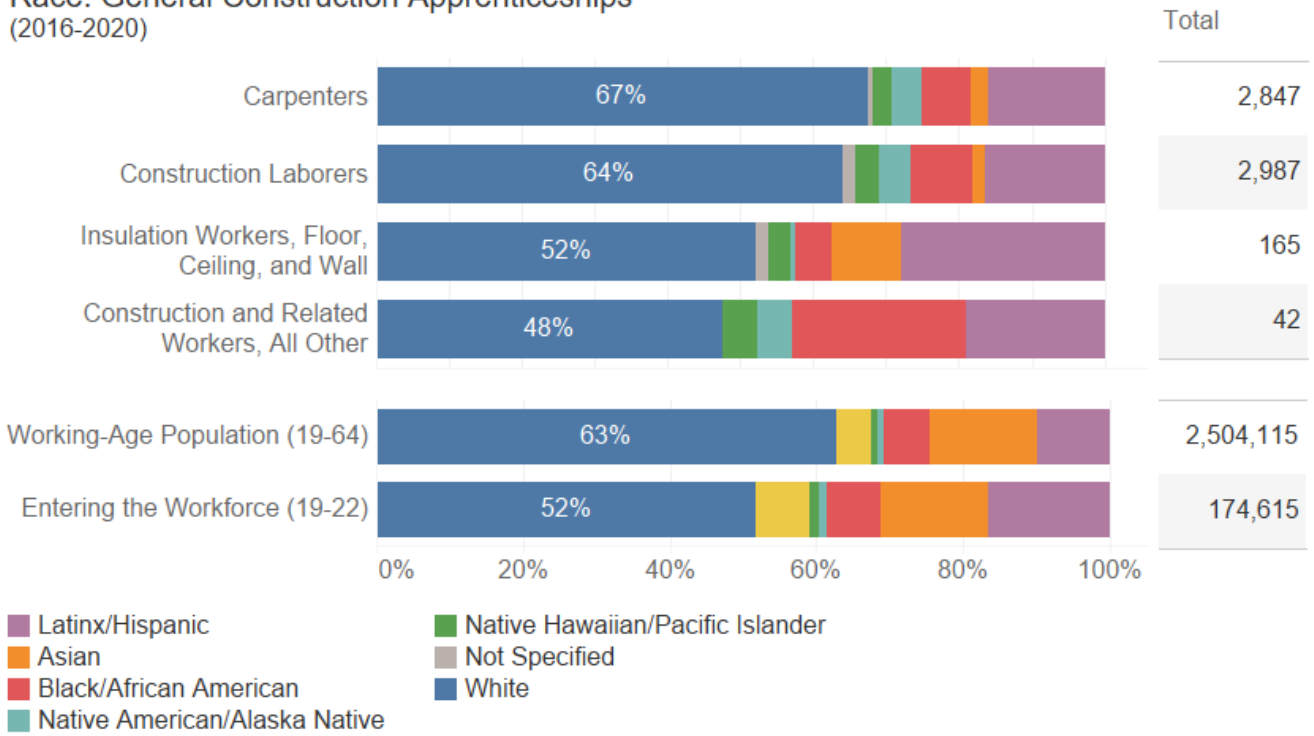


Figure 9. The distribution of General Construction apprentices' race, 2016-2020⁸



Race: Energy-Related Construction Apprenticeships (2016-2020)

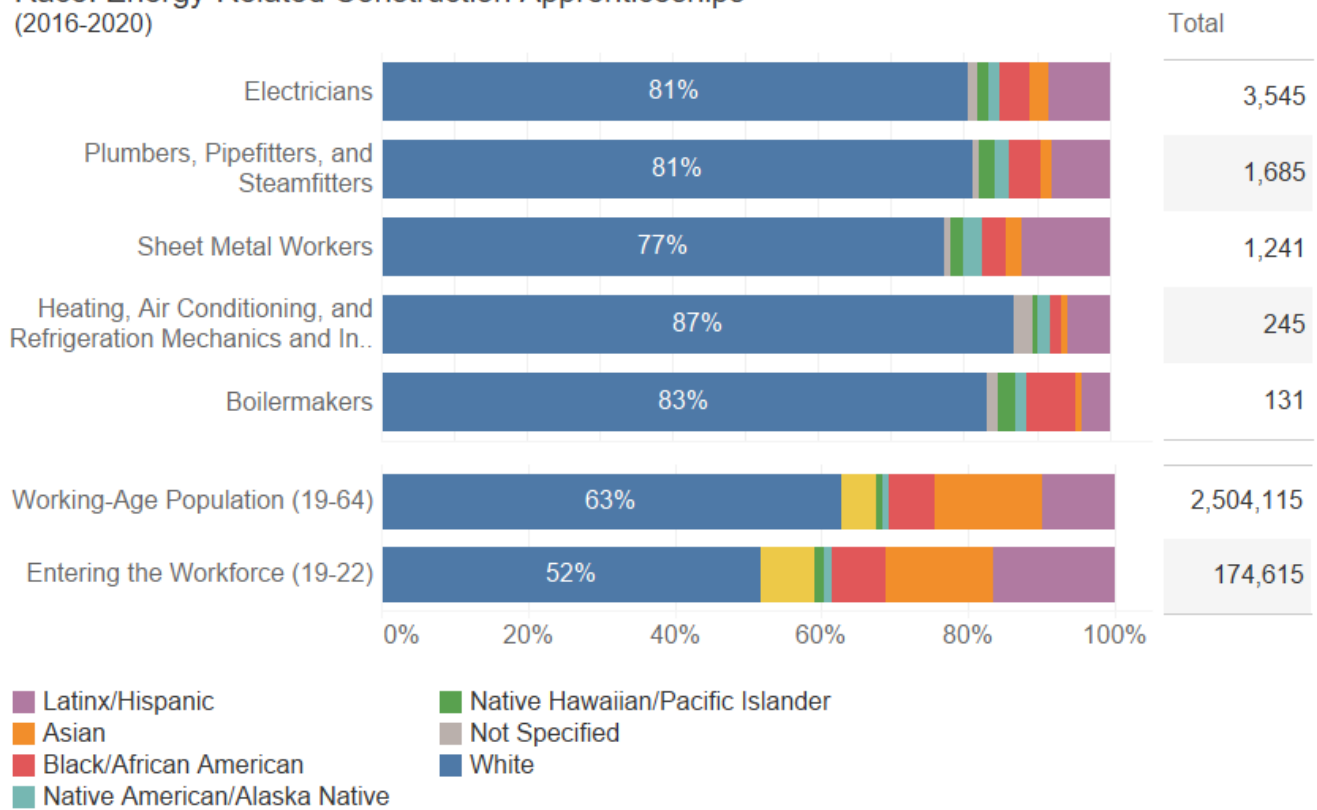


Figure 10. The distribution of Energy-Related Construction apprentices' race 2016-2020⁸

Helpers

Helpers are occupations that support the skilled trades. These workers do work that requires less skill but are related to the skilled trades' work, particularly handling materials, cleaning and preparing the work area, and performing basic maintenance on tools and equipment. The helper category is very diverse, with white workers' share of helper jobs being less than their share of the working-age population in all occupations (Figure 11). However, they are also becoming less diverse. This is concerning as helpers are often waiting for an opportunity to enter an apprenticeship.^{1,3,5}

This swing is possible thanks to two factors. First, Carpenter Helpers (708), Electrician Helpers (418), and Plumber Helpers (471) are relatively small occupations. Second, these are very accessible jobs, requiring no formal education or only a high school diploma and no postsecondary training. Thus, workers can move both in and out of these occupations. However, **helper jobs are an opportunity for people who want to enter journey occupations to gain skills and experience while waiting to be accepted into a formal apprenticeship.** These occupations becoming less diverse may correspond to a less diverse applicant pool for apprentices for those occupations.

“... helper jobs are an opportunity for people who want to enter journey occupations to gain skills and experience while waiting to be accepted into a formal apprenticeship.”

Race: Helpers
Seattle MSA, 2020

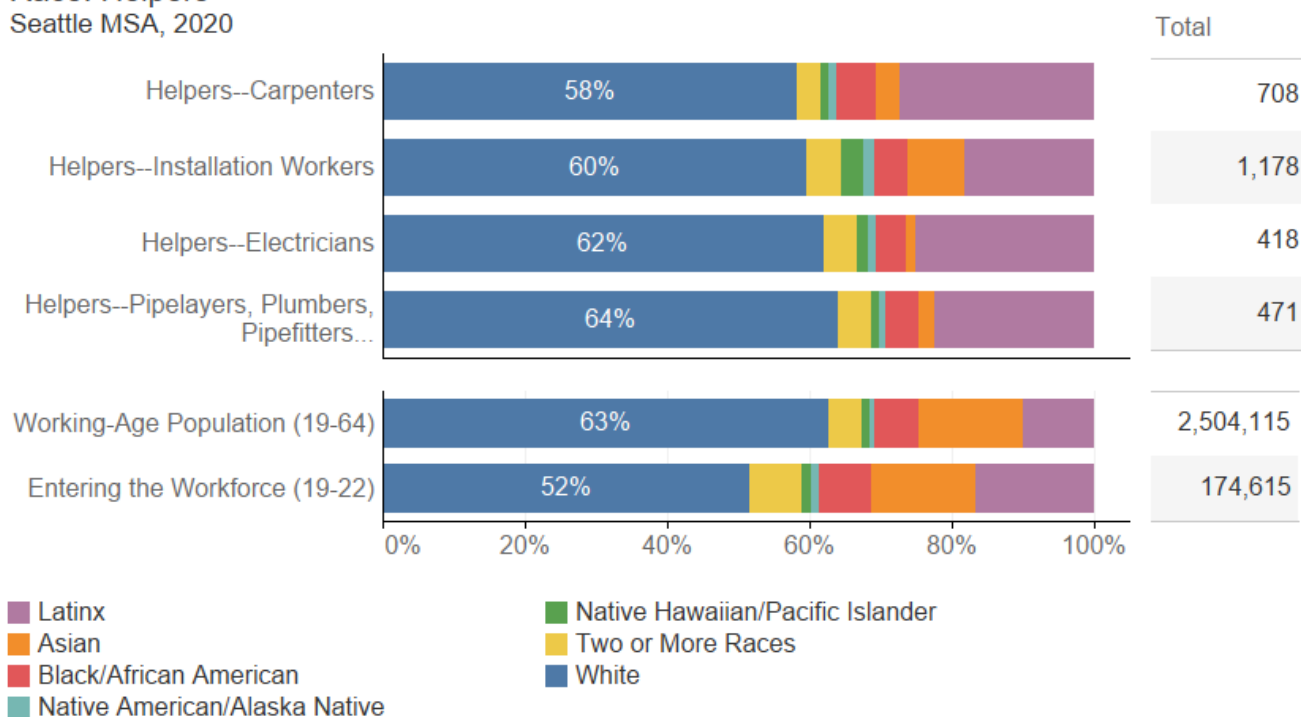


Figure 11. Helper occupations by race^{3,5}

Occupational Sectors

While the trends in racial demographics by occupational level highlight the persistent barriers in these sectors to racial equity based on how accessible education and training are, examining the racial demographics within each sector offers more insight into how this plays out in the day-to-day working environment. The sector demographics reveal a more concerning trend: the proportion of white workers in all sectors is substantially more than the Seattle MSA’s working-age population (Figure 12, Table 9). Energy-related construction Managers and Engineers are particularly skewed though they also account for the Construction and Building Operations workforce’s fewest workers.

Occupational Sector by Race & Ethnicity
Seattle MSA, 2020

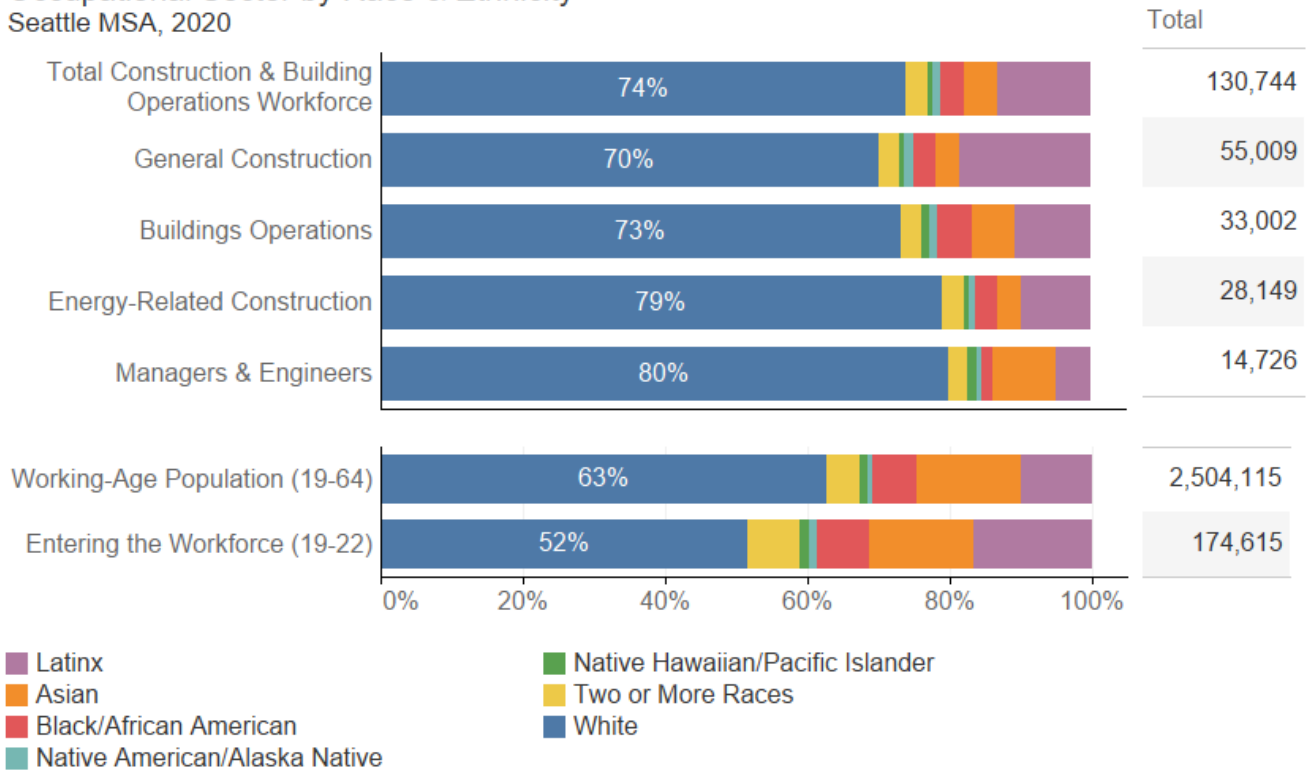


Figure 12. Occupational sector by race^{3,5}

Table 9. Occupational sector by race³

	Latinx	Asian	Black/ African American	Native American/ Alaska Native	Native Hawaiian/ Pacific Islander	Two or More Races	White
Total Construction & Building Operations Workforce	13%	5%	3%	1%	1%	3%	74%
General Construction	18%	3%	3%	1%	1%	3%	70%
Buildings Operations	11%	6%	5%	1%	1%	3%	73%
Energy-Related Construction	10%	3%	3%	1%	1%	3%	79%
Managers & Engineers	5%	9%	2%	1%	1%	3%	80%
Population Entering the Workforce (19-22 years old)	16%	15%	7%	1%	1%	7%	52%
Seattle Working-Age Population (19-64 years old)	10%	15%	6%	1%	1%	5%	63%

Even more concerning than the current distribution of racial demographics in each sector is the fact that all sectors except Managers and Engineers lost diversity between 2014 and 2020 (Figure 13). None are representative, but all are less so than they were in 2020. **Energy-Related Construction and Building Operations saw the largest declines by percentage.**^{1,3,5}

Percent White by Occupational Sector in the Seattle MSA

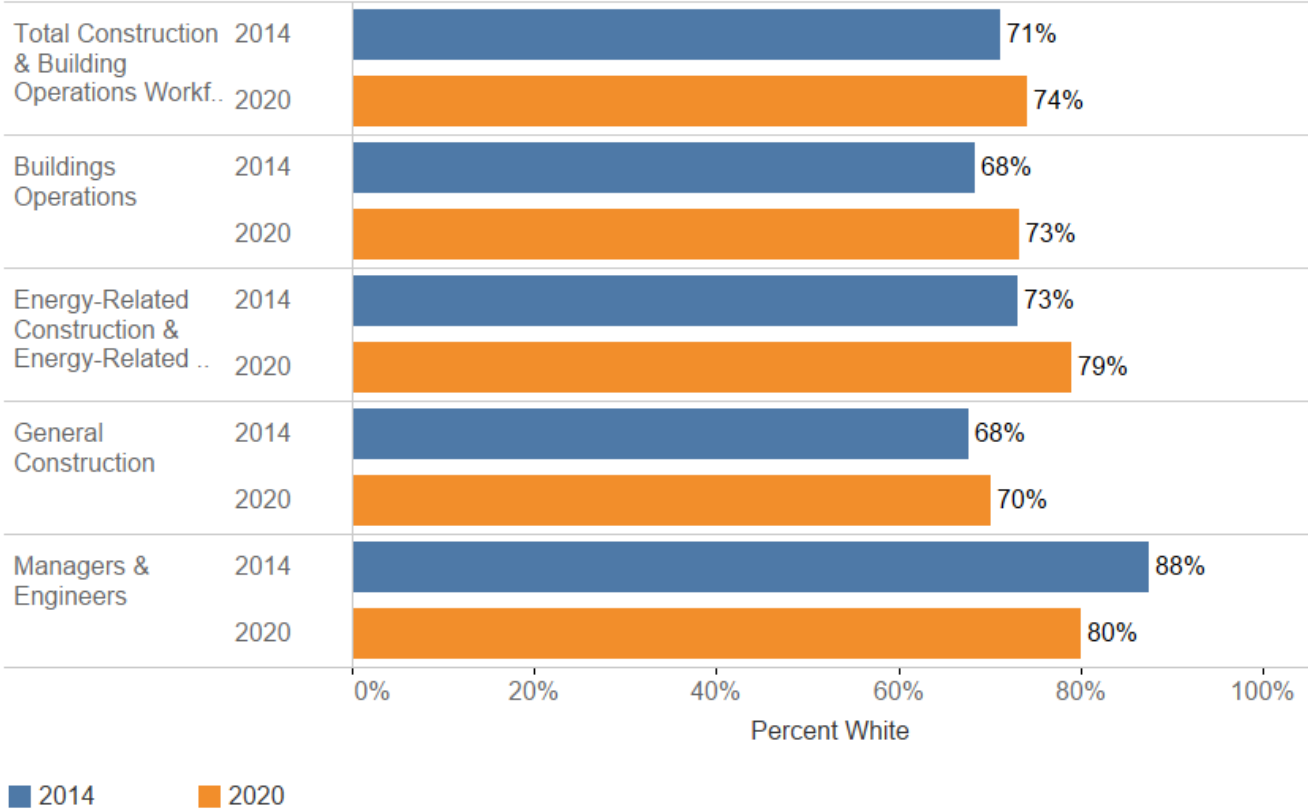


Figure 13. Percent white of occupational sectors, 2014 to 2020^{3,5}

Building Operations

Building Operations accounted for 34,406 jobs in 2020. Of the occupations in this sector, only Installation Helpers’ proportion of white workers is less than the Seattle MSA’s working-age population. In fact, all non-white race categories except Asian are overrepresented in this sector. The remaining occupations are disproportionately white (Figure 14).

Race: Building Operations
Seattle MSA, 2020

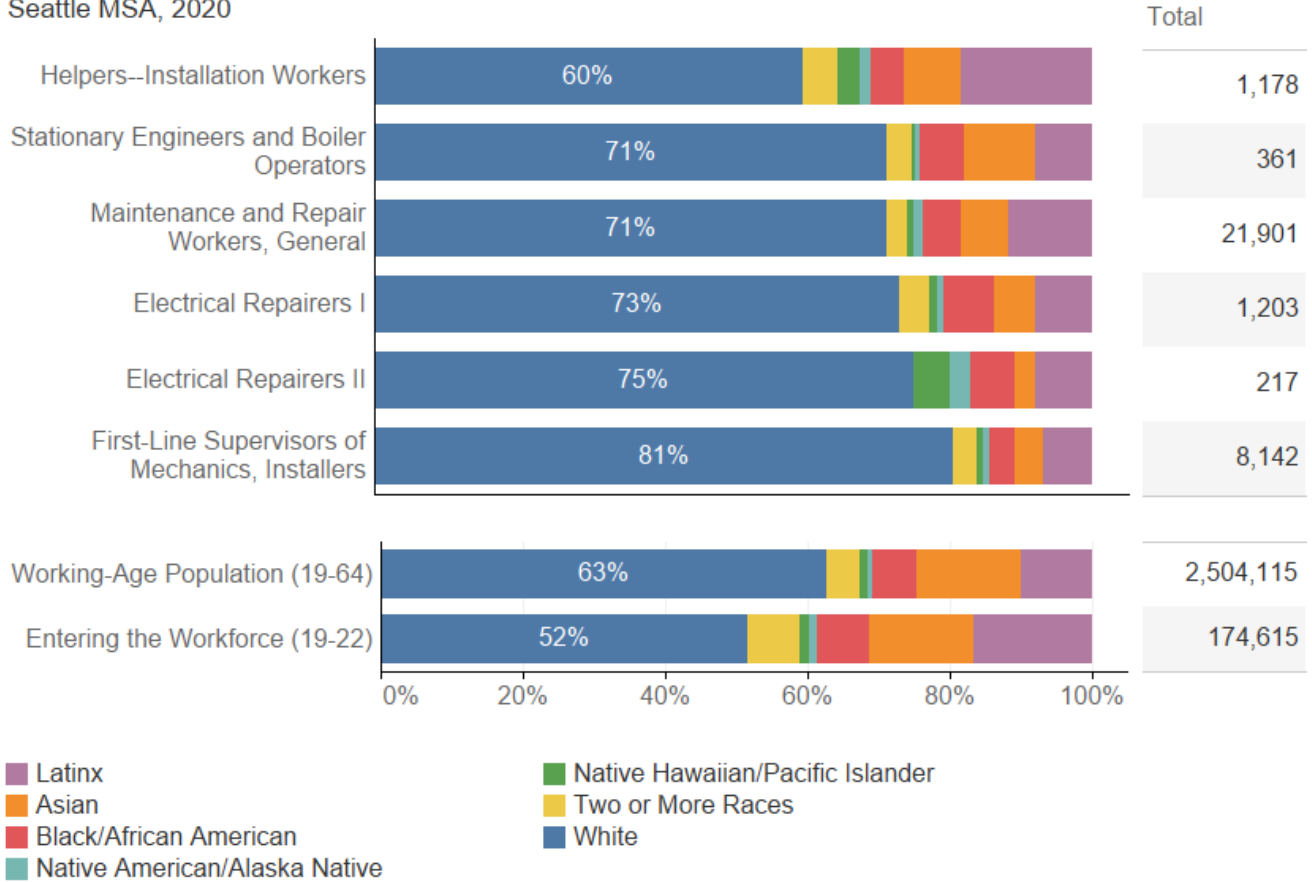


Figure 14. Building Operations occupations by race^{3,5}

Overall, Building Operations saw a decline in diversity between 2014 and 2020. The sector’s largest occupation, Maintenance and Repair Workers (21,901 jobs), had been steadily gaining in representation of BIPOC workers but it sharply reversed between 2014 and 2020 (Table 10). First-Line Supervisors (8,142 jobs) also saw a decline in diversity.^{1,3,5}

Table 10. Diversity of Buildings Operations³

Level	SOC	Occupation	Total Number of Workers (2020)	Diversity Trend 2007-2020	Representative of the Seattle MSA*
Building Operations					
Journey Workers	49-9071	Maintenance and Repair Workers, General	21,901	↗	No
Managers & Supervisors	49-1011	First-Line Supervisors of Mechanics, Installers	8,142	↘	NA

Energy-Related Construction

Energy-Related Construction offers the starkest example of how lower-skill, lower-wage occupations within a sector are more representative and higher-wage occupations are disproportionately white. Only solar photovoltaic installers and the two helpers associated with this category are currently as diverse as the Seattle MSA. Solar Photovoltaic Installers account for fewer than 60 workers, and the two helper occupations are also small. Thus, these occupations contribute very little to the sector’s overall diversity.



* Linear trends were calculated based on percent white of each occupation for select years from 2007 to 2020 and the percent white of the Seattle MSA for select years from 2001 to 2020. Consistent data was not available for occupations not included in the 2016 report and trends for these occupations were not calculated. Occupations with fewer than 2,000 workers are not shown here. See Appendix F for more detail.

Race: Energy-Related Construction
Seattle MSA, 2020

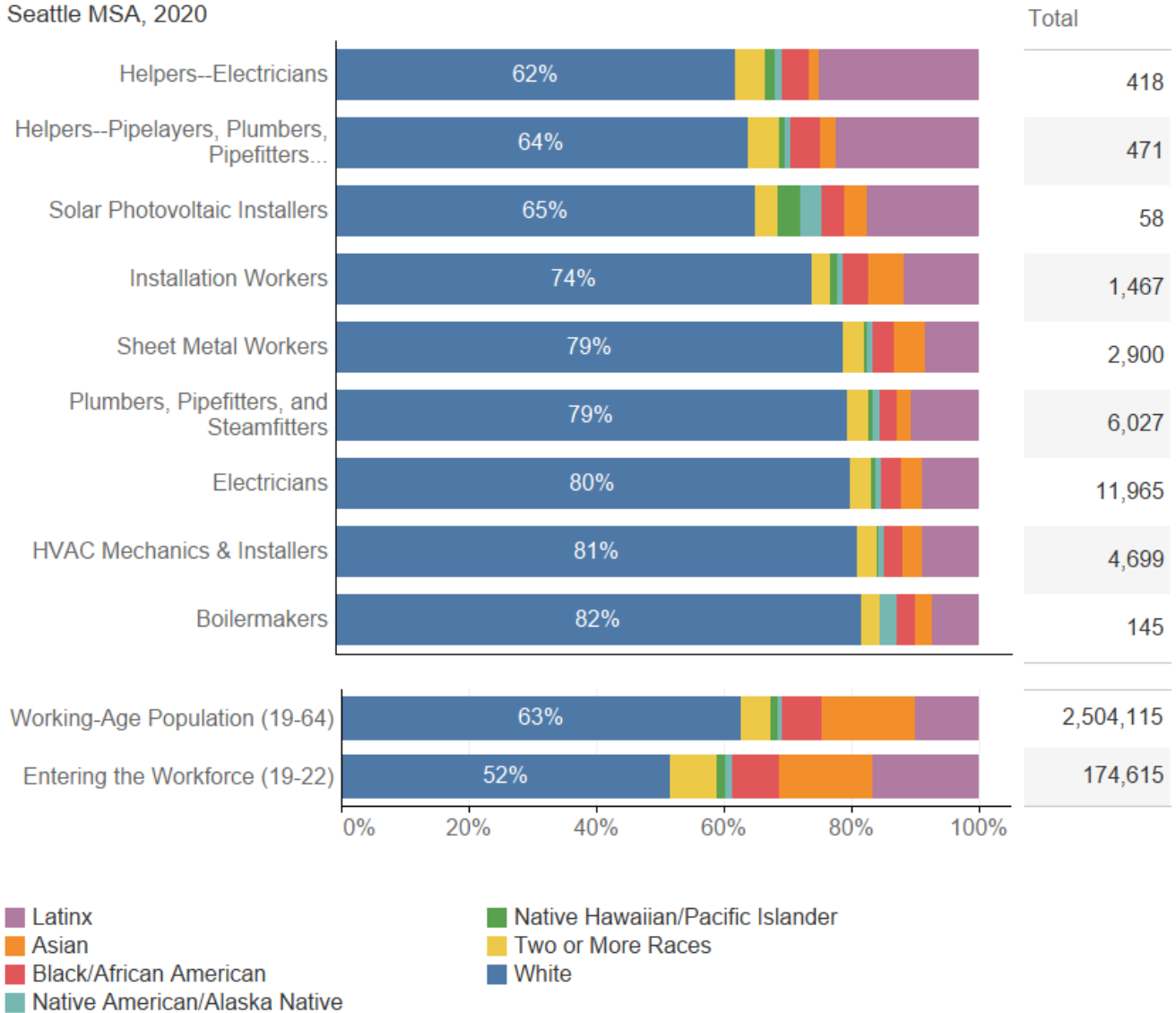


Figure 15. Energy-Related Construction occupations by race^{3,5}

In contrast, the sector’s largest occupations (Electricians; Plumbers, Pipefitters, and Steamfitters; and HVAC mechanics and installers) are among the Construction and Building Operations workforce’s least representative occupations.^{1,3,5}

As noted above in the journey worker section, Sheet Metal Workers have increased in diversity (Table 11). But diversity among more numerous Electricians and HVAC mechanics and installers has remained flat while the Plumbers, Pipefitters, and Steamfitters occupation has declined in diversity.^{1,4,6}

Table 11. Diversity of Energy-Related Construction occupations³

Level	SOC	Occupation	Total Number of Workers (2020)	Diversity (2007-2020)	Representative of the Seattle MSA*
Energy-Related Construction					
Journey Workers	47-2111	Electricians	11,965	=	No
Journey Workers	47-2152	Plumbers, Pipefitters, and Steamfitters	6,027	↘	No
Journey Workers	49-9021	HVAC Mechanics & Installers	4,699	=	No
Journey Workers	47-2211	Sheet Metal Workers	2,900	↗	No

General Construction

General Construction occupations are more representative of the Seattle MSA's working-age population than the Energy-Related Construction occupations. However, only Carpenter Helpers and Construction Laborers are not disproportionately white. Carpenters and First-Line Supervisors are unrepresentative, especially the latter.



* Linear trends were calculated based on percent white of each occupation for select years from 2007 to 2020 and the percent white of the Seattle MSA for select years from 2001 to 2020. Consistent data was not available for occupations not included in the 2016 report and trends for these occupations were not calculated. Occupations with fewer than 500 workers were not calculated.

Race: General Construction
Seattle MSA, 2020

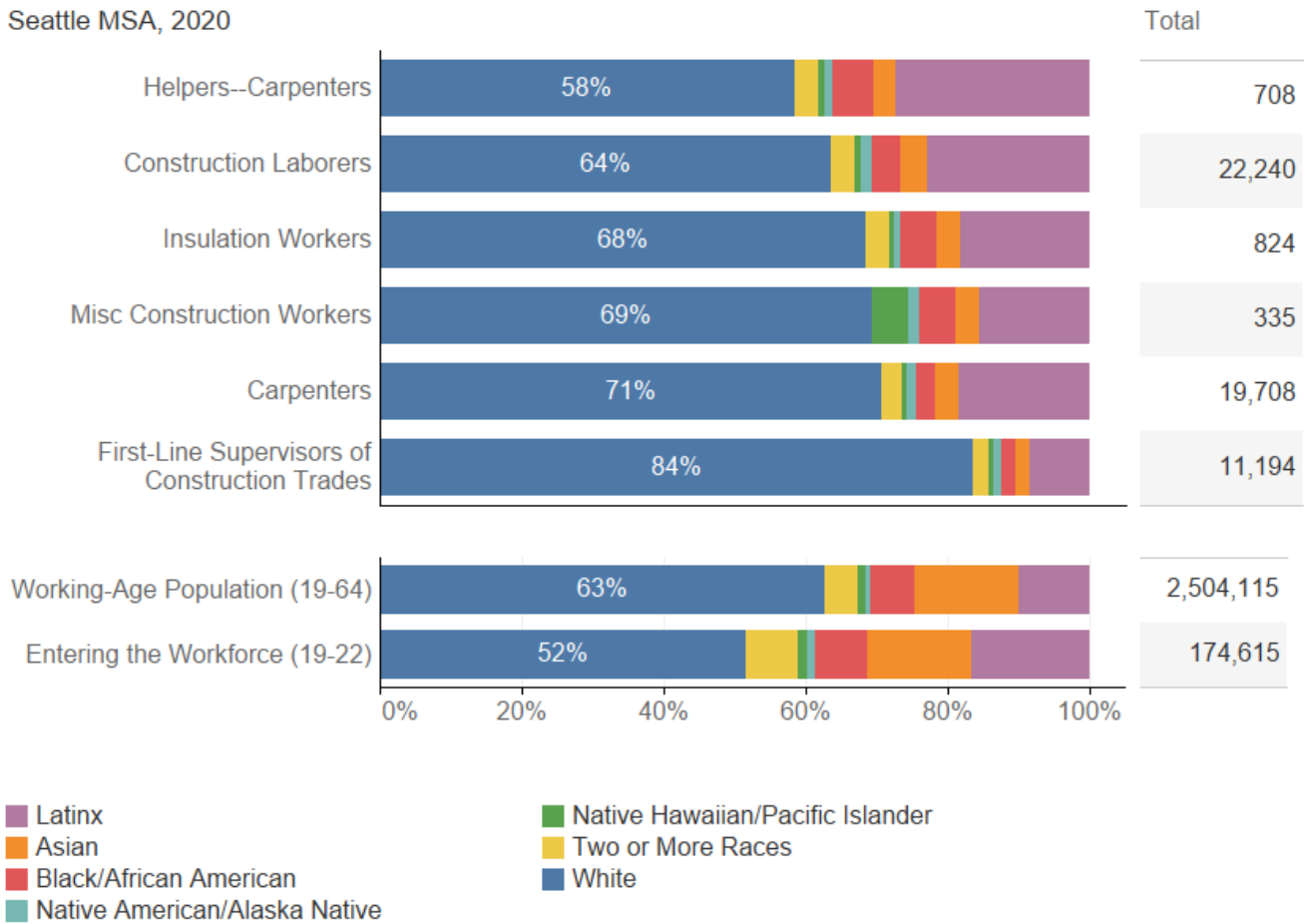


Figure 16. General Construction occupations by race^{3,5}

Though General Construction is also far from representative, it has not seen the decline in diversity that Energy-Related Construction has. First, the occupation with the largest number of jobs in this category, construction laborers (22,240), is roughly representative of the Seattle MSA’s working-age population. The largest group of non-white workers is Latinx. However, the diversity among construction laborers has declined slightly since 2014.

Second, the occupation with the second-highest number of jobs is Carpenters (19,708). The share of non-white carpenters increased between 2014 and 2020. They became more representative overall, with the percentage of Black/African American, Native American/Alaska Native, Native Hawaiian/Pacific Islander, and people of two or more races increasing. However, at the current rate of change, Carpenters will not reach representation of the Seattle MSA.

Table 12. Diversity of Generation Construction occupations^{3,5}

Level	SOC	Occupation	Total Number of Workers (2020)	Diversity (2007-2020)	Representative of the Seattle MSA*
General Construction					
Journey Workers	47-2061	Construction Laborers	22,240	=	Yes
Journey Workers	47-2031	Carpenters	19,708	↗	No
Managers & Supervisors	47-1011	First-Line Supervisors of Construction Workers	11,194	↘	NA

Managers & Engineers

None of the Managers and Engineers occupations approach representation of the Seattle MSA. Mechanical engineers are the most representative but are still disproportionately white and Asian. Unlike the other occupations in Construction and Building Operations workforce, mechanical engineers have relatively few Latinx workers. Construction managers are the most disproportionately white of any of the occupations considered (Figure 17).



* Linear trends were calculated based on percent white of each occupation for select years from 2007 to 2020 and the percent white of the Seattle MSA for select years from 2001 to 2020. Consistent data was not available for occupations not included in the 2016 report and trends for these occupations were not calculated. Occupations with fewer than 500 workers were not calculated.

Race: Managers & Engineers
Seattle MSA, 2020

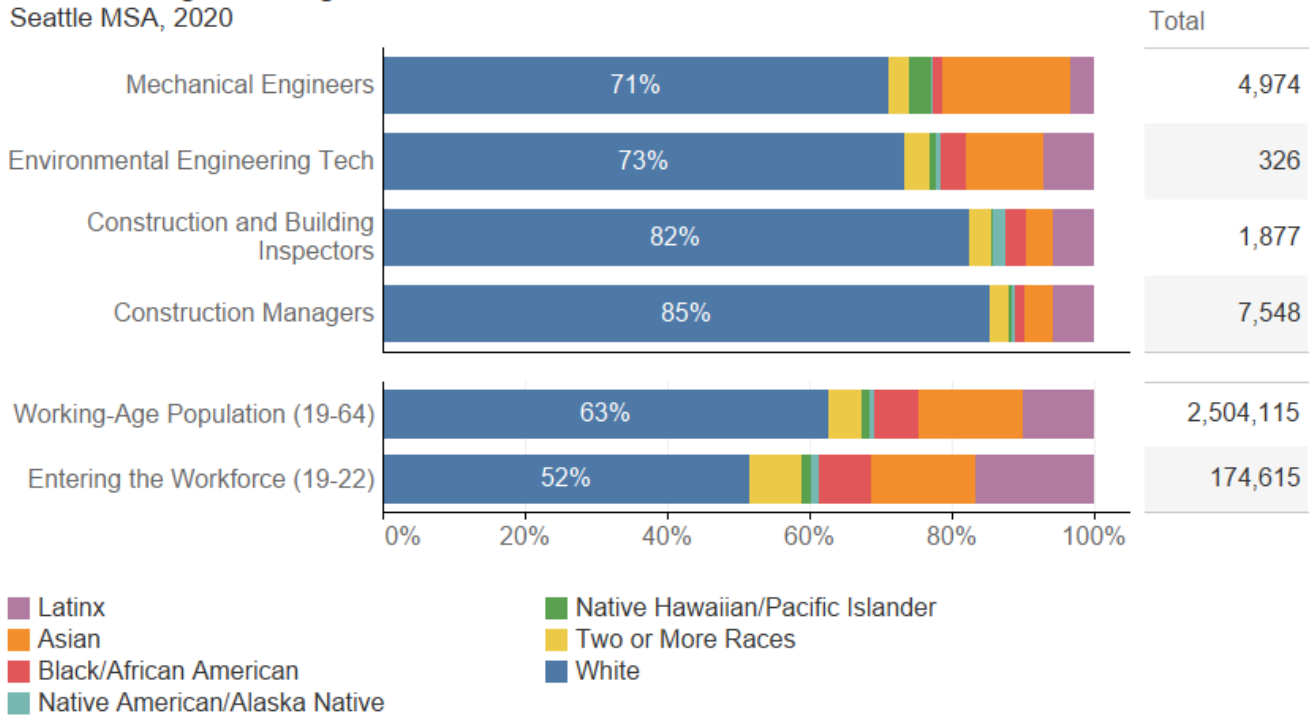


Figure 17. Managers and Engineer occupations by race^{3,5}

Managers and Engineers have become more representative since 2014, with increases in representation among mechanical engineers, construction managers, and construction and building inspectors maintain the same approximate racial distribution (Table 13). Despite the increase in representation, none of the occupations in this sector will reach representative of the Seattle MSA working-age population at the current rate of change.

Table 13. Diversity of Manager and Engineering occupations^{3,5}

Level	SOC	Occupation	Total Number of Workers (2020)	Diversity (2007-2020)	Representative of the Seattle MSA*
Managers & Engineers					
Managers & Supervisors	11-9021	Construction Managers	7,548	↗	No
Engineering Professionals	17-2141	Mechanical Engineers	4,974	↗	No
Journey Workers	47-4011	Construction and Building Inspectors	1,877	↗	By 2060

* Linear trends were calculated based on percent white of each occupation for select years from 2007 to 2020 and the percent white of the Seattle MSA for select years from 2001 to 2020. Consistent data was not available for occupations not included in the 2016 report and trends for these occupations were not calculated. Occupations with fewer than 500 workers were not calculated.

Gender

Similar to race and ethnicity, the Building Operations and construction sectors has been disproportionately male. And similar efforts to increase the number of women in the occupations have paralleled those to attract more workers of color.

Occupation Level

By occupation level, there was a decline in the share of jobs held by women in the professional and helper occupations. There was a slight increase among managers and supervisors. The share of journey worker jobs held by women has remained the same between 2014 and 2020.

In the helper occupations, women are still underrepresented. Their shares are increasing in two helper occupations: Carpentry Helpers and Installation Work Helpers (2014 was an outlier). However, they will not reach gender parity at the current rates. Women's share of electrician helpers is falling, raising a red flag for the prospect of increasing gender diversity among electricians.

Occupational Level by Gender

Seattle MSA, 2020

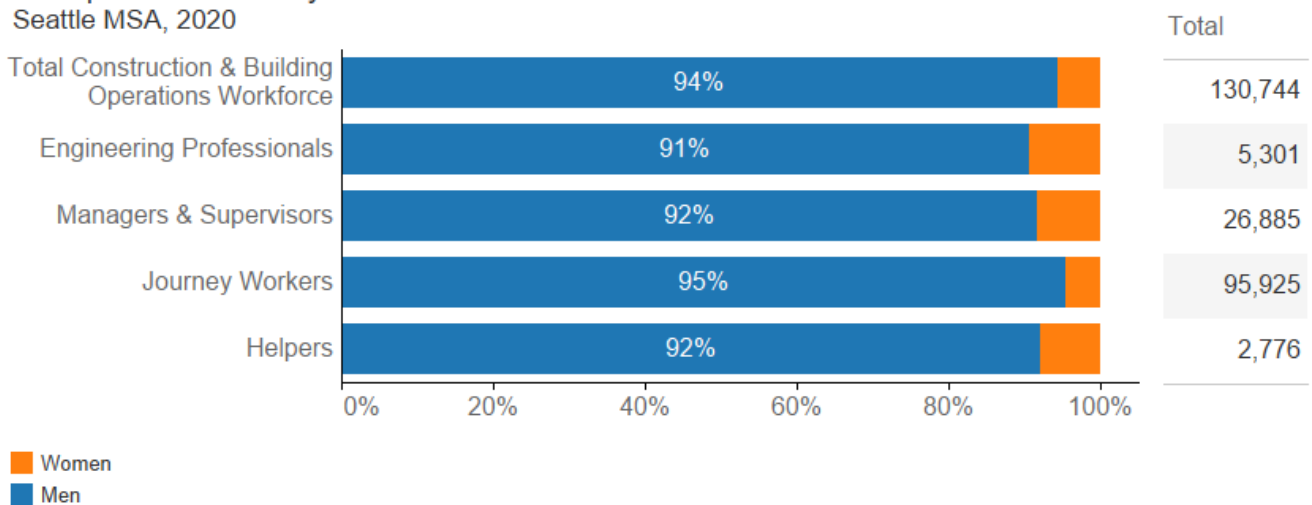


Figure 18. Occupational level by gender³

Occupational Sectors

By sector, the share of jobs held by women is somewhat more mixed. There is a slight increase in women's percentage of jobs in the Managers and Engineers categories. This is entirely due to the increasing gender diversity among construction managers. The share of construction and building inspectors and mechanical engineering jobs held by women has declined.

The trend line up until 2014 for Mechanical Engineers was increasing gender diversity, on track to reach gender parity by 2060. However, both the share and the absolute number of mechanical engineering jobs fell between 2014 and 2020, meaning the occupation is no longer on track to reach gender parity.

Women are better represented in occupations requiring a bachelor's or associate's degree.

Occupational Sector by Gender
Seattle MSA, 2020

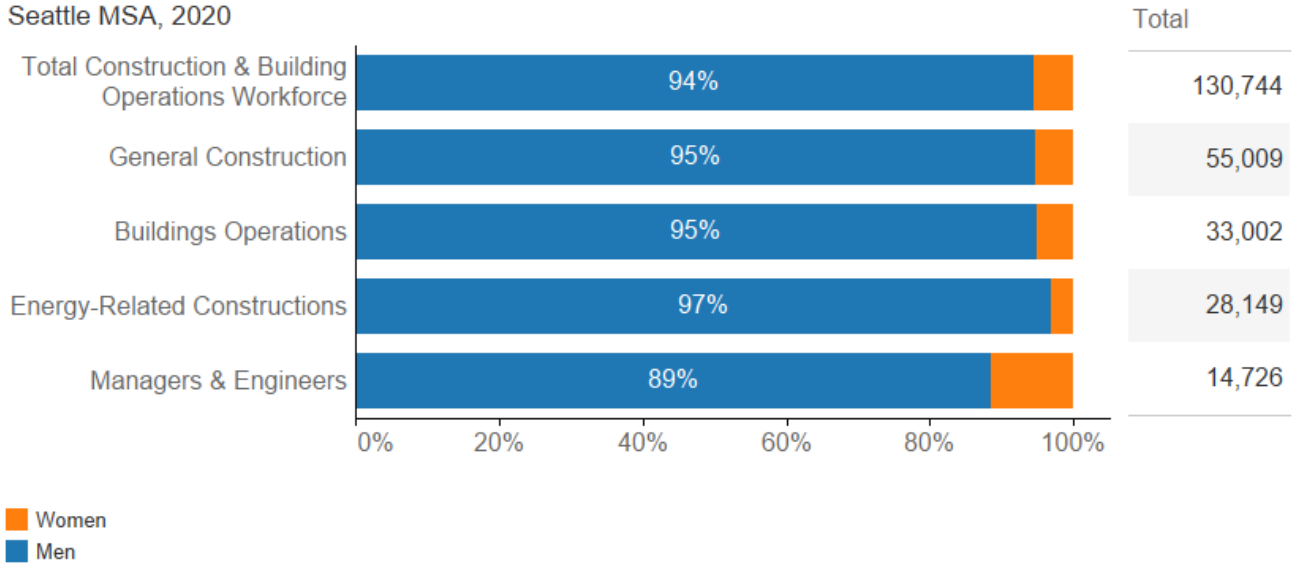


Figure 19. Occupational sector by gender³

Age

The age of workers in the industry has been a focus of concern in the past. The apparent Silver Tsunami was threatening as Baby Boomers began to retire without enough younger workers replacing them. And across the occupations’ age distribution, there is an overall skewing towards slightly older. **However, for most journey worker occupations, more than 50% of the workforce is under 44.** The two notable exceptions are construction and building inspectors and maintenance workers. Solar photovoltaic installers skew far younger than average. As expected, engineering professionals and managers and supervisors skew older, while helpers skew younger (Table 4).

“ ... for most journey worker occupations, more than 55% of the workforce is under 44. ”

Table 14. Age by occupation and occupational level³

Age by Occupation and Occupational Level
Seattle MSA, 2020

		Age 14-18	Age 19-21	Age 22-24	Age 25-34	Age 35-44	Age 45-54	Age 55-64	Age 65+
Total	Total Construction & Building Operations Workforce	1%	3%	5%	22%	25%	23%	17%	5%
Engineering	Mechanical Engineers	0%	1%	4%	26%	22%	22%	20%	4%
Professiona..	Env Engr Tech	0%	3%	5%	21%	23%	24%	20%	4%
Managers & Supervisors	First-Line Supervisors of Mechanics, Installers, etc.	0%	1%	2%	16%	25%	29%	23%	5%
	Construction Managers	0%	0%	2%	16%	27%	26%	22%	7%
	First-Line Supervisors of Construction Trade Workers	0%	1%	2%	17%	26%	27%	21%	7%
Journey Workers	Construction and Building Inspectors	0%	1%	1%	12%	17%	26%	29%	13%
	Stationary Engineers and Boiler Operators	0%	4%	4%	16%	19%	26%	25%	6%
	Maintenance and Repair Workers, General	0%	2%	3%	18%	22%	26%	23%	7%
	Boilermakers	0%	3%	3%	25%	23%	25%	17%	3%
	Electrical Repairers I	0%	6%	9%	30%	20%	16%	16%	3%
	Installation Workers	1%	4%	6%	25%	23%	18%	15%	7%
	Carpenters	1%	3%	5%	24%	26%	21%	15%	5%
	Sheet Metal Workers	0%	3%	6%	26%	25%	21%	15%	3%
	Plumbers, Pipefitters, and Steamfitters	0%	3%	5%	27%	27%	20%	14%	3%
	Electricians	0%	3%	6%	27%	26%	20%	14%	3%
	Electrical Repairers II	0%	7%	11%	31%	19%	17%	14%	2%
	Misc Construction Workers	1%	5%	7%	26%	23%	19%	13%	5%
	Insulation Workers	1%	4%	7%	26%	24%	19%	13%	4%
	HVAC Mechanics & Installers	0%	3%	6%	27%	27%	20%	13%	3%
	Construction Laborers	1%	5%	7%	26%	26%	19%	12%	4%
	Solar Photovoltaic Installers	7%	7%	9%	33%	21%	9%	7%	7%
Helpers	Helpers--Installation Workers	5%	12%	9%	29%	18%	14%	11%	3%
	Helpers--Carpenters	5%	13%	11%	27%	19%	13%	8%	3%
	Helpers--Pipelayers, Plumbers, Pipefitters	3%	13%	13%	31%	20%	12%	6%	2%
	Helpers--Electricians	4%	14%	12%	31%	20%	12%	6%	2%

Language

Construction and Building Operations sectors have several career pathways with living-wage careers for English Language Learning immigrants and refugees. Overall, approximately 20% of Clean Energy workforce workers have a primary language other than English (Figure 14). This is lower than in the United States overall, where 28% of Construction and Building Operations workers have a primary language other than English.⁵

To assess the English language proficiency and languages spoken by occupational sector and occupational level, we relied on American Community Survey data.⁵ However, the following should be interpreted with care as limiting the samples to the selected occupations in the metropolitan area results in small sample sizes.

Language in Occupational Levels

Among the occupational levels, journey workers have the most variability in English language proficiency (Figure 14). Journey workers also include the most sizable group of workers who do not speak English at all. In contrast, managers have both the smallest percent of workers with a primary language other than English. Managers who speak another primary language have high levels of English proficiency.

Engineering professionals have approximately the same percentage of workers who have a primary language other than English as journey workers (20%). However, a larger percentage of those workers have the highest English proficiency level (16% vs. 10%). Helpers have been excluded from this chart as the sample size is too small to produce reliable results.



English Language Proficiency Among Construction & Building Operations Workers
 Whose Primary Language Is Not English
 Seattle MSA, 2019

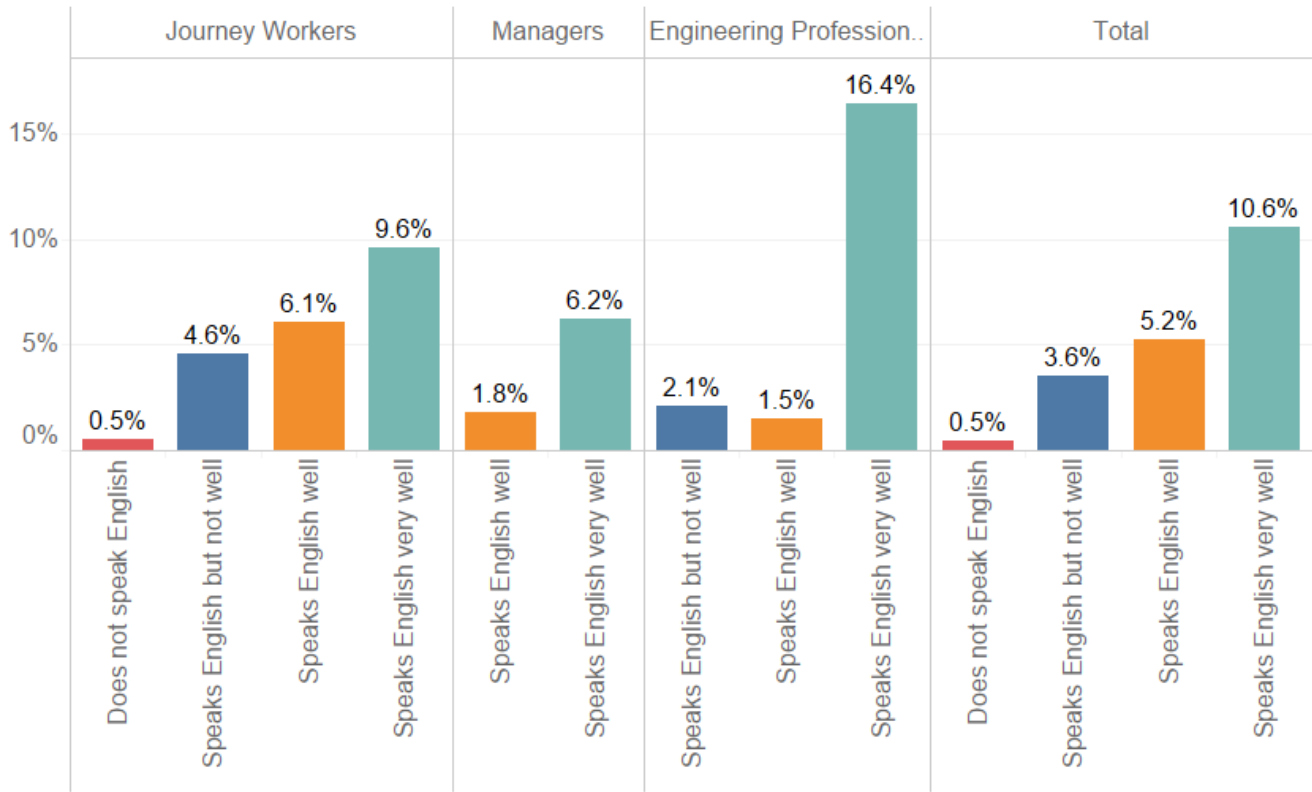


Figure 20. English language proficiency by occupational level⁵

Spanish is the most commonly spoken language among those journey workers with low English-language proficiency (Figure 15). However, Spanish speakers with low English-proficiency levels account for only 3% of journey workers.

Engineering professionals with low English language proficiency speak Vietnamese (1% of engineering professionals), Russian (0.8%), and Chinese (0.5%), while managers with low English proficiency speak Filipino/Tagalog (0.3% of managers).

Primary Language of Construction & Building Operations Workers with Limited English Proficiency
Seattle MSA, 2019

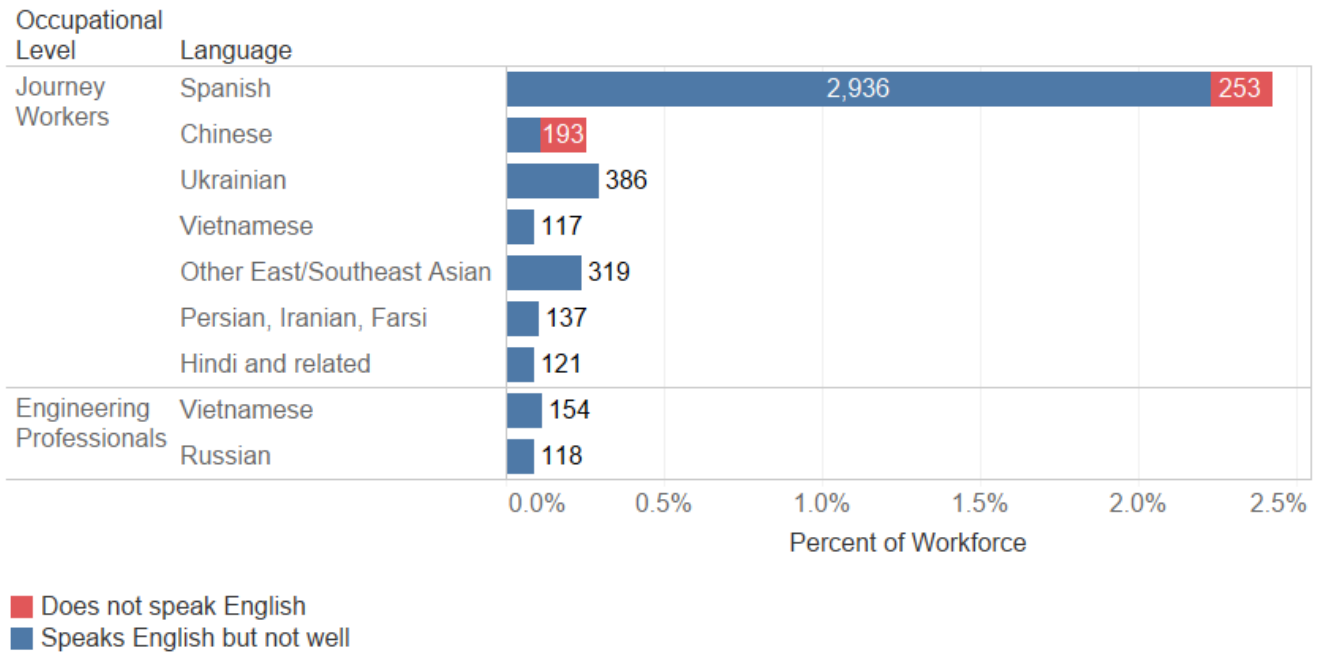


Figure 21. Languages by occupational level⁵

Language in Occupational Sectors

Within the occupational sectors, the limited English-language proficiency among workers ranges from 7% in Building Operations to 27% in General Construction occupations. The only occupational sector with a significant presence of workers who do not speak English is General Construction. More than 53% of workers with another primary language speak English very well across sectors, and another 26% speak it well.

The pattern of English proficiency across sectors is not consistent (Figure 16). Building Operations has the lowest percentage of those with a primary language other than English. It also has the smallest proportion of those with high English-language proficiency. Managers and Engineers have the next smallest percentage of workers who speak another language. However, the overwhelming majority of them have high English proficiency. General Construction has the most evenly spread across the proficiency levels and the most sizable group of workers who do not speak English. Energy-Related Construction shows a similar pattern to General Construction, though with a larger share of workers with high English-language proficiency and smaller percentages of low and moderate levels.

English Language Proficiency Among Construction & Building Operations Workers
 Whose Primary Language Is Not English
 Seattle MSA, 2019

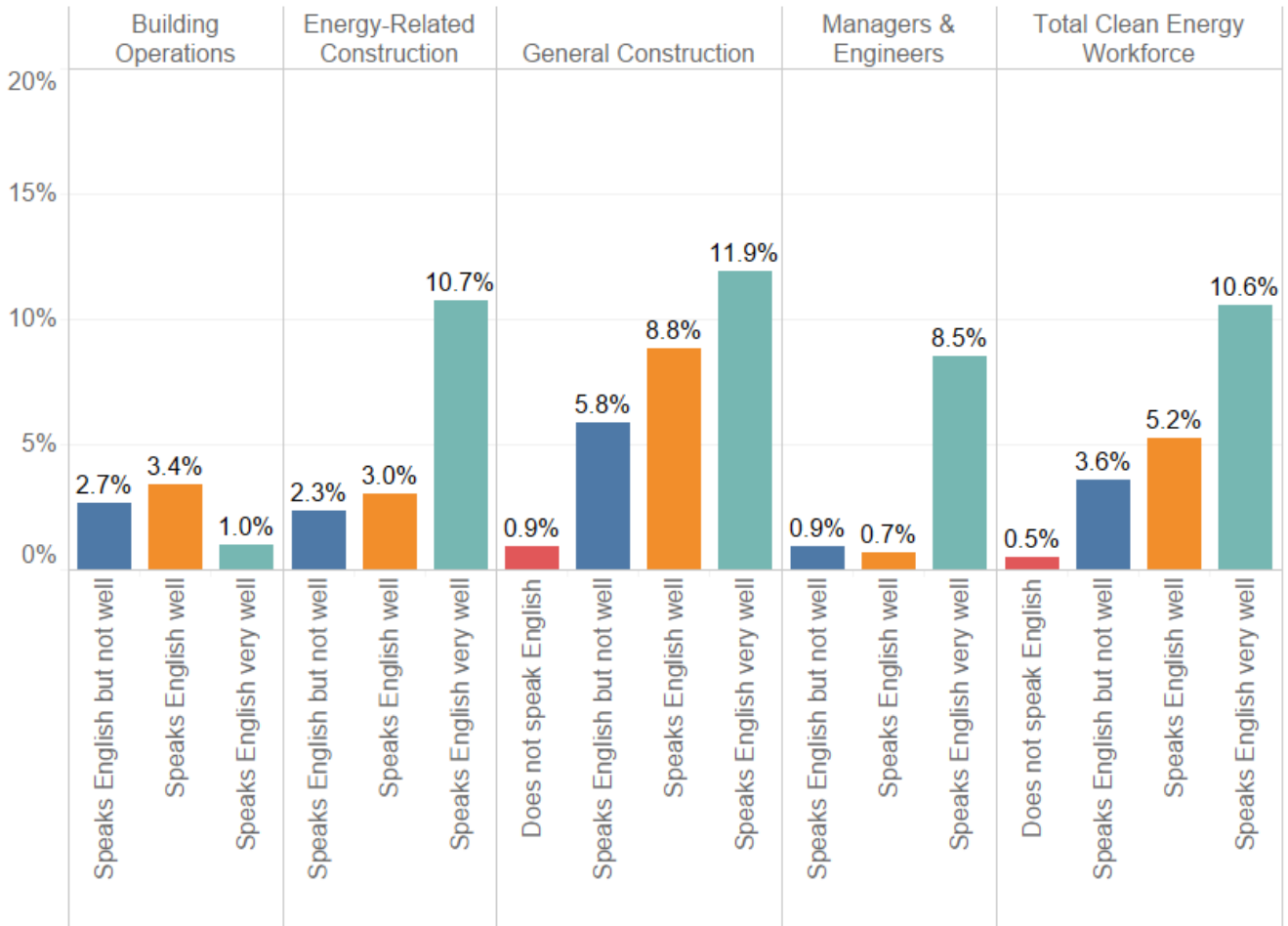


Figure 22. English language proficiency by occupational sector⁵

Among workers whose first language is not English, Spanish is the most common language, accounting for 25% of workers with another primary language (Figure 17). It is the most common language among those with the lowest English-language proficiency, with 55% of those who do not speak English well or at all speaking Spanish.

Other common languages are Chinese, Ukrainian, Vietnamese, Russian, and Hindi. However, individually those are spoken by 1% of workers or less. Chinese is the only language spoken by more than 10% of those with limited English proficiency.

Across the sectors, the languages spoken vary significantly. Spanish is the only language spoken by more than 100 workers with limited English proficiency in Building Operations.

Among Energy-Related Construction occupations, there is a greater variety of languages. However, Spanish is the only individual language that accounts for more than 0.5% of workers in that sector.

General Construction has the most linguistic diversity but, aside from Spanish (20% of General Construction workers), only Ukrainian accounts for more than 1% of the sector’s workers.

Finally, 10% of Managers and Engineers speak a language other than English. The most common languages are Spanish (2% of Managers and Engineers), Dravidian (1.6%), Persian/Farsi (1.3%). But less than 1% of Managers and Engineers have low English proficiency.

Primary Language of Construction & Building Operations Workers with Limited English Proficiency
Seattle MSA, 2019

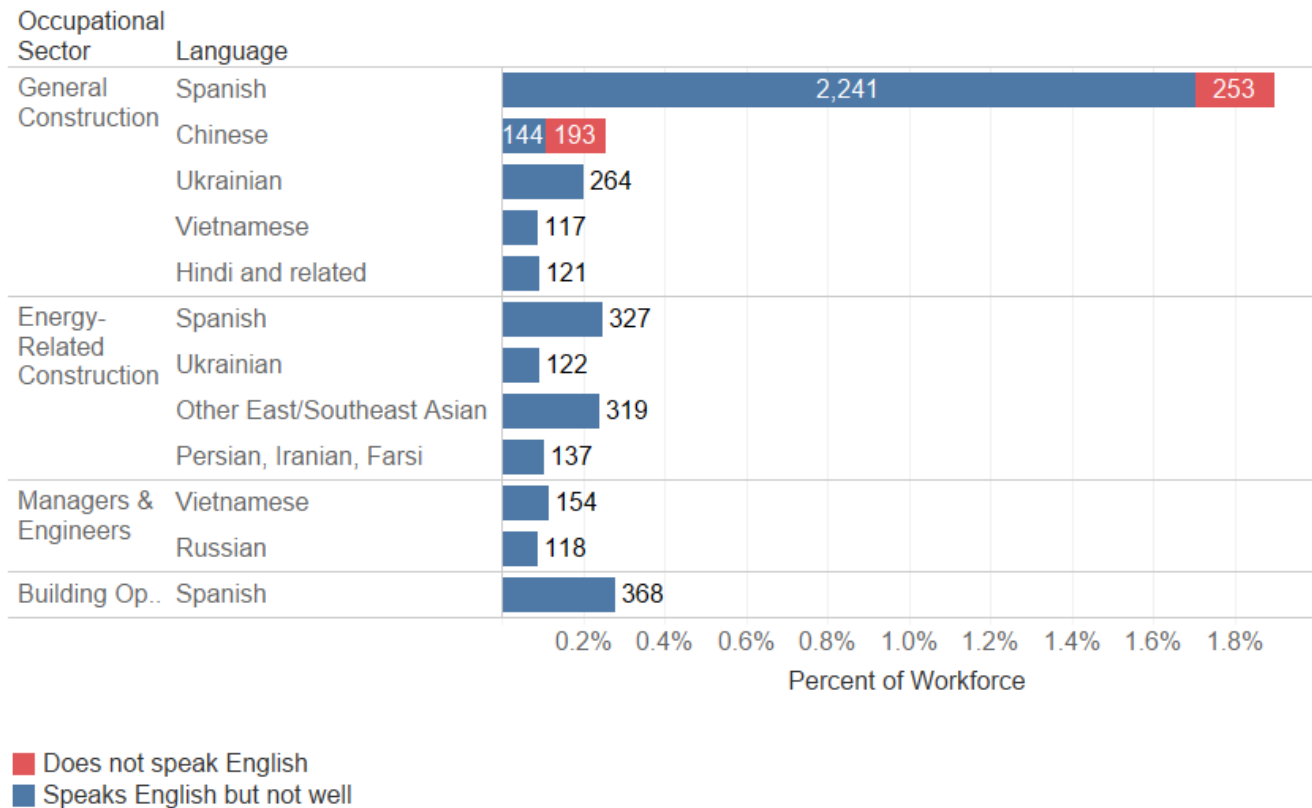


Figure 23. Languages spoke⁵

Workforce Trends

General Trends and Growth Rates

The Construction and Building Operations sectors suffered greatly during the 2008 financial crisis and still do not show the level of employment that would have been expected before the Great Recession. However, after a sharp decline between 2007 and 2011, employment grew vigorously between 2012 and 2015 in the Construction and Building Operations sectors in the Seattle region, shown in Figure 18.

There is a clear catch-up effect from the post-2008 financial crisis recovery between 2012 and 2014. This was followed by a period of strong, sustained regional economic growth when the sector’s employment grew between one and six percent annually.

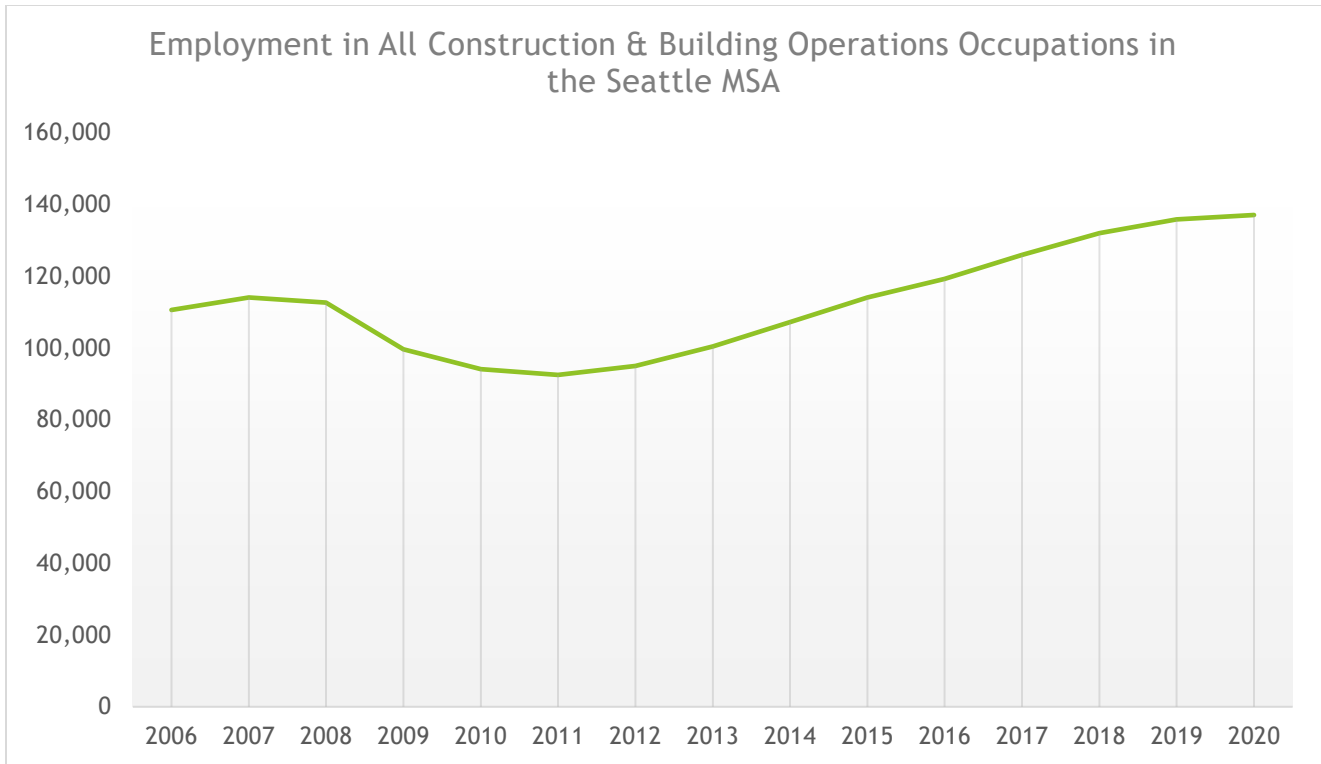


Figure 24. Construction and Building Operations sectors employment annual growth rate³

Despite consistent growth between 2012 and 2020, growth varies between the categories. General Construction occupations contracted sharply during the recession but grew most rapidly in the immediate post-recession era (Figure 19). While construction contracted by 4.7% in 2011, it bounced back the following year and reached a 9.7% growth rate in 2014 (the largest rate observed among all sectors). As a result, General Construction occupations have increased from 39% of the Construction and Building Operations employment in 2011 to 43% in 2020 (Figure 20).

The Energy-Related Construction’s annual growth rate has also been consistently significant over the 2011-2020 time frame, but three distinct periods can be observed. First, the sector contracted by 3.2% in 2011, second only to the General Construction sector. It then caught up to its pre-crisis levels with an average growth rate of 5.7% between 2012-2015. Annual growth rates decreased starting in 2016. However, the sector is still creating many positions with an average growth rate of 3.7% between 2016 and 2019. As a result, the sector’s share of employment in the Construction and Building Operations sectors has remained constant at 22%.

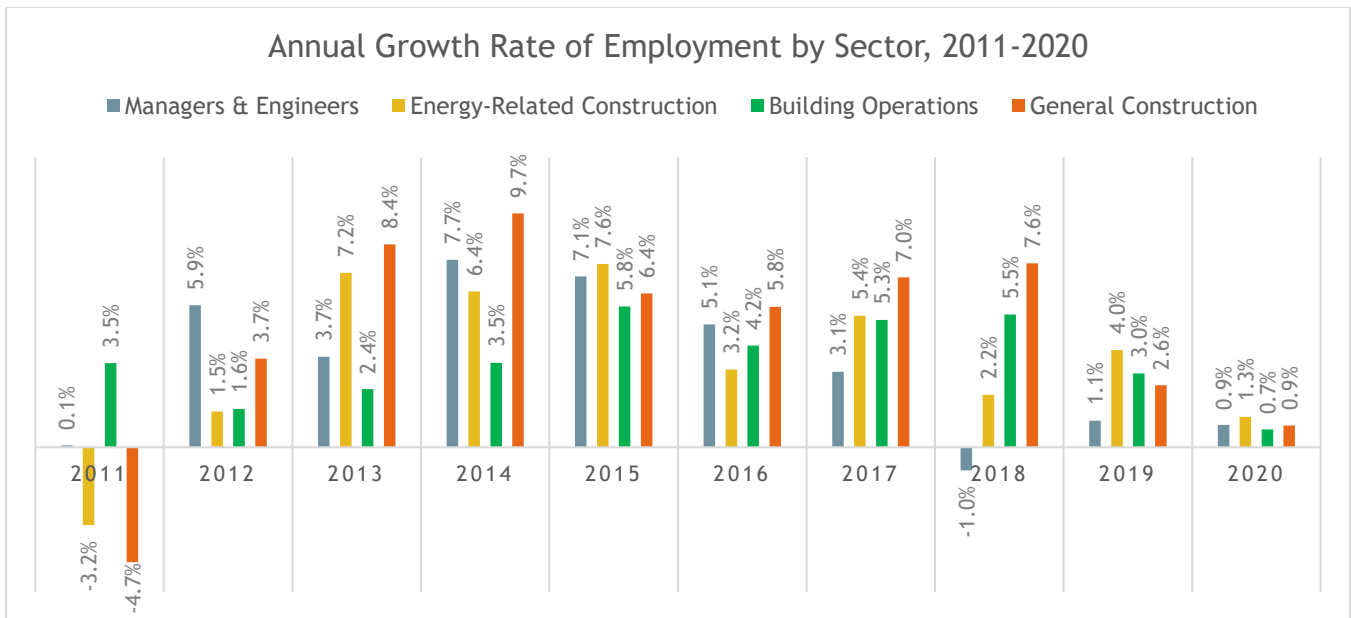


Figure 25. Annual growth rate by occupational category³

A similar pattern can be observed for the Managers and Engineers sector, which also experienced a null growth in 2011 following the Great Recession. But Managers and Engineers caught up to previous employment trends thanks to strong annual growth rates between 2012 and 2017. Job creation in the sector slowed down significantly starting in 2018 when the category experienced a slight contraction (-1% growth). Their share of employment among the sectors has decreased slightly from 12% to 11%.

Finally, Building Operations was the only sector to experience a positive growth rate in 2011. Subsequent growth rates have been strong but not as substantial as other the other categories. This resulted in a decrease in the share of overall employment in the construction. The Building Operations sector accounted for the Building Operations category, which went from 28% of overall employment in 2011 to 25% in 2020.

Sectoral Employment and Growth Rates

Reflecting the trends observed in Figure 19 below, the number of Managers and Engineers had been relatively stable between 2001 and 2011. The number increased consistently starting in 2013 (Figure 21). On the other hand, both General Construction and Energy-Related Construction categories suffered employment losses during the Great Recession and then quickly went back to and even surpassed employment levels pre-recession. In contrast, the Building Operations sector seemed relatively unimpacted by the 2008 financial crisis and has enjoyed a steady growth between 2011 and 2019. Building Operations have two of the occupations with the most workers in 2020: Maintenance and Repair workers (21,901) and First-Line Supervisors of Mechanics, Installers, and Repairers (8,142). This is reflected in Table 4 below.

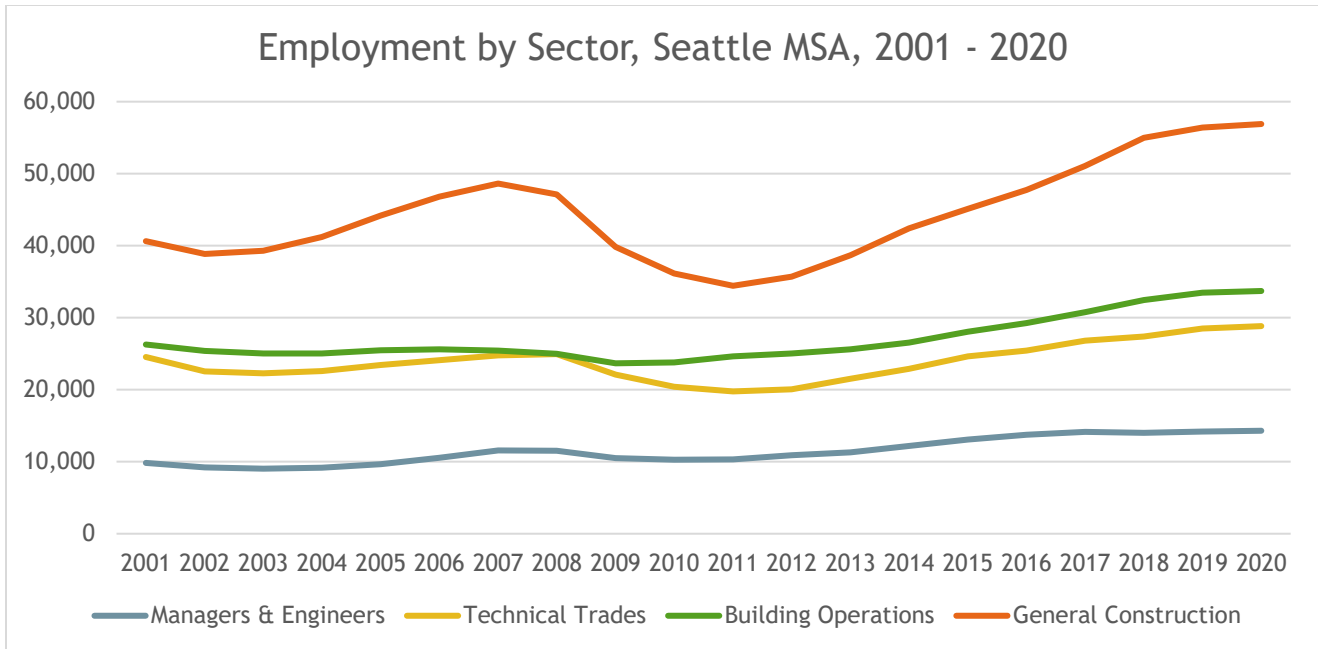


Figure 26. Construction and Building Operations employment, Seattle MSA, 2001-2020³

However, the largest occupations are in the General Construction sector, with construction laborers containing the most workers among all occupations considered in this report (22,240), followed by Carpenters (19,708) and first-line supervisors of construction trades and extraction workers (11,194). On the other hand, Solar Photovoltaic Installers are still very few in the Seattle-MSA labor market. Still, they are expected to grow by 20% by 2030 (see Figure 28 below). The situation is similar for Boilermakers, which are only 145 in 2020 and are expected to grow by 3.04% by 2024.

Job openings are a good metric to measure the number of new workers needed in an occupation. This variable is obtained by combining the number of replacements (estimated vacancies created by workers leaving an occupation following a retirement, career switch, or death) and projected occupation growth. However, it only provides conservative estimates, as workers moving out of the region are not counted. In absolute value, there were more job openings for Construction Laborers than any other occupation, closely followed by Maintenance and Repair Workers. Still, this only reflects the large number of workers in these two occupations. In relative terms, there are many openings for Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters compared to the number of workers.

Table 15. Construction and Building Operation sectors' employment and openings in 2020³

SOC	Description	2020 Jobs	2020 Openings	Opening vs Jobs
Managers & Engineers				
11-9021	Construction Managers	7,548	646	9%
17-2141	Mechanical Engineers	4,832	294	6%
47-4011	Construction and Building Inspectors	1,877	221	12%
17-3025	Environmental Engineering Technologists and Technicians	326	33	10%
Energy-Related Construction				
47-2111	Electricians	11,965	1,379	12%
47-2152	Plumbers, Pipefitters, and Steamfitters	6,027	714	12%
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	4,699	496	11%
47-2211	Sheet Metal Workers	2,900	314	11%
49-9099	Installation, Maintenance, and Repair Workers, All Other	1,467	154	10%
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	471	64	14%
47-3013	Helpers--Electricians	418	49	12%
47-2011	Boilermakers	145	14	10%
47-2231	Solar Photovoltaic Installers	58	<10	
Building Operations				
49-9071	Maintenance and Repair Workers, General	21,901	2,171	10%
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	8,142	708	9%
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	1,203	84	7%
49-9098	Helpers--Installation, Maintenance, and Repair Workers	1,178	159	13%
51-8021	Stationary Engineers and Boiler Operators	361	38	11%
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	217	18	8%
General Construction				
47-2061	Construction Laborers	22,240	2,473	11%
47-2031	Carpenters	19,708	1,949	10%
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	11,194	1,170	10%
47-2131	Insulation Workers, Floor, Ceiling, and Wall	824	93	11%
47-3012	Helpers--Carpenters	708	91	13%
47-4098	Miscellaneous Construction and Related Workers	335	43	13%

Figure 28 shows how each category contributed to the overall growth rate in the Construction and Building Operations sector. First, General Construction consistently accounts for the largest portion of the growth rate in Construction and Building Operations employment, with a maximum of 64.6% of the employment growth rate in 2018. Jobs in General Construction increased by 7.6% that year, much more than the remaining categories.

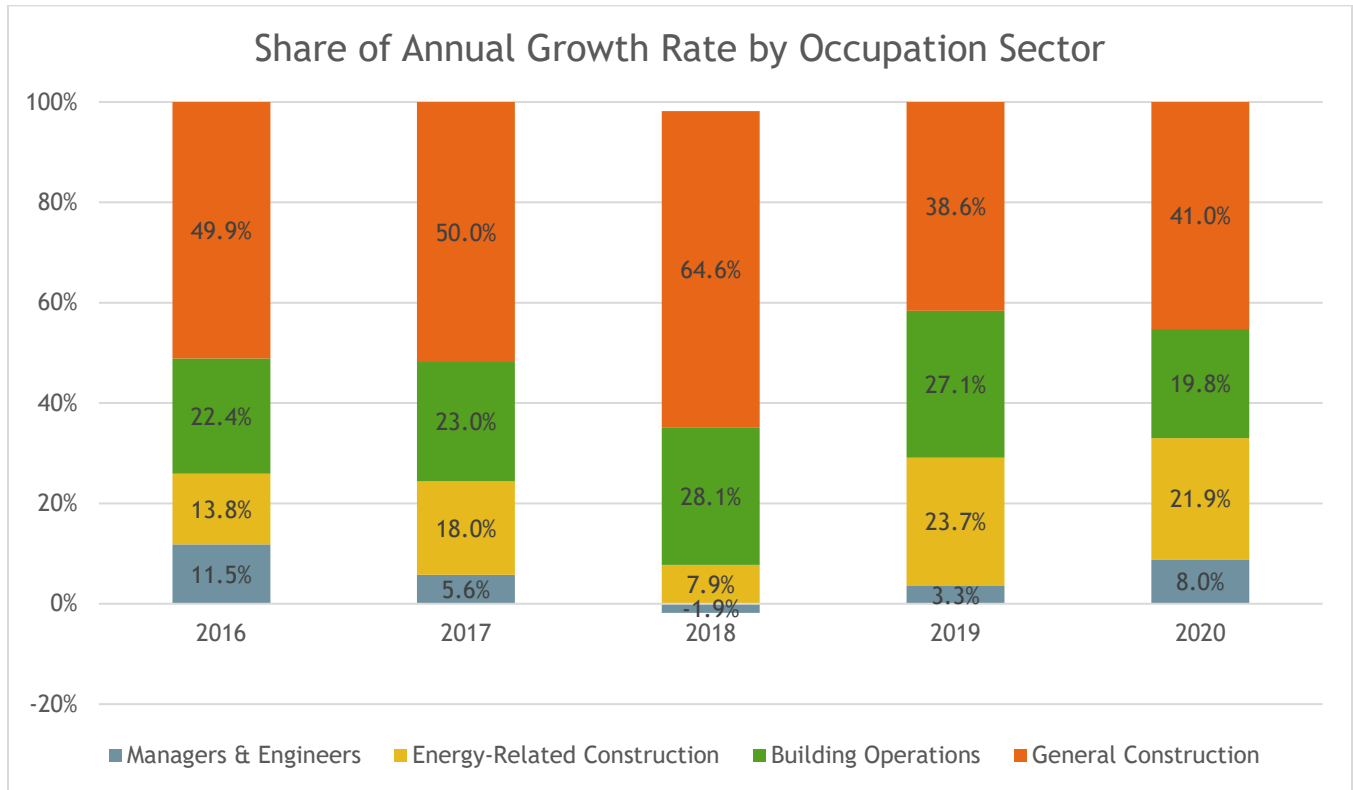


Figure 27. Construction and Building Operations sector growth rate by occupational category³

Additionally, between 2016 and 2018, the composition mix of all occupations' growth rate changed significantly, with General Construction occupations and Building Operations explaining a gradually larger share of the overall growth rate. Inversely, the share of Managers and Engineers and Energy-Related Construction decreased, with the number of Managers and Engineers even decreasing slightly between 2017 and 2018. Additionally, in 2018, Energy-Related Construction was reduced to 7.9% of the overall employment 5.9% growth rate while Building Operations accounted for 28.1%. Through 2018, the growth in the Construction and Building Operations sector was increasingly dependent on the Building Operations subsector. However, in 2019 and 2020, growth in Energy-Related Construction occupations increased to approximately the same share in the overall growth rate as Building Operations.

This overall slowing in Construction and Building Operations' growth reflects a leveling off of construction in the Seattle MSA. As shown in Figure 22, the annual number of permits for new construction in the City of Seattle* grew rapidly from 2011 to 2014. However, it has plateaued between 2015 and 2019.

* Construction permits for the City of Seattle are used as a proxy for the region due the availability of data.

New Building Construction Permits
City of Seattle, 2011-2020

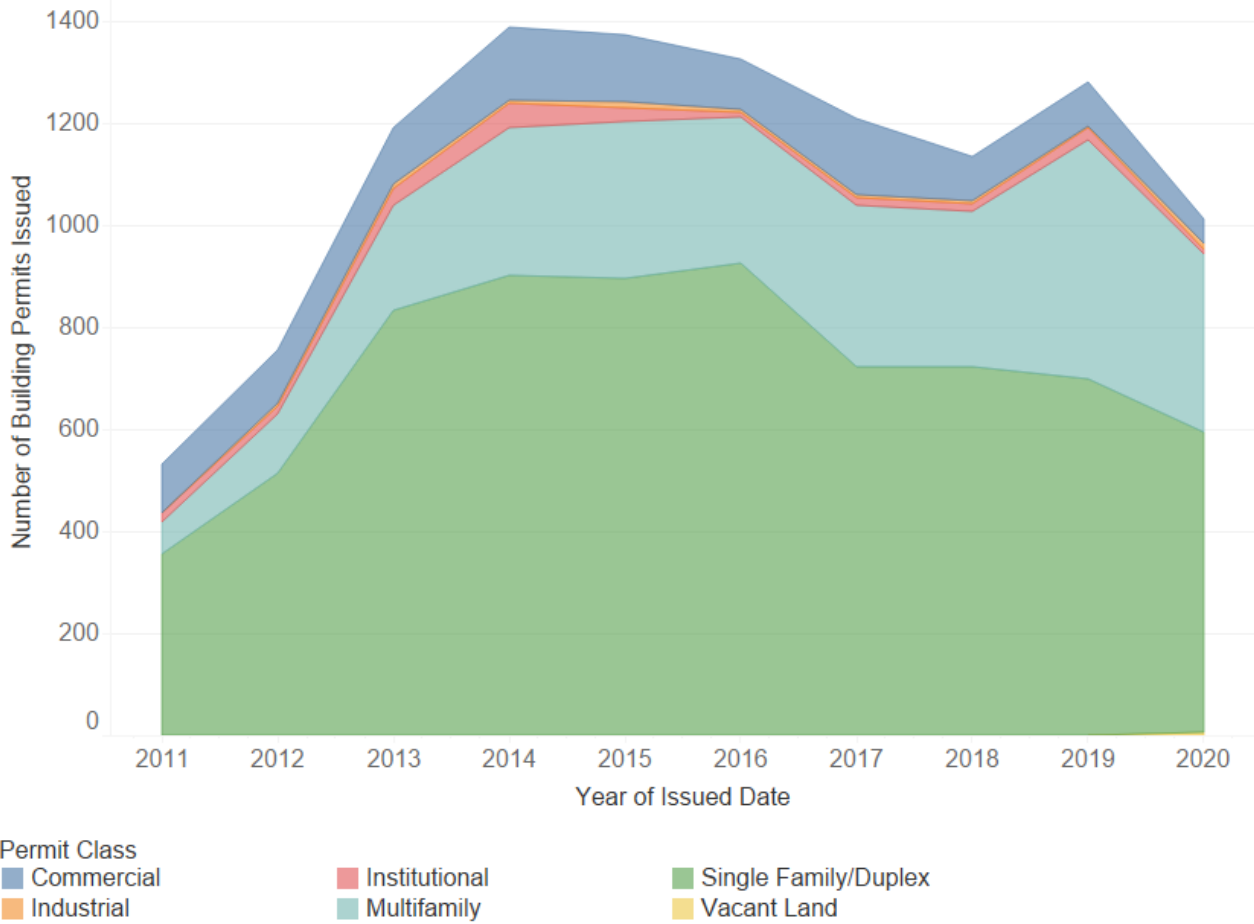


Figure 28. New construction permits in the Seattle MSA⁹

However, this is only slower growth; the number of jobs continued to increase. Hires, which represent the demand for an occupation, have increased for all occupational sectors studied in this report. The dynamics in each category of occupations vary. Further research is needed to assess the impact on the Construction and Building Operations industries in the region in light of the COVID-19 recession and the potential changes in consumer behavior the pandemic has spawned.

Supply and Demand

Employment growth offers a high-level view of a sector, but evaluating supply and demand provides a more detailed understanding of labor market dynamics. The number of unique job postings measures demand for an occupation in a defined period. Supply is all the workers available to fill those jobs. It is calculated by adding together those who have switched jobs or retired (separations^{*}) and those who have completed a training program during the same period. **In a balanced economy, supply slightly exceeds demand to account for some friction in the labor market.** If demand consistently exceeds supply, there is a labor shortage. Inversely, suppose too many workers are looking for a job compared to the number of job postings. In that case, the supply is larger than demand, resulting in a labor surplus.



^{*} Workers who were working for an employer in one quarter but do not appear on the payroll the following quarter.

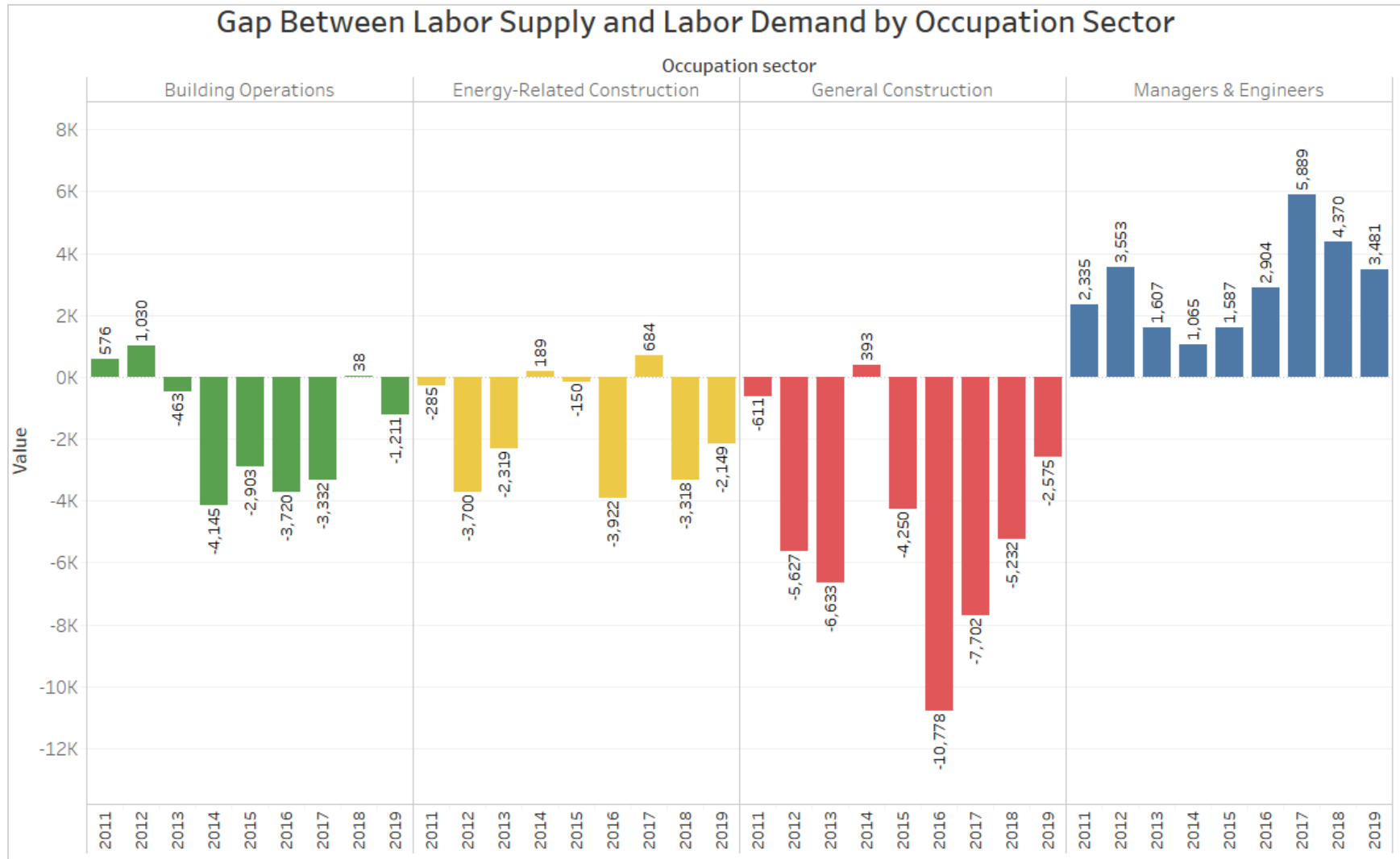


Figure 29. The gap between labor supply and labor shortage by occupation sector³

Building Operations

The Building Operations sector’s supply and demand pattern highlights a chronic worker shortage, similar to the General Construction and Energy-Related Construction sectors. Since 2014, demand has consistently exceeded supply though that narrowed substantially in 2018 and 2019.

Like Energy-Related Construction, supply for Building Operations is mainly made up of separations. The number of completions is low and stable from 2012 to 2018 (see Figure 30).

Typically, training programs should not be expanded when supply and demand converge, as is the case here, as this indicates the market is reaching equilibrium. However, given the increase in separations, incumbent Building Operations workers may engage in continuing education to increase their competitiveness in the market.

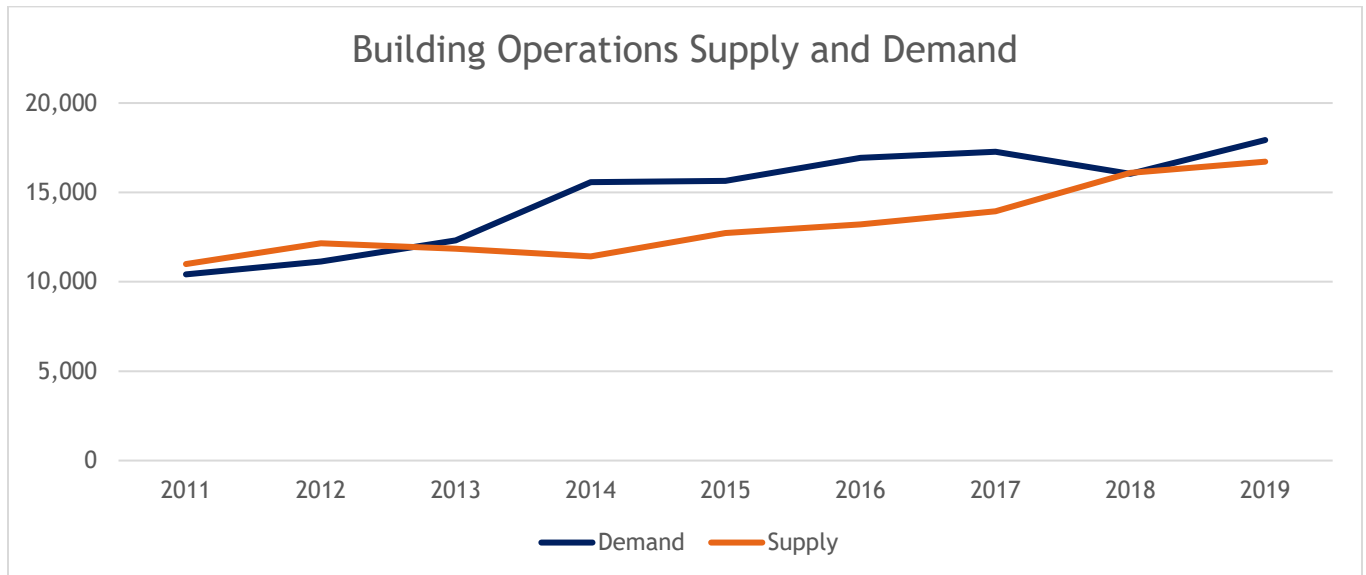


Figure 30. Labor supply and demand in the Building Operations sector³

Energy-Related Construction

Energy-Related Construction has seen a similar shortage (Figure 31). The low completion numbers every year since 2013, except for 2017, explains why demand has only just equaled or exceeded supply in most years. The completion figures from Emsi represent the number of students graduating from a certified training program every year. However, graduations have been much smaller than both demand and separations. The focus group with training programs highlighted the programs' constrained capacity, with some applicants waiting for several years for a spot. **Broadening application criteria and increasing training capacity could help increase completion numbers and reduce the labor shortage.**³

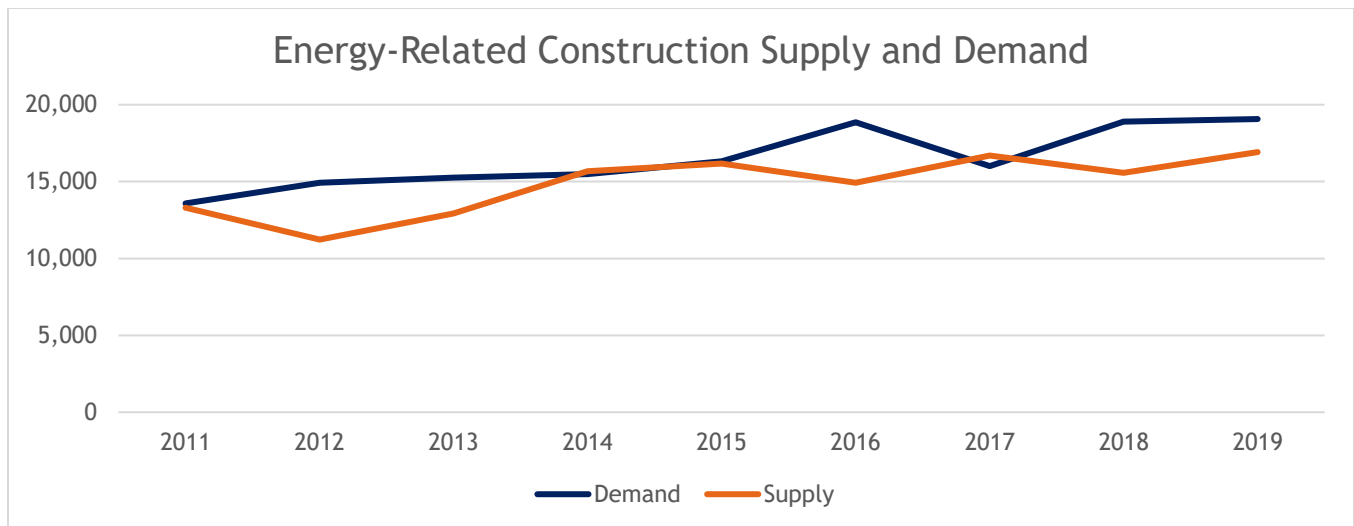


Figure 31. Labor supply and demand in the Energy-Related Construction sector³

General Construction

As noted above, employment in General Construction occupations grew steadily until 2017, when the growth rate slightly declined. However, the number of students and apprentices completing training programs (completions) has been persistently low (shown in Figure 27 below). The 2019 completion numbers were a third of those in 2011. As a result, supply has not kept pace with demand. It has resulted in a shortage in that sector, as shown in Figure 32.³

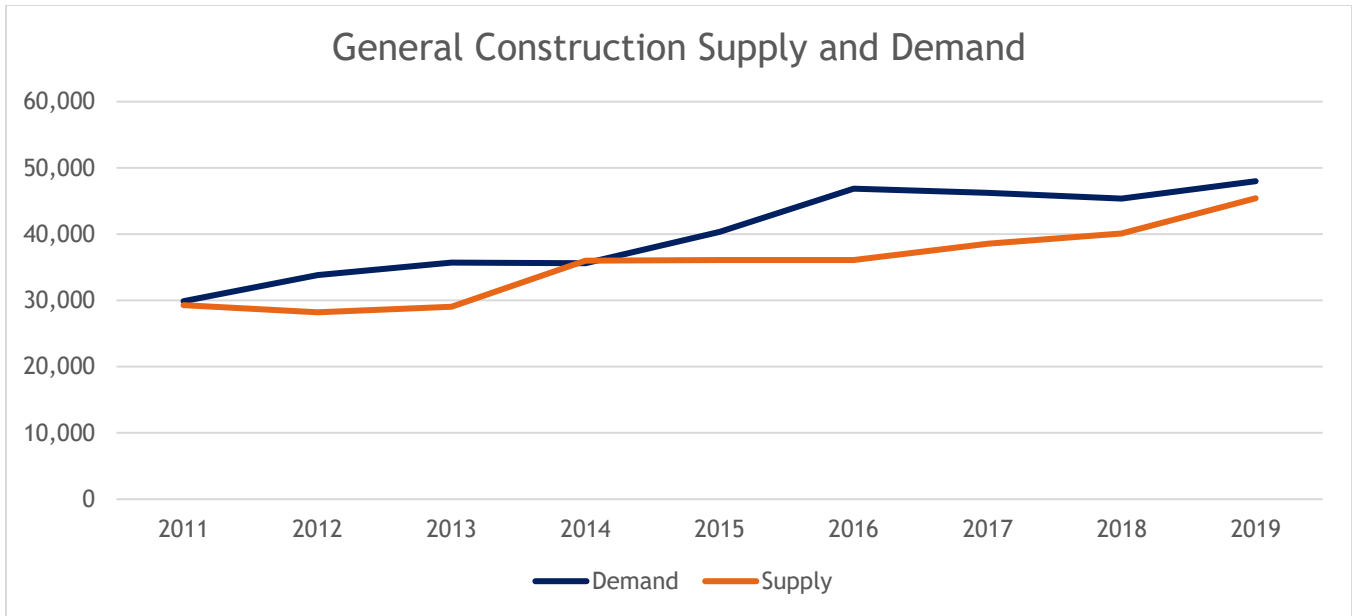


Figure 32. Labor supply and demand in the General Construction sector.³

Managers and Engineers

In contrast, demand for Managers and Engineers has been relatively flat between 2011 and 2019, and supply has been greater than demand for the entire period. Typically, this would indicate that there is an oversupply of workers in this occupation category, meaning there are too many workers relative to open positions (Figure 33).

However, completions account for approximately half of the supply for managers & engineers. This is notable as many of these occupations require a four-year college degree and would indicate that the oversupply is likely to persist even if demand remains high. However, given the concentration of higher educational institutions in the Seattle MSA, many of which serve the entire Pacific Northwest region, many graduates likely move outside of the Seattle MSA. Thus this effect is undoubtedly overstated relative to the other occupational categories.

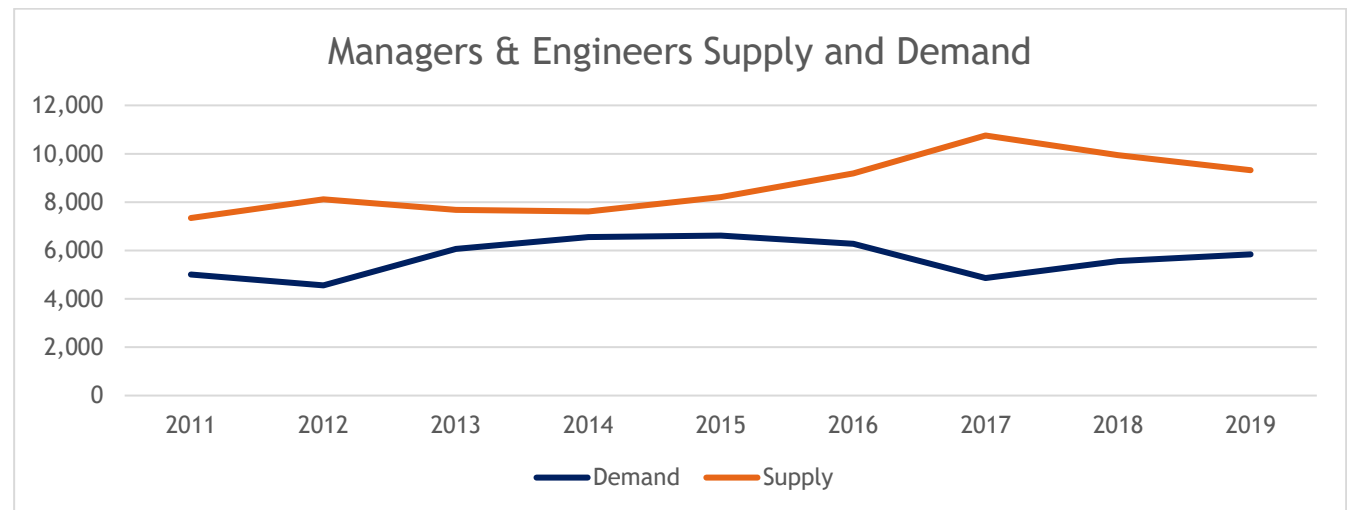


Figure 33. Labor supply and demand in the Managers and Engineers sector³

Training Graduates

Completion numbers vary widely across occupation sectors, with Managers and Engineers making the bulk of graduations from training programs (Figure 34). Comparatively, completions from Energy-Related Construction trades programs are much smaller in magnitude. This could be explained by the fact that many Managers and Engineers graduate from four-year educational institutions with large capacity (e.g., the University of Washington), while trades programs reported smaller graduating cohorts.

From 2017 to 2019, two distinct paths can be highlighted. Both Managers and Engineers and General Construction have experienced a decline in completions. If this trend continues, it might help erase the worker surplus described in the previous section for Managers and Engineers. On the other hand, Building Operations and Energy-Related Construction have grown significantly in relative terms: +31.8% in completions for the former and +136% for the latter between 2017 and 2019. However, this is only in relative terms, given the small number of completions to grow from.

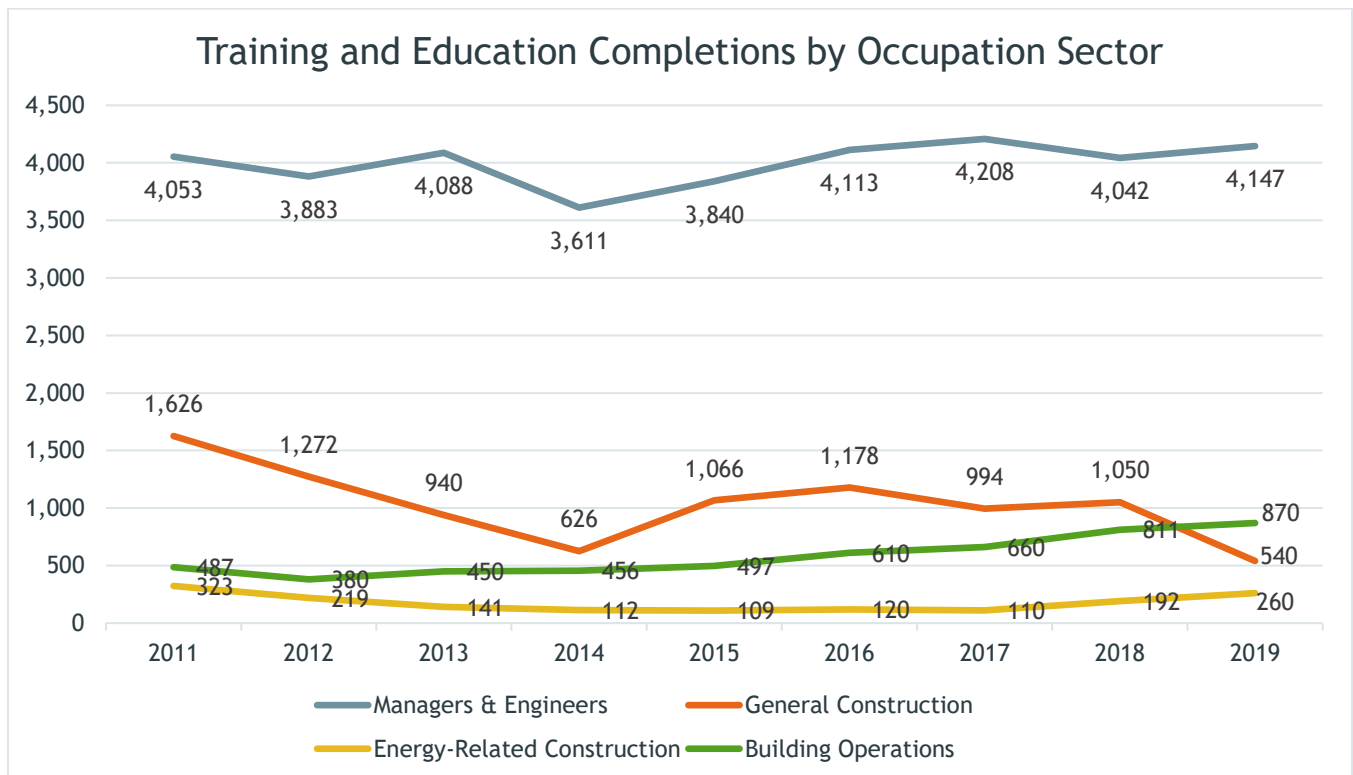


Figure 34. Completions by occupational sector³

Worker Shortage and Surplus

As established in the two previous sections, occupations in the Managers and Engineers category have the largest number of completions. If the job market for new graduates is limited to the Seattle MSA, they suffer from a worker surplus (too many workers compared to the number of job openings).

In contrast, the three other occupational sectors have much smaller completion statistics and a regular worker shortage. Thankfully a convergence between labor demand and labor supply can be observed in recent years, particularly for the Building Operations sector, which experienced a small worker

surplus in 2018. Sustained efforts in increasing training capacity for General Construction occupations can help close the gap and reduce the worker shortage. The graph below presents the gap between labor supply and labor demand between 2011 and 2019 for the four occupation sectors (Figure 35). Negative numbers indicate a labor shortage, while positive figures reflect a labor surplus.

Employment Projections

Projected growth for occupations from Emsi, which are based on Emsi’s proprietary industry data, the Bureau of Labor Statistics’ National Industry-Occupation Employment Matrix (NIOEM), and Washington State projections, indicate that growth is expected to slow starting in 2021 (Figure 35). Growth rates in 2020-2025 and 2025-2030 appear much lower than in previous years. Despite the deceleration, most occupational categories are expected to grow in line with overall employment in the Seattle MSA. Seattle MSA is expected to grow by 7.48% between 2020 and 2030; Managers and Engineers will increase by 7.8%, General Construction occupations by 5.7%, Energy-Related Construction by 9%, and Building Operations by 5.1% between 2020 and 2030.

Among General Construction occupations, Insulation Workers and Carpenters’ Helpers have the best long-term employment prospects with a growth rate of +11% in 2020-2030. Construction Laborers (+9%) and Carpenters’ Helpers (+5%) are also expected to grow significantly. With a growth rate of 3% and 1% respectively in 2020-2030, Carpenters and First-Line Supervisors of Construction Trades will grow the slowest.

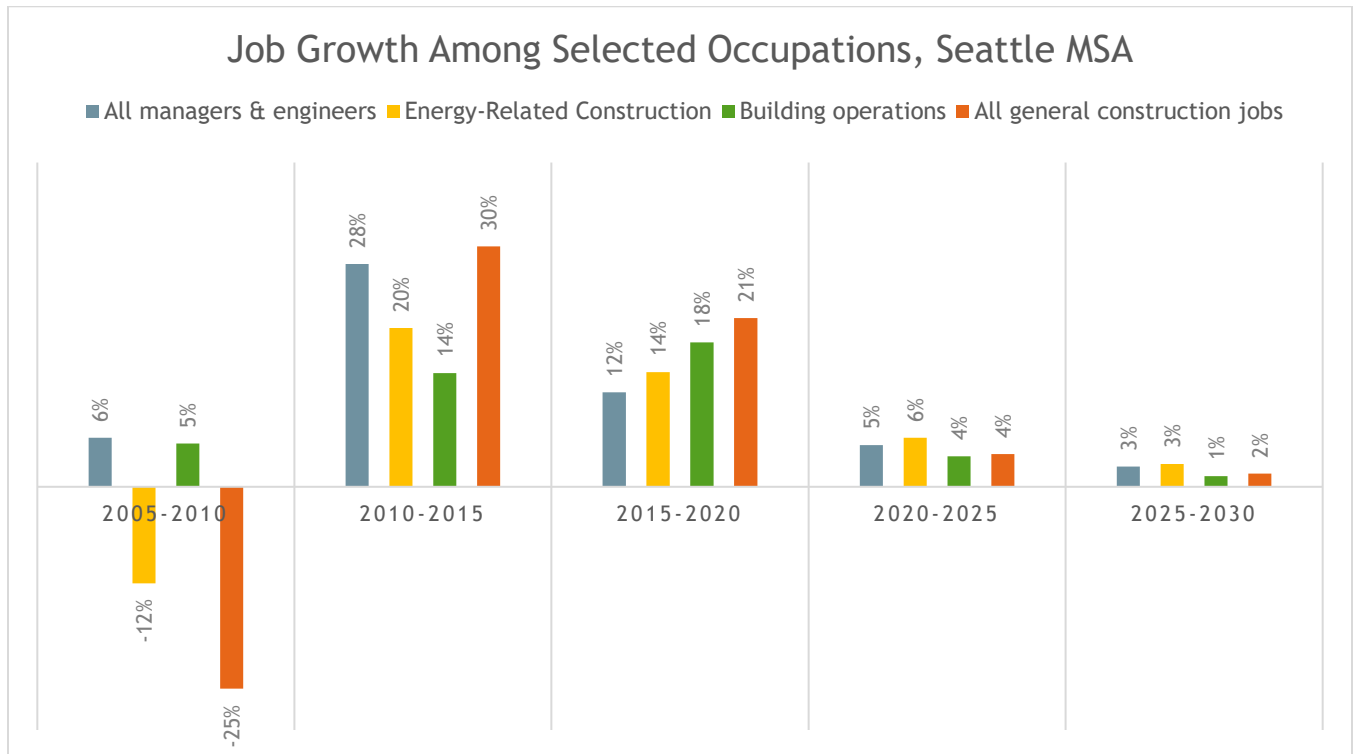


Figure 35. Job growth among selected sectors, Seattle MSA³

Energy-Related Construction occupations will grow the fastest among all sectors. Solar Photovoltaic Installers and Helpers of Pipelayers, Plumbers, Pipefitters & Steamfitters have the brightest prospects with strong growth rates until 2030 of 20% for the former (explained by the low baseline number of jobs in this occupation) and 15% for the latter. All the other Energy-Related Construction sector occupations

will also experience strong growth rates between 2020 and 2030, except for Boilermakers. This occupation is projected to have the lowest growth rate at 3%.

On the other hand, the Building Operations sector will experience a less intense but still comfortable 5% growth rate between 2020 and 2030. Both Maintenance and Repair Workers and Electrical and Electronics Repairers of Powerhouse and Substation will grow the most, by 6%. Inversely, employment for Electrical and Electronics Repairers of Commercial and Industrial Equipment will decline by 3%.

Finally, the Managers and Engineers sector occupations are projected to grow in line with the Seattle MSA’s overall employment (7.8% vs. 7.48%). However, this hides some stark differences across occupations in this sector. For example, Mechanical Engineers are not expected to grow at all (0%), and Construction and Building Inspectors will grow by 5%. On the other hand, Environmental Engineering Technologists and Technicians, and Construction Managers will grow much more quickly, by +9% and +14%, respectively.

Wages and Middle-Wage Careers

Good or Middle-Wage Jobs

Construction and Building Operations has traditionally been a field where people with a high school diploma or less can access jobs and career paths with living wages. The Brookings Institute¹² offers a straightforward definition of these middle-wage jobs. These occupations have a median hourly wage of at least 80% of the metropolitan’s median hourly wage, and fewer than 40% of the workers in those occupations have a bachelor’s degree or more. The Seattle MSA median hourly wage is \$26.40.⁴ Thus, in Seattle, a middle-wage job has a median wage of \$21.12 or more an hour and requires less than a bachelor’s degree.

Of the twenty-five occupations considered, only four do not meet the wage threshold for being considered a middle-wage job, all four of the helper occupations. However, Electrician and Carpenter Helpers fell just short (\$0.12 per hour, \$249.60 annually) of being considered a middle-wage occupation (Table 16).

These jobs do not require any postsecondary education and receive only short on-the-job training. However, these occupations can be a step to entering the respective primary trade, all of which are middle-wage occupations.

Table 16. Construction and Building Operations sectors with earnings, education, experience, and training³

SOC	Description	Median Hourly Earnings	Middle-Wage Occupation	Typical Entry-Level Education Required	Work Experience Required	Typical On-The-Job Training
Building Operations						
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	\$47	Yes	Postsecondary nondegree award	Less than 5 years	Moderate-term
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	\$39	Yes	Postsecondary nondegree award	None	Long-term
51-8021	Stationary Engineers and Boiler Operators	\$36	Yes	High school diploma or equivalent	None	Long-term
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	\$36	Yes	High school diploma or equivalent	Less than 5 years	None
49-9071	Maintenance and Repair Workers, General	\$22	Yes	High school diploma or equivalent	None	Moderate-term

SOC	Description	Median Hourly Earnings	Middle-Wage Occupation	Typical Entry-Level Education Required	Work Experience Required	Typical On-The-Job Training
49-9098	Helpers--Installation, Maintenance, and Repair Workers	\$18	No	High school diploma or equivalent	None	Short-term
Energy-Related Construction						
47-2152	Plumbers, Pipefitters, and Steamfitters	\$37	Yes	High school diploma or equivalent	None	Apprenticeship
47-2111	Electricians	\$36	Yes	High school diploma or equivalent	None	Apprenticeship
47-2011	Boilermakers	\$35	Yes	High school diploma or equivalent	None	Apprenticeship
47-2211	Sheet Metal Workers	\$31	Yes	High school diploma or equivalent	None	Apprenticeship
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	\$30	Yes	Postsecondary nondegree award	None	Long-term
49-9099	Installation, Maintenance, and Repair Workers, All Other	\$25	Yes	High school diploma or equivalent	None	Long-term
47-2231	Solar Photovoltaic Installers	\$23	Yes	High school diploma or equivalent	None	Moderate-term
47-3013	Helpers--Electricians	\$21	No	High school diploma or equivalent	None	Short-term
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	\$19	No	High school diploma or equivalent	None	Short-term on-the-job training
General Construction						
47-2031	Carpenters	\$30	Yes	High school diploma or equivalent	None	Apprenticeship
47-2061	Construction Laborers	\$23	Yes	No formal educational	None	Short-term
47-2131	Insulation Workers, Floor, Ceiling, and Wall Miscellaneous	\$31	Yes	No formal educational	None	Short-term
47-4098	Construction and Related Workers	\$27	Yes	High school diploma or equivalent	None	Moderate-term
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	\$44	Yes	High school diploma or equivalent	5 years or more	None
47-3012	Helpers--Carpenters	\$21	No	No formal educational	None	Short-term
Managers & Engineers						
17-2141	Mechanical Engineers	\$47	No	Bachelor's degree	None	None
11-9021	Construction Managers	\$46	No	Bachelor's degree	None	Moderate-term
17-3025	Environmental Engineering Technologists and Technicians	\$41	Yes	Associate's degree	None	None
47-4011	Construction and Building Inspectors	\$38	Yes	High school diploma or equivalent	5 years or more	Moderate-term

Of all the occupations considered for this report, High Voltage Electricians, Construction Managers, and Mechanical Engineers offer the most significant income potential with median wages well above the Seattle MSA median wage. Additionally, some First-Line Supervisors of Construction Trades and Extraction Workers; Insulation Workers, Floor, Ceiling, and Wall; and Plumbers, Pipefitters, and Steamfitters at the upper hand of the wage distribution (the 75th percentile of hourly wages) also earn a

wage between \$50 and \$54 an hour, much higher than the Seattle-MSA median. This income potential reflects longer work experience and education requirements. However, these jobs are expected to grow slightly less than the other occupations (Mechanical Engineers in particular) (Table 7).

Table 17. Construction and Building Operations sectors with hourly earnings percentiles³

SOC	Description	Pct. 25 Hourly Earnings	Median Hourly Earnings	Pct. 75 Hourly Earnings
Building Operations				
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	\$41	\$47	\$54
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	\$32	\$39	\$45
51-8021	Stationary Engineers and Boiler Operators	\$31	\$36	\$44
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	\$28	\$36	\$45
49-9071	Maintenance and Repair Workers, General	\$17	\$22	\$28
49-9098	Helpers--Installation, Maintenance, and Repair Workers	\$15	\$18	\$25
Energy-Related Construction				
47-2152	Plumbers, Pipefitters, and Steamfitters	\$26	\$37	\$50
47-2111	Electricians	\$25	\$36	\$48
47-2011	Boilermakers	\$33	\$35	\$37
47-2211	Sheet Metal Workers	\$22	\$31	\$47
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	\$23	\$30	\$40
49-9099	Installation, Maintenance, and Repair Workers, All Other	\$18	\$25	\$32
47-2231	Solar Photovoltaic Installers	\$18	\$23	\$28
47-3013	Helpers--Electricians	\$17	\$21	\$30
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	\$16	\$19	\$24
General Construction				
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	\$33	\$44	\$54
47-2131	Insulation Workers, Floor, Ceiling, and Wall	\$20	\$31	\$50
47-2031	Carpenters	\$24	\$30	\$39
47-4098	Miscellaneous Construction and Related Workers	\$20	\$27	\$33
47-2061	Construction Laborers	\$18	\$23	\$31
47-3012	Helpers--Carpenters	\$16	\$21	\$26
Managers & Engineers				
17-2141	Mechanical Engineers	\$36	\$47	\$60
11-9021	Construction Managers	\$34	\$46	\$59
17-3025	Environmental Engineering Technologists and Technicians	\$23	\$41	\$47
47-4011	Construction and Building Inspectors	\$31	\$38	\$45

Overall, occupations in the Construction and Building Operations sector have strong job security in addition to living wages. Eighteen of the 25 are above the Seattle MSA median wage. Another three offer at least 80% of the MSA median wage and can thus be considered middle-wage jobs.

The four remaining occupations are entry-level jobs with no stringent education requirements (Helpers), still offering median hourly wages well above the \$15 minimum. Even though none of the helper occupations can be considered middle-wage, Helpers at the upper end of the hourly earning distribution benefit from a wage larger than the \$21.12 middle-wage criteria, and in some cases, even larger than the Seattle-MSA median hourly wage (Helpers of Electricians). Helper occupations may provide a

pathway for young workers and other individuals with high barriers to employment (e.g., justice-involved, English language learner) to enter the labor market and gain experience and access to living wages occupations without a four-year degree. However, they are not necessarily part of a structured pathway into those careers.

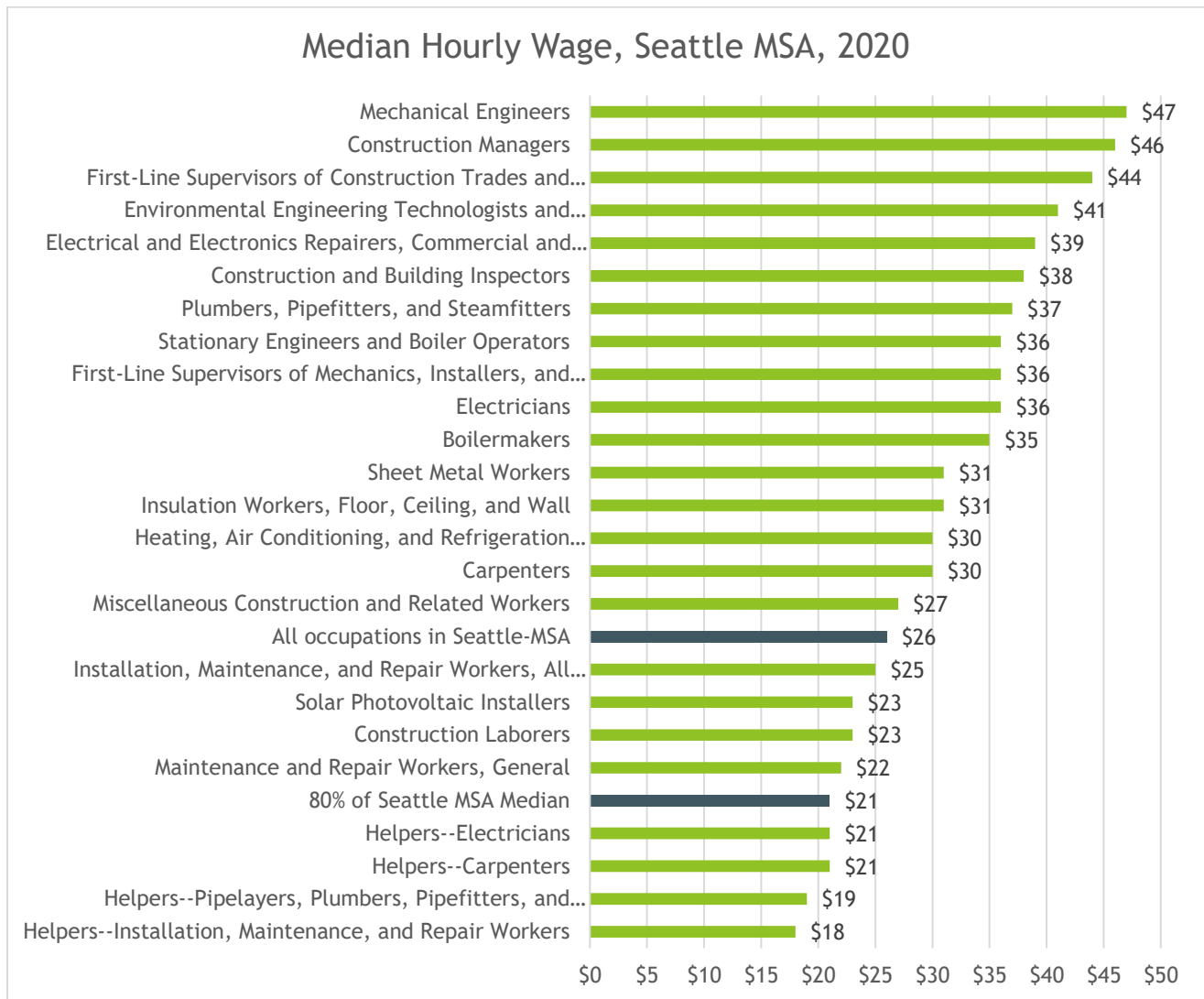


Figure 36. Construction and Building Operations median wage, Seattle MSA, 2020³

Residence of Construction Workers

Figure 30 shows where the Construction and Building Operations workforce lives in the Seattle MSA. Workers are spread relatively evenly over Snohomish County, and southern Pierce County. Relatively few live in King County, and those that do primarily live in South King County (Burien, SeaTac, Tukwila Cities, and White Center).

Limiting the workforce to middle-wage jobs, we see a very similar distribution with the workers concentrated in Snohomish, southern Pierce Counties, and South and Southwest King County.

Relatively few are spread throughout the rest of King County, particularly in the Bellevue and Sammamish, Issaquah, Mercer Island & Newcastle areas.

Finally, limiting it to low-wage occupations, workers are concentrated in southern Pierce County and the City of Tacoma. There is a smaller concentration in the Kent, Renton, Fairwood, Bryn Mawr, and Skyway areas.

This distribution of workers aligns with the cost of housing. The lowest cost housing in the Seattle MSA is in southern Pierce County. In King County, where housing is more accessible via public transportation, the lowest cost housing is in South King County.

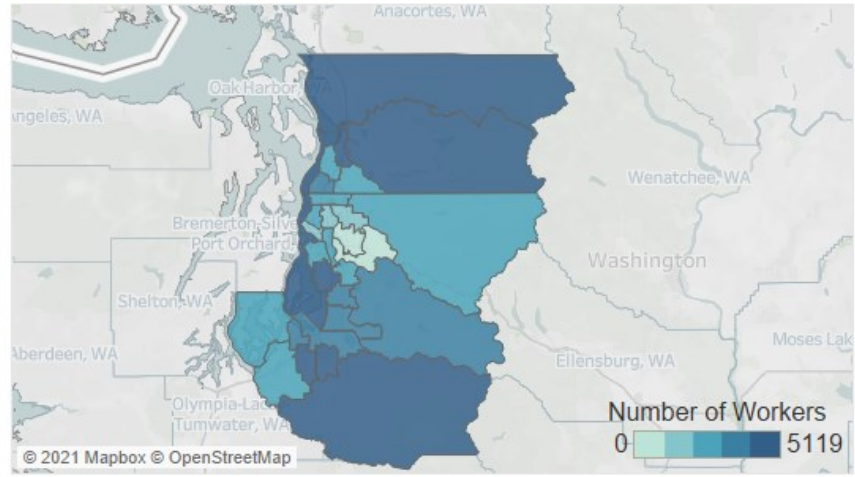


Where the Clean Energy Workforce Lives, Seattle MSA, 2019

All Workers



Middle Wage Workers



Low Wage Workers

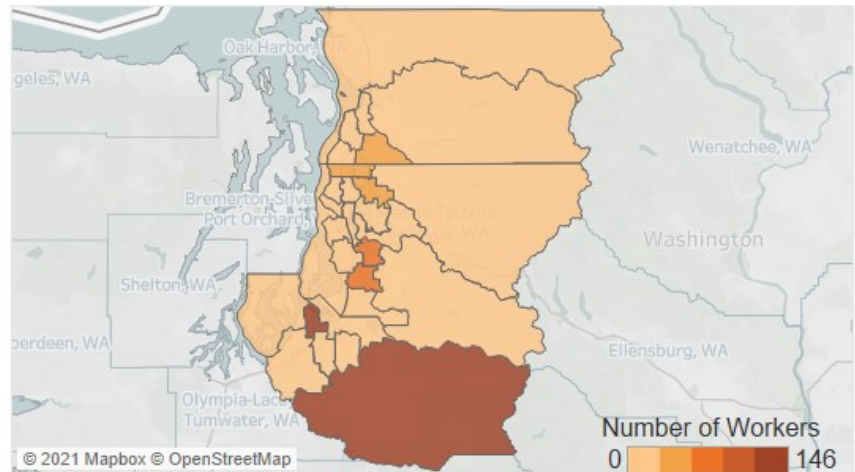


Figure 37. Clean energy workforce residence, Seattle MSA, 2019⁵

Union Membership

The long tradition of union membership and union representation in Construction and Building Operations occupations helped make them middle-wage jobs.* Union representation leads to higher wages, better access to health insurance and pensions, reduced use of safety net programs, and reduced racial and gender wage gaps.^{13 14,15}

Data regarding union representation at the occupation level is not reliable at the metropolitan level. However, state-level estimates are more so, particularly for sector categories.⁶ We have compiled the last five years to increase the sample size's reliability and improve the estimate's accuracy.¹³⁻¹⁵ However, the sample sizes remain small and should be interpreted cautiously.

Washington State has a particularly strong union legacy, and a larger proportion of its workforce is unionized than the US workforce as a whole. An estimated 20% of all Washington workers are covered by union representation compared to 12% nationally,¹³ and an estimated 12% of Washington private-sector workers are unionized compared to 7% nationally.^{13,16}

Percent Represented by Unions
(2015-2019)

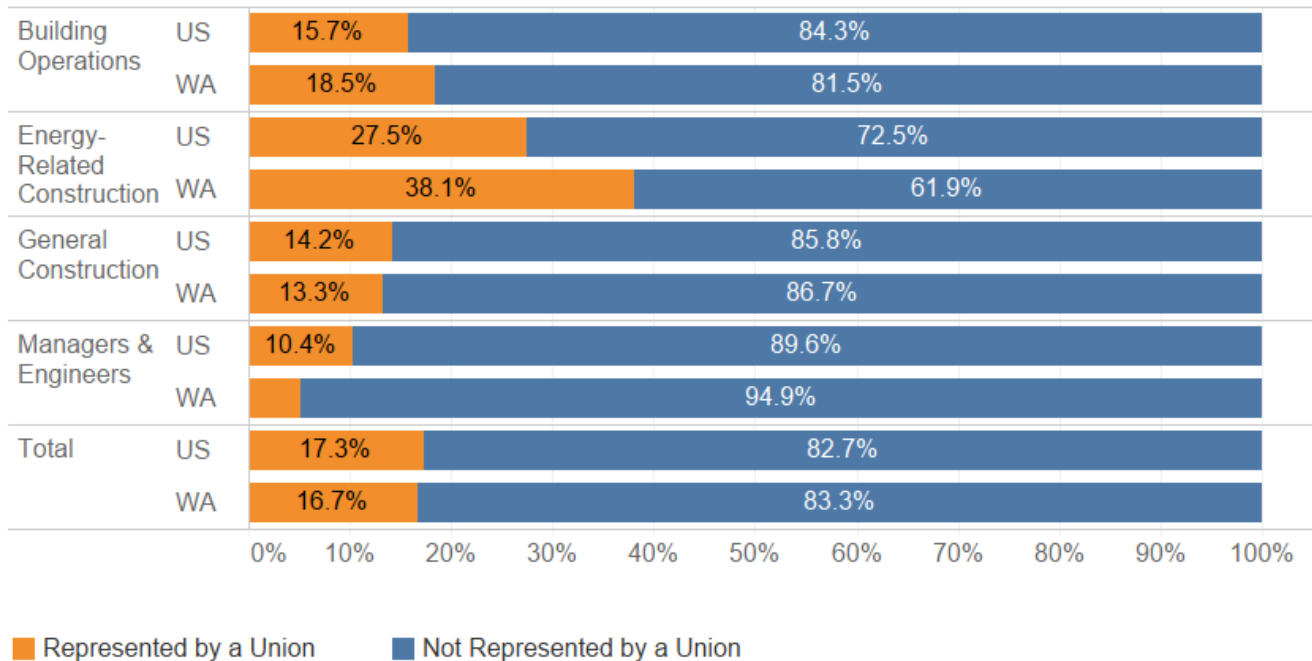


Figure 38. Percent of occupation categories represented by unions, Washington State, 2015-2019⁶

However, this strength in union membership and coverage in Washington State is not uniform across sectors. Washington State's Construction and Building Operations workforce unionization is approximately the same as the United States overall. However, within that, we see that Energy-Related

* Includes those who are not union members but work under union contracts.

Construction has far higher rates of union coverage. At the same time, Managers and Engineers are unionized at substantially lower than the national rate. General Construction is slightly lower, while Building Operations occupations have slightly higher rates.⁶

Educational Pathways

Most Construction and Building Operations occupations are projected to grow over the next five years. The large-scale investments in clean energy and infrastructure proposed at the federal level are anticipated to induce further growth in all of these occupations in the Seattle MSA (Table 18).¹⁷ Recovery from the COVID-19 recession offers an opportunity to increase representation in the Construction and Building Operations occupations. Shorter-term training options that can be stacked to advance in a career and expanding apprenticeship opportunities can offer career paths with living wages to people who have been displaced from other sectors and opportunity youth* who have lost connection to education institutions over the past year.¹⁸

Expanding equity efforts is a crucial part of recovery from both an industry perspective and a workforce perspective. From an industry perspective: many occupations have lost diversity in the last year, and few occupations on are track to be representative of the Seattle MSA demographics at the current rate of change. From a workforce perspective: many people have been unemployed for more than six months, the tipping point at which they begin to experience long-term impacts on their employability and earnings. Opportunities for those people to begin earning a wage while training for a career with a living wage will be critical to helping those hardest hit by the COVID-19 recession to recover.

The Energy-Related Construction and General Construction occupations, in particular, have high baseline levels of growth, and investments in clean energy infrastructure further increase the demand for those workers. These are also primarily journey worker occupations with training done via apprenticeship. The first-line supervisors typically come from the occupations they supervise. Helpers are often in pre-apprenticeship programs or waiting for apprenticeship openings.

“Expanding equity efforts is a crucial part of recovery from both an industry perspective and a workforce perspective.”

* Opportunity youth are defined as people 16 to 24 years of age who are not employed and not enrolled in education or training.

Table 18. Employment projections and training strategies^{3,19}

Occupation	Median Wage ³	Baseline Growth 2020-2024 ³	Net Growth with Clean Energy Investments by 2024 ¹⁹	Training strategies
Managers & Engineers				
Construction Managers	\$95,082	7.35%	0.34%	<ul style="list-style-type: none"> • Bachelor’s degree in Construction Management <i>Short-term training options:</i> <ul style="list-style-type: none"> • Certificates to AAS degrees at technical colleges (Construction Management or Leadership in the Trades). • Short-term online courses on construction scheduling, finance, and management also available
Environmental Engineering Technologists and Technicians	\$84,955	5.52%	0.86%	<ul style="list-style-type: none"> • AAS and bachelor’s degrees in Environmental Sciences & Technology <i>Short-term training options:</i> <ul style="list-style-type: none"> • Online courses and programs in Sustainability, Renewable Energy, Environmental Management available on online platforms (Coursera, EdX)
Construction and Building Inspectors	\$79,967	3.10%	0.47%	<ul style="list-style-type: none"> • Building Inspection certificate - less than 2 years training • ICC Examiner and Inspectors certifications in residence, commercial and green buildings • Home Inspector license from WA State <i>Short-term training options:</i> <ul style="list-style-type: none"> • 1-quarter Residential Building Inspection certificate at Bellingham Technical College • Online courses at InterNACHI (\$49/month) <i>WA State licensing requirements for Home Inspectors:</i> <ul style="list-style-type: none"> • Fundamentals of Home Inspection courses (120 clock hours) (approved course catalog: https://professions.dol.wa.gov/s/course-search) • Field training (40 hours)
Mechanical Engineers	\$97,430	0.91%	1.22%	<ul style="list-style-type: none"> • Certificate, bachelor’s, and master’s degrees in Mechanical Engineering at colleges and universities <i>Short-term training options:</i> <ul style="list-style-type: none"> • Online courses and programs in Mechanical Engineering available on online platforms (Coursera, EdX)
Energy-Related Construction				
Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	\$38,772	9.04%	0.22%	<ul style="list-style-type: none"> • Some experience in the trade but field experience is not required • Short Electricians or electrical technician certificates or short classes at CITC WA could help meet experience requirements
Solar Photovoltaic Installers	\$47,301	8.70%	0.34%	<ul style="list-style-type: none"> • Solar power option (16-hour continuing education class) available at some electrical apprenticeship programs (Puget Sound Electrical Joint Apprenticeship and Training Committee): <i>Short-term training options:</i>

Occupation	Median Wage ³	Baseline Growth 2020-2024 ³	Net Growth with Clean Energy Investments by 2024 ¹⁹	Training strategies
				<ul style="list-style-type: none"> • Many courses and programs on solar energy on online learning platforms
Energy-Related Construction				
Plumbers, Pipefitters, and Steamfitters	\$76,998	7.21%	0.26%	<ul style="list-style-type: none"> • Plumbing requires a certification from L&I. <p><i>Plumber:</i></p> <ul style="list-style-type: none"> • 2-4 years as a trainee (shortest: residential services plumber) • 1-year Plumbing Technician college program (Perry Tech) • Several short courses (code and exam prep) available from CITC of WA state <p><i>Pipefitter and Steamfitter:</i></p> <ul style="list-style-type: none"> • 3-5 years as a trainee (union or college apprenticeship)
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	\$62,068	6.43%	0.29%	<ul style="list-style-type: none"> • Commercial Refrigeration Technology AAS and certificate at technical and community colleges • HVAC Mechanics must be certified by organizations approved by the EPA (trade schools, unions, employer associations) <p><i>Short-term training options:</i></p> <ul style="list-style-type: none"> • 5-week programs on efficient HVAC systems on online learning platforms
Electricians	\$74,727	4.86%	0.45%	<ul style="list-style-type: none"> • Electricians require a certification from L&I, obtained after 4 years as a trainee. • 9-quarter degree at technical colleges <p><i>Short-term training options:</i></p> <ul style="list-style-type: none"> • Mechanical Electrical Technician: short certificate (23 credits) at Walla Walla Community College • Several short courses (introductory and exam prep) available from CITC of WA state
Sheet Metal Workers	\$64,427	4.23%	0.50%	<ul style="list-style-type: none"> • 6-quarter AAS degree (grads credited a full year towards apprenticeship) • 4-year apprenticeship
Installation, Maintenance, and Repair Workers, All Other	\$52,925	3.29%	0.69%	N/A
Boilermakers	\$72,645	3.04%	0.42%	<ul style="list-style-type: none"> • Min 6000 hours apprenticeship (3-4 years)
Helpers--Electricians	\$44,507	2.36%	0.26%	<ul style="list-style-type: none"> • 0-2 years of experience in the electrical trade, but field experience is not required • Short Electricians or electrical technician certificates or CITC WA classes could applicants meet experience requirements <p><i>Other common requirements:</i></p>

Occupation	Median Wage ³	Baseline Growth 2020-2024 ³	Net Growth with Clean Energy Investments by 2024 ¹⁹	Training strategies
				<ul style="list-style-type: none"> • Electrical Safety and OSHA training (can be completed online)
Building Operations				
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	\$98,038	4.13%	0.49%	<ul style="list-style-type: none"> • Electrical Plant Maintenance certificate at RTC • Industrial Power and Control AAS degree (2-year)
Maintenance and Repair Workers, General	\$46,090	3.71%	0.48%	<ul style="list-style-type: none"> • Commercial Building Engineering certificate and AAS degree • 1-quarter certificates to AAS degrees in Facility Maintenance at technical and community colleges
Helpers--Installation, Maintenance, and Repair Workers	\$37,188	3.26%	0.39%	<ul style="list-style-type: none"> • EPA Refrigerant Handling certification is often required. • 1-year experience preferred but not required • Basic understanding of electrical circuits, air flows, gas diagnostics, etc. • Possibility to prepare for certification and get training at select community colleges (SCC, SSC) or technical colleges (RTC): 160-hour HVAC-R Certified Technician Program
Stationary Engineers and Boiler Operators	\$74,665	2.57%	0.38%	<ul style="list-style-type: none"> • Commercial Building Engineering certificate and AAS
First-Line Supervisors of Mechanics, Installers, and Repairers	\$73,971	1.39%	0.49%	<ul style="list-style-type: none"> • Examples of occupations: Electrical Foreman, Facility Maintenance Supervisor, Maintenance Manager, etc. • AAS and Bachelor's in Operations Management and Supervision • Less than 5 years of on-the-job and leadership experience required
Electrical and Electronics Repairers, Commercial and Industrial Equipment	\$80,086	-0.24%	0.66%	<ul style="list-style-type: none"> • Industrial Electronics and Electronics Technology AAS (8-quarter) and certificate (5-quarter)
General Construction				
Insulation Workers, Floor, Ceiling, and Wall	\$64,646	6.13%	0.22%	<ul style="list-style-type: none"> • 4-year apprenticeship for Heat and Frost Insulators and Asbestos Workers
Construction Laborers	\$48,024	5.34%	0.35%	<ul style="list-style-type: none"> • No formal educational credential • Short-term on-the-job training through pre-apprenticeship or apprenticeship programs
Miscellaneous Construction and	\$55,413	4.17%	0.40%	N/A

Occupation	Median Wage ³	Baseline Growth 2020-2024 ³	Net Growth with Clean Energy Investments by 2024 ¹⁹	Training strategies
Related Workers				
General Construction				
First-Line Supervisors of Construction Trades and Extraction Workers	\$91,258	3.74%	0.32%	<ul style="list-style-type: none"> • Examples of occupations: Construction Foreman, Electrical Supervisor, Insulation Foreman, Sheet Metal Foreman, etc. • 5 years of construction and leadership experience required <p><i>Short-term training options:</i></p> <ul style="list-style-type: none"> • Certificates to AAS degrees at technical colleges (Construction Management or Leadership in the Trades). • Short-term online courses on construction scheduling, finance, and management also available on online platforms • Program on project supervision at CITC WA
Helpers--Carpenters	\$44,220	3.68%	0.24%	<ul style="list-style-type: none"> • 0-2 years of experience preferred in carpentry and construction • Pre-apprenticeship in Construction at the Wood Technology Center (Seattle Central College) and ANEW • Short classes at Ballard Woodworks and the Skills Center School could help acquire the required knowledge
Carpenters	\$62,309	2.80%	0.34%	<ul style="list-style-type: none"> • High school diploma or equivalent • 4-year apprenticeship • 5-quarter AAS program in Carpentry at community and technical colleges

Conclusion & Recommendations

Responding to climate change requires that our built environment becomes more energy-efficient and resilient to extreme temperatures and weather events. A variety of state and local policies, both existing and proposed, will drive increased investments in the built environment. The Biden Administration has prioritized responding to climate change, proposing an additional \$3 trillion in jobs and infrastructure spending, with significant investments in clean energy and infrastructure.²⁰ These policies, plus the increased private-sector demand as the economy recovers from the COVID-19 recession, are projected to produce growth across the Construction and Building Operations sector.

As the economy enters recovery, it will be critical to expand training opportunities in the Construction and Building Operations field, particularly the apprenticeship pathways. These journey occupations have been consistently undersupplied for the last decade. They, by and large, are increasing the share of BIPOC workers more slowly than the Seattle MSA's BIPOC population is growing. This means they are not on track to ever be representative of the Seattle workforce.

The COVID-19 recession has had a disproportionate impact on BIPOC workers. They are the most likely to have been unemployed for six or more months, meaning there is a large pool of potential workers waiting to be engaged.²¹ However, thanks to the disproportionate impact of the COVID-19 recession, these workers also face higher barriers to re-entering the workforce. Apprenticeship, pre-apprenticeship, and college programs must be prepared to address these barriers, or their recruitment and registration of BIPOC workers and women workers will continue to lag.

“ The COVID-19 recession has had a disproportionate impact on BIPOC workers. ”

Recommendations:

- Coordinate with organizations that provide wrap-around services (e.g., Basic Food Employment and Training, childcare, rental assistance) to address barriers, especially barriers that have been exacerbated by the COVID-19 recession and allow students and apprentices to participate in training.
- Continue to educate employers about creating a working environment supportive of women and BIPOC workers.
- Strengthen on-ramp programs, particularly pre-apprenticeship programs, address skills gaps (especially digital skills) that prevent workers from advancing on their career paths.
- Strengthen the connections between pre-apprenticeships and apprenticeship and other short-term training options and the full-length training options to improve women and BIPOC workers' retention.

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Appendix A: Seattle-Tacoma-Bellevue Metropolitan Statistical Area

Seattle-Tacoma-Bellevue MSA



Figure 39. Seattle-Tacoma-Bellevue Metropolitan Statistical Area

Appendix B: Descriptions of Studied Occupations²²

Table 19. O*NET Occupation Descriptions

Level	SOC Code	Title	O*NET Description
Building Operations			
Managers & Supervisors	49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	Directly supervise and coordinate the activities of mechanics, installers, and repairers. May also advise customers on recommended services. Excludes team or work leaders.
Journey Workers	49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	Inspect, test, repair, or maintain electrical equipment in generating stations, substations, and in-service relays.
	51-8021	Stationary Engineers and Boiler Operators	Operate or maintain stationary engines, boilers, or other mechanical equipment to provide utilities for buildings or industrial processes. Operate equipment such as steam engines, generators, motors, turbines, and steam boilers.
	49-9071	Maintenance and Repair Workers, General	Perform work involving the skills of two or more maintenance or craft occupations to keep machines, mechanical equipment, or the structure of a building in repair. Duties may involve pipe fitting; HVAC maintenance; insulating; welding; machining; carpentry; repairing electrical or mechanical equipment; installing, aligning, and balancing new equipment; and repairing buildings, floors, or stairs.
	49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	Repair, test, adjust, or install electronic equipment, such as industrial controls, transmitters, and antennas.
Helpers	49-9098	Helpers--Installation, Maintenance, and Repair Workers	Help installation, maintenance, and repair workers in maintenance, parts replacement, and repair of vehicles, industrial machinery, and electrical and electronic equipment. Perform duties such as furnishing tools, materials, and supplies to other workers; cleaning work area, machines, and tools; and holding materials or tools for other workers.

Level	SOC Code	Title	O*NET Description
Energy-Related Construction			
Journey Workers	49-9099	Installation, Maintenance, and Repair Workers, All Other	All installation, maintenance, and repair workers not listed separately.
	47-2152	Plumbers, Pipefitters, and Steamfitters	Assemble, install, alter, and repair pipelines or pipe systems that carry water, steam, air, or other liquids or gases. May install heating and cooling equipment and mechanical control systems. Includes sprinkler fitters.
	47-2231	Solar Photovoltaic Installers	Assemble, install, or maintain solar photovoltaic (PV) systems on roofs or other structures in compliance with site assessment and schematics. May include measuring, cutting, assembling, and bolting structural framing and solar modules. May perform minor electrical work such as current checks.
	47-2011	Boilermakers	Construct, assemble, maintain, and repair stationary steam boilers and boiler house auxiliaries. Align structures or plate sections to assemble boiler frame tanks or vats, following blueprints. Work involves use of hand and power tools, plumb bobs, levels, wedges, dogs, or turnbuckles. Assist in testing assembled vessels. Direct cleaning of boilers and boiler furnaces. Inspect and repair boiler fittings, such as safety valves, regulators, automatic-control mechanisms, water columns, and auxiliary machines.
	47-2211	Sheet Metal Workers	Fabricate, assemble, install, and repair sheet metal products and equipment, such as ducts, control boxes, drainpipes, and furnace casings. Work may involve any of the following: setting up and operating fabricating machines to cut, bend, and straighten sheet metal; shaping metal over anvils, blocks, or forms using hammer; operating soldering and welding equipment to join sheet metal parts; or inspecting, assembling, and smoothing seams and joints of burred surfaces. Includes sheet metal duct installers who install prefabricated sheet metal ducts used for heating, air conditioning, or other purposes.

Level	SOC Code	Title	O*NET Description
Energy-Related Construction			
Journey Workers	49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Install or repair heating, central air conditioning, HVAC, or refrigeration systems, including oil burners, hot-air furnaces, and heating stoves.
	47-2111	Electricians	Install, maintain, and repair electrical wiring, equipment, and fixtures. Ensure that work is in accordance with relevant codes. May install or service streetlights, intercom systems, or electrical control systems.
Helpers	47-3013	Helpers--Electricians	Help electricians by performing duties requiring less skill. Duties include using, supplying, or holding materials or tools, and cleaning work area and equipment.
	47-3015	Helpers--Pipefitters, Plumbers, Pipefitters, and Steamfitters	Help plumbers, pipefitters, steamfitters, or pipelayers by performing duties requiring less skill. Duties include using, supplying, or holding materials or tools, and cleaning work area and equipment.
General Construction			
Managers & Supervisors	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	Directly supervise and coordinate activities of construction or extraction workers.
Journey Workers	47-4098 & 47-4099	Construction and Related Workers, All Other	All construction and related workers not listed separately.
	47-2031	Carpenters	Construct, erect, install, or repair structures and fixtures made of wood and comparable materials, such as concrete forms; building frameworks, including partitions, joists, studding, and rafters; and wood stairways, window and door frames, and hardwood floors. May also install cabinets, siding, drywall, and batt or roll insulation. Includes brattice builders who build doors or brattices (ventilation walls or partitions) in underground passageways.
	47-2131	Insulation Workers, Floor, Ceiling, and Wall	Line and cover structures with insulating materials. May work with batt, roll, or blown insulation materials.

Level	SOC Code	Title	O*NET Description
General Construction			
Journey Workers	47-2061	Construction Laborers	Perform tasks involving physical labor at construction sites. May operate hand and power tools of all types: air hammers, earth tampers, cement mixers, small mechanical hoists, surveying and measuring equipment, and a variety of other equipment and instruments. May clean and prepare sites, dig trenches, set braces to support the sides of excavations, erect scaffolding, and clean up rubble, debris, and other waste materials. May assist other craft workers.
Helpers	47-3012	Helpers--Carpenters	Help carpenters by performing duties requiring less skill. Duties include using, supplying, or holding materials or tools, and cleaning work area and equipment.
Managers & Engineers			
Engineering Professional	17-3025	Environmental Engineering Technologists and Technicians	Apply theory and principles of environmental engineering to modify, test, and operate equipment and devices used in the prevention, control, and remediation of environmental problems, including waste treatment and site remediation, under the direction of engineering staff or scientists. May assist in the development of environmental remediation devices.
	17-2141	Mechanical Engineers	Perform engineering duties in planning and designing tools, engines, machines, and other mechanically functioning equipment. Oversee installation, operation, maintenance, and repair of equipment such as centralized heat, gas, water, and steam systems.
Managers & Supervisors	Nov-21	Construction Managers	Plan, direct, or coordinate, usually through subordinate supervisory personnel, activities concerned with the construction and maintenance of structures, facilities, and systems. Participate in the conceptual development of a construction project and oversee its organization, scheduling, budgeting, and implementation. Includes managers in specialized construction fields, such as carpentry or plumbing.
Journey Workers	47-4011	Construction and Building Inspectors	Inspect structures using engineering skills to determine structural soundness and compliance with specifications, building codes, and other regulations. Inspections may be general in nature or may be limited to a specific area, such as electrical systems or plumbing.

Appendix C: Gross Regional Product Estimations

Table 10 below presents the gross regional product (GRP) for each occupation. These estimates were obtained using data from EMSI, including: Gross Regional Product per industry (NAICS 6-digit level) in the Seattle, MSA area; occupational staffing patterns by industry (number of workers from each occupation employed in each NAICS 6-digit level industry); and annual median wage per occupation. First, using the occupation median wage and number of workers per industry, we estimate for each industry the total earnings of the occupations considered in this report. Then, since GRP is a function of the total industry earnings, we compute a value-added labor income coefficient indicating how \$1 in earnings translates into the industry's total regional product. Finally, the occupational earnings GRP is scaled by the value-added labor income coefficient to compute the occupation's GRP.

Using this methodology, it appears that occupations considered in this report contribute significantly to the Seattle MSA's total GRP, which amounts to slightly more than \$478 billion in 2020. Separately, each occupation represents a small fraction of the regional gross product (maximum 0.39% for carpenters, and minimum 0.001% for Solar Photovoltaic Installers). But together, they contribute to 2.7% of the regional GRP (Table 10).

Unsurprisingly, the occupations with the largest number of workers (carpenters, maintenance workers, and construction laborers) contribute the most in absolute value to the Seattle-MSA regional gross regional product (GRP). Occupations with the fewest workers (solar photovoltaic installers and boilermakers) contribute smaller amounts.

However, looking at the gross product per worker in each occupation offers a different perspective. In fact, with a product of \$250,732, each electrical and electronics repairers of powerhouse, substation, and relay contribute more to the Seattle MSA gross product than any other worker in the occupations considered for this report. While this doesn't reflect an occupation's utility for its employer, it is tied by the value of the goods and services produced by that occupation. Output value can be driven by consumers' demand, and costs of production and distribution. For example, in the Seattle MSA, powerhouse repairers are mainly employed by the Federal Government (Military) and Electric Power Distribution sectors. Power plants generate electricity for thousands of households and firms, explaining the high value of electricity produced and ultimately of powerhouse repairers.

The next highest GRP per worker is seen for mechanical engineers (\$169,767 per worker) and electrical and electronics repairers of commercial and industrial equipment (\$152,559 per worker). Finally, with a GRP per worker of \$46,890, Helpers of Pipelayers, Plumbers, Pipefitters, and Steamfitters contribute the least to the regional product among this report's occupations. Most of these workers are employed in the Plumbing, Heating, and Air-Conditioning Contractors sector (NAICS code 238220), which has a total regional product of \$2.1 billion. However, they only make up less than 3% of that industry, explaining the relatively low GRP per worker.

Table 20. Occupation gross regional product ³

SOC	Occupation	Occupation GRP	Occupation GRP as % of Seattle-MSA GRP	Jobs in 2020	Occupation GRP per worker	Occupation GRP vs Median Wage
Building Operations						
49-9071	Maintenance and Repair Workers, General	\$1,314,039,771	0.34%	21,901	\$59,999	130%
51-8021	Stationary Engineers and Boiler Operators	\$46,791,980	0.01%	361	\$129,618	174%
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	\$83,528,801	0.05%	1,203	\$152,559	190%
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	\$54,408,835	0.01%	217	\$250,732	256%
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	\$1,025,818,050	0.26%	8,142	\$125,991	170%
49-9098	Helpers--Installation, Maintenance, and Repair Workers	\$60,001,945	0.02%	1,178	\$50,935	137%
Energy-Related Construction						
47-2111	Electricians	\$1,155,673,307	0.30%	11,965	\$96,588	129%
47-2152	Plumbers, Pipefitters, and Steamfitters	\$574,431,513	0.15%	6,027	\$95,310	124%
47-2211	Sheet Metal Workers	\$245,429,987	0.06%	2,900	\$84,631	131%
47-2011	Boilermakers	\$13,134,273	0.00%	145	\$90,581	125%
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	\$377,708,927	0.10%	4,699	\$80,381	130%
47-2231	Solar Photovoltaic Installers	\$4,612,390	0.00%	58	\$79,524	168%
47-3013	Helpers--Electricians	\$22,573,020	0.01%	418	\$54,002	121%
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	\$22,085,265	0.01%	471	\$46,890	121%
49-9099	Installation, Maintenance, and Repair Workers, All Other	\$125,119,854	0.03%	1,467	\$85,290	161%
General Construction						
47-2031	Carpenters	\$1,500,506,543	0.39%	19,708	\$76,137	122%
47-2061	Construction Laborers	\$1,307,611,782	0.34%	22,240	\$58,795	122%
47-2131	Insulation Workers, Floor, Ceiling, and Wall	\$64,529,479	0.02%	824	\$78,312	121%
47-4098	Miscellaneous Construction and Related Workers	\$25,238,820	0.01%	335	\$75,340	136%
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	\$1,255,951,095	0.32%	11,194	\$112,199	123%
47-3012	Helpers—Carpenters	\$38,230,542	0.01%	708	\$53,998	122%

SOC	Occupation	Occupation GRP	Occupation GRP as % of Seattle-MSA GRP	Jobs in 2020	Occupation GRP per worker	Occupation GRP vs Median Wage
Manages and Engineers						
11-9021	Construction Managers	\$882,385,414	0.23%	7,548	\$116,903	123%
47-4011	Construction and Building Inspectors	\$172,482,605	0.04%	1,877	\$91,893	115%
17-2141	Mechanical Engineers	\$820,314,466	0.21%	4,832	\$169,767	174%
17-3025	Environmental Engineering Technologists and Technicians	\$40,449,208	0.01%	326	\$124,077	146%

Appendix D: List of Stakeholders

- Jacob Jackson, Executive Dean of the Workforce, Trades & Economic Development Department at Renton Technical College
- Clay Tschillard, Training Director of the Puget Sound Electrical Apprenticeship
- Steve Harper, Training Director of the International Brotherhood of Electrical Workers (IBEW) Local 76
- Seth Thompson, Training Director of the United Association Local 26
- Steven Banks, BCO employment coach at Trade Occupations Opportunity Learning (TOOL) Center at Bates Technical College
- Catie Chaplan, Lead Instructor in Carpentry at the Pre-Apprenticeship Construction Training Program of Seattle Central College

Appendix E: Data Collection Methodology

Current Workforce

The number employed by race, gender, and age for each occupation in the Seattle MSA was drawn from the Emsi Labor Market Analytics, 2021.³ The Seattle MSA working-age population race and ethnicity and population entering working the workforce was calculated from the American Community Survey Public Use Microdata Sample (PUMS)⁵ 2019 one-year data, downloaded from the IPUMS USA database, Version 11.0.⁵ The data was limited to Public Use Microdata Areas (PUMAs) in the Seattle MSA.²³

The English Language Proficiency and Primary language by occupational sector and level were calculated from the American Community Survey Public Use Microdata Sample (PUMS)⁵ 2019 one-year data, downloaded from the IPUMS USA database, Version 11.0.⁵ The data was limited to Public Use Microdata Areas (PUMAs) in the Seattle MSA.²³

Workforce Trends

The trends and growth rates for each occupation in the Seattle MSA calculated based on data from the Emsi Labor Market Analytics, 2021.³

Wages and Middle-Wage Careers

The wages for each occupation in the Seattle MSA and the median income for the MSA were calculated based on data from the Emsi Labor Market Analytics, 2021.³

Residence

The locations of workers in the selected occupations drawn from the American Community Survey Public Use Microdata Sample (PUMS)⁵ 2019 one-year data, downloaded from the IPUMS USA database, Version 11.0.⁵ The data was limited to Public Use Microdata Areas (PUMAs) in the Seattle MSA.²³

Union Membership

Union membership percentages were calculated based on data from the Current Population Study (CPS) for the State of Washington. We used CPS Outgoing Rotation Group (ORG) files downloaded from IPUMS CPS, Version 8.0.⁶ Five years of data, 2015 to 2019, were pooled to improve reliability. A union worker is someone who has membership in a union or is covered by a union contract.^{13,14}

Education Pathways

Apprenticeship data was drawn from the Washington State Labor & Industry Apprenticeship Program and Apprentice Registration and Tracking Systems (ARTS) databases.^{7,8}

Projected Growth

The projected growth with additional investment in clean energy and infrastructure is calculated based on unpublished data from "Rebuilding American manufacturing—potential job gains by state and industry: Analysis of trade, infrastructure, and clean energy/energy efficiency proposals" by the Economic Policy Institute (accessed February 12, 2021) and from personal communication with Robert Scott (February 24, 2021).¹⁹ This unpublished data estimates job creation per industry following investment in clean energy and infrastructure. Using EMSI inverse staffing data that details the industries employing an occupation, it is possible to know how each SOC role considered in this report will be impacted by these job creation estimates.

Appendix F: Data Tables

Table 21. Occupational sector race & ethnicity³

Occupation	Latinx		Asian		Black/African American		Native American/Alaska Native		Native Hawaiian/Pacific Islander		Two or More Races		White		Total
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
Building Operations															
Electrical Repairers I	95	7.92%	70	5.79%	85	7.03%	12	1.00%	12	0.97%	51	4.28%	879	73.01%	1,203
Electrical Repairers II	17	8.02%	6	2.77%	14	6.30%	6	2.77%	11	5.07%			163	75.07%	217
First-Line Supervisors of Mechanics, Installers	567	6.96%	309	3.79%	291	3.58%	78	0.96%	61	0.75%	269	3.31%	6,567	80.65%	8,142
Helpers--Installation Workers	215	18.24%	93	7.93%	56	4.74%	18	1.50%	37	3.16%	56	4.76%	703	59.67%	1,178
Maintenance and Repair Workers, General	2,575	11.76%	1,449	6.62%	1,160	5.30%	282	1.29%	210	0.96%	614	2.80%	15,611	71.28%	21,901
Stationary Engineers and Boiler Operators	29	7.92%	36	9.89%	23	6.25%	2	0.55%	2	0.55%	13	3.53%	257	71.31%	361
Total	3,498	10.6%	1,963	5.9%	1,628	4.9%	398	1.2%	333	1.0%	1,004	3.0%	24,179	73.3%	33,002
Energy-Related Construction															
Boilermakers	10	7.22%	4	2.77%	4	2.77%	4	2.77%	0	0.00%	4	2.77%	118	81.71%	145
Electricians	1,061	8.87%	402	3.36%	361	3.01%	109	0.91%	69	0.57%	397	3.32%	9,567	79.96%	11,965
Helpers—Electricians	104	24.97%	6	1.44%	18	4.20%	5	1.20%	6	1.44%	19	4.61%	260	62.15%	418
Helpers--Pipelayers, Plumbers, Pipefitters...	105	22.36%	11	2.34%	22	4.57%	4	0.85%	5	1.06%	23	4.82%	302	64.01%	471
HVAC Mechanics & Installers	414	8.81%	150	3.20%	133	2.82%	37	0.80%	15	0.32%	146	3.10%	3,803	80.94%	4,699
Installation Workers	172	11.70%	82	5.59%	59	4.02%	11	0.75%	15	1.02%	44	2.99%	1,085	73.94%	1,467
Plumbers, Pipefitters, and Steamfitters	635	10.53%	132	2.20%	165	2.74%	67	1.10%	37	0.62%	200	3.32%	4,790	79.49%	6,027
Sheet Metal Workers	248	8.54%	140	4.84%	94	3.25%	22	0.76%	17	0.60%	93	3.22%	2,286	78.80%	2,900
Solar Photovoltaic Installers	10	17.56%	2	3.44%	2	3.44%	2	3.44%	2	3.44%	2	3.44%	38	65.22%	58
Total	2,759	9.8%	930	3.3%	856	3.0%	261	0.9%	167	0.6%	927	3.3%	22,248	79.0%	28,149

Occupation	Latinx		Asian		Black/African American		Native American/Alaska Native		Native Hawaiian/Pacific Islander		Two or More Races		White		Total
General Construction															
Carpenters	3,634	18.44%	687	3.48%	514	2.61%	255	1.29%	139	0.70%	582	2.95%	13,897	70.52%	19,708
Construction Laborers	5,127	23.05%	828	3.72%	894	4.02%	330	1.48%	216	0.97%	712	3.20%	14,133	63.55%	22,240
First-Line Supervisors of Construction Trades	947	8.46%	238	2.12%	218	1.94%	118	1.06%	76	0.68%	250	2.23%	9,347	83.50%	11,194
Helpers--Carpenters	194	27.35%	23	3.27%	40	5.59%	8	1.13%	7	0.99%	24	3.40%	413	58.28%	708
Insulation Workers	150	18.26%	28	3.44%	41	5.00%	7	0.85%	7	0.85%	27	3.23%	563	68.36%	824
Misc Construction Workers	53	15.68%	11	3.37%	17	5.14%	5	1.49%	17	5.14%			232	69.18%	335
Total	10,105	18.4%	1,815	3.3%	1,723	3.1%	724	1.3%	461	0.8%	1,595	2.9%	38,586	70.1%	55,009
Managers & Engineers															
Construction and Building Inspectors	106	5.65%	72	3.85%	52	2.77%	35	1.86%	6	0.32%	58	3.11%	1,547	82.44%	1,877
Construction Managers	427	5.65%	305	4.04%	92	1.21%	49	0.66%	24	0.32%	201	2.66%	6,451	85.46%	7,548
Environmental Engineering Tech	23	7.11%	35	10.86%	12	3.53%	2	0.61%	3	0.92%	12	3.63%	239	73.33%	326
Mechanical Engineers	166	3.33%	887	17.84%	67	1.34%	10	0.20%	165	3.32%	142	2.85%	3,537	71.12%	4,974
Total	722	4.9%	1,300	8.8%	67	1.5%	96	0.7%	198	1.3%	413	2.8%	11,775	80.0%	17,726
Construction & Build Operations Total	17,084	13.07%	6,014	4.60%	4,432	3.39%	1,475	1.13%	991	0.76%	3,960	3.03%	96,788	74.03%	130,744
Seattle-Tacoma-Bellevue Metropolitan Statistical Area															
Population Entering the Workforce (ages 19-22 years)	28,759	16.47%	25,891	14.83%	12,806	7.33%	1,820	1.04%	2,331	1.33%	12,704	7.28%	90,304	51.72%	174,615
Seattle Working-Age Population (ages 19-64 years)	248,831	9.94%	366,290	14.63%	157,252	6.28%	18,653	0.74%	22,645	0.90%	119,272	4.76%	1,571,172	62.74%	2,504,115

Table 22. Occupational level race & ethnicity³

Occupation	Latinx		Asian		Black/African American		Native American/Alaska Native		Native Hawaiian/Pacific Islander		Two or More Races		White		Grand Total
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
Engineering Professionals															
Environmental Engineering Tech	23	7.11%	35	10.86%	12	3.53%	2	0.61%	3	0.92%	12	3.63%	239	73.33%	326
Mechanical Engineers	166	3.33%	887	17.84%	67	1.34%	10	0.20%	165	3.32%	142	2.85%	3,537	71.12%	4,974
Total	189	3.57%	923	17.41%	78	1.48%	12	0.23%	168	3.17%	154	2.90%	3,777	71.25%	5,301
Managers & Supervisors															
Construction Managers	427	5.65%	305	4.04%	92	1.21%	49	0.66%	24	0.32%	201	2.66%	6,451	85.46%	7,548
First-Line Supervisors of Construction Trades	947	8.46%	238	2.12%	218	1.94%	118	1.06%	76	0.68%	250	2.23%	9,347	83.50%	11,194
First-Line Supervisors of Mechanics, Installers	567	6.96%	309	3.79%	291	3.58%	78	0.96%	61	0.75%	269	3.31%	6,567	80.65%	8,142
Total	1,941	7.22%	851	3.17%	601	2.23%	246	0.92%	161	0.60%	719	2.68%	22,365	83.19%	26,885
Journey Workers															
Boilermakers	10	7.22%	4	2.77%	4	2.77%	4	2.77%	0	0.00%	4	2.77%	118	81.71%	145
Carpenters	3,634	18.44%	687	3.48%	514	2.61%	255	1.29%	139	0.70%	582	2.95%	13,897	70.52%	19,708
Construction and Building Inspectors	106	5.65%	72	3.85%	52	2.77%	35	1.86%	6	0.32%	58	3.11%	1,547	82.44%	1,877
Construction Laborers	5,127	23.05%	828	3.72%	894	4.02%	330	1.48%	216	0.97%	712	3.20%	14,133	63.55%	22,240
Electrical Repairers I	95	7.92%	70	5.79%	85	7.03%	12	1.00%	12	0.97%	51	4.28%	879	73.01%	1,203
Electrical Repairers II	17	8.02%	6	2.77%	14	6.30%	6	2.77%	11	5.07%			163	75.07%	217
Electricians	1,061	8.87%	402	3.36%	361	3.01%	109	0.91%	69	0.57%	397	3.32%	9,567	79.96%	11,965
HVAC Mechanics & Installers	414	8.81%	150	3.20%	133	2.82%	37	0.80%	15	0.32%	146	3.10%	3,803	80.94%	4,699
Installation Workers	172	11.70%	82	5.59%	59	4.02%	11	0.75%	15	1.02%	44	2.99%	1,085	73.94%	1,467
Insulation Workers	150	18.26%	28	3.44%	41	5.00%	7	0.85%	7	0.85%	27	3.23%	563	68.36%	824
Maintenance and Repair Workers, General	2,575	11.76%	1,449	6.62%	1,160	5.30%	282	1.29%	210	0.96%	614	2.80%	15,611	71.28%	21,901
Misc Construction Workers	53	15.68%	11	3.37%	17	5.14%	5	1.49%	17	5.14%			232	69.18%	335

Occupation	Latinx		Asian		Black/African American		Native American/Alaska Native		Native Hawaiian/Pacific Islander		Two or More Races		White		Grand Total
Journey Workers															
Plumbers, Pipefitters, and Steamfitters	635	10.53%	132	2.20%	165	2.74%	67	1.10%	37	0.62%	200	3.32%	4,790	79.49%	6,027
Sheet Metal Workers	248	8.54%	140	4.84%	94	3.25%	22	0.76%	17	0.60%	93	3.22%	2,286	78.80%	2,900
Solar Photovoltaic Installers	10	17.56%	2	3.44%	2	3.44%	2	3.44%	2	3.44%	2	3.44%	38	65.22%	58
Stationary Engineers and Boiler Operators	29	7.92%	36	9.89%	23	6.25%	2	0.55%	2	0.55%	13	3.53%	257	71.31%	361
Total	14,336	14.94%	4,101	4.27%	3,616	3.77%	1,186	1.24%	775	0.81%	2,943	3.07%	68,969	71.90%	95,925
Helpers															
Helpers--Carpenters	194	27.35%	23	3.27%	40	5.59%	8	1.13%	7	0.99%	24	3.40%	413	58.28%	708
Helpers--Electricians	104	24.97%	6	1.44%	18	4.20%	5	1.20%	6	1.44%	19	4.61%	260	62.15%	418
Helpers--Installation Workers	215	18.24%	93	7.93%	56	4.74%	18	1.50%	37	3.16%	56	4.76%	703	59.67%	1,178
Helpers--Pipelayers, Plumbers, Pipefitters...	105	22.36%	11	2.34%	22	4.57%	4	0.85%	5	1.06%	23	4.82%	302	64.01%	471
Total	618	22.28%	134	4.81%	134	4.84%	35	1.25%	55	1.99%	122	4.40%	1,677	60.43%	2,776
Construction & Build Operations Total	17,084	13.07%	6,014	4.60%	4,432	3.39%	1,475	1.13%	991	0.76%	3,960	3.03%	96,788	74.03%	130,744
Seattle-Tacoma-Bellevue Metropolitan Statistical Area															
Population Entering the Working Age	28,759	16.47%	25,891	14.83%	12,806	7.33%	1,820	1.04%	2,331	1.33%	12,704	7.28%	90,304	51.72%	174,615
Seattle Working-Age Population	248,831	9.94%	366,290	14.63%	157,252	6.28%	18,653	0.74%	22,645	0.90%	119,272	4.76%	1,571,172	62.74%	2,504,115

Table 23. Occupation Diversity

Level	SOC	Occupation	Total Number of Workers (2020)	Diversity (2007-2020)	Representative of the Seattle MSA*
Building Operations					
Journey Workers	49-9071	Maintenance and Repair Workers, General	21,901	↗	No
Managers & Supervisors	49-1011	First-Line Supervisors of Mechanics, Installers	8,142	↘	NA
Helpers	49-9098	Helpers--Installation Workers	1,178	↗	Yes
Journey Workers	49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	1,203	↗	NA
Journey Workers	51-8021	Stationary Engineers and Boiler Operators	361	=	NA
Journey Workers	49-2095	Electrical and Electronics Repairers, Substation and Relay	217	↗	NA
Energy-Related Construction					
Journey Workers	47-2111	Electricians	11,965	=	No
Journey Workers	47-2152	Plumbers, Pipefitters, and Steamfitters	6,027	↘	No
Journey Workers	49-9021	HVAC Mechanics & Installers	4,699	=	No
Journey Workers	47-2211	Sheet Metal Workers	2,900	↗	No
Journey Workers	49-9099	Installation Workers	1,467	↘	By 2030
Helpers	47-3015	Helpers--Pipelayers, Plumbers, Pipefitters...	471	↘	By 2030
Helpers	47-3013	Helpers--Electricians	418	↘	By 2030
Journey Workers	47-2011	Boilermakers	145	↗	By 2060
Journey Workers	47-2231	Solar Photovoltaic Installers	58	↗	Yes
General Construction					
Journey Workers	47-2061	Construction Laborers	22,240	=	Yes
Journey Workers	47-2031	Carpenters	19,708	↗	No
Managers & Supervisors	47-1011	First-Line Supervisors of Construction Workers	11,194	↘	NA
Journey Workers	47-2131	Insulation Workers	824	↘	By 2030
Helpers	47-3012	Helpers--Carpenters	708	↘	By 2030
Journey Workers	47-4098	Miscellaneous Construction Workers	361	↗	NA

* Linear trends were calculated based on percent white of each occupation for select years from 2007 to 2020 and the percent white of the Seattle MSA for select years from 2001 to 2020. Consistent data was not available for data not included in the 2016 report and trends for these occupations were not calculated. Occupations with fewer than 500 workers were not calculated.

Level	SOC	Occupation	Total Number of Workers (2020)	Diversity (2007-2020)	Representative of the Seattle MSA *
Managers & Engineers					
Managers & Supervisors	11-9021	Construction Managers	7,548	↗	No
Engineering Professionals	17-2141	Mechanical Engineers	4,974	↗	No
Journey Workers	47-4011	Construction and Building Inspectors	1,877	↗	By 2060
Engineering Professionals	17-3025	Environmental Engineering Technicians and Technologists	326	↘	NA