Metropolitan Policy Program
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Infrastructure skills: Knowledge, tools, and training to increase 0pportunity

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Summary

This report expands on previous analyses to describe the skills needed to fill infrastructure occupations nationally. More than 14.5 million workers—or 11 percent of the entire U.S. workforce—are employed in infrastructure-related activities, many of which operate different physical assets and extend far beyond construction projects. In turn, a wide variety of knowledge, tools and technologies, and education and training is often required in these occupations. Ultimately, since millions of workers in infrastructure occupations earn competitive wages and need to be replaced over the next decade, they represent a crucial segment of the workforce when it comes to expanding economic opportunity and require targeted workforce development strategies from public, private, and civic leaders across the country.

As the U.S. labor market continues to gain momentum, concerns over wage stagnation and income inequality persist, especially at a regional level. In response, many public, private, and civic leaders across a variety of metropolitan areas are forging new collaborations and launching innovative strategies to support greater economic opportunity. Infrastructure investment represents a key priority in this respect, whether aimed at boosting transportation access, increasing broadband adoption, strengthening freight connectivity, or improving water quality.

Infrastructure helps facilitate the exchange of information, drive production, and deliver resources, spanning multiple sectors of the economy and serving as a foundation to long-term growth. Yet, infrastructure's prominent role in the labor market is perhaps one of its most overlooked strengths. Too often framed in terms of short-term construction projects, infrastructure activities involve a considerable depth and breadth of employment opportunities across the country. Workers must oversee and maintain an assortment of different infrastructure facilities over time.

Infrastructure jobs depend on a steady stream of talent to construct, operate, design, and govern the country's major physical assets, directly employing more than 14.5 million workers or 11 percent of the entire U.S workforce. Most of these workers are concentrated in 95 distinct infrastructure occupations, often performing tasks in

warehouses, power plants, and other facilities that last decades beyond construction projects.[1] In logistics hubs like Memphis, Tenn., Stockton, Calif., and Harrisburg, Pa., infrastructure occupations can account for nearly 15 percent of all employment.

Infrastructure occupations also boast competitive wages with relatively low barriers to entry, frequently paying up to 30 percent more to workers with a high school diploma or less compared to those in all other occupations. Plumbers, truck mechanics, and power line installers are among the numerous infrastructure occupations that fall into this category, which tend to emphasize on-the-job training rather than higher levels of formal education.

At the same time, the infrastructure workforce is aging and experiencing high levels of turnover. Almost 3 million infrastructure workers will need to be replaced over the next decade, requiring significant numbers of new hires in nearly every market across the country.[2] With some infrastructure occupations like bus drivers being far older in age (53.5 years old) than the national median (42.3), public and private employers alike are bracing for a wave of retirements.[3] Moreover, the high turnover rate among truck drivers and other related occupations is leading to an immediate surge in hiring.[4]

In turn, recruiting, training, and retaining infrastructure workers will be especially important in years to come given their enormous economic scale and geographic extent. This report builds off previous analyses to identify skills typically required in infrastructure

1. The focus of this analysis is on "workers in infrastructure occupations," often phrased interchangeably with "infrastructure workers" for simplicity. As described in previous analyses, the 95 infrastructure occupations have an employment of nearly 11.9 million workers, out of the 14.5 million infrastructure jobs total. In this particular analysis, only 92 of the 95 SOC occupations can be linked to the O*NET classifications, which form the basis of all data concerning knowledge, tools, training, employment, and wages. Rail transportation workers, all other (53-4099); transportation workers, all other (53-6099); and material moving workers, all other (53-7199) are the excluded SOC infrastructure occupations.

2. To project replacement needs, the Bureau of Labor Statistics (BLS) Employment Projections program estimates the number of openings resulting from workers retiring or otherwise permanently leaving their occupation, as described at: http://www.bls.gov/emp/ep_replacements.htm [Accessed April 2016].

3. Demographic data by detailed occupations, including age and race, can be found from the Current Population Survey, available at: http://www.bls.gov/cps/cpsaat11b.htm [Accessed April 2016].

4. It is important to note, however, that the prospect of automated trucking and other technological developments will likely weigh on certain occupations more than others in years to come.

occupations, helping inform future workforce development efforts at a national, state, and local level. Educational institutions, workforce development agencies, and a range of regional employers—from transit agencies to water utilities—can more easily identify and emphasize particular training opportunities as a result.

By examining data from O*NET—an information resource sponsored by the U.S. Department of Labor's Employment and Training Administration—the report classifies occupations based on particular categories and levels of knowledge. It also further clarifies the specific tools, technologies, education, and experience commonly required in infrastructure occupations. Viewing these O*NET patterns alongside 2014 employment and wage data from the U.S. Bureau of Labor Statistics, the report reveals how infrastructure occupations offer clearer pathways to opportunity throughout the country and highlights the types of training that workers need to fill these positions.

Additional background on the methods used to classify infrastructure occupations in this report is available in a downloadable appendix.

Infrastructure occupations require higher levels of knowledge in 11 different content areas, most of which have little to do with construction.

To accelerate workforce development efforts, policymakers, educators, employers, and workers not only need to focus their attention on the broad array of occupations involved in infrastructure, but they also need to better understand the specific areas of knowledge required to fill these positions. In most cases, infrastructure workers rely on higher levels of knowledge in disciplines that extend far beyond building and construction in order to move goods, serve passengers, and coordinate a range of other activities.

Through a series of worker questionnaires, O*NET ranks the extent to which occupations require knowledge across 33 different categories on a scale from 0 (minimum) to 7 (maximum). Relative to all occupations nationally, the 95 infrastructure occupations score above average in 11 of these knowledge categories, the breadth of which speak to the wide variety of processes and equipment handled by millions of workers in this field (Table 1).[5] For example, among the 11.9 million workers employed in infrastructure

5. Note that many infrastructure occupations also score highly in "production and processing" knowledge according to O*NET; however, this category often falls out of scope for many other sizable infrastructure occupations and is largely excluded in this analysis as a result.

occupations in 2014, 10.9 million (92.3 percent) and 8.5 million (71.4 percent) required above-average levels of knowledge in transportation and public safety and security, respectively. By comparison, only 4.1 million (34.4 percent) required above-average levels of building and construction knowledge.

Table 1. Categories of infrastructure knowledge and related occupational employment totals, 2014

Knowledge category	Average knowledge score, infrastructure occupations (0-7)	Workers in infrastructure occupations with a high level of knowledge in this category	Share of of all workers in infrastructure occupations
Mechanical	3.54	6,224,560	52.3%
Public safety and security	3.48	8,495,130	71.4%
Transportation	3.21	10,977,050	92.3%
Engineering and technology	2.84	3,664,640	30.8%
Law and government	2.43	3,535,230	29.7%
Design	2.40	3,429,830	28.8%
Physics	2.34	3,318,770	27.9%
Building and construction	2.25	4,087,610	34.4%
Geography	2.19	5,265,750	44.3%
Chemistry	2.11	2,386,390	20.1%
Telecommunications	1.90	4,793,990	40.3%

*Source: Brookings analysis of O*NET and BLS Occupational Employment Statistics data*

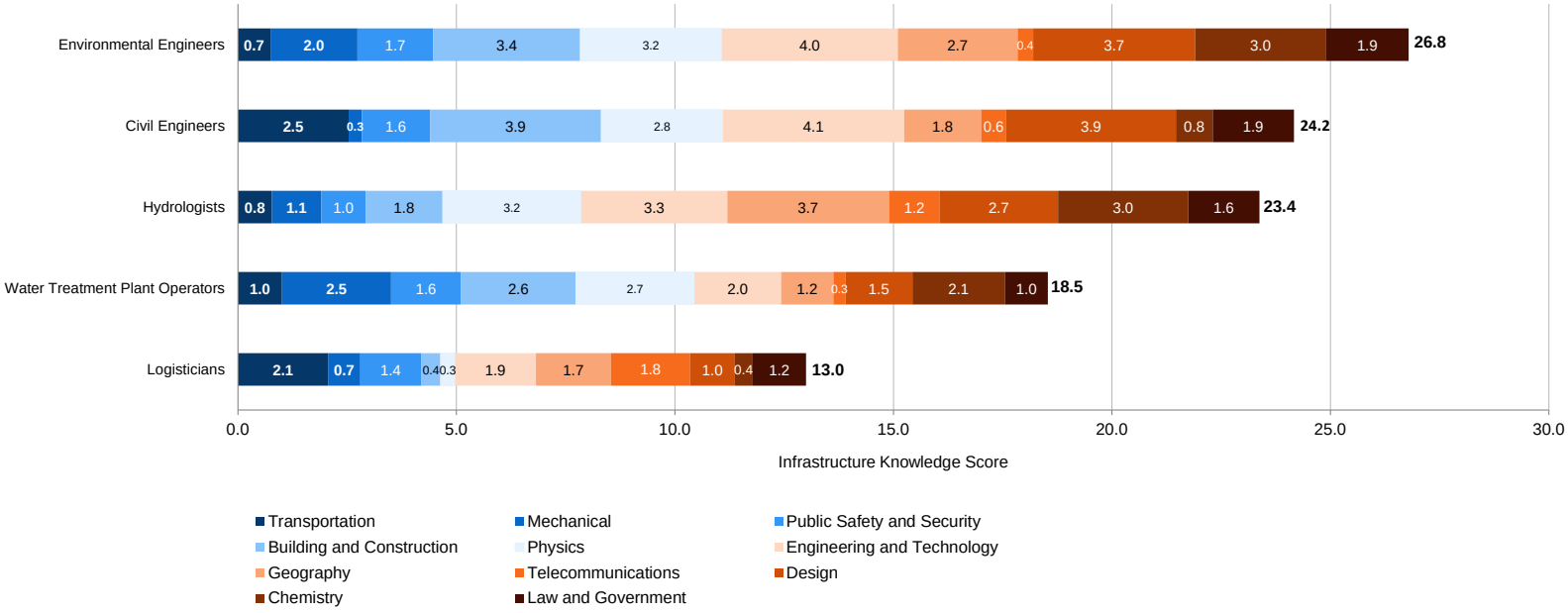
Note: Employment in this table is based on the 95 infrastructure occupations only

Indeed, similar to workers involved in STEM (science, technology, engineering, and math) fields, infrastructure occupations tend to require different combinations of specialty knowledge. By calculating a cumulative "Infrastructure Knowledge Score" across all 11 categories, this analysis aims to better quantify the extent of total infrastructure knowledge required for individual occupations. As described more extensively in the methodological appendix, this cumulative score is based on summing the differences between an infrastructure occupation's actual knowledge score in each of the 11 categories and the average knowledge score across all occupations. In short, this cumulative score further illustrates how most infrastructure occupations focus on operating physical assets rather than simply constructing them.

For example, as Figure 1 shows, environmental engineers have among the highest infrastructure scores nationally (26.8), along with civil engineers (24.2) and hydrologists (23.4). Since environmental engineers score more than 4 points higher in engineering and technology knowledge (6.3) relative to the national average in this category

(2.2), that difference is included in their total infrastructure score. Similarly, they have above-average knowledge in design (+3.7 points) and physics (+3.2 points), indicative of their specialized skillsets. In this way, many of these high-scoring infrastructure occupations require additional expertise across many of the 11 knowledge categories, as opposed to having a more generalized background.

Figure 1. Selected infrastructure occupations with high infrastructure knowledge scores



*Source: Brookings analysis of O*NET data*

Note: Scores for individual categories have been rounded, so they may not add up precisely to total infrastructure knowledge scores

In addition, many infrastructure occupations that require more specialized knowledge tend to pay higher wages. Among the 25 occupations with the highest infrastructure knowledge scores, 1.9 million workers across 22 of these occupations earned annual wages higher than the national average ($47,230) in 2014 (Table 2). Ranging from smaller occupations like traffic technicians (6,490 workers) to larger occupations like aircraft mechanics (116,830 workers), these positions can vary widely in the specific types of work they carry out.

Table 2. Employment and annual mean wages for occupations with the highest infrastructure knowledge scores, 2014

Infrastructure occupation	2014 employment	Annual mean wage	Infrastructure knowledge score
Environmental Engineers	53,240	$86,340	26.79
Nuclear Engineers	16,520	$104,630	24.27
Civil Engineers	263,460	$87,130	24.16
Hydrologists	6,580	$81,930	23.37
Marine Engineers and Naval Architects	7,570	$99,160	20.72
Ship Engineers	10,060	$74,600	20.24
Traffic Technicians	6,490	$46,540	19.04
Water and Wastewater Treatment Plant and System Operators	111,640	$46,140	18.53
Landscape Architects	18,110	$69,530	18.12
Airline Pilots, Copilots, and Flight Engineers	75,760	$131,760	15.93
Wind Turbine Service Technicians	3,710	$51,790	15.69
Radio, Cellular, and Tower Equipment Installers and Repairers	13,310	$49,880	14.67
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	22,120	$70,110	14.54
Environmental Engineering Technicians	18,080	$51,030	14.52
Civil Engineering Technicians	71,300	$50,290	14.03
Commercial Divers	3,620	$51,070	13.66
Avionics Technicians	17,150	$58,460	13.48
Plumbers, Pipefitters, and Steamfitters	372,570	$54,620	13.48
Captains, Mates, and Pilots of Water Vessels	30,690	$79,180	13.37
Architectural and Civil Drafters	91,520	$52,480	13.00
Logisticians	125,670	$76,830	12.99
Aircraft Mechanics and Service Technicians	116,830	$58,850	12.71
Forest and Conservation Technicians	30,310	$37,990	12.49
Electricians	566,930	$54,520	12.33
Airfield Operations Specialists	7,050	$51,190	12.23

*Source: Brookings analysis of O*NET and BLS Occupational Employment Statistics data*

Note: Employment in this table is based on the 95 infrastructure occupations only

It is important to note, however, that not every infrastructure occupation requires above-average knowledge in each of these 11 categories. In total, nearly 5.8 million workers across 19 infrastructure occupations require less specialized knowledge and have lower infrastructure knowledge scores as a result.[6] With a greater focus on administration and customer service, couriers, ticket agents, transportation attendants, and packers and packagers are among the larger infrastructure occupations that rely on alternate types of skills and face fewer detailed knowledge requirements overall.

6. Note that several infrastructure occupations can have negative infrastructure knowledge scores, both cumulatively and in individual knowledge categories. For instance, traffic technicians tend to require more extensive knowledge in engineering and technology as well as law and government, which contribute to their high overall infrastructure score (19.0), but they actually require below-average knowledge in chemistry – hence, their negative score associated with that particular category.

On average, workers in infrastructure occupations tend to use more than 14 distinct tools and technologies to perform their jobs, double the amount typically used by all U.S. workers.

Since most infrastructure workers require knowledge across a variety of disciplines, with a focus on operating and maintaining different physical assets, it should come as no surprise that they also use a number of different tools and technologies to perform their jobs. O*NET classifies tools and technologies in terms of specific commodities—from power saws and forklifts to laser printers and desktop computers—while relating them to individual occupations.[7]

Infrastructure workers account for an outsized share of tools and technologies relative to their total national employment; together, they make up about 11 percent of all U.S. workers, but they use nearly 30 percent of all the tools and technologies available.[8] Each infrastructure occupation also uses 14 different tools and technologies on average, compared to the average of six tools and technologies across all occupations nationally. As a result, current and prospective infrastructure workers must frequently become familiar with a wider range of instruments, devices, and software packages than the average American worker.

Tables 3 and 4 show the most common tools and technologies in this respect based on the number of infrastructure workers that use them. When it comes to tools, personal computers are used by almost three-quarters of these workers, including many engineers. Given the large number of cargo agents, laborers, and truck drivers, forklifts and two-way radios are also quite common, especially relative to what most other occupations require nationally. Even while using an assortment of physical tools, a variety of software technologies are crucial as well, including those involved in database management, operating systems, and computer aided design (CAD).

7. An aggregation of these O*NET classifications reveals that 4,300 different commodities are used nationally across all occupations, with 1,300 linked specifically to the 95 infrastructure occupations. O*NET provides extensive commodity detail on specific tools and technologies, classified according to the United Nations Standard Products and Services Code (UNSPSC). More information on these classifications is available at: https://www.unspsc.org/ [Accessed April 2016].
8. Note that the 11 percent share of national employment is based on the 14.5 million worker infrastructure total, rather than the infrastructure occupation total (11.9 million).

Table 3. 20 most common tools used by infrastructure occupations, 2014

Tool	Workers in infrastructure occupations using this tool	Share of all workers in infrastructure occupations	Total U.S. workers using this tool	Share of total U.S. workers
Personal computers	8,678,820	72.9%	103,312,380	76.5%
Forklifts	7,897,010	66.4%	25,001,750	18.5%
Two way radios	6,559,490	55.1%	19,674,510	14.6%
Hoists	5,854,160	49.2%	18,540,500	13.7%
Screwdrivers	5,746,100	48.3%	32,086,380	23.7%
Winches	5,575,070	46.9%	10,045,580	7.4%
Hand trucks or accessories	5,182,210	43.6%	18,594,830	13.8%
Notebook computers	5,137,390	43.2%	78,690,390	58.2%
Jacks	5,086,760	42.8%	12,571,760	9.3%
Power saws	5,006,130	42.1%	20,610,950	15.3%
Hammers	4,239,490	35.6%	19,448,990	14.4%
Pallet trucks	4,191,830	35.2%	11,151,080	8.3%
Scaffolding	4,185,000	35.2%	13,420,440	9.9%
Lifts	4,135,350	34.8%	9,817,960	7.3%
Desktop computers	4,040,800	34.0%	93,101,390	68.9%
Wrapping machinery	3,864,700	32.5%	6,698,330	5.0%
Global positioning system GPS receiver	3,791,610	31.9%	10,180,220	7.5%
Scanners	3,634,700	30.6%	45,190,860	33.4%
Slings	3,473,650	29.2%	8,589,630	6.4%
Personal digital assistant PDAs or organizers	3,415,160	28.7%	36,165,050	26.8%

Table 4. 20 most common technologies used by infrastructure occupations, 2014

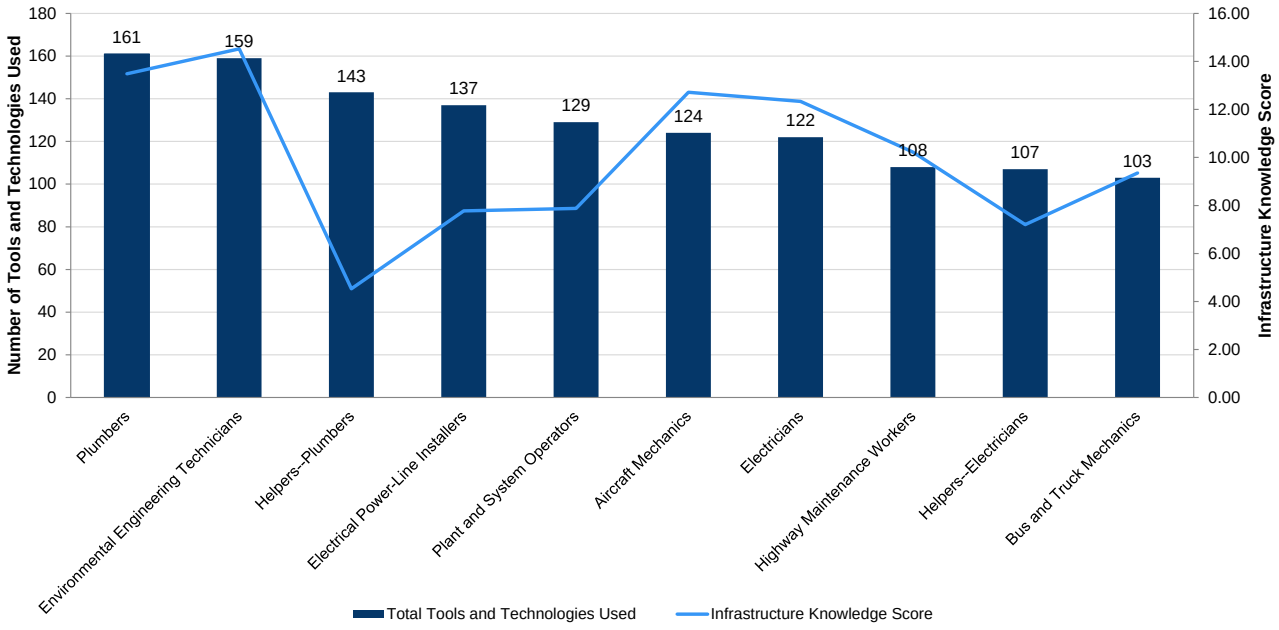
Technology	Workers in infrastructure occupations using this technology	Share of all workers in infrastructure occupations	Total U.S. workers using this technology	Share of total U.S. workers
Spreadsheet software	10,853,470	91.2%	119,918,090	88.7%
Office suite software	10,375,460	87.2%	108,797,370	80.5%
Data base user interface and query software	9,971,480	83.8%	108,175,900	80.1%
Operating system software	6,945,360	58.4%	48,231,320	35.7%
Inventory management software	6,915,430	58.1%	28,415,880	21.0%
Word processing software	6,879,250	57.8%	104,239,260	77.1%
Enterprise resource planning ERP software	5,809,030	48.8%	60,996,870	45.1%
Computer aided design CAD software	5,793,440	48.7%	25,288,570	18.7%
Analytical or scientific software	3,943,790	33.1%	36,473,380	27.0%
Internet browser software	3,724,280	31.3%	73,131,430	54.1%
Industrial control software	3,670,570	30.9%	12,101,260	9.0%
Route navigation software	3,020,500	25.4%	3,278,630	2.4%
Materials requirements planning logistics and supply chain software	2,805,940	23.6%	14,660,020	10.8%
Electronic mail software	2,484,530	20.9%	82,633,850	61.2%
Presentation software	2,023,430	17.0%	71,834,480	53.2%
Project management software	1,766,360	14.8%	52,718,750	39.0%
Map creation software	1,744,990	14.7%	10,687,360	7.9%
Accounting software	1,572,690	13.2%	51,950,870	38.4%
Calendar and scheduling software	1,357,620	11.4%	46,395,310	34.3%
Facilities management software	1,038,340	8.7%	10,991,120	8.1%

*Source: Brookings analysis of O*NET and BLS Occupational Employment Statistics data*

Note: Infrastructure employment in these tables is based on the 95 infrastructure occupations only

Moreover, as Figure 2 illustrates, some of the largest infrastructure occupations nationally like plumbers and electricians depend on more than 100 different tools and technologies to perform their jobs—far exceeding the 14 tools and technologies related to the average infrastructure worker. They also typically require higher levels of infrastructure knowledge, although these requirements are not uniform across the board. Helpers to plumbers and electricians, for instance, demonstrate how having familiarity with specific tools and technologies is crucial, perhaps even more so than having advanced knowledge, which they can gradually develop over time through experience.

Figure 2. Infrastructure occupations using the most tools and technologies



*Source: Brookings analysis of O*NET data*

While workers in infrastructure occupations require knowledge across a variety of areas and use many different tools and technologies, 93 percent do not require a bachelor's degree.

Even though infrastructure workers tend to gain knowledge across many different disciplines and use a sizable number of tools and technologies to perform their jobs, only a

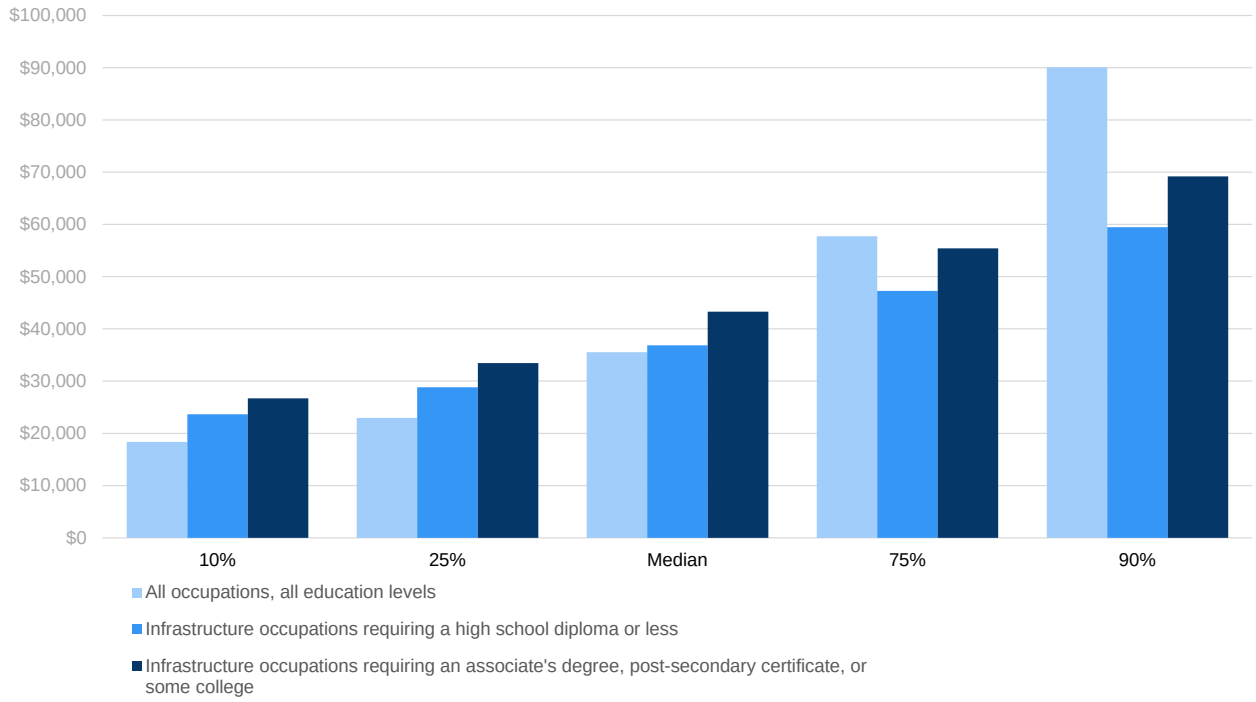
fraction have a bachelor's degree or higher, as described in previous analyses.[9] As such, the educational barriers to entry in these occupations can be relatively low compared to all jobs nationally, where higher levels of schooling are increasingly required and almost 36 percent of workers ages 25 years and older now hold at least a bachelor's degree. Instead, most infrastructure workers develop skills through on-the-job training and gain expertise through related work experience, while still earning competitive wages along the way.

According to detailed O*NET educational data, for instance, 74 different infrastructure occupations filled by 10.9 million workers—or 93 percent of the 11.9 million infrastructure occupation total—did not require a bachelor's degree in 2014. Employed as water treatment plant operators, rail car repairers, and bridge and lock tenders, 9.3 million of these 10.9 million workers required a high school diploma or less; the other 1.6 million primarily required associate's degrees or post-secondary certificates, working as ship engineers, transportation inspectors, and electrical installers. Beyond these 74 infrastructure occupations, though, nearly 1 million workers across 18 infrastructure occupations, such as hydrologists and logisticians, commonly required higher levels of education, including advanced degrees in some cases.

Significantly, workers employed in infrastructure occupations with lower educational requirements often earned competitive wages compared to all workers nationally in 2014 (Figure 3). These distinctions were especially apparent at lower-income levels, where infrastructure occupations requiring a high school diploma or less frequently paid higher wages to workers at the 10th and 25th percentile ($23,650 and $28,830 annually) compared to all occupations ($18,350 and $22,950) across all education levels. The same proved true for workers employed in infrastructure occupations requiring an associate's degree, post-secondary certificate, or some college, even at the median ($43,290). Still, most infrastructure occupations tended to lag behind at the 75th and 90th percentile.

9. Note this finding is primarily concerned with educational requirements rather than educational attainment. For more information on educational attainment—including the 12 percent share of infrastructure workers with a bachelor's degree or higher—please see data from the Bureau of Labor Statistics Employment Projections Program, available at: http://www.bls.gov/emp/ [Accessed April 2016].

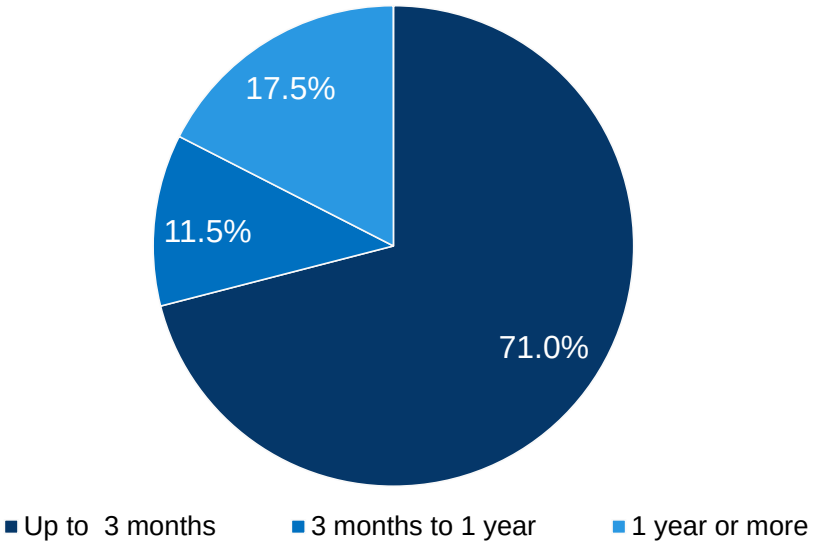
Figure 3. Annual wage comparison, infrastructure occupations and all occupations, by required education for entry, United States, 2014



*Source: Brookings analysis of O*NET and BLS Occupational Employment Statistics data*

While high levels of unionization and other industry norms likely contribute to these wage practices, that most infrastructure occupations require on-the-job training to build skills is an important factor to consider as well. According to O*NET, 99 percent of infrastructure workers in 2014 emphasized some level of on-the-job training to perform their jobs, ranging in duration from a few months to two years or more (Figure 4). The vast majority of infrastructure workers (8.4 million or 71 percent) usually only require up to three months of training, as is often the case for meter readers, pipelayers, and septic tank servicers. Although there can be tremendous variety within individual occupations depending on the particular employer, location, and duties involved, a fairly low share of infrastructure workers overall tend to involve significant on-the-job training upfront. Civil engineers, air traffic controllers, and power distributors are among the infrastructure occupations – employing 2.1 million workers – that typically emphasize more than one year of on-the-job training.

Figure 4. Most frequently required levels of on-the-job training in infrastructure occupations, by share of total infrastructure employment, 2014[10]



*Source: Brookings analysis of O*NET and BLS Occupational Employment Statistics data*

Similarly, having related work experience is also a critical element in many infrastructure occupations, where employers play a key role in skills development (Table 5). While half of all workers in infrastructure occupations (6.4 million) only call for short-term experience, their wages can be lower; transportation attendants and laborers, for instance, require less experience and generally receive less compensation. However, with even six months or one year of related experience, prospective workers can realize a wider variety of higher-paying opportunities, whether working as solar photovoltaic installers or aircraft cargo handling supervisors. Meanwhile, more specialized, technical occupations, such as avionics technicians, involve considerably higher levels of related experience and receive much greater compensation. Overall, a worker's ability to stay in infrastructure occupations and steadily earn more experience presents an opportunity to grow their income.

10. Note that the three on-the-job training categories used in this figure are based on aggregated totals from more detailed O*NET classifications.

Table 5. Most frequently required levels of related work experience in infrastructure cccupations, 2014

Related work experience	Workers in infrastructure occupations	Share of all workers in infrastructure occupations	Annual mean wage
None or short term	6,357,360	53.4%	$32,180
Over 3 months, up to and including 6 months	41,080	0.3%	$40,730
Over 6 months, up to and including 1 year	381,440	3.2%	$41,850
Over 1 year, up to and including 2 years	408,530	3.4%	$48,080
Over 2 years, up to and including 4 years	3,637,940	30.6%	$49,130
Over 4 years, up to and including 6 years	764,030	6.4%	$67,780
Over 10 years	306,850	2.6%	$85,310

*Source: Brookings analysis of O*NET and BLS Occupational Employment Statistics data*

Note: Infrastructure wages in each work category are calculated using a weighted average based on associated employment totals

Policy implications

To equip infrastructure workers with the skills they need, public, private, and civic leaders at the national and regional level must customize training efforts to reflect specific knowledge required, tools used, and experience demanded in these occupations. Rather than continually emphasizing the number of direct, indirect, or induced jobs created from construction projects, leaders should instead highlight the variety of long-term employment opportunities available to prospective workers and create clearer pathways for training and recruitment. Doing so will not only benefit infrastructure assets in need of oversight, maintenance, or outright replacement, but it will also open up more enduring economic opportunity nationally.

Any such efforts must recognize how infrastructure workers need to develop skills across many different disciplines, while often gaining familiarity with a sizable number of tools and technologies. While advanced levels of formal education are essential for many engineering occupations, the vast majority of infrastructure workers learn more through on-the-job training experience, similar to pre-baccalaureate healthcare workers. In turn, infrastructure workforce development strategies must be better tailored to meet these needs.

At the federal level, several different agencies are already spearheading some of these solutions, frequently in conjunction with industry groups, private employers, and educational institutions. The U.S. Department of Transportation, for instance, remains at the forefront of many ongoing efforts, including its Ladders of Opportunity initiative designed to attract new workers and channel funding into disadvantaged communities. Efforts to increase diversity in the transportation workforce also remain a priority, in addition to forging stronger partnerships alongside regional workforce development strategies. Likewise, joint efforts among a host of other federal agencies—including the U.S. departments of Labor, Education, and Energy, as well as the U.S. Environmental Protection Agency—have helped build additional momentum behind apprenticeships, certification programs, and on-the-job training opportunities.[11]

"States and metropolitan areas will ultimately lead the charge toward greater training and recruitment in years to come."

Of course, a multitude of other national organizations are accelerating training efforts behind the future infrastructure workforce as well. Whether primarily concerned with transportation jobs, energy positions, or any number of other career opportunities, these organizations have helped create new frameworks, partnerships, and training guidelines for employers and workers alike. For example, a variety of labor groups, including the AFL-CIO, have not only shed light on the workforce age gap emerging in the field, but they have also driven successful local workforce solutions for trade occupations, including continuing education for electricians and plumbers. Similarly, dozens of associations and membership organizations—from the American Water Works Association and Value of Water Coalition to the American Public Transportation Association and American Trucking Associations—have spread research, convened experts, and promoted greater investment in workforce development resources.

However, states and metropolitan areas will ultimately lead the charge toward greater training and recruitment in years to come. Given their prominent role targeting infrastructure investments and tackling other pressing workforce concerns, a wide range of regional actors—from utilities, transit agencies, and port authorities—will need to

11. For more information on these efforts, see: U.S. Departments of Education, Transportation, and Labor, "Strengthening Skills Training and Career Pathways across the Transportation Industry." 2015. Available online at: https://s3.amazonaws.com/PCRN/docs/Strengthening_Skills_Training_and_Career_Pathways_Across_Transportation_Industry_Data_Report.pdf [Accessed April 2016].

collaborate more extensively with community colleges, workforce development agencies, and others to attract, develop, and retain new talent. While no single program can possibly address all the various infrastructure employment needs from region to region, identifying emerging best practices and other novel approaches can offer useful insights to consider.

When it comes to transportation jobs, for instance, Seattle, Jacksonville, and Detroit are among the many markets promoting interest in growing sectors like logistics, creating mentorship opportunities, crafting stronger partnerships with local employers and schools, and helping prospective workers navigate different training requirements. Filling transit positions has been a top priority as well, with Los Angeles and Denver leading in the development of technical skills, job placement, and other planning activities. Innovative and collaborative efforts to provide workers with relevant on-the-job training and experience has also been actively pursued in many regions, including: Louisville through its UPS Metropolitan College, Memphis through its "Aerotropolis" career initiative, and Chicago through its supply chain management training at Harper College and elsewhere.

Among other infrastructure sectors, regions are also prioritizing career pathways in water, energy, and several additional maintenance activities. For example, numerous water utilities, including those in San Francisco, Riverside, and Kansas City, are seeking ways to advance workforce development, while boosting their systems' environmental sustainability and technological capacity. Likewise, to fill thousands of positions in electric utilities nationwide, many regions have stepped up with new collaborations, such as Pittsburgh's University Energy Partnership and Florida's Gateway to Power Consortium. When it comes to telecommunications, private employers like AT&T are partnering with schools like Georgia Tech to prepare students in technology-driven careers. Meanwhile, places like Milwaukee and Boston have focused on extending technical training and apprenticeships in various trade occupations, with an eye toward reaching high school students, veterans, and other prospective workers.

Conclusion

While the United States faces a number of different infrastructure challenges, its looming infrastructure workforce gap is perhaps one of its most significant. Throughout every region, millions of workers operate and maintain the country's major physical assets—from its highways and railroads to its port facilities and power plants—but many are

reaching the end of their careers. Relying on specialized skillsets to support long-term economic growth, a new generation of infrastructure workers will need to assume this mantle in years to come. In addition to prioritizing physical investments, national, state, and local leaders must continue exploring ways to fill these infrastructure positions, often amid constrained budgets and other pressing concerns.

As levels of poverty and inequality continue to rise, however, the time is ripe for jumpstarting these development efforts. While the federal government and a number of other national actors represent crucial partners, states and metropolitan areas are well-positioned to take the lead. Having already launched a variety of customized training initiatives, coordinated development strategies, and innovative partnerships, these regions should look to further experiment and accelerate such efforts in the future. By doing so, they can help create clearer career pathways for the country's infrastructure workers and help them achieve greater economic opportunity. ■

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