



SEIZING THE U.S. INFRASTRUCTURE OPPORTUNITY: INVESTING IN CURRENT AND FUTURE WORKERS

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Executive Summary

Investing in infrastructure can stimulate economic growth and unleash job creation across the nation. Whether it's building roads, repairing pipes, or upgrading power plants, investments in the country's transportation, water, energy, and broadband systems not only support more economic output, but also drive the need for more workers. Several recent pieces of federal legislation—including the Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Act (IRA), and CHIPS and Science Act—are pumping hundreds of billions of dollars toward new projects and new jobs. This is a level of investment not seen since the New Deal.

But national, state, and local leaders risk squandering this window of opportunity if they focus only on future job creation without addressing the cracking foundation of the country's current workforce.

Infrastructure investment already supports millions of workers nationally. Moving goods, producing energy, managing water, and carrying out many other essential

activities depend on workers across every corner of the country and are foundational to economic growth and opportunity. Past Brookings research has highlighted the multiple career pathways, higher wages, lower formal educational barriers to entry, and in-demand skills across the infrastructure sector. Yet the hiring, training, and retention gaps across this workforce remain vast, as fewer workers are entering these careers and more are retiring and leaving these jobs than ever before. At the same time, too few of these job opportunities are filled by younger people, women, and people of color.

How can leaders expand the future infrastructure workforce if they cannot even hold onto the current one? Many infrastructure leaders have experience building projects, but far less in collaborating with workforce partners or recruiting and retaining talent. Failing to address these workforce gaps may not only delay projects and limit short-term construction, but also interfere with long-term operation and maintenance and limit the ultimate economic reach of new federal funding.

This report aims to equip leaders with more consistent data and information to better target, measure, and address their infrastructure workforce needs. It builds off past Brookings research to provide an updated look at U.S. infrastructure employment, leading to several findings:

In 2021, 16.6 million workers were employed in infrastructure jobs across the country, accounting for 11.8% of national employment.

Infrastructure workers are primarily concentrated in 95 occupations that tend to focus more on operation rather than construction, which speaks to the sector's multiple branching career pathways. The largest occupations are electricians, plumbers, civil engineers, and other skilled trades positions, particularly those involved in the transportation and energy sectors.

Infrastructure occupations pay wages that are 30% higher for workers at lower income levels, which supports more equitable career pathways.

Infrastructure jobs pay \$31,750 and \$39,270 at the 10th and 25th percentile, respectively, compared to \$23,980 and \$29,950 for all occupations at these percentiles. Large infrastructure jobs that pay higher wages range from bus and truck mechanics to highway maintenance workers to electrical power-line installers. This means higher pay for workers just entering the labor market or transitioning into these positions, which offers more opportunity to those at the bottom rungs of the career ladder.

Most infrastructure workers (53.8%) have a high school diploma or less, but they achieve higher wages than in other industries and grow their careers through on-the-job training.

The share of infrastructure workers with a high school diploma or less contrasts sharply with the share of workers across all occupations nationally, 31.6% of whom have a high school diploma or less. Meanwhile, 86.8% of infrastructure workers need some level of on-the-job training, compared to 62.6% of workers across all occupations nationally. Through apprenticeships and other work-based learning, they develop knowledge in many common categories, such as public safety and security or engineering and technology—highlighting

the need for more collaborative approaches among employers and educators.

From 2021 to 2031, projections show 1.7 million infrastructure workers (12.2%) will leave their jobs each year on average, leading to huge replacement needs.

Recent research shows that up to 1.5 million new jobs will be created annually over the next decade due to new federal infrastructure funding. But Bureau of Labor Statistics (BLS) projections estimate that 1.7 million current infrastructure workers will separate from their jobs each year over the same span due to retirements and other labor force exits as well as transfers to occupations elsewhere in the economy.

The infrastructure workforce skews older, male, and white—signaling a need to reach more and different types of workers in coming years.

Many infrastructure workers are 45 years and older: 72.8% of transit and intercity bus drivers are in this age group, as are 55.7% of power distributors and dispatchers and 53.8% of rail yard engineers. Perhaps even more concerning, though, is that only 11% of the infrastructure workforce is 24 years or younger. In addition, women make up only 18.5% of all infrastructure workers, while they make up 49.6% of all workers nationally; the shares of Black, Latino or Hispanic, and Asian American infrastructure workers are also frequently lower than national averages across a range of occupations.

Collectively, these findings contextualize the current state of the country's infrastructure workforce—one that boasts multiple pathways to opportunity with demonstrated hiring needs, but also one that faces considerable challenges given the mounting number of workers leaving their jobs or struggling to enter in the first place. However, with an infusion of new federal funding, a need to accelerate projects, and an appetite to test new approaches, leaders have a chance to address these gaps. This report examines several national, state, and local actions that leaders can take to drive conversations, inform plans, and ultimately strengthen their infrastructure talent pipelines with an eye toward more durable models for economic equity.



Introduction

For decades, leaders across the U.S. have called for greater infrastructure investment to repair aging transportation and water systems, launch new energy and broadband upgrades, and more. These projects not only stimulate economic growth (through faster movement of people and goods, cleaner electricity generation, and easier exchange of data and ideas), but also drive economic opportunity by supporting millions of jobs.¹ Now, with the passage of the Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Act (IRA), and CHIPS and Science Act, hundreds of billions of dollars in new federal funding is flowing across the country, representing a once-in-a-generation chance for national, state, and local leaders to further expand the infrastructure workforce opportunity.

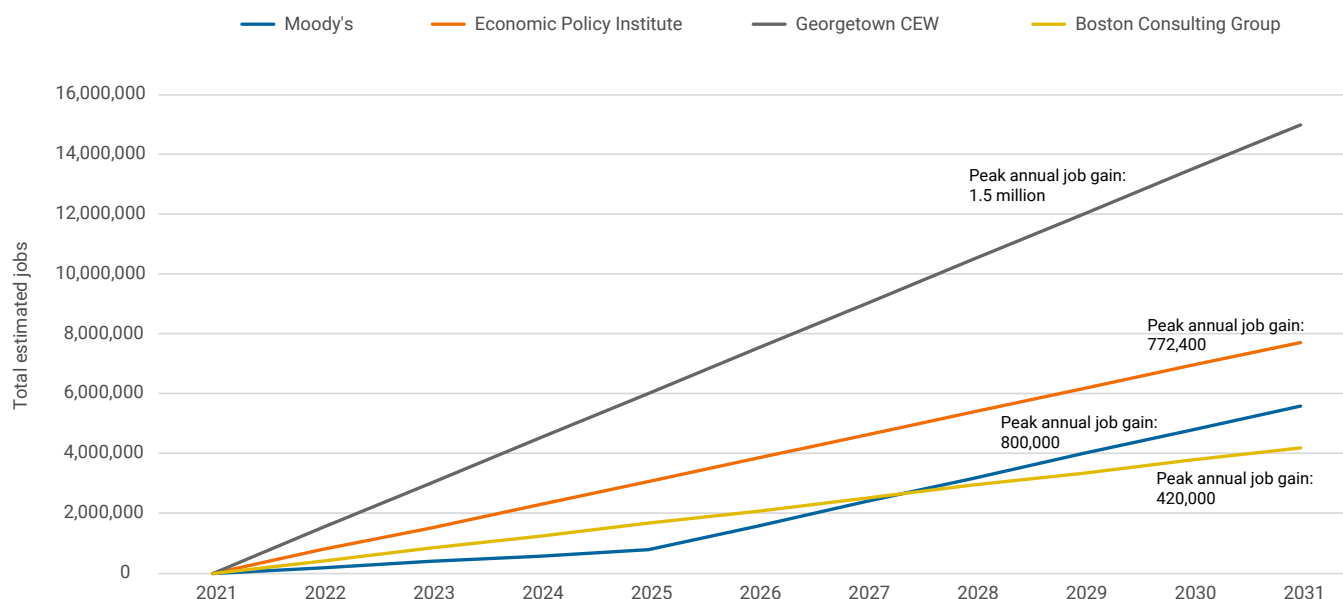
From the New Deal of the 1930s to the American Recovery and Reinvestment Act of 2009, the U.S. has a history of launching bold infrastructure investments to create more jobs. But this latest legislative push holds perhaps the greatest promise. Federal infrastructure spending is poised to reach heights never seen before—possibly exceeding 2% of gross domestic product, compared to 1.3% during the New Deal—and millions of workers will need to oversee and execute projects across the country.² Constructing roads, fixing

pipes, installing solar panels, and laying broadband will require a wide range of laborers, technicians, and other workers across every region.³ Beyond these direct jobs, many indirect and induced jobs will also emerge for suppliers and other industries supported by this spending.⁴

Estimates vary on the exact number of new jobs that will be created, pointing anywhere from 13,000 to 30,000 jobs for every \$1 billion in federal funding.⁵ And with \$863 billion from the IIJA alone, the impacts could be enormous. The Economic Policy Institute estimates that new federal infrastructure funding could support 772,000 jobs annually—a figure similarly reflected in research from Moody’s, which points to more than 800,000 jobs annually during the IIJA’s “peak impact in the middle of the decade.”^{6,7} Estimates from the Boston Consulting Group put the figure closer to 4.2 million jobs over the next decade, or 420,000 jobs per year on average.⁸ On the other hand, research from the Georgetown University Center on Education and the Workforce estimates that \$1.5 trillion in new federal infrastructure spending could create 15 million jobs over the next decade, or 1.5 million jobs annually.⁹ The White House has also released statements pointing to 1.5 million jobs created annually.¹⁰

FIGURE 1

Estimated job creation from new federal infrastructure spending, by information source, 2021 to 2031



NOTE: Methods to develop estimates vary by source and are based on different iterations of federal infrastructure proposals. Peak annual gains and cumulative totals shown here are based on a Brookings analysis of available data and approaches described in these reports.

SOURCE: Moody's, Economic Policy Institute, Georgetown University Center on Education and the Workforce, and Boston Consulting Group.

However, simply throwing more money at infrastructure is no guarantee that all people and places will benefit. By fixating on new jobs, many national, state, and local leaders are focusing more on growth without clearly addressing current workforce gaps. Or, even worse, these leaders are simply overlooking workforce gaps entirely. New pots of money and new opportunities

for ribbon cuttings can overshadow the significant challenges facing the country's current infrastructure workers, who are aging, leaving their jobs in higher numbers, and struggling to keep up with a backlog of projects.¹¹ Without a dual focus on future *and* current workers, the country may struggle to maximize this infrastructure opportunity.



Background

While new federal funding offers enormous potential to create more jobs, leaders face a massive challenge that has existed for some time: the struggle to **hire, train, and retain** current infrastructure workers. This limits the country's pool of talent to take on existing needs, let alone expand the pool of talent to take on new tasks.

RECRUITMENT AND HIRING CHALLENGES

Even before the new federal legislation passed, infrastructure jobs lacked visibility among prospective workers and struggled to recruit new talent. Historically low unemployment and a tight labor market have led to shortages in construction, with 88% of construction contractors having “moderate-to-high levels of difficulty finding skilled workers” according to a recent U.S. Chamber of Commerce survey.¹² But as past Brookings research has highlighted, infrastructure jobs go far beyond short-term construction positions; they involve dozens of different occupations in infrastructure operation, maintenance, and design, ranging from electricians to water treatment operators to civil

engineers.¹³ They distribute energy, pump water, and measure and monitor the performance of systems vital to utilities and other major employers. Many of these activities can appear dirty and dangerous or may be out of sight and out of mind for most Americans, including prospective workers.¹⁴

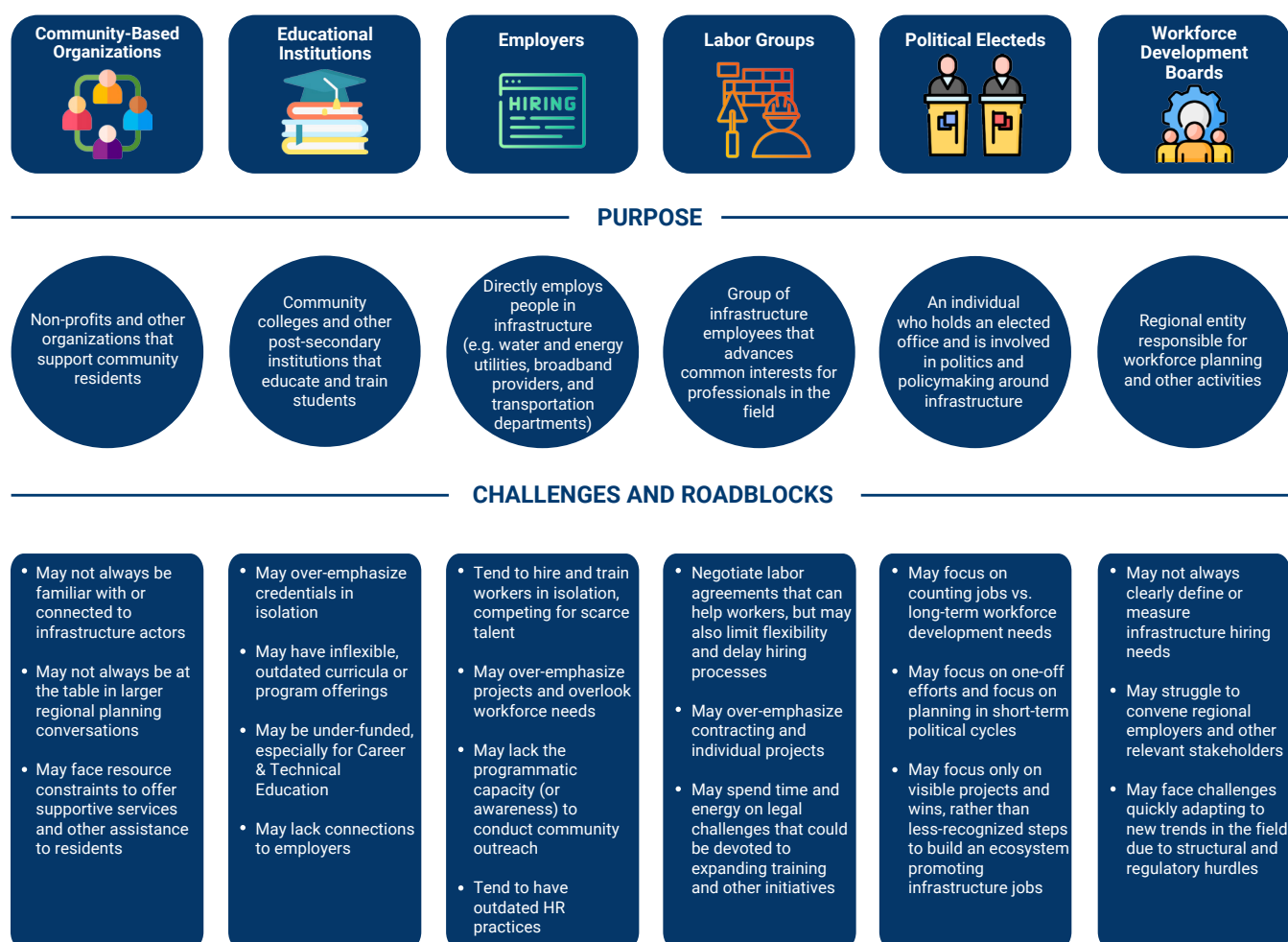
In particular, many younger students, women, and people of color lack exposure to these pathways and may not view infrastructure as a career of choice.¹⁵ Students in high school (and earlier) may not enroll in classes geared toward these careers—including those in science, technology, engineering, and math (STEM) fields—and may not have the mentorships or other connections and repeated opportunities to explore related careers.¹⁶ Women, who remain historically underrepresented in construction and the skilled trades, face harassment and discrimination in the workplace.¹⁷ And people of color are not only underrepresented in many of these same positions, but also face several other long-standing barriers to entry, including lower pay and hiring biases.¹⁸

At the same time, a lack of coordination among key infrastructure actors—employers, educational institutions, workforce development boards, community-based organizations, and labor groups, among others—continues to obscure these career pathways. For example, many infrastructure employers, including transportation agencies and utilities, tend to operate in isolation, focus on project delivery, and lack the programmatic capacity (or awareness) to conduct more extensive community outreach.¹⁹

These employers may also rely on rigid, outdated human resources practices—including inflexible job descriptions—to onboard new workers, and may struggle to rethink existing contracting practices, including working with women- and minority-owned businesses.²⁰ Meanwhile, workforce development boards may not always clearly define, measure, or track infrastructure hiring needs for their regions. Figure 2 summarizes more of these overarching challenges.

FIGURE 2

Examples of actors involved in infrastructure workforce development



SOURCE: Brookings interviews with leaders on infrastructure workforce challenges

TRAINING CHALLENGES

Since infrastructure jobs are so expansive and varied, they lack a cohesive, sector-wide strategy for helping workers gain necessary knowledge, skills, and experience.²¹ Workforce development approaches in infrastructure are often highly siloed and fragmented by industry, employer, and geography. Workers tend to gain degrees, licenses, and certifications for a particular job in a particular place, which can limit their ability to move or advance their careers elsewhere. There is a need for more versatile and portable credentials as well as common curricula and training approaches (see Box A). More cohesive, coordinated approaches include sector partnerships (collaborations among education, training, labor, and community organizations) that can build technical and financial capacity around different infrastructure career pathways. However, such efforts remain nascent across the country.²²

The need for extensive on-the-job training and related work experience also remains a hurdle. Many students and younger prospective workers continue to opt for four-year college degrees by default, while career and technical education (CTE) programs, which focus on the skilled trades, can suffer from underfunding and struggle to attract applicants.²³ Work-based learning—such as apprenticeships, pre-apprenticeships, and internships—can provide valuable ways for students to gain skills and connections on the job.^{24,25,26} These last anywhere from a few months to a few years, but they remain underutilized and underfunded in the U.S. For

instance, funding for public higher education was \$385 billion in 2017-18, compared to only \$14 billion in public funding for other training, including those that support these earn-and-learn options.²⁷ Moreover, community colleges that support CTE programs have seen some of the steepest enrollment declines in recent years, particularly during the COVID-19 pandemic.²⁸ The result is a narrowing of options for students and other prospective workers who would even consider infrastructure careers in the first place.

While the IIJA, IRA, and other new federal investments may offer more support for these training options, most of the funding is project-specific and geared toward eligible infrastructure entities that are historically disconnected from broader workforce development programming.²⁹ In turn, there are huge divides in reaching unemployed, underemployed, and other disadvantaged individuals.³⁰ Workers looking to transition into infrastructure careers—including women, veterans, and nontraditional workers such as the formerly incarcerated—can lack supportive services such as child care and transportation to get to training or a job site.³¹ Although workers need to gain more skills and experience to qualify for these jobs (a so-called “skills gap”), there is also a considerable “opportunity gap” in which workers lack career navigation assistance, access to training resources, and other equitable hiring practices.³² The same could be said for many already-employed infrastructure workers, who may struggle to re-skill amid new technologies, gain new competencies, and grow their careers over time.³³



BOX A

The need for more portable and versatile credentials

Many infrastructure workers develop knowledge and experience through on-the-job training—typically gaining specific licenses or certifications to demonstrate their prowess in key tasks. For instance, workers in the skilled trades, such as electricians, need to enter an apprenticeship program for several years, log thousands of hours of (paid) on-the-job training, and take multiple courses at a technical school.³⁴ They may also need to take an exam and enroll in continuing education courses to receive (and retain) a particular license. Such requirements can create hurdles to train and retain talent, and the lack of consistency in these requirements across occupations and geographies can further limit the portability and versatility of infrastructure-related credentials.

Employers often require workers to hold a specific license or certification (or both) to fill a job, which creates a needed screen for candidates but also a barrier to entry. Licenses, including those in engineering, give individuals the legal authority to work in an occupation and are usually overseen by a governmental entity at a state level. On the other hand, certifications serve as a signal of skills and competency in a particular line of work, but are not legally required and are typically awarded by a professional organization or other nongovernmental body.³⁵ Beyond the time and resources needed to gain these credentials, workers face a dizzying range of requirements depending on where their job is located. Construction workers in Los Angeles, for example, may receive training and credentials that vary from those in San Francisco or another state, which can limit their mobility.³⁶

The lack of national consistency in credentials in terms of measurement and support does not help matters. While the Department of Labor and other national organizations provide resources and guidance on needed credentials, there is still widespread fragmentation depending on occupation and geography. The BLS tracks the number and share of workers nationally who need credentials (which stands at about a quarter of the total workforce), but this data varies widely across industries and does not provide a geographically granular picture of particular markets.³⁷ The lack of detailed information on the wage premiums and professional advantages gained through credentials also leads to many unknowns for workers, employers, and researchers involved in these issues.³⁸

However, some national, state, and local entities are offering clearer guidance on credentials and supporting training efforts that align with industry-recognized credentials that can transfer across occupations and geographies. In the water sector, for example, the Department of Labor and the Water Environment Federation have developed joint standards on apprenticeships.³⁹ In the transportation sector, apprenticeship programs such as Syracuse Build in New York are coalescing around nationally recognized curricula and standards (such as the North America's Building Trades Unions' Multi-Craft Core Curriculum).⁴⁰ Syracuse Build also aims to expand these training opportunities to groups who have historically been left out of the infrastructure workforce, including women and people of color. And pre-apprenticeship initiatives supporting disadvantaged and low-income workers, such as San Diego's Workforce Opportunities for Rising Careers, have also championed more flexible credentials.⁴¹

RETENTION CHALLENGES

The hiring and training of infrastructure workers have posed difficulties for several decades, but simply holding on to these workers is becoming increasingly problematic as well. Across all types of infrastructure jobs—from construction to long-term operation and maintenance—retention is a persistent challenge for employers and is deepening the talent gap in two primary ways.

First, many infrastructure workers are aging and eligible for retirement. A “silver tsunami” has swelled in recent years, causing many infrastructure employers to see 10% or more of their workers retire annually.⁴² At some transit agencies, up to 50% of bus maintenance employees are eligible to retire in the next three to five years, while an increasing share of skilled technicians, mechanics, and drivers are 50 or older.⁴³ This reflects larger national demographic shifts, with many baby boomers and other infrastructure workers having been hired following the passage of environmental legislation and a boom of infrastructure projects during the 1970s. And as more of these workers reach the

end of their careers with fewer younger workers ready to pick up the baton, vast amounts of institutional knowledge and skills may be lost forever.⁴⁴

Second, many infrastructure workers are simply leaving their jobs. The number of workers quitting positions in construction, transportation, warehousing, and utilities has surged by almost 20% over the past year, according to the latest BLS job openings and labor turnover survey.⁴⁵ Some of these workers could be transitioning to closely related positions or industries, but they are leaving their current employers. Septic tank servicers, electricians, highway maintenance workers, and telecommunication line installers are among the many infrastructure jobs that require workers to be on-site and potentially face long hours in hazardous conditions.⁴⁶ Similar to “essential workers” in health care and education, this work has been especially taxing during the COVID-19 pandemic. Increasingly, the skilled trades are susceptible to the “Great Resignation” challenges facing the larger economy, with more workers seeking additional pay and workplace flexibility.⁴⁷



ADDRESSING FUTURE AND CURRENT INFRASTRUCTURE WORKFORCE NEEDS

Together, the challenges facing the country's current infrastructure workforce are sizable and will only create more hurdles in the future. While new federal funding holds promise to address these challenges, national, state, and local leaders cannot just lunge for pots of money without beginning to address these hiring, training, and retention gaps. Leaders need to consistently recognize who infrastructure workers are—including their individual struggles to take on these careers—and not simply count the potential number of new jobs created.

A wide range of actors has realized the urgency of these challenges, especially in light of new funding. Federal agencies, including the Department of Transportation, Department of Energy, Department of Commerce, Department of Labor, and Environmental Protection Agency, have all expressed the need to address infrastructure worker shortages.⁴⁸ Governors and other state leaders, including departments of transportation and energy offices, have echoed the call for more targeted training and better harnessing of new funding in support of greater equity.⁴⁹ Local leaders, including transit agencies, utilities, and other

infrastructure employers in addition to educational institutions, labor groups, and community-based organizations, have also joined this chorus calling for faster action.⁵⁰

However, despite this urgency, the infrastructure workforce challenge remains poorly defined, inconsistently monitored, and haphazardly addressed across the country.

This report aims to equip leaders with more consistent data and information to better target, measure, and address their infrastructure workforce needs. It builds off past Brookings research to provide an updated look at current U.S. infrastructure employment in 2021, including projected growth and replacement needs over the next decade. It also explores the educational and training requirements for infrastructure occupations, and further contextualizes the characteristics of the current infrastructure workforce, including occupational wages and demographics (e.g., race, gender, age). Lastly, the report examines several national, state, and local actions that leaders can take to drive conversations, inform plans, and ultimately strengthen their infrastructure talent pipelines with an eye toward more durable models for economic equity.



Defining and measuring infrastructure jobs

This analysis focuses on defining a clear set of infrastructure industries and occupations to determine national levels of employment, wages, and other statistics. To do so, it follows the methods used in several previous Brookings reports on the infrastructure workforce, described at greater length in “Beyond Shovel-Ready: The Extent and Impact of U.S. Infrastructure Jobs,” released in 2014.⁵¹ While “infrastructure” involves many different physical systems and is a constantly evolving term (making it difficult to develop consistent classifications or isolate employment), this analysis uses the following definition based on other research, nationally and globally:

Infrastructure encompasses a broad range of systems and facilities designed, constructed, operated, and governed across the public and private sector. Foundational in nature, these physical assets are either manmade or natural, often operate as part of larger networks, support a variety of economic activities, and provide a host of other services with a clear public benefit over the course of many years.⁵²

Based on this definition, we first looked at a discrete set of infrastructure sectors to organize relevant physical systems, projects, and work activities. These seven sectors (see Figure 3) capture a wide assortment of jobs.

FIGURE 3

Infrastructure sectors used to classify infrastructure jobs

Seven Infrastructure Sectors	
	Intra-Metro Transportation includes local roads and bridges; public transit such as subways and buses; taxis and limousines; sightseeing transportation; and bicycle/pedestrian infrastructure.
	Inter-Metro Transportation includes passenger rail, airports, and highways, and inter-urban and rural bus transportation.
	Trade and Logistics includes freight rail, air cargo operations, trucking, seaports/inland waterways, transportation support, and warehousing and express/local delivery services.
	Energy includes the generation, transmission, and distribution of energy from natural gas (pipelines), facilities responsible for electricity (nuclear, hydroelectric, and solar/wind), and other utilities.
	Water includes clean/drinking water, stormwater, wastewater, sewage/water treatment facilities, and “green” infrastructure critical to conserving related natural resources.
	Telecommunications include broadband and transmission infrastructure (wired, wireless, and satellite), concentrated in facilities outside radio and television broadcasting.
	Public Works include streetscapes, land redevelopment, and waste/landfills (solid waste, hazardous materials, and remediation).

SOURCE: “Beyond Shovel Ready: The Extent and Impact of U.S. Infrastructure Jobs,” Brookings, 2014.

We then used these sectors to develop a list of 38 “infrastructure industries” with closely related services based on an analysis of the Census Bureau’s Industry Statistics Portal for the 2017 North American Industry Classification System (NAICS). These 38 industries are at the 4-digit level of detail, ranging from Electric Power Generation, Transmission and Distribution (NAICS 2211) to Urban Transit Systems (NAICS 4851).⁵³

Finally, we developed a list of 95 “infrastructure occupations” via a three-step process: 1) their share of national employment in the infrastructure industries; 2) their share of national employment in related government activities; and 3) other relevant job duties.⁵⁴ In other words, these occupations represent the jobs with the greatest specialization and concentration in infrastructure construction, operation, design, and governance. From telecommunication line installers to water treatment operators, these are

detailed occupations based on the 2018 Standard Occupational Classification (SOC) system.

Most of the employment and wage data in this report comes from the BLS Occupational and Wage Statistics (OEWS) program. Additional data on skills and educational attainment comes from the BLS Employment Projections program and the Occupational Information Network (O*NET), an online resource center and database sponsored by the Department of Labor’s Employment and Training Administration. Demographic information comes from Lightcast, which includes a proprietary database with a variety of labor market indicators.

Additional background on the data sources and methods used to classify infrastructure jobs in this report is available in a downloadable appendix.

Key terms

Infrastructure jobs: Employment opportunities based on the total number of workers in occupations and industries in the seven infrastructure sectors.

Occupations: The activities that employees regularly carry out for pay, which are grouped into distinct categories on the basis of similar job duties as outlined in the 2018 SOC system. There are approximately 830 detailed occupations found across all industries. “Infrastructure occupations” in particular are often concentrated in infrastructure activities and perform duties central to infrastructure design, construction, operation, and governance.

Industries: Groups of establishments that provide similar goods or services, as determined by the 2017 NAICS. Private and government-owned establishments are included, while agricultural establishments and private households are excluded. “Infrastructure industries” in particular provide services closely linked to at least one of the seven infrastructure sectors.

Employment: The total number of full-time and part-time workers paid a wage or salary, excluding household and self-employed workers, as defined in the OEWS survey.

Wages: Based on straight-time, gross pay over a standard work period, as defined in the OEWS survey. These include tips, production bonuses, cost-of-living allowances, and over-the-road pay based on mileage. However, overtime pay, back pay, and holiday bonuses are among the types of compensation excluded. Wages include mean hourly and annual pay, but also percentile wages (10th, 25th, 50th, 75th, and 90th). The latter are based on the percentage of workers who earn wages below a certain value. For instance, if \$9.00 represents the 10th percentile wage for a given occupation, this means that 10% of workers employed in the occupation earn less than this amount.

Skills: Levels of education and training typically needed to perform duties in a particular line of work. Similar to BLS, we use three categories to classify skills across occupations: education required for entry, related work experience, and on-the-job training to demonstrate competency. We also examine some related data from O*NET, described more extensively in the report’s methodological appendix.



Findings

In 2021, 16.6 million workers were employed in infrastructure jobs across the country, accounting for 11.8% of national employment.

Whether employed as electricians, plumbers, civil engineers, or many other roles, the country's infrastructure workforce carries out an expansive number of activities and accounts for more than one out of every 10 workers nationally. They are primarily found in 95 separate occupations that tend to focus more on infrastructure operation and maintenance

rather than construction. Whether moving goods, distributing electricity, or managing water, more than three-quarters of these workers operate infrastructure, while 14.5% are involved in construction, 6% in design, and 1.2% in governance. The largest occupations are employed in the skilled trades; however, many other occupations are found in management, human resources, customer service, and support activities that take place in local government offices, utility headquarters, and other establishments.

TABLE 1

Fifteen largest occupations by infrastructure employment and activity, 2021

Rank	Occupation	Infrastructure Activity	Employment
1	Laborers and Freight, Stock, and Material Movers, Hand	Operate	2,729,010
2	Heavy and Tractor-Trailer Truck Drivers	Operate	1,903,420
3	Light Truck Drivers	Operate	1,010,040
4	Industrial Truck and Tractor Operators	Operate	758,290
5	Electricians	Construct	650,580
6	Packers and Packagers, Hand	Operate	585,270
7	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	Operate	549,260
8	Plumbers, Pipefitters, and Steamfitters	Construct	417,620
9	Bus Drivers, School	Operate	361,420
10	Civil Engineers	Design	304,310
11	Bus and Truck Mechanics and Diesel Engine Specialists	Operate	261,420
12	Dispatchers, Except Police, Fire, and Ambulance	Operate	194,330
13	Logisticians	Design	189,320
14	Shuttle Drivers and Chauffeurs	Operate	175,660
15	Telecommunications Equipment Installers and Repairers, Except Line Installers	Construct	172,830
	15 Occupation Total		10,262,780

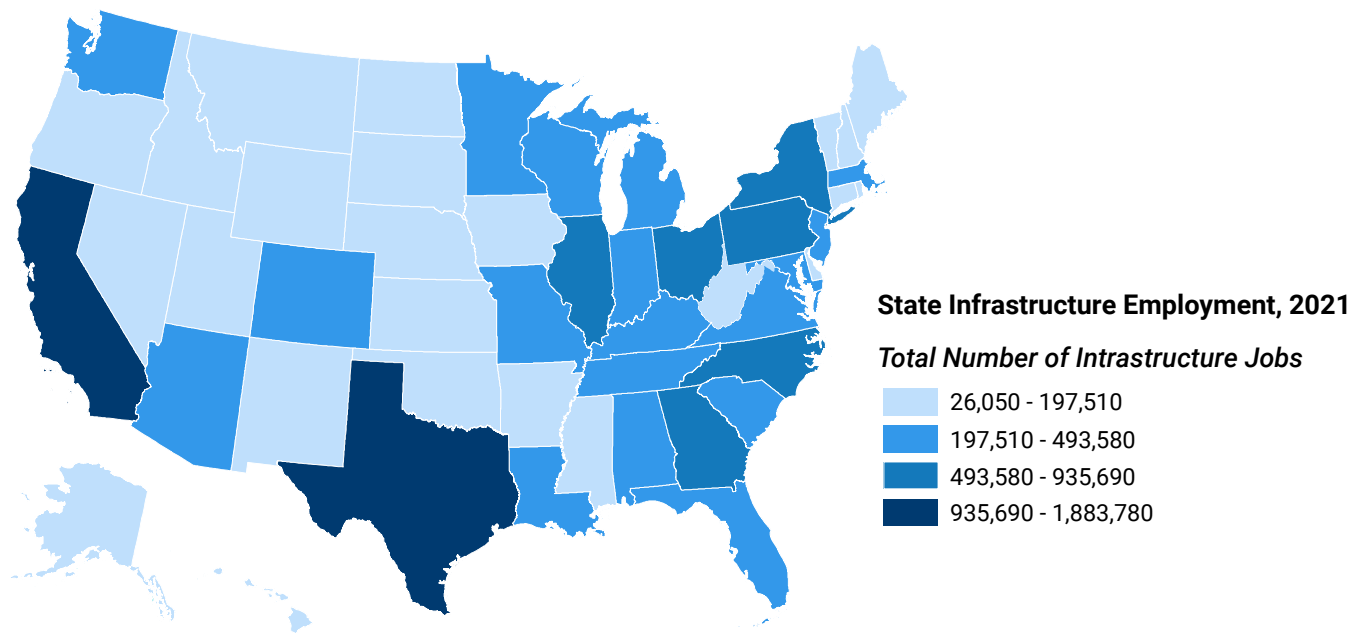
SOURCE: Brookings analysis of BLS Occupational Employment and Wage Statistics

These workers are employed across a variety of infrastructure sectors, but most (72.8%) are concentrated in transportation, especially in trade and logistics.⁵⁵ Warehousing and storage, truck transportation, and freight transportation arrangement are among the largest industries and employ nearly 3.5 million workers. There are millions of workers in other transportation activities as well, such as scheduled air transportation, rail transportation, and highway, street, and bridge construction. Among other infrastructure sectors, 12.2% of workers are in energy, including utility system construction and electric power generation, transmission, and distribution. The remaining workers are in telecommunications (7.6%) and water and public works (7.4%), the latter of which includes waste management and related activities.

The need to construct and maintain roads, pipes, power lines, and other systems touches every corner of the country, but some states depend more on infrastructure workers than others. Not surprisingly, states with the largest labor markets overall tend to employ the most infrastructure workers, led by California (1.9 million infrastructure workers), Texas (1.5 million), Florida (936,000), New York (817,000), and Illinois (750,000). These five states employ more than one-third of the country's infrastructure workforce. However, states that specialize in transporting goods and moving energy tend to employ the highest *shares* of infrastructure workers, such as Alaska (14.7%), Wyoming (14.6%), Kentucky (14%), and Tennessee (13.8%).

FIGURE 4

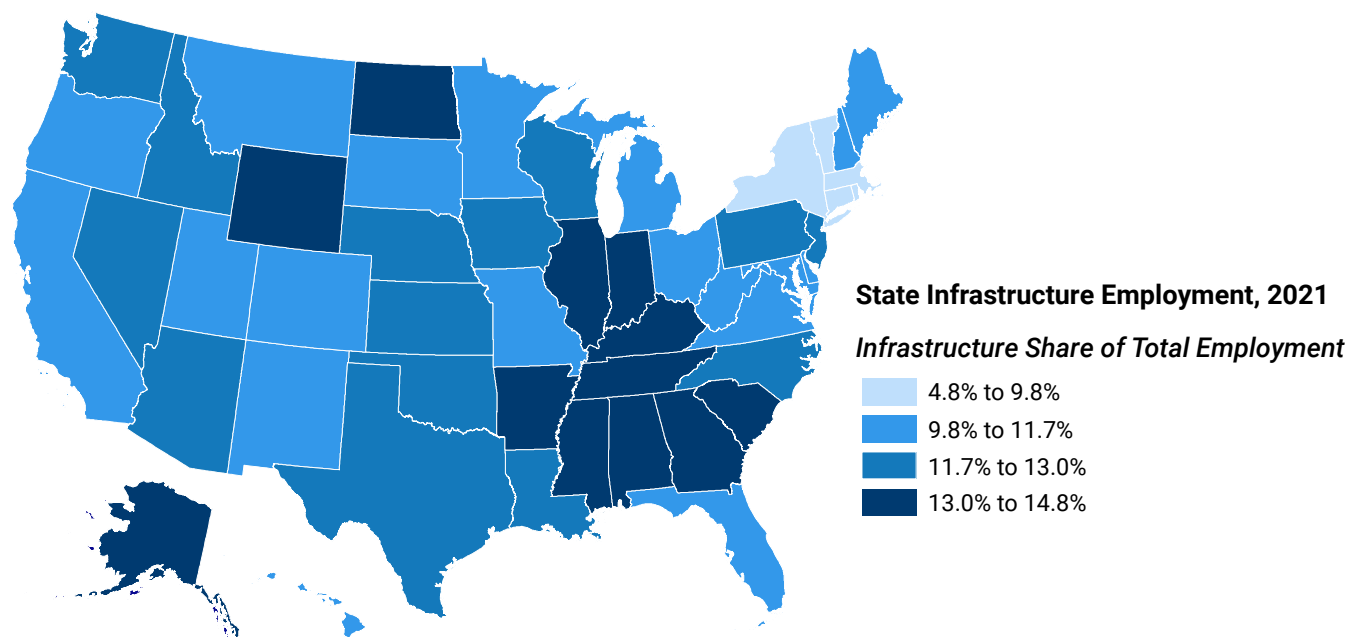
Total infrastructure employment by state, 2021



SOURCE: Brookings analysis of BLS Occupational Employment Statistics

FIGURE 5

Infrastructure share of total employment by state, 2021



SOURCE: Brookings analysis of BLS Occupational Employment Statistics

Infrastructure occupations pay wages that are 30% higher for workers at lower income levels, which supports more equitable career pathways.

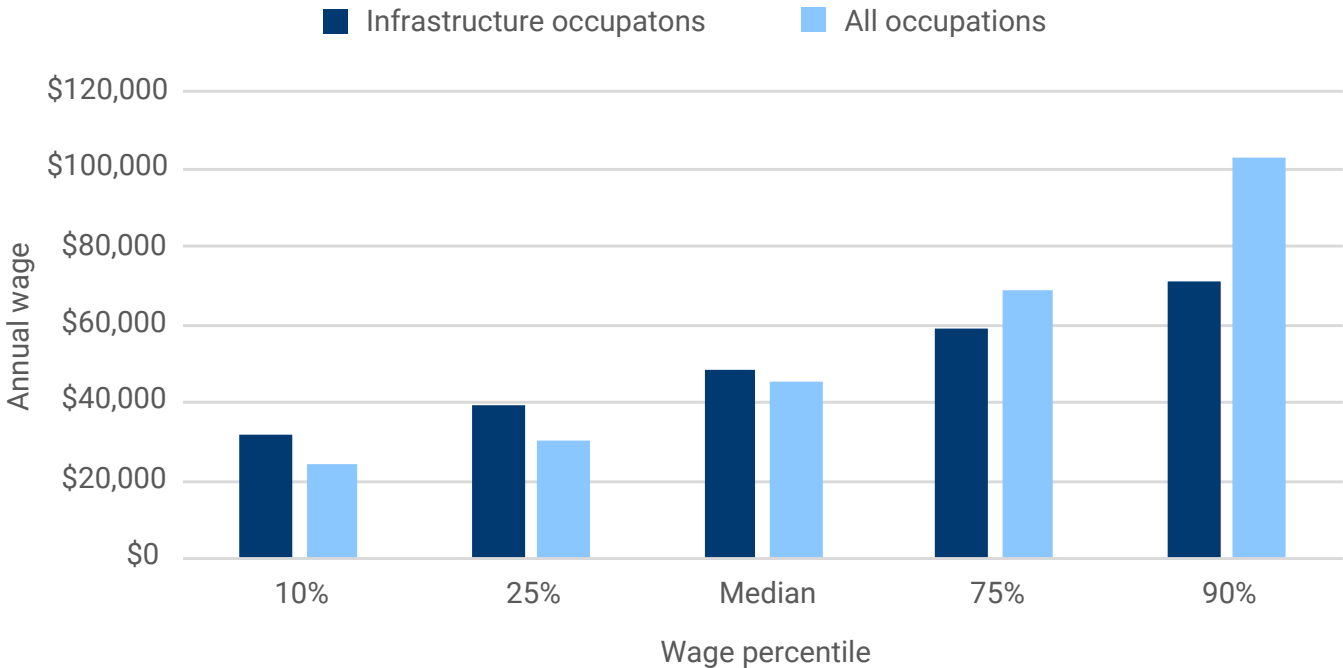
Infrastructure occupations not only offer multiple branching career pathways for workers across the country, but they also pay more equitable wages—meaning they have a higher floor for workers at the bottom of the wage spectrum. While they pay slightly higher median wages (\$48,100 annually) compared to all occupations nationally (\$45,760), they can pay wages that are 30% higher or more to workers at the 10th and 25th percentiles. At those percentiles, they pay \$31,750 and \$39,270, respectively, compared to \$23,980 and \$29,950 for all occupations. In total, 83 of the 95 infrastructure occupations (employing nearly 9.1 million workers) offer higher wages at both percentiles. This means higher pay for workers just entering the labor market or transitioning into these positions, which offers more opportunity to those at the bottom

rungs of the career ladder. And while higher pay alone does not fully capture the quality of these jobs, it does signal important steps toward “good-paying” jobs and livable wages.⁵⁶

Electricians, plumbers, and heavy-truck drivers are among the largest infrastructure occupations paying higher wages at the 10th and 25th percentiles. Other smaller, more specialized occupations that pay higher wages include airline pilots, nuclear power reactor operators, and environmental engineers. While many infrastructure jobs are in the public sector and have higher unionization rates (which partially explains this wage premium—see Box B), these workers also possess valuable, transferable skills and experience. This is especially true for positions outside trade and logistics; excluding those occupations increases the infrastructure wage premium at the 10th and 25th percentiles to \$37,060 and \$46,450, respectively—nearly 55% higher than all occupations nationally.⁵⁷

FIGURE 6

Annual wages for infrastructure occupations vs. all occupations nationally, 2021



SOURCE: Brookings analysis of BLS Occupational Employment and Wage Statistics

TABLE 2

Employment and 10th and 25th percentile wages for selected infrastructure occupations, 2021

Occupation	Employment	10th Percentile Wage	25th Percentile Wage
Heavy and Tractor-Trailer Truck Drivers	1,903,420	\$30,710	\$38,570
Electricians	650,580	\$37,020	\$46,900
Plumbers, Pipefitters, and Steamfitters	417,620	\$36,700	\$46,590
Civil Engineers	304,310	\$60,550	\$74,250
Bus and Truck Mechanics and Diesel Engine Specialists	261,420	\$35,730	\$41,600
Highway Maintenance Workers	141,150	\$29,130	\$36,700
Electrical Power-Line Installers and Repairers	123,940	\$46,200	\$60,480
Water and Wastewater Treatment Plant and System Operators	121,150	\$30,070	\$37,720
Telecommunications Line Installers and Repairers	101,530	\$37,140	\$43,570
Architectural and Civil Drafters	101,310	\$37,370	\$47,450
Infrastructure Occupations		\$31,750	\$39,270
All Occupations		\$23,980	\$29,950

SOURCE: Brookings analysis of BLS Occupational Employment and Wage Statistics

However, not all infrastructure occupations pay more. This is reflected in lower mean wages (\$51,050) in infrastructure occupations compared to all occupations nationally (\$58,260). They also pay lower wages at the 75th and 90th percentiles (\$58,700 and \$71,480, respectively) compared to all occupations nationally (\$68,590 and \$102,810). Once again, occupations in trade and logistics tend to weigh heavily on these estimates, including material

movers and packers and packagers—indicative of ongoing struggles to boost pay and other workplace protections for these positions.⁵⁸ If these occupations were excluded from the analysis, the mean wage for infrastructure occupations would increase to \$61,880—further signaling the competitive pay for occupations ranging from power plant operators (\$83,740) to landscape architects (\$74,980) to signal and track switch repairers (\$74,220).

BOX B

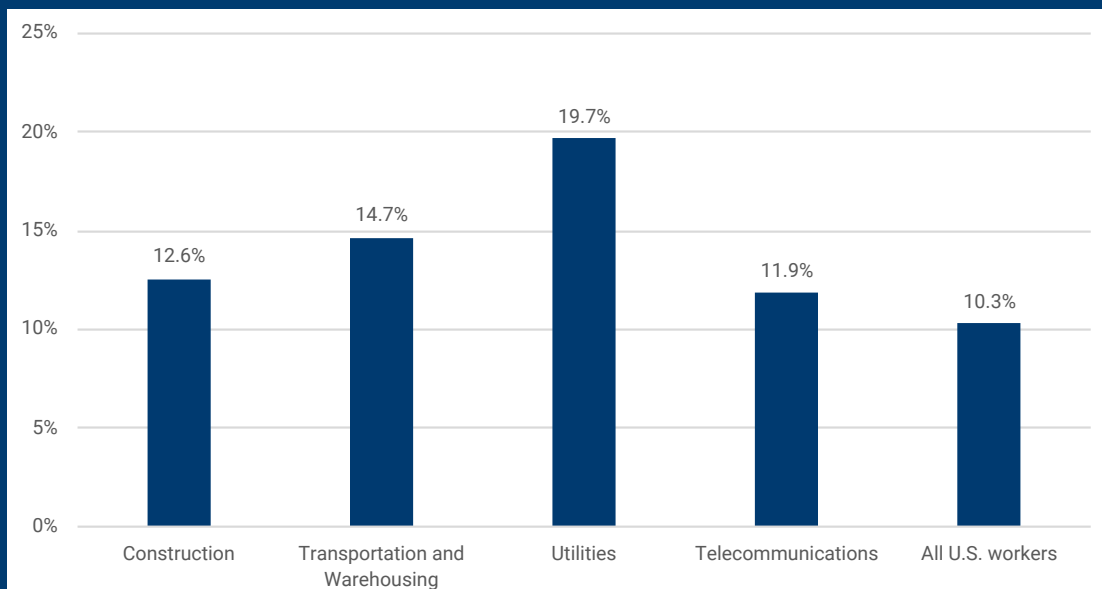
Examining unionization across the infrastructure workforce

In both the public and private sector, many infrastructure workers are union members. While the specific occupation, industry, and geography play key roles determining unionization levels across the sector, these workers tend to benefit from unions in many ways.⁵⁹ In addition to aiding in workforce development and training, unions can promote greater worker protections and job security.⁶⁰ They can encourage robust health and safety protocols, including helping workers secure additional benefits and insurance coverage.⁶¹ And perhaps most significantly, they can support higher wages through bargaining and other efforts; union members can earn 10.2% more than non-union peers, and Black and Latino or Hispanic workers receive an even larger wage bump from unionization: 13.7% and 20.1% more, respectively, than their non-union peers.⁶²

The most recent BLS unionization data underscores this point. While the level of occupational detail is not as robust in this dataset, many related industries employ unionized workers. For example, all four major infrastructure-related industries in the data—construction, transportation and warehousing, utilities, and telecommunications—post higher unionization rates compared to the national average for all workers (10.3%). Utilities have a particularly high unionization rate (19.7%).

FIGURE 7

Share of U.S. workers who are union members, by selected infrastructure industries, 2021

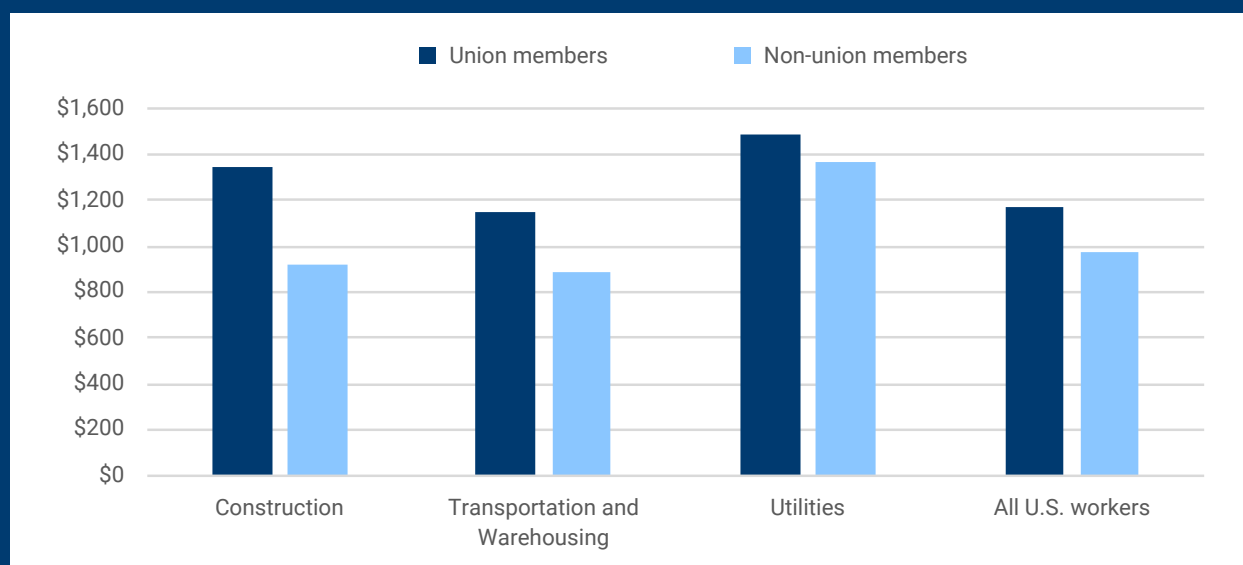


SOURCE: Brookings analysis of BLS unionization data

Nationally and in three major infrastructure-related industries, union members also post higher wages. That gap is most prominent in construction, where union members make 45% higher median weekly earnings (\$1,344) compared to non-union members (\$922). The gap is the least prominent in utilities, although these workers still have 8% higher median weekly earnings (\$1,482) compared to non-union members (\$1,369).

FIGURE 8

Share of U.S. workers who are union members, by selected infrastructure industries, 2021



SOURCE: Brookings analysis of BLS unionization data

In coming years, new federal infrastructure funding aims to expand support for these and other unionized positions. In its IIJA guidance, the Biden administration has continued to promote the role of unions, while federal agencies have started collaborating more on unionized labor issues.⁶³ For example, the Department of Labor has worked with the Department of Transportation (DOT) and Department of Energy (DOE) to craft language in funding guidelines to promote unionization; competitive grants within DOT and DOE give preference to applicants who support jobs with “the free and fair choice to join a union.”⁶⁴ These agencies have also focused on new labor agreements and local hiring preferences in IIJA-supported projects.⁶⁵ This emphasis on unionization has also fed into IRA implementation, with the aim to support companies that pay prevailing wages and offer apprenticeships.⁶⁶

Most infrastructure workers (53.8%) have a high school diploma or less, but they achieve higher wages than in other industries and grow their careers through on-the-job training.

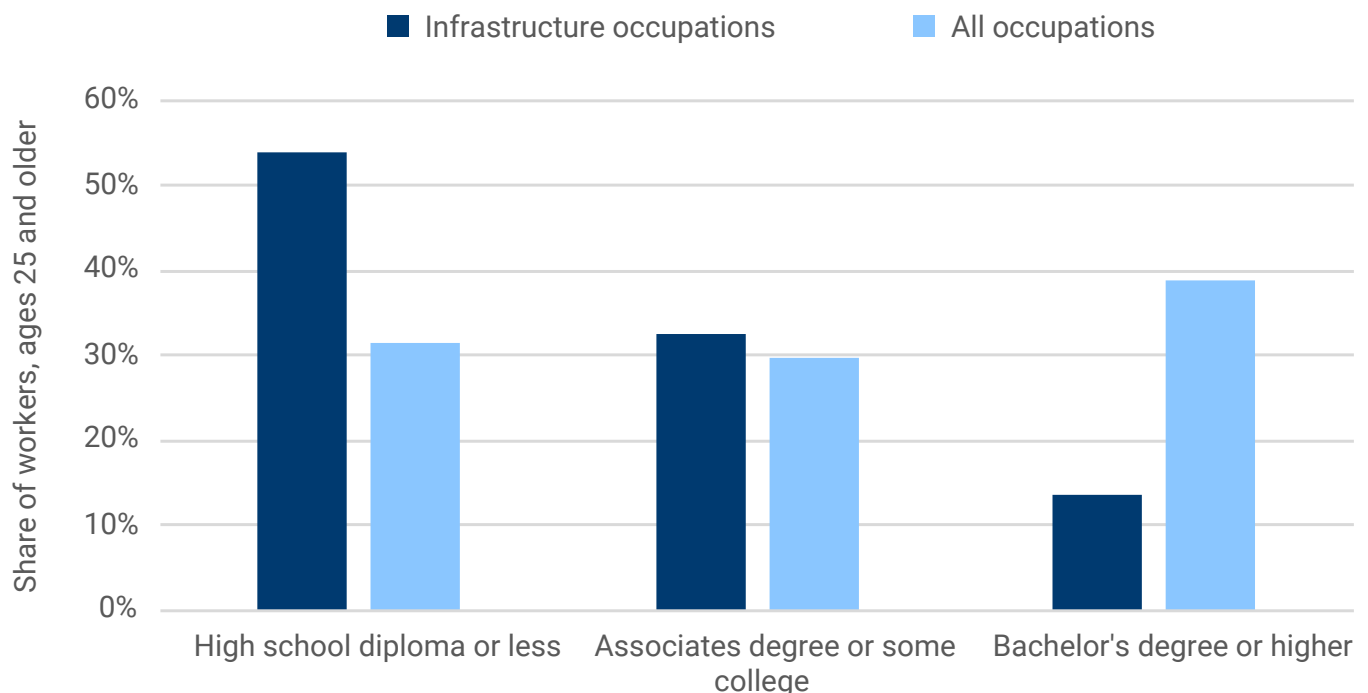
Only 13.6% of infrastructure workers have a bachelor's degree or higher, while a majority (53.8%) have a high school diploma or less. That contrasts sharply with workers across all occupations nationally, 38.7% of whom have a bachelor's degree or higher and 31.6% have a high school diploma or less. Some infrastructure occupations have even higher shares of workers with less formal education, including helpers to electricians (73% have a high school diploma or less), septic tank servicers (69%), and rail-track laying and maintenance equipment operators (65%). Meanwhile, nearly one-third of infrastructure workers

(32.6%) have an associate degree or some college, compared to 29.8% of workers across all occupations.

Perhaps more importantly, many of these workers still earn competitive wages. Sixty-nine of the 95 infrastructure occupations have above-average shares of workers with only a high school diploma or less (i.e., more than 31.6%); 64 of these 69 occupations pay higher wages at the 10th percentile than all occupations nationally (i.e., higher than \$23,980). For instance, 68% of pipelayers have a high school diploma or less, and their wage at the 10th percentile is \$30,000. Similarly, 59% of rail car repairers have a high school diploma or less, and their wage at the 10th percentile is \$37,430. Many of these same occupations also pay higher wages at the 25th percentile as well.

FIGURE 9

Levels of educational attainment for infrastructure occupations vs. all occupations, 2021



SOURCE: Brookings analysis of BLS Employment Projections data

TABLE 3

Selected infrastructure occupations ranked by share of workers with high school diploma or less, 2021

Occupation	Employment	Percent with high school diploma or less	10th percentile wage	25th percentile wage
Dredge Operators	1,650	74.0%	\$35,440	\$38,250
Paving, Surfacing, and Tamping Equipment Operators	44,200	73.0%	\$30,220	\$37,630
Helpers—Electricians	72,150	73.0%	\$27,680	\$29,630
Septic Tank Servicers and Sewer Pipe Cleaners	28,620	69.0%	\$29,310	\$36,240
Pipelayers	33,330	68.0%	\$30,000	\$36,910
Rail-Track Laying and Maintenance Equipment Operators	21,030	65.0%	\$37,620	\$48,070
Highway Maintenance Workers	141,150	65.0%	\$29,130	\$36,700
Plumbers, Pipefitters, and Steamfitters	417,620	62.0%	\$36,700	\$46,590
Rail Car Repairers	22,800	59.0%	\$37,430	\$47,200
Wind Turbine Service Technicians	10,100	53.0%	\$46,420	\$47,040
Infrastructure Occupations		53.8%	\$31,750	\$39,270
All Occupations		31.6%	\$23,980	\$29,950

SOURCE: Brookings analysis of BLS Employment Projections data and Occupational Employment and Wage Statistics

Rather than pursuing advanced levels of formal education, many infrastructure workers learn on the job: 86.8% need some level of on-the-job training, compared to 62.6% of workers across all occupations nationally. The most common is short- to medium-term (a few months or up to a year) on-the-job training, which nearly three-quarters (72.9%) of infrastructure workers undergo to gain the competencies needed to perform their jobs.⁶⁷ These workers include aircraft mechanics, meter readers, and rail yard engineers, among many others. The remaining 13.2% of infrastructure workers need long-term on-the-job training lasting years, or an apprenticeship; these include air traffic controllers, water treatment operators, and electricians.

Infrastructure workers develop specialized skills and earn specialized credentials through work-based

learning, but they still rely on many similar types of knowledge. Worker surveys from O*NET—an information resource sponsored by the Department of Labor’s Employment and Training Administration—reveal the common categories of knowledge required across the 95 infrastructure occupations. O*NET surveys rank the extent to which occupations require knowledge across 33 categories on a scale from 0 (minimum) to 7 (maximum). They find that infrastructure occupations score above-average in 11 categories, including knowledge in public safety and security, engineering and technology, law and government, and more. In other words, regardless of whether these workers are employed in transportation, energy, or another sector, they rely on many similar categories of required knowledge—speaking to the need for more cohesive sector strategies in workforce development.⁶⁸

TABLE 4

Categories of knowledge most required in infrastructure occupations, 2021

Knowledge category	Average knowledge score, infrastructure occupations (0-7)	Average knowledge score, all occupations (0-7)	Infrastructure advantage
Transportation	2.88	1.78	1.09
Mechanical	3.31	2.37	0.93
Building and Construction	2.27	1.46	0.81
Public Safety and Security	3.18	2.56	0.62
Engineering and Technology	2.87	2.32	0.55
Physics	2.28	1.74	0.54
Geography	2.19	1.69	0.51
Design	2.40	2.08	0.32
Telecommunications	1.73	1.46	0.28
Chemistry	2.07	1.95	0.13
Law and Government	2.34	2.28	0.07

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

From 2021 to 2031, projections show 1.7 million infrastructure workers (12.2%) will leave their jobs each year on average, leading to huge replacement needs.

Although the infrastructure sector offers multiple career pathways, pays equitable wages, and tends to pose lower formal educational barriers to entry, there are enormous struggles to recruit and retain workers. The infusion of new federal infrastructure funding is causing many leaders to focus on job creation, but the country faces an even bigger opportunity—and challenge—in filling the shoes of current infrastructure workers leaving their jobs.

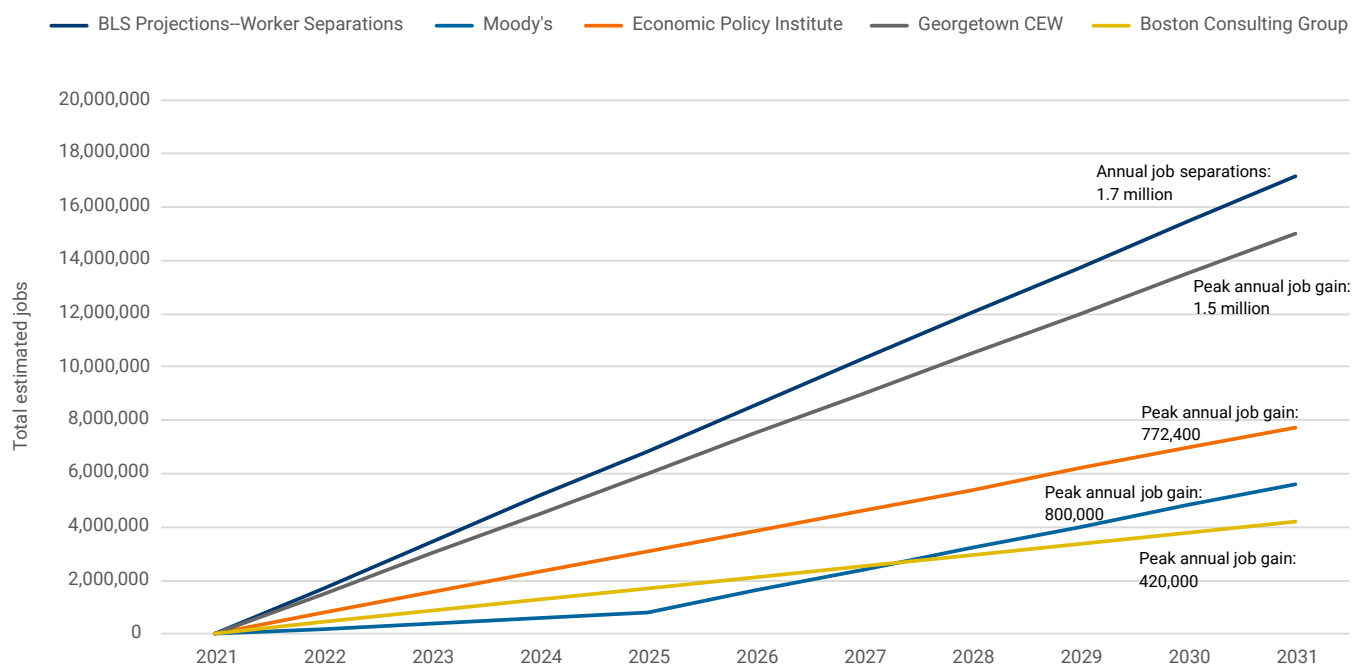
The latest BLS projections show that infrastructure employment will increase by 820,000 workers (5.8%) from 2021 to 2031, which is faster than the rate for all occupations nationally (5.3%). Among the fastest-growing infrastructure occupations are wind turbine service technicians (a 44.3% increase), logisticians (27.7%), and solar photovoltaic installers (27.2%). BLS

projections do not necessarily include the impacts of recently passed federal legislation, including the IIJA and IRA—meaning that these figures could expand considerably in coming years.⁶⁹ For instance, the job creation estimates shown earlier in this report—from the Economic Policy Institute, Moody's, Boston Consulting Group, and Georgetown University Center on Education and the Workforce—reach upward of 1.5 million more workers each year, or 15 million more workers over the next decade.

But at the same time, more than 1.7 million infrastructure workers (12.2%) are projected to leave their jobs each year on average over the next decade due to retirements and other labor force exits as well as transfers to other occupations.⁷⁰ In other words, that means 17 million infrastructure workers will need to be replaced over the next decade—more than the entirety of the current infrastructure workforce. That also exceeds every estimate noted earlier in this report for the total jobs created from new federal infrastructure spending.

FIGURE 10

Estimated new infrastructure job creation vs. infrastructure jobs that need to be filled due to worker separations, 2021 to 2031



NOTE: New jobs created are estimated based on new federal infrastructure spending, while the projected jobs that need to be filled are based on retirements and other labor force exits as well as transfers to other occupations.

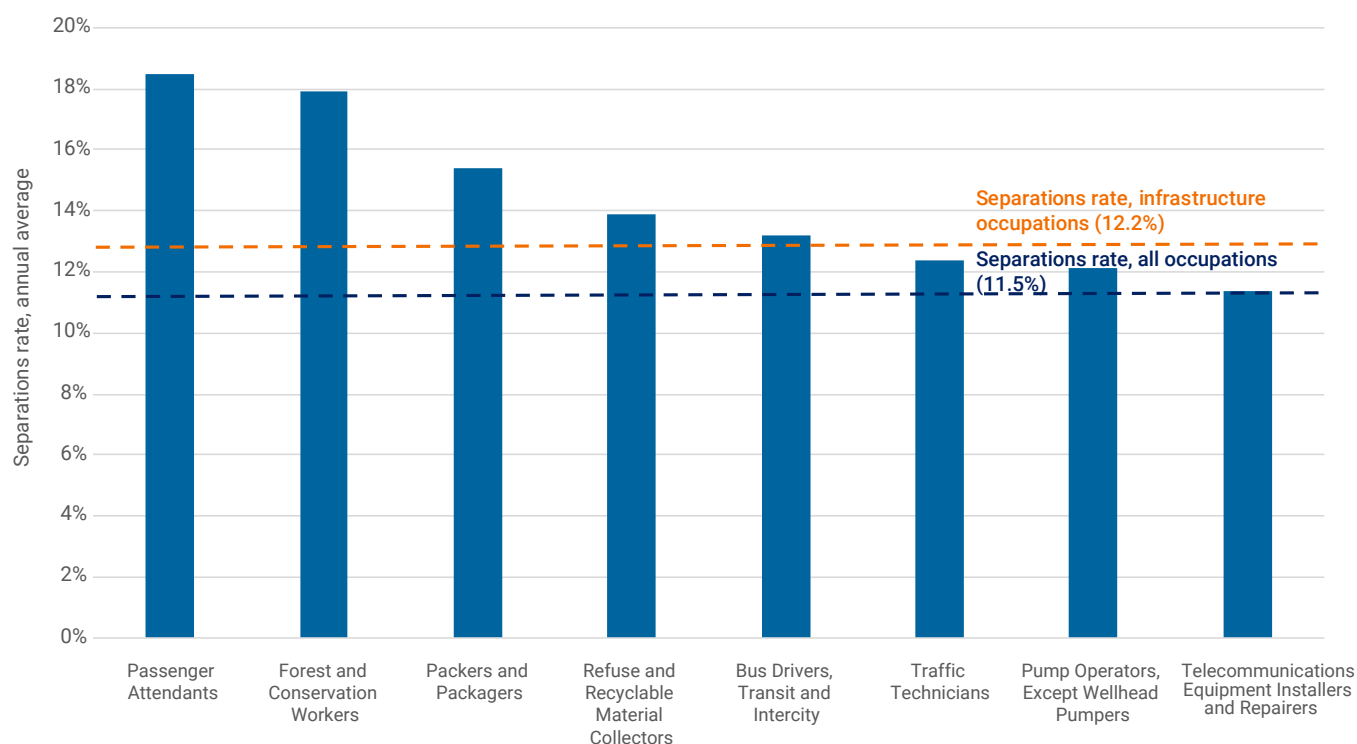
SOURCE: Brookings analysis of BLS Employment Projections data and estimated job creation data from EPI, Moody's, BCG, and Georgetown CEW

Occupational separations—a measure of how many existing workers “separate” from their jobs—show just how pressing replacement needs are across the infrastructure workforce.⁷¹ On average, about 11.5% of all U.S. workers are projected to permanently leave their jobs each year. Infrastructure occupations with the highest separation rates include packers and packagers (15.4%), who face some of the most difficult work conditions, including long hours.⁷²

Many other positions are also struggling to retain workers, including refuse and recyclable material collectors (13.9%), transit and intercity bus drivers (13.2%), and traffic technicians (12.4%). These positions can also face difficult work conditions—especially those that have been more public-facing during the pandemic—and face a wave of retirements, as this report will explain further.⁷³

FIGURE 11

Separations rate for selected infrastructure occupations, annual average, 2021 to 2031



SOURCE: Brookings analysis of Employment Projections data

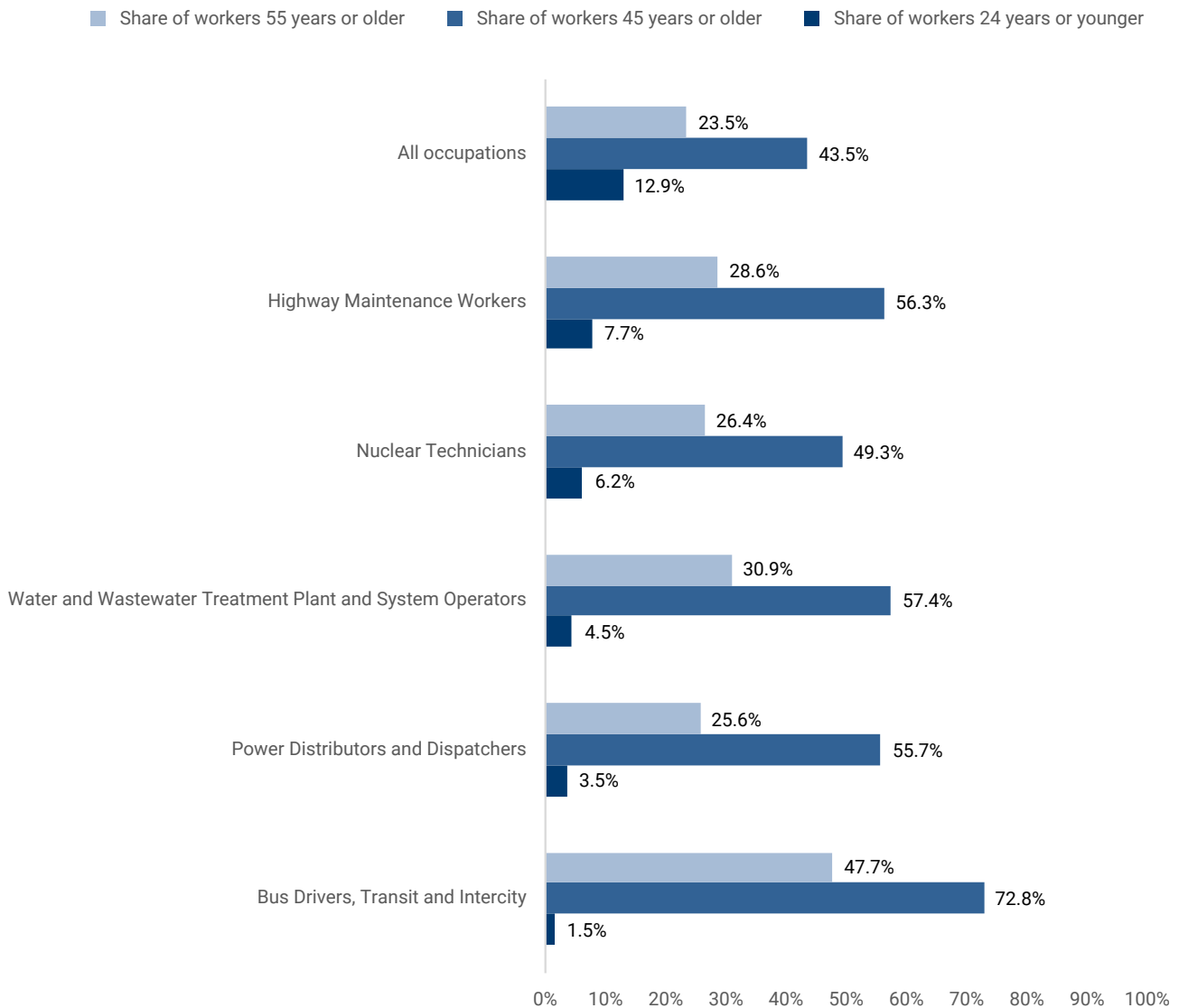
The infrastructure workforce skews older, male, and white—signaling a need to reach more and different types of workers in coming years.

In the rush to hire workers for new infrastructure jobs, it can be easy to overlook the current infrastructure workforce's talent drain, especially as many workers are nearing or eligible for retirement. The age breakdown is fairly similar to the economy as a whole: 45.3% of these workers are 45 or older, compared to 43.5% of all workers nationally. At the same time, nearly a quarter of infrastructure workers are 55 or older, compared to 23.5% of all workers nationally. However, older workers are concentrated in certain skilled trades positions and occupations essential to infrastructure operations, such as transit and intercity bus drivers (72.8% of whom are 45 or older), power distributors and dispatchers (55.7%), and rail yard engineers (53.8%).

But an aging workforce may not be the biggest concern—the lack of younger talent is particularly glaring. Only 11% of infrastructure workers are 24 or younger, compared to 12.9% of all workers nationally. Once again, this share gets more extreme when excluding positions in trade and logistics (8.5%). Collectively, 78 of the 95 infrastructure occupations—employing 9.9 million workers—have below-average shares of workers 24 or younger. Occupations with the lowest shares of younger workers include locomotive engineers (2%), subway and streetcar operators (2.8%), and telecommunications equipment installers (6.9%). Admittedly, some of these occupations depend on slightly older workers because they require more years of experience and training. However, the broad lack of younger talent shows that many current workers have no one to succeed them and few individuals to mentor, which may stall infrastructure projects and risk operational failures over time.

FIGURE 12

Selected infrastructure occupations, by age group, 2021



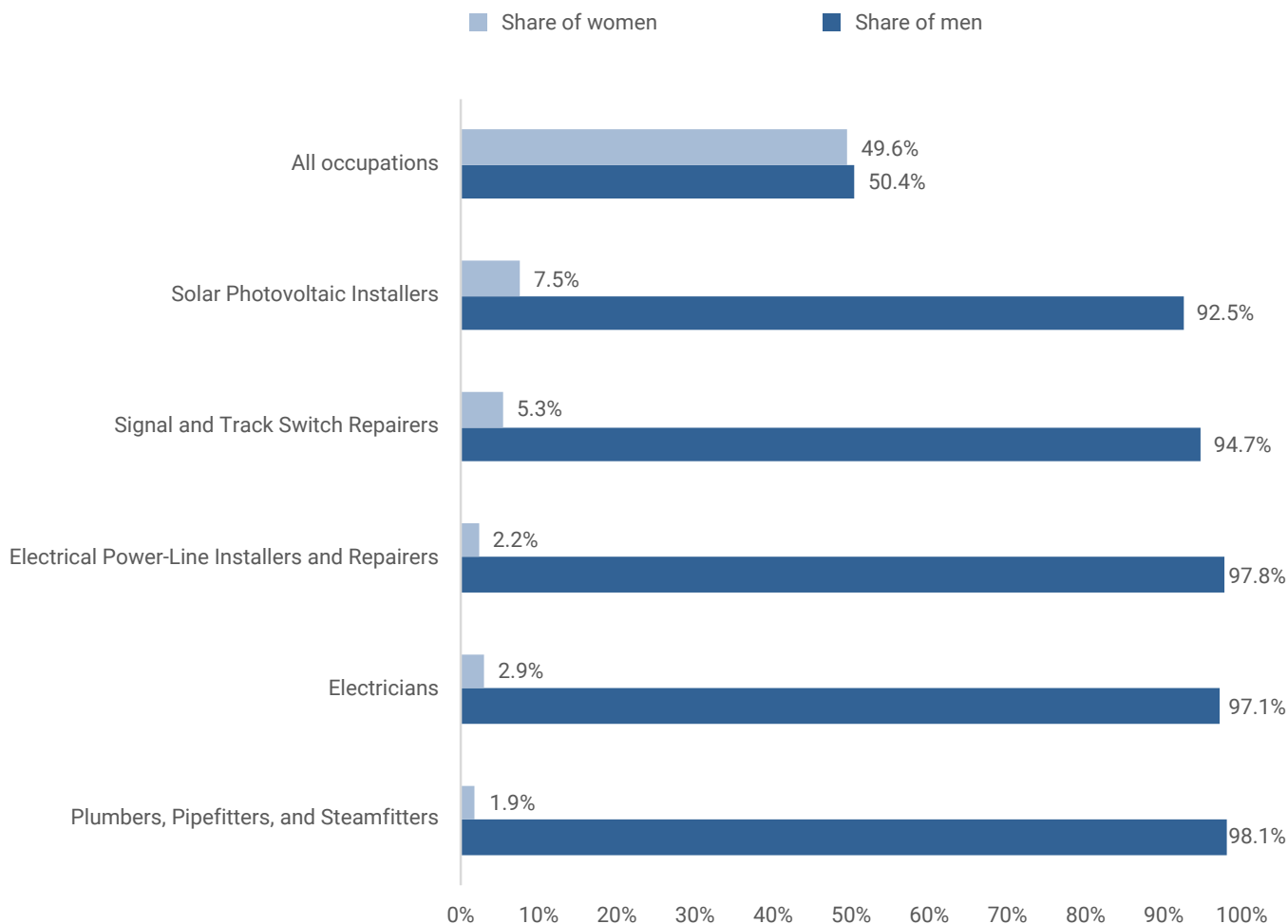
SOURCE: Brookings analysis of BLS Occupational Employment and Wage Statistics and Lightcast data

The lack of women also continues to define the current infrastructure workforce. Women make up only 18.5% of all infrastructure workers, while they make up 49.6% of all workers nationally. They are most underrepresented in skilled trades positions, including plumbers (1.9%) and electricians (2.9%). But women are also few and far between in a range of

other occupations vital to infrastructure construction and operation, including electrical power line installers (2.2%), signal and track switch repairers (5.3%), and solar photovoltaic installers (7.5%). Instead, many women fill positions in human resources, office and administrative support, and other service activities, similar to many other industries.⁷⁴

FIGURE 13

Selected infrastructure occupations, by gender, 2021



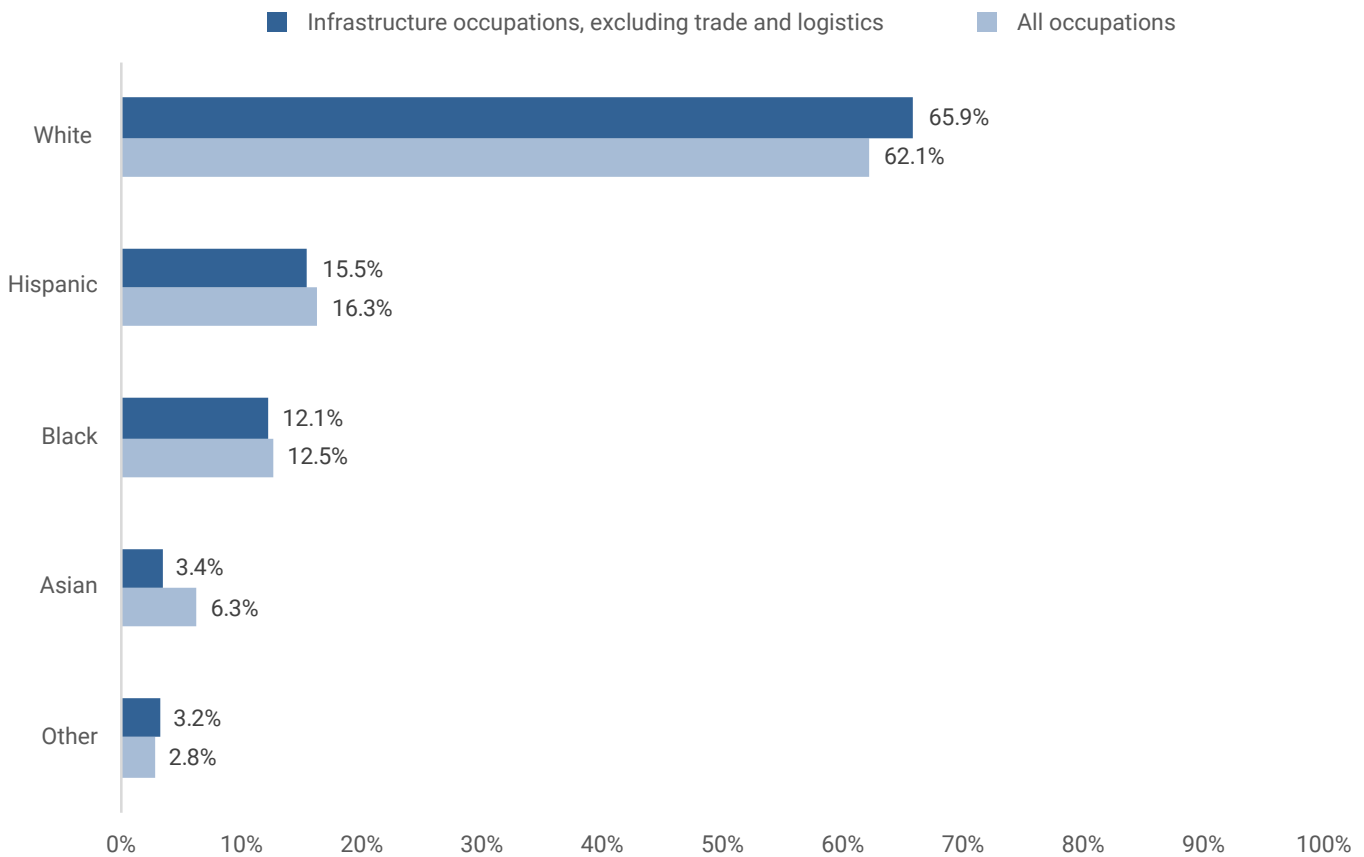
SOURCE: Brookings analysis of BLS Occupational Employment and Wage Statistics and Lightcast data

Lastly, many infrastructure occupations lack racial and ethnic diversity, which demonstrates gaps in reaching more and different types of workers. This is especially true when excluding large occupations in trade and logistics that have above-average shares of Black and Latino or Hispanic workers, which tend to skew estimates.⁷⁵ Beyond trade and logistics, for instance, Black workers account for only 12.1% of the current infrastructure workforce, compared to 12.5% for all

occupations nationally.⁷⁶ Likewise, Latino or Hispanic workers account for only 15.5% of this workforce, compared to 16.3% for all occupations nationally.⁷⁷ Meanwhile, Asian American workers and those of other races, including Native Americans, account for only 6.6% of this workforce, compared to 9.1% of all occupations nationally. White workers account for two-thirds (65.9%)—slightly higher than their share in all occupations nationally (62.1%).

FIGURE 14

Share of infrastructure workers, by race, excluding trade and logistics, 2021



NOTE: Excludes large trade and logistics occupations described more fully in the main report text.

SOURCE: Brookings analysis of BLS Occupational Employment and Wage Statistics and Lightcast data

The higher shares of Black and Latino or Hispanic workers in larger, lower-paying occupations—particularly in trade and logistics—demonstrates a need to connect them to occupations that not only offer higher pay and more long-term career growth, but also have less racial diversity. For instance, Black and Latino or Hispanic workers account for a combined 44.3% of the country's 2.7 million laborers and material movers, which pay a mean wage of \$34,950—considerably less than the national average

of \$58,260. They also account for 56.9% of the country's 585,000 packers and packagers, which make \$30,950. By comparison, they only account for 22.9% of electricians, which have a mean wage of \$63,310, and 14% of civil engineers, which have a mean wage of \$95,490. Other occupations with higher pay and lower racial diversity include power plant operators, architectural and civil drafters, electrical installers, and transportation equipment repairers.

TABLE 5

Employment and wages for selected infrastructure occupations, by race, 2021

Occupation	Employment	Mean wage	Share of Black workers	Share of Hispanic workers
Laborers and Freight, Stock, and Material Movers, Hand	2,729,010	\$34,950	22.1%	22.2%
Electricians	650,580	\$63,310	6.3%	16.6%
Packers and Packagers, Hand	585,270	\$30,950	19.5%	37.4%
Plumbers, Pipefitters, and Steamfitters	417,620	\$63,350	6.0%	18.9%
Civil Engineers	304,310	\$95,490	4.6%	9.4%
Aircraft Mechanics and Service Technicians	125,440	\$69,470	10.3%	17.3%
Architectural and Civil Drafters	101,310	\$60,620	4.0%	13.3%
Control and Valve Installers and Repairers, Except Mechanical Door	44,870	\$67,310	11.4%	13.8%
Power Plant Operators	28,960	\$83,740	6.7%	6.1%
Electrical and Electronics Installers and Repairers, Transportation Equipment	10,710	\$70,650	11.4%	13.4%
All Occupations		\$58,260	12.5%	16.3%

SOURCE: Brookings analysis of BLS Occupational Employment and Wage Statistics and Lightcast data

Reaching more workers—including those who are younger, women, and people of color—will be a challenge for infrastructure employers who continue to conduct business as usual. The labor force participation rate for the entire economy is projected to drop another 1.6% by 2031 (to 60.1%) as more workers retire or simply do not join the labor market. This is particularly true for workers 24 and younger, who will see their participation rate drop by 9.4%. At

the same time, the labor market is projected to grow among groups traditionally underrepresented in the infrastructure workforce. There will be a 6.1% increase in women compared to a 3.5% increase in men, as well as an 8.2% increase in Black workers and 23.6% increase in Latino or Hispanic workers, compared to a 1.6% increase in white workers. Filling open infrastructure positions will demand expanding the net to capture more and different types of workers.



Policy implications and recommendations

With the passage of historic federal infrastructure legislation, the country has an opportunity to expand its infrastructure workforce. But in seeking to create new jobs, national, state, and local leaders can overlook the opportunities—and challenges—facing current infrastructure workers.

Today, millions of workers fill a wide range of infrastructure occupations—not just picking up shovels and putting on hard hats, but also constructing, operating, designing, and governing a vast array of transportation, water, energy, and broadband systems.

But across the country, these workers are disappearing. The potential number of new jobs created from recent federal infrastructure funding—even according to the most ambitious estimates—pales in comparison to the wave of infrastructure workers leaving their jobs. This “silver tsunami” of older infrastructure workers retiring and taking their specialized knowledge with them is not looming on the horizon—it is happening right now. And many younger and mid-career infrastructure workers are fed up with their jobs, opting to transfer to other sectors or leave the labor force entirely.⁷⁸

This talent drain is not just a threat to future economic growth—it also stifles current economic opportunity. Infrastructure occupations offer higher pay, especially to workers at lower ends of the income scale. Whether employed as electricians, plumbers, civil engineers, or dozens of other occupations, this equitable pay supports millions of people who may only have a high school diploma or less. In addition, these workers are learning on the job and developing in-demand skills that are valuable and transferable to many jobs across the infrastructure sector and beyond.

Additionally, struggles reaching out to and retaining younger students, women, and people of color continue to hobble the infrastructure workforce. Traditionally underrepresented and marginalized in these careers, these groups’ lack of employment represents a missed opportunity for employers as well. Many current infrastructure workers are aging, white, male, and dwindling across the economy. Employers, from transportation departments to energy utilities, are

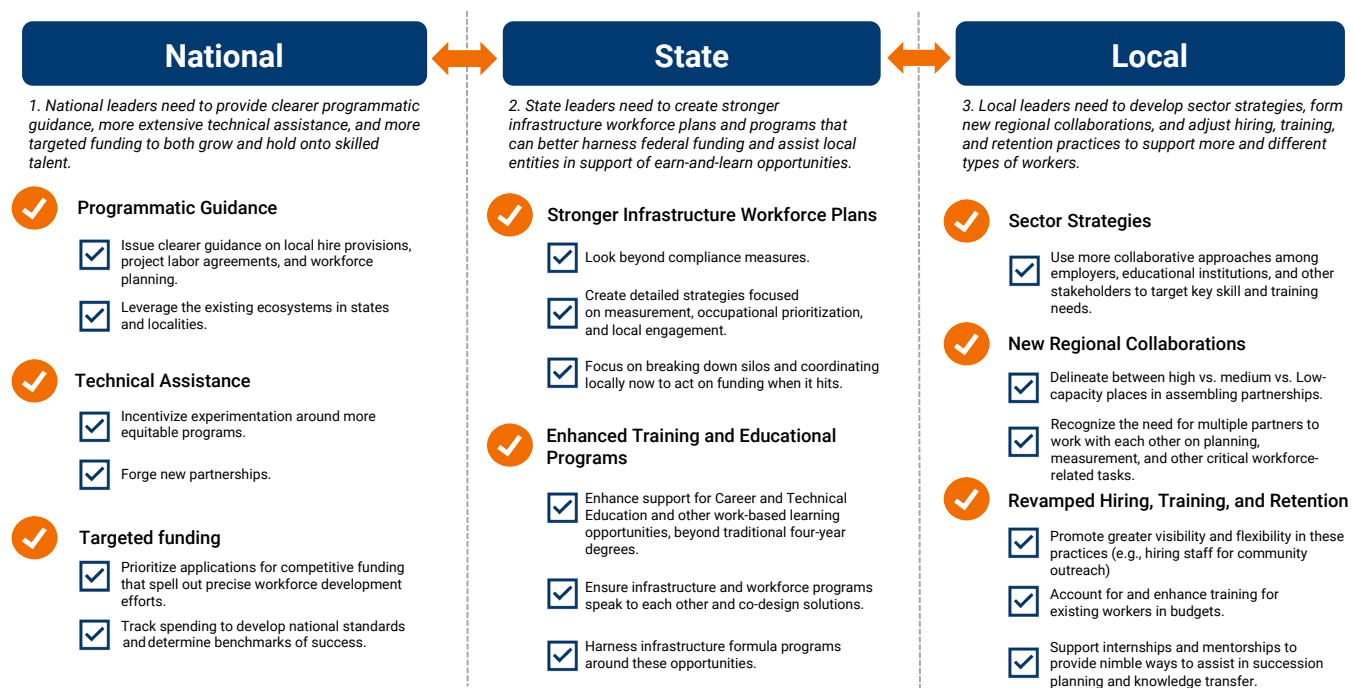
facing heightened pressure to find more workers, but relying on the same kinds of job candidates and business-as-usual approaches.

Addressing these existing workforce gaps—not just creating potential new jobs in the future—is a major reason why this federal window for infrastructure action matters so much. National, state, and local leaders need to harness federal funding in ways that invest in future *and* current infrastructure workers. They cannot simply pump more money into projects that “create” new construction jobs—they need to ensure existing hiring practices and recruitment strategies become more flexible; that training and education reach more and different types of workers; and that infrastructure employers are able to retain existing workers.

A combination of national, state, and local actions is necessary to achieve such durable changes and unlock greater economic opportunity across the country.

FIGURE 15

National, state, and local actions to accelerate infrastructure workforce development



SOURCE: Brookings interviews with leaders on infrastructure workforce challenges

National leaders need to provide clearer programmatic guidance, more extensive technical assistance, and more targeted funding to both grow and retain skilled talent.

National leaders, particularly federal agencies, play a vital role overseeing the flow of all this new funding and helping eligible state and local entities target it for needed infrastructure workforce development.

That should start with clearer **programmatic guidance**, by requiring or encouraging these entities to hire, train, and retain more diverse workers. They can do that by emphasizing stronger labor standards for projects, including local-hire provisions, the enforcement of worker protections, and project-labor agreements (PLAs) that can boost wages and other benefits.⁷⁹ At the same time, they should prioritize the awarding of funding in competitive grants for applications that stress workforce development, while also exploring ways to encourage states and localities to use (typically much larger) formula funding for this purpose as well.⁸⁰ The Department of Labor launched a “Good Jobs Initiative” providing resources on many of these issues.⁸¹ The department also recently released guidance on “building pathways to infrastructure careers” aimed at workforce agencies, educational institutions, and other partners collaborating with eligible infrastructure entities; it stresses plans and programs to better engage nontraditional workers, prioritize equity in project procurement, and more.⁸² The Environmental Protection Agency similarly released a technical memo for states and utilities to use new water funding to “meet local workforce needs” by relying on PLAs, enforcing prevailing wage requirements, and expanding apprenticeships.⁸³

Of course, providing guidance means little if states and localities do not have the programmatic capacity to even consider these steps when applying for or using federal funding. Federal agencies alongside national associations, philanthropies, and groups involved in infrastructure workforce issues need to

provide greater **technical assistance**. That includes not only explaining different funding opportunities and helping entities apply for it, but also incentivizing experimentation around more equitable programs, forging new partnerships, and creating short- and long-term workforce strategies. With the launch of a “Talent Pipeline Challenge,” the White House worked with federal agencies and other national partners to expand training collaborations, highlight best practices, and convene stakeholders.⁸⁴ This comes on top of other ongoing efforts at federal agencies such as DOT, which is disseminating information on programs that can boost local-hire provisions, job quality, and other supportive services.⁸⁵ Expansive engagement efforts are also underway through a “Local Infrastructure Hub” led by a variety of philanthropies and city-focused associations that are helping underserved communities.⁸⁶

Offering guidance and assistance needs to ultimately be in service of larger national workforce strategies, not just individual pots of funding. Federal agencies need to **target funding** based on a set of national priorities and standards, determine relevant benchmarks of success, and track and evaluate spending. The seeds for these efforts can start in individual agencies as they look to provide flexibility in new federal funding and prioritize the state and local applications that spell out precise workforce development efforts, such as expanding work-based learning options.⁸⁷ However, there needs to be a whole-of-government approach on infrastructure workforce development, in which multiple agencies operate from a similar playbook and set of priorities. For instance, new executive orders on climate and economic equity touch on workforce priorities, and the Justice40 Initiative aims to direct federal investment more consistently toward underserved communities.⁸⁸ But federal agencies, from DOT to DOE to EPA, need to take additional steps together as part of larger interagency efforts, including better accounting of workforce spending and collaborating on a national infrastructure workforce plan.⁸⁹

State leaders need to create stronger infrastructure workforce plans and programs that can better harness federal funding and assist local entities in support of earn-and-learn opportunities.

State infrastructure agencies, including departments of transportation and energy offices, need to bridge many of the country's infrastructure workforce gaps by better harnessing new federal funding. But state workforce leaders, including labor departments, workforce boards, and educational institutions, also need to be actively involved in ongoing hiring, training, and retention efforts. Separate state fact sheets for this report highlight the most pressing workforce needs and spell out more detailed strategies for these leaders to consider. They cover issues across six states (Massachusetts, Pennsylvania, Illinois, Wisconsin, Colorado, and California), and capture a diverse range of workforce needs and actions.⁹⁰

State entities eligible for federal infrastructure funding need to look past compliance and the bare minimum of getting projects done. As federal leaders call for the creation of voluntary state human capital plans and other workforce development efforts as part of new legislation, state leaders need to create stronger **infrastructure workforce plans** that prioritize training for mission-critical occupations, engage local leaders around these priorities, and focus on improved measurement and accountability. While many states feel a sense of urgency to get more federal money in the door as quickly as possible, they should be more intentional and calculated in how they can best utilize this funding in support of durable workforce solutions based on a clear needs assessment. For example, Pennsylvania has developed a National Electric Vehicle Infrastructure (NEVI) state plan aimed at harnessing new federal funding to install charging systems and address other workforce priorities, including identifying occupational priorities, engaging with community colleges, supporting training on electric vehicle maintenance, and giving preference to contractors associated with Registered Apprenticeship Programs.⁹¹

Related to these state plans is a need for leaders to develop stronger **infrastructure training and**

educational programs, including more emphasis and funding for CTE and work-based learning programs. Ideally, state infrastructure agencies need to collaborate more closely with state workforce leaders around industry (and sector) partnerships that identify and act on shared priorities around skills development, hiring needs, training hurdles, industry-based credentials, supportive services, and more.⁹² Ideally, these partnerships can support eligible state agencies as they receive flexible formula funding that they can direct more intentionally to such workforce development priorities. California's High Road Training Partnerships (HRTTP) initiative represents an "industry-based, worker-focused training" effort around transit, water, logistics, and other sectors and engages major employers and educators across the state.⁹³ Wisconsin has also launched several efforts aimed at preparing underrepresented workers to fill construction and transportation positions, including its Transportation Alliance for New Solutions (TrANS) program, which includes more than 24 industry and educational partners that have developed customized instruction and provide supportive services to boost the state's talent pool.⁹⁴

Local leaders need to develop sector strategies, form new regional collaborations, and adjust hiring, training, and retention practices to support more and different types of workers.

Ultimately, local leaders—including employers, workforce boards, educational institutions, labor groups, and community-based organizations, among others—are most directly attuned to workforce challenges on the ground and involved in addressing them. Additional federal infrastructure funding has the potential to build their fiscal and technical capacity, but they need to be ready to harness this funding in ways that respond to their most pressing needs and demonstrate their ability to act regionally. Doing so can help them further qualify for federal competitive grants and stretch every dollar they receive.

Similar to their state peers, local leaders need to launch (or strengthen) **sector strategies** around infrastructure. Common knowledge requirements and skill needs across many infrastructure occupations

demand more collaborative approaches among employers, educational institutions, and other local leaders to grow the talent pool, rather than continuing to channel workers toward a narrow set of credentials (e.g., commercial driver's licenses) and competing against each another for scarce talent. The formation of "infrastructure academies"—centralized destinations for screening, training, and recruitment for infrastructure jobs—in cities such as Washington, D.C. have bridged gaps among utilities, transit agencies, and other employers in service of greater worker exposure and recruitment.⁹⁵ Similar efforts, such as the SEED School of Los Angeles County (a partnership between LA Metro and Los Angeles County), represent place-based educational and training models geared toward helping at-risk youth and prospective job candidates.⁹⁶

Extending the reach of education and training beyond a single neighborhood or jurisdiction can also create greater economies of scale, foster more collaboration, and build greater financial and technical capacity for local partners who may have less bandwidth to take on additional workforce development activities. The formation of **new regional collaborations**, both formal and informal, can set common meeting points, encourage broader planning efforts, aid in data collection, and create other opportunities for knowledge exchange and experimentation. Workforce development boards should play a lead role in such efforts to prioritize infrastructure careers as cross-cutting areas of focus for transportation, energy, water, and other employers. At the same time, employers, labor groups, and community-based organizations can pioneer some of these efforts themselves; for instance, BAYWORK represents a consortium of San Francisco Bay Area water and wastewater utilities focused on workforce development, in tandem with other community partners.⁹⁷ And the Camden Collaborative Initiative—a partnership between more than 40 community organizations and businesses in New Jersey—has served as a regional body and platform to define priorities, encourage discussion, and test new ideas, with a focus on improving environmental and economic outcomes.⁹⁸

Beyond additional local collaboration, supporting more visible and flexible pathways into infrastructure careers is a must. And that starts with **adjusting existing hiring, training, and retention practices**.⁹⁹ Employers in particular need to take steps toward more proactive and inclusive workforce development practices given the need for extensive on-the-job training in these careers. That includes hiring staff for additional community outreach, accounting for and enhancing training for existing workers in program budgets, and supporting more internships and mentorships to provide nimble ways to assist in succession planning and knowledge transfer. That also includes broader local efforts, including adjusted local hiring practices, PLAs (including community benefits agreements), and contracting opportunities that emphasize women- and minority-owned businesses.¹⁰⁰

Several local efforts aiming to elevate and act on these types of approaches have emerged. Syracuse Build, Kentuckiana Builds, and HireNYC represent three city-led programs to boost equity in construction careers using outreach to minority contractors, local hiring practices, supportive services, union partnerships, apprenticeships, and other steps toward recruiting underrepresented workers.¹⁰¹ The San Diego Association of Governments (SANDAG)—the primary regional transportation planning agency in San Diego—has pursued similar efforts with its Workforce Opportunities for Rising Careers (WORC) program, which includes a community benefits agreement, a pre-apprenticeship program, and more.¹⁰² In Virginia, the Hampton Roads Workforce Council is looking to launch careers for underrepresented workers in the blue economy, clean energy, and other industries through its Workforce Training System for Good Jobs effort, which includes collaborations with historically Black colleges and universities, employers, and other local leaders.¹⁰³ Similar efforts focused on green jobs, digital technologies, and related careers are continuing to emerge in other localities.¹⁰⁴



Conclusion

With once-in-a-generation federal funding, the country faces an enormous infrastructure workforce opportunity in the coming years—but also an enormous challenge. Creating more jobs and ensuring there are enough workers to fill them is difficult enough. Yet expanding the infrastructure workforce depends on investing in and holding on to the skilled workers the country already employs in this sector. Existing hiring, training, and retention gaps underscore the hurdles many workers—especially younger students, women, and people of color—face entering these careers today, and they highlight the talent drain happening as current workers retire or leave their positions in greater numbers. Piling more workers onto a ship that is already beginning to sink is not a strategy for success.

This report has explored the current state of the country's infrastructure workforce to better highlight

these employment needs, training and educational demands, and demographic shortfalls. However, it has also emphasized the sector's equitable wages, accessible entry points, and long-term pathways toward greater opportunity. To help more and different groups of workers enter and navigate these pathways, national, state, and local leaders share a number of responsibilities—from programmatic guidance and technical assistance to the formation of new sector partnerships and regional collaborations. These steps are especially important as eligible state and local leaders look to harness new federal funding. But enhancing infrastructure workforce development does not end after the next few years; it must feed into durable models of collaboration, experimentation, and evaluation for decades to come.

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