Infrastructure Jobs Methodological Appendix

Note: Additional methodological details are available in past Brookings infrastructure jobs reports, including: Beyond Shovel Ready: The Extent and Impact of U.S. Infrastructure Jobs and Infrastructure skills: Knowledge, tools, and training to increase opportunity.

Employment data

This report uses 2021 employment data publicly available from the U.S. Bureau of Labor Statistics (BLS) Occupational Employment and Wage Statistics (OEWS) program and Employment Projections (EP) program. Supplemental information has also been gathered from Lightcast, which includes a proprietary database with a variety of labor market indicators (e.g., demographics), and the Occupational Information Network (O*NET), an online resource center and database sponsored by the Department of Labor's Employment and Training Administration.

We draw infrastructure employment and wage totals primarily from the OEWS program, which releases estimates annually. The OEWS program bases these estimates on a mail survey in May and November in partnership with state workforce agencies. The survey measures employment for workers in non-farm establishments. Estimates for 2021 were drawn from 1.2 million establishments across six panels of data collected over three years (May 2021, November 2020, May 2020, November 2019, May 2019, and November 2018). The sample is developed from state unemployment insurance files.

OEWS employment and wage data are defined in terms of specific occupations and industries, as established under the 2018 Standard Occupational Classification (SOC) system and 2017 North American Industry Classification System (NAICS). This report focuses on detailed SOC occupations and four-digit NAICS industries. OEWS cross-industry occupational employment and wage estimates are available across national, state, metropolitan statistical area, metropolitan division, and nonmetropolitan geographies, while industry-specific estimates are available for the nation only.

In contrast, infrastructure employment totals used to analyze skills and projections in this report are drawn from the EP program, which relies on a National Employment Matrix that combines employment data from several sources, including the OEWS program, the Current Employment Statistics (CES) program, and the Current Population Survey (CPS). Detailed information on EP skill and projection estimates is described later in this appendix.

Criteria used to define infrastructure jobs

This report defines infrastructure jobs based on a set of industries and occupations tied to seven infrastructure sectors. As such, workers in infrastructure jobs must meet at least one of the following two criteria:

- Employed in industries that provide services closely linked to infrastructure assets classified under the seven key sectors.

- Employed in occupations that perform duties central to the design, construction, operation, and governance of these infrastructure assets.

Given the variety of assets and range of activities in the nation's infrastructure network, this analysis aims to move beyond abstract discussions to consistently define, quantify, and measure infrastructure-related employment. The two criteria above are structured in a way to classify infrastructure jobs in terms of a clear list of related industries and occupations, offering a useful guide to focus in on specific work activities.

Infrastructure industries and occupations

The report classifies infrastructure industries according to seven key infrastructure sectors: intra-metro transportation; inter-metro transportation; trade and logistics; energy; water; telecommunications; and public works (described more fully below). Relevant information from the Census Bureau's Industry Statistics Portal has also aided in the identification of these industries.

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, 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).

In turn, this analysis classified 38 four-digit NAICS industries, ranging from Electric Power Generation, Transmission and Distribution (NAICS 2211) to Urban Transit Systems (NAICS 4851). Workers in these industries typically initiate the development and oversee the maintenance of the nation's major infrastructure assets. Excluded are industries in manufacturing (NAICS 31-33), mining (NAICS 21), residential or other building construction (NAICS 236 and 238), retail or wholesale trade (NAICS 42 and 44-45), and various service activities such as finance (NAICS 52), health care (NAICS 62), and education (NAICS 61).

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After identifying these industries, the report separately classifies a specific set of infrastructure occupations based on a three-step process: 1) their share of national employment in the infrastructure industries; 2) their share of national employment in related government activities (NAICS 99 OES designation); and 3) other relevant job duties as defined by O*NET. On the basis of these three measures, the report identifies 95 infrastructure occupations. Ultimately, these occupations, similar to the industries that employ them, have a particular role in designing, constructing, operating, and governing the nation's infrastructure assets, outlined in the table below.

Infrastructure job activities

Design involves knowledge of design techniques and tools for developing plans, drawings, maps, and models. Engineering principles and processes are often used, as well as other technology and analytics to determine project feasibility, develop reports, and communicate findings, among other activities. In total, 10 occupations are classified under this category, including civil engineers, urban planners, and landscape architects.

Construction involves knowledge of building and construction techniques, related equipment and tools, and maintenance and repair. With an understanding of different system designs, components, and materials, workers physically build or install roadways, railroads, wiring, and piping, among numerous other types of infrastructure. In total, 17 occupations are classified under this category, including electricians, pipe layers, and telecommunication line installers.

Operation involves knowledge of different physical and mechanical operations that vary depending on the specific processes, equipment, instruments, controls, and labor entailed. Monitoring the movement of people and goods, the generation and distribution of energy, and the treatment of water and waste are among the activities the workers carry out.
In total, 60 occupations are classified under this category, including material movers, truck drivers, railroad conductors, power plant operators, meter readers, water treatment plant operators, and hazardous material removal workers.

Governance involves knowledge of law and government, public safety and security, and environmental conservation. Assessing different transportation activities, recording potential violations, and overseeing environmental conditions are among the central tasks these workers perform. In total, eight occupations are classified under this category, including transportation security screeners and transportation inspectors.

Measuring infrastructure employment

Workers employed in the 95 infrastructure occupations and 38 infrastructure industries serve as the basis for measuring infrastructure employment.

At the national level, the report counts the number of workers employed in infrastructure occupations regardless of their industry (13.2 million in 2021), and adds this total to the number of workers employed in infrastructure industries regardless of their occupation. To avoid double-counting, we subtract employment from infrastructure industries for those workers who are also employed in any of the infrastructure occupations.

At the state level, the report follows a similar methodology. The analysis counts all workers employed in infrastructure occupations, and adds this total to the number of workers employed in infrastructure industries. However, since OEWS does not release industry data for individual states, the report uses the national share of employment to estimate infrastructure employment at this geographic scale. When calculating the infrastructure employment for each state, then, cross-industry occupation totals are weighed by national infrastructure shares.

Comparing wages at the national level

Throughout the report, OEWS wages are based on straight-time, gross pay, which includes forms of compensation such as cost-of-living allowances and over-the-road pay, but excludes overtime pay and holiday bonuses. Mean hourly and annual wages are highlighted in this report, in addition to percentile wages (10th, 25th, 50th, 75th, and 90th). By definition, workers at the 10th and 25th percentiles earn wages at the lower end of each occupation and industry, while workers at the 75th and 90th percentiles earn wages at the higher end.

Nationally, we look exclusively at cross-industry wages for the 95 infrastructure occupations. Although wages for individual occupations can vary by industry, this cross-industry perspective follows the same approach used to count national infrastructure employment, consistently viewing these occupations in a larger national context. However, we exclude wages for workers employed in other occupations within the 38 infrastructure industries.

As such, mean and percentile wages for individual occupations such as truck drivers and civil engineers are a main focus of this report. When viewed together, though, we average wages for all 95 infrastructure occupations based on employment. Without the full OEWS survey sample, this approach is intended to approximate a distribution of earnings across all infrastructure occupations, reflecting the large number of workers earning competitive wages at lower percentiles compared to the small number of workers earning competitive wages at higher percentiles.

Measuring skills in terms of education and training

This report examines skills in terms of the education and training typically needed for the 95 infrastructure occupations. BLS tracks levels of education, related work experience, and on-the-job training required for different occupations. While some occupations can have multiple paths of entry, BLS only tracks one typical path in its classification system. BLS gathers information from O*NET, the National Center for Education Statistics, and the Census Bureau's American Community Survey (ACS), and uses a combination of quantitative and qualitative measures to evaluate skills across detailed occupations.

Typical levels of education attained and needed for entry are based on the following education levels for workers ages 25 years and older: doctoral or professional degree; master's degree; bachelor's degree; associate degree; postsecondary non-degree award; some college, no degree; high school diploma or equivalent; and less than high school.

While not common for infrastructure occupations, related work experience is considered necessary for many other jobs nationally and is defined in three categories: five years or more, less than five years, and none.

Based on competency requirements, typical on-the-job training needed falls into six categories: internship/residency; apprenticeship; long-term on-the-job training (more than 12 months); moderate-term on-the-job training (more than one month and up to 12 months); short-term on-the-job training (one month or less); and no training.

To determine levels of knowledge, the report relies on O*NET, which surveys workers to rate the level of knowledge needed in specific occupations. On a scale from 0 (minimum) to 7 (maximum), workers rate their required knowledge across 33 distinct categories, ranging from biology and chemistry to communications and media. Higher levels of knowledge in a category typically mean that workers possess an advanced understanding of how to perform certain tasks in that category. To determine which categories of knowledge are required at higher levels among infrastructure occupations, we first calculated the average score in each category among all occupations nationally. We then did the same for the 95 detailed SOC infrastructure occupations that had available data in O*NET, and compared the differences.

Projecting employment growth and separations

Since OEWS estimates are not designed for comparisons across time due to changing NAICS and SOC classifications and other factors, the report instead uses the projected employment growth and separations calculated by BLS from 2021 to 2031. However, similar to the skills data, occupational employment in these projections does not precisely match those reported by the OEWS program. BLS releases projections every other year.

BLS industry and occupation projections are based on several different assumptions relating to the labor force, aggregate economy, industry output, and other economic indicators. Future changes in population and industry demand, for instance, are two measures used to estimate and allocate occupational employment. However, these estimates may not fully account for the impact of increased federal infrastructure spending, at least at the time of this report's publication. The projections in this report are calculated using a base year of 2021.

Estimates of separations are determined based on the number of workers exiting the labor force due to retirements or other reasons, including transfers to different occupations.