Methodological Appendix – Infrastructure Jobs Update

Note: Methods used to classify infrastructure jobs, including specific occupations and industries, are described at greater length in "Beyond Shovel-Ready: The Extent and Impact of U.S. Infrastructure Jobs" available at:

http://www.brookings.edu/~/media/research/files/reports/2014/05/09-infrastructure-jobs/beyond-shovel-ready.pdf

1. Employment Data

This report uses 2003 to 2013 employment data publicly available from the U.S. Bureau of Labor Statistics (BLS) Occupational Employment Statistics (OES) program. Additional data on skills and educational attainment comes from the BLS Employment Projections (EP) program. Supplemental information has also been gathered from 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 OES program, which releases estimates annually. The OES program bases these estimates on a semi-annual mail survey in May and November in partnership with State Workforce Agencies. The survey measures employment for workers in non-farm establishments. Estimates for 2013 were drawn from 1.2 million establishments across six panels of data collected over three years (May 2013, November 2012, May 2012, November 2011, May 2011, and November 2010). The sample is developed from state unemployment insurance files.

2013 OES employment and wage data are defined in terms of specific occupations and industries, as established under the 2010 Standard Occupational Classification (SOC) system and 2012 North American Industry Classification System (NAICS). This report focuses on detailed SOC occupations and 4-digit NAICS industries. OES 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. OES data prior to 2012 rely on earlier iterations of the NAICS and SOC system.

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 different sources, including the OES program, the Current Employment Statistics (CES) program, and the Current Population Survey (CPS).

While we focus on detailed infrastructure employment and wages in 2013, we do consider broader infrastructure comparisons over time, including changes in employment from 2010 to 2013 and changes in wages from 2003 to 2013. Although there are limitations to tracking such changes with OES data, primarily due to evolving occupation, industry, and geographic classifications as well as other survey features, we have aimed to minimize these inconsistencies in several ways, which are described in more depth below.

2. Infrastructure Industries and Occupations

This report defines infrastructure jobs based on a particular set of industries and occupations tied to seven infrastructure sectors.

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).

Based on these sectors, the report has determined a list of closely related NAICS industries. Relevant information from the U.S. Census Bureau Industry Statistics Portal has aided in this process as well, resulting in the classification of 42 four-digit NAICS industries, which range from warehousing and storage (NAICS 4931) to utility system construction (NAICS 2371) and waste collection (NAICS 5621). 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).

Beyond these 42 infrastructure industries, the report classifies a specific set of infrastructure occupations separately 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 has identified 95 infrastructure occupations. Ultimately, these occupations, similar to the industries that employ them, have a particular role to play 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 frequent activities carried out by these workers. 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 performed by these workers. In total, eight occupations are classified under this category, including transportation security screeners and transportation inspectors.
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3. Measuring Infrastructure Employment at the National and Metropolitan Level

Workers employed in the 95 infrastructure occupations and 42 infrastructure industries serve as the basis for measuring infrastructure employment across the nation and metropolitan areas.

At the national level, the report counts the number of workers employed in infrastructure occupations regardless of their industry (11.7 million in 2013), 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 metropolitan level, the report follows a similar methodology. It includes all workers employed in infrastructure occupations, and adds this total to the number of workers employed in infrastructure industries. However, since OES does not release industry data for individual metropolitan areas, the report uses a national share of employment to estimate infrastructure employment at this geographic scale. When calculating the infrastructure employment for each metropolitan area, then, cross-industry occupation totals are weighed by national infrastructure shares.

The same methods are used to measure changes in employment from 2010 to 2013. Since OES data for these years are consistently based on the 2010 SOC system, the analysis counts total cross-industry employment for the 95 infrastructure occupations and then adds this amount

to the share of relevant employment in the 42 infrastructure industries. Only totals for non-suppressed occupations are included. Although OES industry data prior to 2012 rely on the 2007 NAICS, each of the 42 infrastructure industries remains consistent across each year, allowing for a relatively seamless comparison. Critically, 2013 infrastructure industry shares are used to weigh infrastructure employment in each year to maintain further clarity and consistency. For example, since 24.7 percent of all construction laborers were employed in the 42 infrastructure industries in 2013, this same share is used to weigh their employment in 2010, 2011, and 2012. Metropolitan-level changes are tracked in the same manner.

Again, since OES data are generally less useful for comparisons over time—especially for detailed occupations—the analysis focuses more exclusively on broader groups of occupations. Since the OES survey relies on six panels of data across multiple years, these employment changes can often be gradual or vary from similar government estimates, including those released annually in the U.S. Census Bureau's American Community Survey (ACS). At the same time, it is important to note that the total and percent change in employment can fluctuate at the metropolitan level depending on the reliability of the OES estimates, including the number of suppressions in a given year.

4. Comparing Wages at the National Level

Throughout the report, OES 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 42 infrastructure industries.

As such, mean and percentile wages for individual occupations like 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 OES 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.

Due to inconsistencies in the OES data, the report only compares wages from 2003 to 2013. These comparisons, moreover, only cover non-suppressed infrastructure occupations over the ten-year period. In addition, since OES estimates rely on the 2000 SOC and 2010 SOC systems during this span, the analysis uses a crosswalk to relate similar occupations and excludes three newly-formed occupations: transportation security screeners, solar photovoltaic installers, and wind turbine service technicians. Similar to tracking changes in employment over time, the report concentrates on broader infrastructure comparisons as opposed to detailed occupations.

All wages have been adjusted for inflation to 2013 levels, using the annualized BLS Consumer Price Index for All Urban Consumers (CPI-U) across all items, less shelter.

5. Measuring Skills in Terms of Education and Training

This report examines skills in terms of 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 potentially have multiple paths of entry, BLS only tracks one typical path in its classification system. Gathering information from O*NET, the National Center for Education Statistics, and the U.S. Census Bureau's American Community Survey (ACS), BLS 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's degree; postsecondary non-degree award; some college, no degree; high school diploma or equivalent; and less than high school. EP educational attainment by detailed occupation, in particular, is based on 2010 to 2011 totals.

While not common for infrastructure occupations, related work experience is considered necessary for many other jobs nationally and defined in three categories: 5 years or more, less than 5 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 1 month and up to 12 months); short-term on-the-job training (1 month or less); and no training.