



## **UNPRECEDENTED OPPORTUNITY: MEETING THE WORKFORCE DEMANDS OF NEW CLEAN ENERGY, MANUFACTURING, AND INFRASTRUCTURE INVESTMENTS**

The combined historic investments of three new federal clean energy, manufacturing, and infrastructure laws—the Inflation Reduction Act (IRA), the Bipartisan Infrastructure Law (BIL), and the CHIPS and Science Act—will transform America’s physical landscape and our country’s workforce. Combined, these three laws will invest \$2 trillion into our country’s infrastructure.\* While this investment will create millions of new jobs, much less has been invested in education and training to prepare people to fill these new jobs sufficiently.

To better understand these laws’ impact on the workforce, National Skills Coalition and BlueGreen Alliance commissioned an analysis from the University of Massachusetts Amherst

Political Economy Research Institute (PERI) to examine labor supply, demand, and potential shortages that will be generated by these three laws. The first part of the analysis released in 2023 estimated job creation, job quality, and demographic distribution measures from these three investments.<sup>1</sup> The second part of this analysis quantified the impacts of the laws on our nation’s labor supply and produced many of the findings in this brief.<sup>2</sup> The analysis forms the basis of this data brief, providing a more precise understanding of whether our country will have enough workers to fill these job openings and which occupations and populations will be most impacted.

# KEY FINDINGS

- 1** Investments from the Inflation Reduction Act, the Bipartisan Infrastructure Law, and the CHIPS and Science Act programs are expected to generate, in total, an average of 2.9 million jobs per year and 19 million job-years over the time span of these laws.
- 2** The analysis identifies forty-eight specific occupations expected to experience significant increases in demand due to these investments, with the top five being construction laborers, first-line supervisors of construction trades and extraction workers, electrical power-line installers and repairers, operating engineers and other construction equipment operators, and general and operations managers.
- 3** Approximately two in three jobs directly created by these three investments are expected to occur in the construction and manufacturing sectors, representing 453,000 jobs and 230,000 jobs annually, respectively.
- 4** In construction, the occupations that will experience the most significant increases are laborers, operating engineers, electrical power-line installers and repairers, and in manufacturing, the most growth will occur among assemblers and fabricators and electrical, electronic, and electromechanical assemblers.
- 5** Sixty-nine percent of jobs created by these three investments will be available to workers without a bachelor's degree, compared to fifty-nine percent of jobs in the entire U.S. workforce.
- 6** Among the 48 occupations with forecasted growth in demand, twenty-one have relatively low entry requirements regarding a formal postsecondary education credential but have significant skill requirements requiring shorter-term and/or on-the-job training. Twenty-seven have significant entry requirements, which include some form of a postsecondary credential, related skills training, and/or apprenticeship.
- 7** Jobs created by these three laws are projected to pay a median hourly wage of \$26.20–10.5 percent higher than the median hourly wage of \$23.70 for the entire U.S. workforce—with slightly lower job quality supports than the U.S. workforce regarding health coverage, retirement plans, and union membership.
- 8** Twenty occupations will face labor shortages, resulting in an anticipated total labor shortage of nearly 1.1 million workers who—without training and other workforce investments—will lack the skills to fill these jobs. The construction sector is projected to have the highest concentration of potential shortages.
- 9** Women and people of color are significantly underrepresented in the infrastructure occupations most likely to face labor shortages.

\* Recent research has found that the projected cost estimates for the Inflation Reduction Act's energy provisions have risen since the Act's inception by about two-thirds, from \$400 billion to \$660 billion through 2031 to \$790 billion through 2033. See Committee for a Responsible Federal Budget. (2023, July 6). IRA Energy Provisions Could Cost Two-Thirds More Than Originally Estimated [Blog post]. Retrieved from <http://tinyurl.com/mwamsnf7>; and The White House. (2021, August 2). Updated Fact Sheet: Bipartisan Infrastructure Investment and Jobs Act [Press release]. Washington, DC: The White House. <https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/02/updated-fact-sheet-bipartisan-infrastructure-investment-and-jobs-act/>.

## IMPLICATIONS

These findings show that these three laws and their investments provide a once-in-a-generation opportunity to strengthen the backbone of our economy—the blue-collar, middle-class jobs that require skills training. This moment also emphasizes the urgent need to invest heavily in inclusive education and training programs, a more diverse workforce, and strengthening job standards and protections. To realize the possibilities, our nation must build a diverse, multi-generation infrastructure workforce.

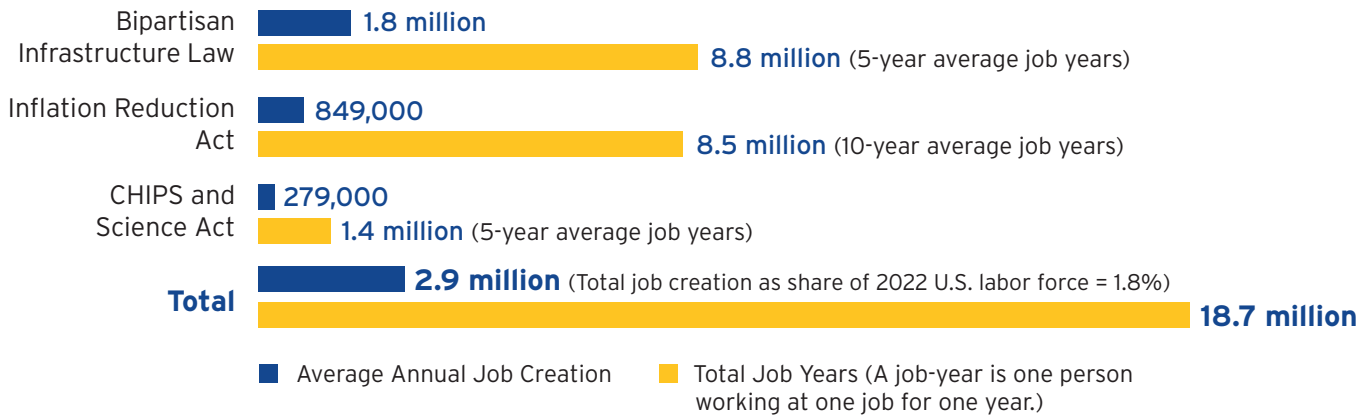
# JOB CREATION

FINDING

1

Investments from the Inflation Reduction Act, the Bipartisan Infrastructure Law, and the CHIPS and Science Act programs are expected to generate, in total, an average of 2.9 million jobs per year and 19 million job-years in total over the time span of these laws.\*

### Average Annual Budgets and Job Creation through the Inflation Reduction Act, the Bipartisan Infrastructure Law, and the CHIPS and Science Act



**NOTES:** Figures in table are rounded. Average annual budgets include public and estimated private spending.

**SOURCE:** Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G., & Lala, C. (2023). *Employment Impacts of New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu/publication/item/1514-employment-impacts-of-new-u-s-clean-energy-manufacturing-and-infrastructure-laws>.

## UNDERSTANDING JOB CREATION CHANNELS

The 2.9 million jobs per year estimate noted in the first finding is rooted in three channels for job creation. The original report from PERI describes these three channels through an example involving home retrofitting and installing solar panels:

- Direct job creation is “the jobs created, for example, by retrofitting buildings to make them more energy efficient or installing solar panels.”
- Indirect job creation is “the jobs associated with industries that supply intermediate

goods for the building retrofits or solar panels, such as glass, steel, and transportation. In other words, indirect effects measure job creation along the clean energy investment supply chain.”

- Induced job creation involves “the expansion of employment that results, for example, when people who are paid in the construction or steel industries spend the money they have earned on other products in the economy. These are the multiplier effects within a standard macroeconomic model.”<sup>3</sup>

\* These job figures assume these three laws will be funded at their anticipated levels over their time frames: 5 years for BIL and CHIPS and 10 years for IRA.

# JOB CONCENTRATION

## FINDING

# 2

The analysis identifies forty-eight specific occupations expected to experience significant increases in demand due to these investments, with the top five being construction laborers, first-line supervisors of construction trades and extraction workers, electrical power-line installers and repairers, operating engineers and other construction equipment operators, and general and operations managers.

## FINDING

# 3

Approximately two in three jobs directly created by these three investments are expected to occur in the construction and manufacturing sectors, representing 453,000 jobs and 230,000 jobs annually, respectively.

### Direct Job Creation through the Inflation Reduction Act, the Bipartisan Infrastructure Law, and the CHIPS and Science Act, and Distribution by Sector for U.S. Economy

| Sector                         | Direct Job Creation Through BIL, IRA, and CHIPS |   | % Employment by Sector for Overall U.S. Economy |
|--------------------------------|---|---|---|
|                                | Average Annual Direct Job Creation              | % of Average Annual Direct Job Creation |   |
| Construction                   | 453,000   | 44.0%                                   | 5.9%  |
| Manufacturing                  | 230,000   | 22.4%                                   | 6.6%  |
| Services                       | 172,000   | 16.7%                                   | 0.4%  |
| Transportation and Warehousing | 117,000   | 11.4%                                   | 4.9%  |
| Utilities                      | 7,800   | 0.8%                                    | 0.3%  |
| Wholesale and Retail Trades    | 0   | 0.0%                                    | 11.7%   |



#### NOTES

Figures in table are rounded. The remaining job creation is divided among agriculture/forestry/hunting; mining and mining-related activities.

**SOURCE:** Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G., & Lala, C. (2023). *Employment Impacts of New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu/publication/item/1514-employment-impacts-of-new-u-s-clean-energy-manufacturing-and-infrastructure-laws>.

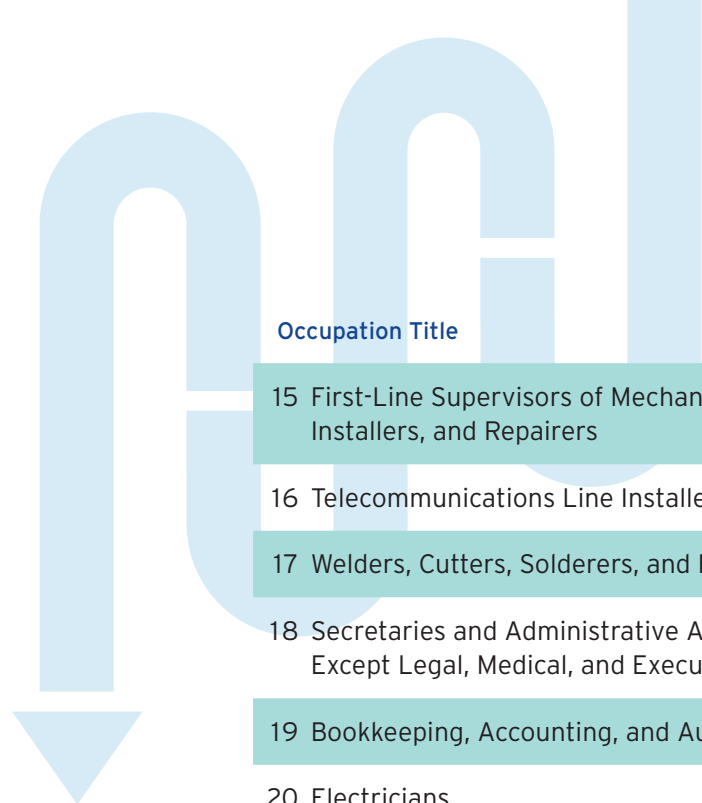
**FINDING**

**4**

In construction, the occupations that will experience the most significant increases are laborers, operating engineers, electrical power-line installers and repairers, and in manufacturing, the most growth will occur among assemblers and fabricators and electrical, electronic, and electromechanical assemblers.

**Top 30 Occupations by Total Annual Direct Jobs Added and Percentage of 2022 Employment Due to The Inflation Reduction Act, the Bipartisan Infrastructure Law, and the CHIPS And Science Act**

| Occupation Title  | Total Number of Annual Direct Jobs Added | Annual Direct Jobs Added as % of 2022 Employment |
|---|--|--|
| 1 Construction Laborers   | 80,900                                   | 3.8%   |
| 2 First-Line Supervisors of Construction Trades and Extraction Workers                                  | 40,000                                   | 3.0%   |
| 3 Electrical Power-Line Installers and Repairers  | 34,500                                   | 16.4%  |
| 4 Operating Engineers and Other Construction Equipment Operators  | 32,500                                   | 6.7%   |
| 5 General and Operations Managers   | 29,000                                   | 0.6%   |
| 6 School Bus Drivers  | 27,000                                   | 3.5%   |
| 7 Carpenters  | 23,800                                   | 1.1%   |
| 8 Miscellaneous Assemblers and Fabricators  | 22,900                                   | 1.4%   |
| 9 Construction Managers   | 22,100                                   | 2.3%   |
| 10 Project Management Specialists   | 21,200                                   | 1.3%   |
| 11 Shuttle Drivers and Chauffeurs   | 19,800                                   | 3.1%   |
| 12 Office Clerks, General   | 18,300                                   | 0.5%   |
| 13 Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers | 18,100                                   | 6.3%   |
| 14 Heavy and Tractor-Trailer Truck Drivers  | 17,300                                   | 0.6%   |



| Occupation Title  | Total Number of Annual Direct Jobs Added | Annual Direct Jobs Added as % of 2022 Employment |
|---|--|--|
| 15 First-Line Supervisors of Mechanics, Installers, and Repairers                                   | 16,200                                   | 1.8%   |
| 16 Telecommunications Line Installers and Repairers   | 15,400                                   | 9.7%   |
| 17 Welders, Cutters, Solderers, and Brazers   | 14,400                                   | 3.0%   |
| 18 Secretaries and Administrative Assistants, Except Legal, Medical, and Executive                  | 12,700                                   | 0.5%   |
| 19 Bookkeeping, Accounting, and Auditing Clerks   | 12,200                                   | 0.5%   |
| 20 Electricians   | 11,700                                   | 3.6%   |
| 21 Transit and Intercity Bus Drivers  | 11,700                                   | 3.7%   |
| 22 Laborers and Freight, Stock, and Material Movers, Hand Laborers                                  | 11,400                                   | 0.3%   |
| 23 First-Line Supervisors of Production and Operating Workers                                       | 9,900                                    | 1.4%   |
| 24 Software Developers  | 9,700                                    | 0.3%   |
| 25 Customer Service Representatives   | 9,100                                    | 0.2%   |
| 26 Accountants and Auditors   | 9,000                                    | 0.4%   |
| 27 Inspectors, Testers, Sorters, Samplers, and Weighers   | 8,800                                    | 1.3%   |
| 28 Civil Engineers  | 8,400                                    | 1.8%   |
| 29 Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel | 7,900                                    | 0.5%   |
| 30 Industrial Engineers   | 7,700                                    | 2.0%   |
| <b>All Top 30 Occupations</b>   | <b>583,600</b>                           | <b>-</b>   |
| <b>Across All Occupations</b>   | <b>1.0 million</b>                       | <b>0.5%</b>                                      |

**SOURCE:** Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G., & Lala, C. (2023). *Employment Impacts of New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu/publication/item/1514-employment-impacts-of-new-u-s-clean-energy-manufacturing-and-infrastructure-laws>.

# SKILLS NEEDED

## FINDING

# 5

**Sixty-nine percent of jobs created by these three investments will be available to workers without a bachelor's degree,** compared to fifty-nine percent of jobs in the entire U.S. workforce.<sup>4</sup>

## FINDING

# 6

**Among the forty-eight occupations with forecasted growth in demand, twenty-one have relatively low entry requirements regarding a formal postsecondary education credential** but have significant skill requirements requiring shorter-term and/or on-the-job training. Twenty-seven have significant entry requirements, which include some form of a postsecondary credential, related skills training, and/or apprenticeship.

## DEFINING OCCUPATIONS WITH "LOW ENTRY" AND "SIGNIFICANT SKILL" REQUIREMENTS.

In the original analysis from the PERI, occupations with low-entry requirements were defined as, "the formal educational credential is no more than a high school diploma or equivalent. Further, these occupations do not require prior work experience in a related job. The typical level of on-the-job training is either 'short-term' or 'moderate term' as defined by the U.S. Labor Department."

However, caution should be exercised when defining these occupations as "low entry." PERI notes that while the formal educational or training requirements are relatively modest for these occupations, virtually all entail significant knowledge or training in certain skills when considering the actual job requirements. For example: "Pipelayers are responsible for assembling and connecting

pipe systems for water mains, sewers and drains. Before laying pipes, they must inspect the ground, dig the pipe trenches, and seal the pipe joints successfully with cement glue. Customer service representatives typically must generate sales leads, build relationships with customers, handle customer complaints, provide appropriate solutions and follow up to ensure resolutions."

Occupations that do require significant prior training, educational credentials, or on-the-job experience were defined as: "occupations requiring training or prior experience along with a high school diploma; occupations requiring an apprenticeship program or similar training and a high school diploma; and occupations with postsecondary educational requirements."<sup>5</sup>

# JOB QUALITY

## FINDING

# 7

Jobs created by these three laws are projected to pay a median hourly wage of \$26.20—10.5 percent higher than the median hourly wage of \$23.70 for the entire U.S. workforce—with slightly lower job quality supports than the U.S. workforce regarding health coverage, retirement plans, and union membership.

### Key Indicators of Job Quality in Jobs Created by the Inflation Reduction Act, the Bipartisan Infrastructure Law, and the CHIPS and Science Act

|                                       | BIL, IRA, and CHIPS Combined (1.0 Million Average Annual Direct Jobs) | BIL (644,000 Average Annual Direct Jobs) | IRA (305,000 Average Annual Direct Jobs) | CHIPS (79,000 Average Annual Direct Jobs) | Total U.S. Workforce |
|---------------------------------------|---|--|--|---|----------------------|
| Median Hourly Wage                    | \$26.20   | \$25.20                                  | \$26.20                                  | \$30.25                                   | \$23.70              |
| Health Insurance Coverage, Percentage | 49.0%   | 46.2%                                    | 53.0%                                    | 55.6%                                     | 50.0%                |
| Retirement Plans, Percentage          | 33.7%   | 31.7%                                    | 36.6%                                    | 39.4%                                     | 40.8%                |
| Union Membership                      | 10.9%   | 12.5%                                    | 9.1%                                     | 6.9%                                      | 11.3%                |

**SOURCE:** Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G., & Lala, C. (2023). *Employment Impacts of New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu/publication/item/1514-employment-impacts-of-new-u-s-clean-energy-manufacturing-and-infrastructure-laws>.



# LABOR SHORTAGES

## FINDING

# 8

Twenty occupations will face labor shortages, resulting in an anticipated total labor shortage of nearly 1.1 million workers who—without training and other workforce investments—will lack the skills to fill these jobs. The construction sector is projected to have the highest concentration of potential shortages.

### Twenty Significant Entry-Level Occupations with Likely Labor Shortages associated with investments from the Inflation Reduction Act, the Bipartisan Infrastructure Law, and the CHIPS and Science Act

| Occupation Title  | % of Jobs That Will Go Unfilled Without Training and Other Workforce Investments* |
|---|---|
| <b>OCCUPATIONS REQUIRING TRAINING OR PRIOR EXPERIENCE ALONG WITH HIGH SCHOOL DIPLOMA</b>    |   |
| 1 First-Line Supervisors of Production and Operating Workers                                | 79.3%   |
| 2 Electrical Power-Line Installers and Repairers  | 96.0%   |
| 3 Mobile Heavy Equipment Mechanics (Except Engines)   | 75.4%   |
| 4 Electrical Power-Line Installers and Repairers  | 88.8%   |
| 5 Crane and Tower Operators   | 69.5%   |
| 6 Water and Wastewater Treatment Plant and System Operators                                 | 90.5%   |
| 7 Crane and tower operators   | 28.0%   |
| <b>OCCUPATIONS REQUIRING APPRENTICE PROGRAM OR SIMILAR TRAINING AND HIGH SCHOOL DIPLOMA</b> |   |
| 8 Carpenters  | 38.7%   |
| <b>OCCUPATIONS WITH POSTSECONDARY EDUCATIONAL REQUIREMENTS</b>                              |   |
| 9 Bookkeeping, Accounting, and Auditing Clerks  | 80.2%   |

\* PERI defined these figures as the percentage of increased labor demand relative to labor supply. For detail on these calculations, see Table 12 in Wicks-Lim, J., & Pollin, R. (2024). *Labor Supply, Labor Demand and Potential Labor Shortages through New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu>.

% of Jobs That Will Go Unfilled Without Training and Other Workforce Investments\*

| Occupation Title   | % of Jobs That Will Go Unfilled Without Training and Other Workforce Investments* |
|--|---|
| 10 Heavy and Tractor-Trailer Truck Drivers                             | 76.2%   |
| 11 Software Developers   | 50.7%   |
| 12 Accountants and Auditors  | 55.0%   |
| 13 Construction Managers   | 58.0%   |
| 14 General and Operations Managers                                     | 10.5%   |
| 15 Civil Engineers   | 37.5%   |
| 16 Industrial Engineers  | 40.6%   |
| 17 Telecommunications Line Installers and Repairers                    | 77.3%   |
| 18 Occupational Health and Safety Specialists                          | 50.0%   |
| 19 Electrical and Electronic Engineering Technologists and Technicians | 15.9%   |
| 20 Radio, Cellular Tower Equipment Installers and Repairers            | 24.3%   |

**SOURCE:** Wicks-Lim, J., & Pollin, R. (2024). *Labor Supply, Labor Demand and Potential Labor Shortages through New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu>.

## UNDERREPRESENTED POPULATIONS

### FINDING

9

Women and people of color are significantly underrepresented in the infrastructure occupations most likely to face labor shortages.

**In ten of the twenty infrastructure-related occupations with estimated labor shortages, women make up ten percent**, compared to forty-seven percent in the entire U.S. workforce.

**In fifteen of the twenty infrastructure-related occupations with estimated labor shortages, people of color\* make up less than thirty-nine percent**, compared to thirty-nine percent in the entire U.S. workforce.

\* Based on the data source for this research, "people of color" refers to people who self-identify as Black or African American, Asian, American Indian or Alaska Native, Hispanic or Latino yet non-White, and multi-racial.

# IMPLICATIONS

These historic investments will transform America's physical landscape and create millions of jobs. This is a once-in-a-generation opportunity to strengthen the backbone of our economy – the blue collar, middle-class jobs that require skills training. The job opportunities created by these investments are a tremendous opportunity for workers in fields and occupations that require education or training past high school, but not a four-year degree. But to realize the possibilities, our nation must build a diverse, multi-generation infrastructure workforce.

Based on the data findings in this report, we've identified critical insights for meeting the demand and opportunities posed by this historic investment while ensuring that a greater number and diversity of workers have the training, credentials, and support to access and succeed in these roles.

## **Investing in Inclusive Education and Training Programs**

Job growth is projected to outpace the number of existing trained workers. Without training more people for new infrastructure and clean energy jobs, local communities and businesses will not be able to fully implement planned projects and will miss the moment to train the next generation of infrastructure workers. This illustrates the urgent need to invest in increased training through pre-apprenticeship and registered apprenticeship programs, and postsecondary education programs for workers – especially women and workers of color. Strategies that include economic supports for childcare and transportation are key to expanding access and inclusion in skills training.

## **Diversifying the Infrastructure and Clean Energy Workforce**

Demographic findings underscore a significant need to diversify the infrastructure workforce by recruiting, retaining, and advancing women and people of color who have been underrepresented in occupations facing labor shortages. Industry partnerships and local hiring initiatives can support recruitment, retention, and career advancement for people of color and women in infrastructure sectors. Industry partnerships bring together businesses, unions, training providers, and community organizations to develop and activate workforce strategies, broker apprenticeship and local hiring, validate industry-specific training and credentials, inform industry practices, and shape career advancement paths. Since they design training, hiring, and advancement opportunities in partnership with businesses and workers, industry partnerships can also be a vehicle for diversifying the talent pipeline and disrupting occupational segregation.

## **Elevating Job Quality and Enhancing Worker Protections**

The higher-than-average median wage projections of these new jobs mean these investments should be considered a tool to boost wages, job quality, and security in the U.S. workforce. There is a tremendous opportunity to shift workers from low-wage jobs with few benefits to careers in construction and manufacturing that provide better wages and benefits. However, the below-average union membership, health insurance coverage, and retirement investment rates illustrate a strong need for labor standards to ensure job quality and policies and strategies that protect workers' rights to organize and that help workers advance to higher-skill and high-paid occupations.

## NOTES

1. Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G., & Lala, C. (2023). *Employment Impacts of New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu/publication/item/1514-employment-impacts-of-new-u-s-clean-energy-manufacturing-and-infrastructure-laws>.
2. Wicks-Lim, J., & Pollin, R. (2024). *Labor Supply, Labor Demand and Potential Labor Shortages through New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst. <https://www.peri.umass.edu>.
3. Wicks-Lim, J., & Pollin, R. (2024).
4. Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G., & Lala, C. (2023).
5. Polin, R. et al. (2023).



1250 Connecticut Ave NW, Suite 200  
Washington, DC 20036

The National Skills Coalition fights for inclusive, high-quality skills training so that people have access to a better life, and local businesses see sustained growth. We engage in analysis and technical assistance, organizing, advocacy, and communications to improve state and federal skills policies. Learn more at [nationalskillscoalition.org](https://nationalskillscoalition.org) and follow us [@skillscoalition](https://twitter.com/skillscoalition).



1020 19th Street NW, Suite 750  
Washington, DC 20036

The BlueGreen Alliance unites labor unions and environmental organizations to solve today's environmental challenges in ways that create and maintain quality jobs and build a clean, thriving, and equitable economy. Learn more at [bluegreenalliance.org](https://bluegreenalliance.org) and follow us [@BGAlliance](https://twitter.com/BGAlliance).

## CONTRIBUTORS

Jeannine LaPrad  
Kate Michaels  
Brooke DeRenzis  
Nicky Lauricella Coolberth

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Read the full report from PERI at [peri.umass.edu](https://peri.umass.edu).