

Three Tiers for Victory

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ABSTRACT

The training system that best prepares workers for family sustaining careers as skilled construction workers has three distinct tiers consisting of pre- apprenticeship, apprenticeship and post-apprenticeship career technical education. This paper explores how these three tiers fit together to improve the recruitment, training and retention of skilled workers and how for many critical energy related crafts the skills they teach improve building performance and lower energy demand and cost.

In the U.S., apprenticeship has been paired with the prevailing wage as a package that has incorporated industrial policy into public works projects for nearly a century with very good results. Pre-apprenticeship programs are a relatively new invention, but have rapidly proven themselves as tools to broaden the pool of interested and qualified applicants for state and federally approved apprenticeship programs.

When pre-apprenticeship programs are connected to prevailing wage work and apprenticeship opportunities, the result is economic mobility for workers and a strengthening of the skilled workforce needed to build the high-performance buildings associated with an energy efficient future.

Introduction

The United States faces two urgent and interconnected challenges: the need to build and retrofit high-performance buildings that reduce energy demand, and the need to expand access to family-sustaining careers in the skilled construction trades. Addressing these challenges requires a workforce training system capable of recruiting, preparing, and sustaining highly skilled workers.

The most effective system for achieving these goals consists of three interconnected tiers of workforce development:

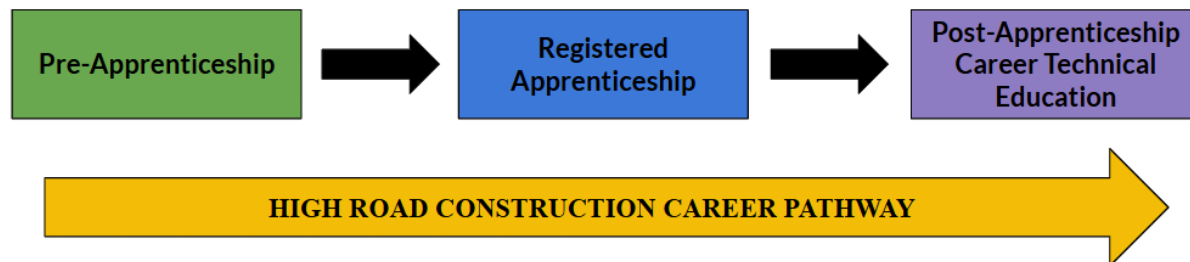


Figure 1. High Road Construction Career Pathway

Together, these tiers form a comprehensive workforce pipeline that supports recruitment, training, and long-term career advancement in the skilled trades. This structure ensures that

construction workers possess the technical competencies necessary to build and maintain high-performance, energy-efficient buildings.

For nearly a century, registered apprenticeship programs paired with prevailing wage standards have provided the backbone of workforce development in the construction industry (Belman 2022). These policies embed industrial policy into public works investments by ensuring that public infrastructure spending develops skilled workers while supporting middle-class careers.

Crucially, apprenticeship and prevailing wage function most effectively when they operate together. Apprenticeship provides the rigorous training system that develops skilled workers, while prevailing wage ensures that construction careers offer wages and benefits strong enough to attract and retain that workforce. Together they create a stable labor market in which workers are incentivized to enter the trades, invest years in skill development, and remain in the industry over the long term.

More recently, pre-apprenticeship programs have emerged as effective tools for expanding access to apprenticeship opportunities, particularly for people with disadvantaged backgrounds. The North American Building Trades Unions (NABTU) has developed a standardized pre-apprenticeship curricula described in detail later and has actively encouraged the proliferation of programs teaching that curricula. There are now 241 MC3 programs distributed across the US and Canada (Trade Path Hub 2026). When connected to registered apprenticeship programs and prevailing wage projects, these programs create pathways to economic mobility while strengthening the construction workforce.

Finally, post-apprenticeship career technical education ensures that skilled workers continue to develop specialized competencies throughout their careers. This ongoing training is especially critical in energy-related trades where emerging technologies and evolving building standards require continual skill development.

State of the Industry

The construction industry is undergoing a significant transformation. Increasing demand for energy-efficient buildings, electrification, renewable energy infrastructure, and climate-resilient construction is expected to produce surging demand for the crafts associated with this work. At the same time, the industry faces persistent workforce shortages and demographic challenges. Many skilled workers are approaching retirement age, while younger workers often lack awareness of career pathways in the skilled trades. Addressing these challenges requires a workforce development system that accomplishes several goals simultaneously:

- Expands the pool of qualified workers entering the trades
- Provides rigorous training aligned with industry standards
- Ensures ongoing skill development as technologies evolve
- Supports long-term career advancement
- Sustains a workforce capable of delivering high-quality construction outcomes

The three-tier workforce development model – pre-apprenticeship, registered apprenticeship, and post-apprenticeship training – provides an effective framework for achieving these goals. This model supports the entire career lifecycle of a construction worker, from initial exposure to the trades through advanced technical specialization.

Historical Foundations: Apprenticeship and Prevailing Wage

The foundation of the U.S. construction workforce training system is the registered apprenticeship model. For nearly a century, apprenticeship has served as the primary mechanism for developing skilled trades workers. Registered apprenticeship programs combine:

- Paid on-the-job training
- Structured classroom instruction
- Industry standards for competency and safety
- Progressive wage increases tied to skill development

The fundamental structure of apprenticeship programs as we know them today was established by two New Deal laws signed by President Franklin D. Roosevelt during the great depression. The Federal Apprenticeship Act, commonly known as the National Apprenticeship Act or Fitzgerald Act, which was signed into law in 1937. This act authorized national standards for apprentices and provided a structure for labor and management to cooperatively manage training programs. It established a federal/state relationship regarding apprenticeship program management that persists to today.

The Apprenticeship Act itself builds on and complements the Davis Bacon Act, signed into law in 1931, which ensures workers receive locally “prevailing wages” and fringe benefits for projects receiving federal funding over a specified amount, which today is set at \$2,000 (Department of Labor 2026).

The Davis-Bacon Act of 1931 supports workforce development through several mechanisms. Under the Davis Bacon Act, contractors may only pay workers “apprentice” rates (which are lower than journeyman rates) if those workers are registered in an apprenticeship program that meets the standards of the Fitzgerald Act. Moreover, to pay apprentice wages on a Davis-Bacon project, the contractor must maintain a specific apprentice to journeyman ratio as defined by the registered program. This provides a structural incentive for contractors to use apprentices. In addition, by mandating a prevailing wage, the law prevents contractors from winning bids simply by lowering the wages of their construction trades workers. Instead, they must compete on productivity, quality and worker skill, which incentivizes investment in a more capable workforce.

Since the New Deal, apprenticeship has been paired with prevailing wage standards, particularly on public works projects. State and federal prevailing wage policies require contractors on publicly funded projects to pay wages and benefits consistent with local industry standards. Notably, one of the fringe benefits specified in every prevailing wage schedule is a contribution to a training fund which pays for both apprenticeship and post-apprenticeship career technical education provided free of charge to the worker. Apprenticeship creates the training infrastructure necessary to develop skilled workers who can earn a prevailing wage, while prevailing wage policies pay for the training and ensure that construction careers provide the wages, benefits, and stability necessary to attract workers into the trades and retain them over time. Together, apprenticeship and prevailing wage function as a form of industrial policy embedded within public investment.

When these systems operate together, they create a powerful workforce development engine. Workers are encouraged to enter the trades because they see a clear pathway to stable,

well-paying careers. Employers benefit from a reliable pipeline of skilled workers capable of delivering complex construction projects safely and efficiently.

While both federal and state rules allow for either joint labor management programs (union) or unilateral programs (non-union), the overwhelming majority of apprenticeship programs are joint labor management. About 9 out of 10 apprenticeship graduates in the U.S. are union members. Over decades, this integrated system has produced a mostly unionized, high road, apprenticeship-trained side of the construction industry that features some of the most skilled construction workers in the world while supporting middle-class employment opportunities for millions of workers.

Pre-apprenticeship programs represent the final piece of the puzzle. In the latter part of the 20th century, labor reformers pushed for more diverse participation in the skilled trades. Pre-apprenticeship programs grew out of these efforts to provide supportive services and remedial math or literacy skills to women, minorities, veterans, the justice impacted and other populations that would benefit from access to good jobs in the trades.

The U.S. Department of Labor (DOL) significantly boosted these programs in the early 2010s. By 2015, initiatives like the Workforce Innovation and Opportunity Act (WIOA) and federal grants (e.g., American Apprenticeship Initiative) began funding and standardizing “quality frameworks” for pre-apprenticeships to ensure they lead directly into registered programs. The Construction Trades Workforce Initiative (CTWI) owes its origins to this new investment in expanding access to the Trades, as that is what we were formed to do and the majority of our annual budget is focused on that work.

Tier One: Pre-Apprenticeship

Pre-apprenticeship programs represent the first tier of the workforce development pipeline. These programs prepare individuals to successfully enter and complete registered apprenticeship programs by providing foundational skills, industry exposure, and career readiness training. While relatively new compared to apprenticeship itself, pre-apprenticeship programs have rapidly proven their effectiveness in expanding access to construction careers and strengthening the applicant pool for apprenticeship programs.

One of the most widely recognized models is the Multi-Craft Core Curriculum (MC3) developed and endorsed by the North America’s Building Trades Unions (NABTU). The MC3 curriculum introduces participants to multiple construction trades while teaching the foundational knowledge and workplace expectations necessary to succeed in registered apprenticeship programs.

The MC3 program allows for considerable flexibility to add content, but must consist of at least 120 total instructional hours, with a specific core that all programs must include. Topics covered in the MC3 curriculum include:

Table 1 NABTU Sponsored Multi Craft Core Curricula (MC3)

Topic	Learning Objectives	Required Hours
Construction Industry Awareness	-Explain how the construction industry operates.	8

	-Identify the different trades and professions in the construction industry and what they do. -Describe the demographics and composition of those who work in the construction trades. -Familiarize students with the wages and benefits of construction industry jobs. -Identify and emulate behaviors that lead to a successful career in the construction industry. -Help students make an informed decision about whether to pursue a career in the construction industry.	
Construction Trades and Apprenticeship Awareness	-Explain what a union is and identify the benefits and services they provide. -Explain what it means to be a union member and identify member roles and responsibilities to the union. -Explain what construction trades apprentices are and do. -Explain the rights and responsibilities of an apprentice. -Explain the process for becoming an apprentice. -Develop a plan for setting and achieving SMART goals to attain a construction career.	8
Construction Health and Safety: Osha 10	-Complete OSHA 10 training and receive OSHA 10 Certification	10
Construction Health and Safety: CPR/First Aid	-Complete First Aid Training and receive CPR/First Aid Certificate	8
Construction Health and Safety: Women's Health and Safety	-Describe why gender matters in health and safety issues in the construction industry. -Describe how health and safety issues are impacted by gender. -Describe how issues that are specific to gender can be safety concerns. -Demonstrate what individuals can do to protect themselves and their co-workers and to promote equitable health and safety practices and policies in the workplace.	2
Tools and Materials	-Familiarize the students with various tools and materials used in construction -Complete hands-on projects.	8
Heritage of the American Worker	-The history of labor and unions -Learn about legislation that has come to support the Building Trades from the initial signing of the Apprenticeship Act,	8

	-Subsequent fights to preserve the rights of construction workers throughout the history of the building trades, -Understanding of the constantly evolving socioeconomic demographics of the building trades, the demands for greater pay and adequate benefits and other quality-of-life criteria.	
Diversity in the Industry: Diversity Awareness	-Explain the importance of a diverse workforce in the construction industry -Identify the importance of the construction industry to diverse populations -Identify the historical and social roots of under-representation of women and minorities in the trades -Explain the barriers and challenges to building a diverse construction workforce and an equitable worksite -Explain what it means to be a culturally competent person and organization -Identify equal employment opportunity and non-discrimination rights in the workplace and classroom	4
Diversity in the Industry: Sexual Harassment	-Identify respectful practices and behaviors in the workplace -Distinguish between the legal application of sexual harassment and workplace policies for acceptable behavior. -Recognize and define different forms of sexual harassment. -Explain why sexual harassment is a problem in the construction workplace. -Identify who is harmed by sexual harassment. -Demonstrate action steps to take in response to witnessing or experiencing sexual harassment.	8
Construction Math	-Trace the history of mathematics and identify systems of measurement -Perform mathematical operations with whole numbers -Perform mathematical operations with common fractions -Perform mathematical operations with decimal fractions	40
Blueprint Reading	-For students to recognize the symbols on blueprints and successfully read and measure the scope of work, regardless of the type of plan or drawing, or their respective contribution to the job site. Whereas much of these plans are being translated via technical platforms, students will learn the practice in the traditional literacy and test out their construction math skills in measurement while becoming visually literate in the practice.	4-8
Green Construction	-Describe the basics elements of green construction and green buildings and the part they will play as a construction worker on green job sites.	4-8

- Understand basic green building terms.
- Describe the role of green building certification and how it works.
- Recognize green awareness on construction projects, including sustainable site development, efficient use of water resources, energy conservation, the use of sustainable building materials, reducing and recycling construction waste and protecting indoor and outdoor environmental quality.

Financial Literacy	-Students will be able to identify the rationale for understanding financial literacy -Students will be able to construct a budget -Students will be able to devise a strategy for savings and debt management -Students will be able to define financial services and products for financial security	4-8
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Total Hours	120
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Though all MC3 programs offer at least 120 hours of instructional time, many MC3 programs build additional content into their curricula, and offer services in addition to that training.

The Rising Sun Center for Opportunity in Oakland, California is a partner of CTWI that runs an MC3 program called Opportunity Build. A promotional blurb from their website describes what they offer: “Opportunity Build students commit to 10-12 weeks of learning and preparing for success in the construction trades. Following up to 325 hours of classroom instruction and hand-on training with retired union tradespeople, graduates receive a full year of employment and job retention support—entirely free.” (Rising Sun 2026) The Rising Sun program is particularly interesting because once a year they run a class with all women students called “Women Building the Bay.” Their women students outperform men in terms of both graduation and placement. One clear lesson from this is that, if properly supported, women can thrive in the Trades (California Department of Industrial Relations 2022). Key components of successful pre-apprenticeship programs typically include:

- Introduction to all the different construction trade options
- Basic technical skills training
- Industry-recognized safety credentials
- Math and mechanical reasoning skills training
- Soft skills development
- Career readiness and job placement support
- Direct connections to registered apprenticeship programs

The MC3 curriculum is taught in a variety of settings including high schools, community colleges, adult education programs, correctional institutions and in stand-alone non-profit programs.

Many building trades unions also operate trade-specific pre-apprenticeship programs that prepare prospective applicants for entry into their particular craft. While these programs focus more directly on the skills and expectations of a single trade, they typically cover many of the

same core competencies emphasized in the MC3 curriculum, including safety training, construction math, tool familiarity, and jobsite readiness.

Together, MC3-based programs and single craft pre-apprenticeships help ensure that apprenticeship applicants arrive prepared for the demands of the trades while giving employers access to a broader pool of qualified candidates that know what they are getting into and have been vetted. Pre-apprenticeship programs expand access to construction careers by reaching individuals who may otherwise face barriers to entering the trades. Prospective workers who benefit from these programs include:

- Women
- Residents of low-income communities
- Justice-impacted individuals
- Veterans
- People of color
- Dislocated workers
- Young adults entering the workforce

When designed in partnership with apprenticeship programs and industry stakeholders, pre-apprenticeship initiatives help ensure that participants are prepared for the demands of apprenticeship and construction careers. As a result, these programs strengthen both recruitment into the trades and long-term retention within the skilled construction workforce.

Tier Two: Registered Apprenticeship

The second and most central tier of the workforce training system is registered apprenticeship. Based on a 2021 Illinois Economic Policy Institute Study that examined national data from 2010 to 2020, union construction apprenticeships provide bachelor's degree level economic outcomes, offering high wages and significant retirement security (Manzano IV et al. 2021). Construction apprenticeships offer up to 41% more training hours than public university bachelor programs, and 183% more than associated degrees.

The Illinois EPI study also found significant disparity between union and non-union apprenticeship programs, highlighted in the table below. The joint labor management system is also dramatically larger in scale, graduating 9 times as many journeymen as the non-union programs.

Table 2 Illinois EPI Study

	Union Construction Apprenticeship Programs	Non-Union Construction Apprenticeship Programs
Wages	\$40 per hour on average	\$32 per hour on average
Graduation Rates	54% completion rate	31% completion rate
Cohort Demographics	31% enrollment by people of color	21% enrollment by people of color

Apprenticeship programs typically last three to five years and combine thousands of hours of paid on-the-job training with classroom instruction. During this period, apprentices progressively develop the full range of technical, safety, and problem-solving skills required to become journey-level workers. At the beginning of an apprenticeship, pay will typically start at 40% to 60% of the journey workers wage for their craft. That rate will regularly increase according to a schedule defined by the DOL until they graduate and receive a journey workers wage.

The length of the program depends on craft, and even within specific crafts there can be variations. The typical laborers program requires 240 hours of classroom time and 4,000 hours of on-the-job-training (OJT). At the other end of the spectrum an IBEW inside wireman in California requires approximately 1,100 hours of classroom time and 8,000 hours of OJT. Apprentices from registered apprenticeship programs gain their OJT from either public or private employers. When working on a public project, their wages are a DOL specified fraction of the journeyman's prevailing wage that increases at regular intervals depending on classroom progress and the number of OJT hours they have completed. When working on private projects, their wages are determined by their union's collective bargaining agreement (CBA) CBA rates are often identical to the prevailing wage in areas with substantial union presence.

When work is plentiful, apprentices will typically complete their classroom training at about the same time as they complete the OJT requirements. When the economy is slow, catching up with OJT requirements can take extra time. When there is a shortfall of work, apprentices suffer both because of fewer paid hours and because their rate of pay can't progress. In order to help existing apprentices to complete their apprenticeships as close to on time as possible, joint labor management committees tend to admit new apprentices based on estimates of available prevailing wage work that will carry those apprentices through their program without delay. Because of this phenomenon, the single most effective way to create more available slots in joint labor management apprenticeship programs is to simply use union contractors. The joint labor management apprenticeship model offers several key advantages:

- **Earn While You Learn:** Apprentices are paid employees from the beginning of their training. This allows individuals to build careers without incurring educational debt.
- **Industry-Driven Training Standards:** Curricula are developed jointly by labor and management organizations to reflect real-world industry needs, while also incorporating components required by law - such as safety training - that are mandated across all construction apprenticeship programs.
- **Structured Skill Development:** Training includes classroom instruction and lab work sequenced to progressively build competency, with these lessons reinforced through on-the-job training that provides the repetition necessary to cement newly learned skills.
- **High Completion and Employment Outcomes:** Registered apprentices are employed and gaining experience throughout their multi-year training, with graduates who reach journey-level status demonstrating strong long-term retention in the construction workforce, contributing to a stable and highly skilled labor force (Manzano and Thorsen 2021).

This model has consistently produced highly skilled construction workers capable of delivering complex projects safely and efficiently.

Tier Three: Post-Apprenticeship Career Technical Education

The third tier of the training system is post-apprenticeship education and skill advancement. Construction technology continues to evolve rapidly, particularly in areas related to energy efficiency, electrification, and building performance. As a result, journey-level workers must continue developing new competencies throughout their careers. Many construction trades maintain extensive continuing education programs through the same joint labor-management training centers that teach apprentices. Some courses are open to apprentices and journeymen alike. Some post apprenticeship coursework, as for instance training to become a foreman, is reserved for apprenticeship graduates. Post-apprenticeship training can include advanced certifications, specialized technical courses, manufacturer training and supervisory and leadership development. This ongoing training ensures that the workforce remains capable of implementing emerging technologies and meeting increasingly demanding building standards.

Workforce Development and Energy Efficiency

The three-tier training model plays a critical role in advancing national energy and climate goals. Many aspects of building construction have significant implications for energy efficiency and environmental outcomes. The crafts that have significant roles in shaping building energy performance have explicitly incorporated skills training aimed at optimizing this performance.

Some building technologies are exceptionally sensitive to the quality of workmanship. Refrigerant systems are at the top of this list. According to a study by DNV published at the ACEEE Summer Study in 2024, some 80% of high global warming potential refrigerants sold today escape to the atmosphere on account improper handling (Hoover et al. 2024). Because most of these refrigerants are very-high global warming potential gasses, their escape seriously degrades progress towards limiting the financial and social and security costs of global warming. To avoid these impacts, systems using these chemicals have to be flawlessly installed, maintained and decommissioned. For HVAC systems to be efficient, the units also need to be properly sized, properly located and the air handling systems and refrigerant systems need to be carefully constructed to avoid both leaks and to design for favorable fluid dynamics. This work requires careful attention to lots of detail. The two unions whose scope of work covers appliances that use refrigerants are the United Association of Plumbers and Pipefitters (UA) and the Sheetmetal Workers (SMW). Both unions train HVAC installers through apprenticeship programs that feature nearly 1,100 hours of classroom time and 8,000 hours of OJT. However, that kind of training is only reliably required on the union side of the industry. The overwhelming majority of non-union contractors installing HVAC system do not use registered apprenticeship programs at all to train their workers.

Heat pump water heaters hold the potential for substantial energy efficiency gains but also harbor the potential for energy or economic losses if improperly installed or maintained. According to researchers at the Pacific Northwest National Laboratory (PNNL), contractors who are unfamiliar or inexperienced with heat pump technology are significant risk factor for heat pump water heater (HPWH) performance issues. These systems need proper sizing, ventilation

and condensate management to avoid efficiency losses, damage to the building or failure to meet customer's comfort needs (Kono et al. 2024). To address this need, the Plumbers and Pipefitters offer training which allow their members to obtain and maintain ANSI certified UA STAR Certification, which ensures they are up-to-date with the latest code changes and high-efficiency water heating technologies.

Union training programs across the range of critical crafts for energy efficiency teach the curricula needed to prepare workers to build high performance buildings. In addition to HVAC and plumbing workers, many other skilled crafts have critical scopes of work for energy efficient buildings. These include electricians, insulators, drywallers, carpenters, framers and roofers. Errors made by under-skilled workers in any of these crafts can compromise the efficiency of buildings and raise costs for consumers. For all of these crafts, joint labor management training programs provide classes addressing energy related issues.

The Electrical Workers JATC teaches a curriculum that is central to the challenge of electrification and energy efficiency. Building Information Systems (BIMs), solar PV installation, electric vehicle charging systems certificates (EVITP) and Energy Storage and Microgrid Training and Certification (ESAMTAC). In California, the IBEW/NECA JATCs also teach the curricula for the California Advanced Lighting Controls Training Program (CALCTP) developed by the California Energy Commission.

Training programs for framers provided by the Carpenters Union include classes on energy efficient framing that address techniques for reducing thermal bridging. Drywallers can also find classes addressing thermal bridging in joint labor management apprenticeship programs. JATCs for the Roofers' Union routinely update their journey level and apprentice coursework to match modern industry demands including how roofs and solar interact. This ensures that as commercial and residential solar becomes more common, the roof's warranty remains intact, and leaks are prevented during installation.

Conclusion

The construction industry sits at the intersection of two national priorities: building a clean energy economy and expanding access to quality jobs. The three-tier training model, including pre-apprenticeship, joint labor management registered apprenticeship and post apprenticeship career training provides a proven framework for achieving these goals. When paired with prevailing wage standards, this workforce development system creates the conditions necessary to recruit, train, and retain the skilled workers needed to build the nation's infrastructure and energy systems. The simplest way for public policy to support this is to utilize public works labor standards and to choose union labor where possible.

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AI-assisted Tools Disclosure Template

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