

Strategy for a
**21ST CENTURY ENERGY
WORKFORCE**



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REPORT OF THE ENERGY WORKFORCE ADVISORY BOARD
TO JENNIFER M. GRANHOLM, SECRETARY, U.S. DEPARTMENT OF ENERGY

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EXECUTIVE SUMMARY

Now is the time to sharpen DOE’s workforce strategy.

The U.S. energy sector is in a period of transformation driven by climate imperatives, technology, trends in consumption and consumer demand, geopolitics, increased federal and state investment, and a range of other shifting policies.

The pace and magnitude of these changes require accelerated development and adoption of new technology and modernization of the nation’s energy infrastructure to ensure its capacity, reliability, resilience, and security. The transition also gives rise to an historic opportunity to create high-quality jobs that offer the benefit of rewarding, purposeful careers and that are attainable and accessible to a wide range of the population, especially displaced and unemployed energy workers, communities that have been underserved by the energy system, and those who are underrepresented in the sector’s workforce.

The Department of Energy has both an opportunity and an urgent need to implement an energy workforce strategy that aligns with DOE’s new, expanded functions. DOE is no longer making investments almost exclusively focused on research and development (R&D); it now is a major catalyst for the deployment of clean energy infrastructure and a resurgence of domestic manufacturing. DOE is well-positioned to lead a national strategy to support the development and retention of the needed workforce to support that sea change. At the same time, DOE is well-positioned to champion, as fundamental priorities in that change, job quality and job access—two indispensable factors in successful workforce development.

DOE has a long history of funding effective workforce activities in STEM disciplines and nuclear energy—the R&D workforce. Prior to the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) investments, 86% of DOE’s workforce investments went into nuclear and cross-cutting science topics (mostly high-performance computing).¹ With the passage of BIL and IRA, DOE must now also command the development, attraction, and retention of the future energy workforce required to build, construct, manufacture, maintain, and operate energy infrastructure and vital supply chain inputs—the deployment workforce. The addition of a deployment workforce focus equal to that of DOE’s R&D focus is imperative to avoid workforce-related bottlenecks to deployment and accelerate an efficient, effective, and inclusive clean energy transition.

The 21st Century Energy Workforce Advisory Board (EWAB or Board) was established under the Bipartisan Infrastructure Law and directed to develop a strategy for the Department that addresses the rapidly evolving needs of workers and employers in the current and future energy sector.

To support the development of its recommendations, the Board identified a set of strengths and assets that position the Department to lead workforce strategies that will have a lasting impact.

DOE has unique assets that should form the basis of its workforce strategy, allowing its workforce investments and activities to have outsized, multiplying impact.

The Department already commands resources critical to implementing a 21st Century energy workforce strategy. These unique strengths include notably:

- Highly regarded STEM education infrastructure and activities, especially related to nuclear energy;
- An annual analysis of the energy workforce, with national, state, and energy subsector details (U.S. Energy and Employment Report) and future-looking Energy Workforce Needs Assessment;
- Deployment of hundreds of billions in federal competitive funding opportunities that require community benefit plans—the requirement to develop a CBP creates an incentive for applicants to detail plans to support good-quality jobs and take steps to create inclusive workforces on the projects; and
- The unique influence of DOE over the energy sector, rooted in its credibility, investments, relationships, technical expertise, and “bully pulpit” power to shape decisions of a range of energy sector stakeholders.

To capitalize on its strengths, DOE needs a centralized structure to align and bolster workforce development operations that are cohesive, principled, proficient, scalable, and informed by data. Below are themes that emerge from the Board’s recommended workforce strategy:

- **Cohesive:** Many of DOE’s workforce development initiatives and investments are currently siloed by technology area and program office. But this approach does not lead to investments that effectively address workforce challenges shared across multiple technology areas, nor does it effectively engage external partners. DOE needs to have public-facing comprehensive information on its workforce development investments and opportunities that is user-friendly, as opposed to siloed information held only by program offices, related only to STEM, or nonexistent.
- **Principled:** Without “north star” guiding principles, program offices may invest in workforce activities that inadvertently contribute to workforce shortages, instability, and precarity. Agency-wide principles would structure workforce efforts across the Department to support a highly-skilled, diverse, and retained workforce, focusing on preparing people for jobs with career potential, benefiting underserved communities and underrepresented populations, aligning with the needs of both workers and employers, and leveraging the broader federally-funded workforce education and training infrastructure to support the energy sector. DOE’S unique influence in the energy sector should be used more intentionally and urgently to focus on the quality of jobs that are created and drive bold actions to create meaningful opportunity for underrepresented populations and disadvantaged communities. This is not merely a matter of outreach, but rather of intentional investment.
- **Proficient:** DOE needs to invest in and grow its in-house workforce development expertise and capacity to execute effective, inclusive workforce development strategies. This begins with more coordination of workforce activities across the Department. As DOE expands beyond the STEM workforce, DOE will need more experts in apprenticeship, community colleges, career and technical education, and K-12 education pertinent to the infrastructure and deployment goals of the Department. DOE will also need to develop understanding of issues relating to workplace safety, what constitutes living wages, and effective strategies for ensuring compliance with standards that align with job quality.
- **Scalable:** DOE’s workforce investments should focus on influencing workforce development activities at a greater scale than its direct investment. This includes influencing employers to be meaningful, proactive partners in workforce development. It includes engaging labor unions and other

organizations that represent workers and can facilitate bringing workers' perspectives, experiences, and interests into the workforce development process. It also means building upon and tapping into the workforce development infrastructure and funding supported by other federal agencies such as the Departments of Labor and Education. It means boosting the capacity of institutions to play strategic workforce roles on the ground where jobs are being created and across priority industries in energy. Shifting away from small-scale, technology-specific workforce programs to broader strategies can scale DOE's impact from hundreds of workers to hundreds of thousands of workers.

- **Informed by data:** DOE's workforce investments and activities should be informed by such questions as: Where are the jobs? What are the training pathways for those jobs? Where are the gaps? Where is workforce displacement? What DOE workforce development investments have worked to get participants into good-quality careers? What do we know about disparities in access or advancement by race and gender? How well are these investments serving underrepresented populations and disadvantaged communities? What energy subsectors are failing to attract and retain a workforce because of job quality (using data related to as many elements of DOE's definition of job quality as possible) or barriers to employment?

SUMMARY OF THE REPORT'S RECOMMENDED STRATEGY

The EWAB proposes DOE adopt three higher-order strategic recommendations. The first is a set of principles to institutionalize as priorities for all DOE workforce activities. The second and third strategic recommendations each contain more specific substrategies and actions in the body of the report.

I. Issue an Agency Directive adopting eight principles for all DOE workforce activities.

- I.1. Begin by gathering and analyzing crucial data, including on labor market demand and supply, the Department's current workforce activities and outcomes, and equity and quality measures for energy jobs.
- I.2. Prioritize broad occupational training for careers, rather than task training for unique jobs.
- I.3. Break down silos across workforce efforts that focus on specific technologies or tasks.
- I.4. Leverage, partner with, and boost the capacity of existing workforce and education infrastructure, including union-sponsored apprenticeship, pre-apprenticeship, and labor-management partnerships, to impact job quality and equity.
- I.5. Use every tool in DOE's toolbox to incentivize employer commitment to direct hiring, retention, and career path strategies.
- I.6. Focus on partnerships over standalone programs.
- I.7. Drive employer commitment to and investment in job quality and equity.
- I.8. Choose meaningful metrics—then measure early, evaluate often, and make timely adjustments to meet mission-critical goals.

II. Institutionalize and bolster the Department's coordination of critical workforce activities internally and across federal agencies.

- II.1. Recommendation: Establish the Office of Energy Jobs as a standalone office and clarify that it is charged with leadership and coordination of DOE's cohesive workforce strategy.
- II.2. Recommendation: Lead and expand collaboration with other federal agencies implementing workforce development for critical energy sector occupations.
- II.3. Recommendation: Make information on how DOE funding can be used for workforce development more usable and accessible.

III. To support DOE's industrial strategy to revitalize the U.S. energy and manufacturing sectors, integrate six interdependent strategies into DOE's work to increase cohesion, effectiveness, and planning for the future.

Strategy III.1. Compile and maintain the data required to project workforce needs and prioritize investment in the energy workforce.

- III.1.A. Recommendation: Prioritize data that informs a cohesive, effective energy workforce strategy for the Department.

Strategy III.2. Continue and in some cases expand DOE's investment in training engineers and scientists.

- III.2.A. Recommendation: Build on DOE's and the National Labs' leadership in STEM education.
- III.2.B. Recommendation: Maximize the role played by community and technical colleges, TCUs, HBCUs, and MSIs in developing a diverse pipeline of engineers and scientists.
- III.2.C. Recommendation: Expand DOE STEM K-12 programs and partnerships, especially in disadvantaged communities.

Strategy III.3. Strengthen and expand a cohesive, sector-focused skills development infrastructure with direct connection to critical trade, technical, and operations jobs.

- III.3.A. Recommendation: Build new sector initiatives, support existing sector partnerships, and build up the capacities of stakeholders and workforce intermediaries to execute these strategies.
- III.3.B. Recommendation: Deepen investment in registered apprenticeship.

Strategy III.4. Break down barriers and build on-ramps to high-quality energy jobs, especially for disadvantaged communities, underrepresented populations, displaced and unemployed energy workers, veterans, and youth.

- III.4.A. Recommendation: Continue and amplify DOE investment across STEM programs in education institutions serving disadvantaged and underrepresented populations.
- III.4.B. Recommendation: Partner with the Department of Labor to increase investment in proven on-ramps to quality apprenticeship for disadvantaged communities and underrepresented populations, and support retention and completion efforts in registered apprenticeship.
- III.4.C. Recommendation: Increase DOE technical assistance to support effective, inclusive, place-based workforce strategies.
- III.4.D. Recommendation: Strengthen incentives or requirements for energy employers receiving DOE funds on large-scale deployment projects to invest in effective, inclusive workforce development practices.
- III.4.E. Recommendation: Target resources to workers and communities impacted by and vulnerable to dislocation as a result of the energy transition.

Strategy III.5. Document the state of job quality and drive improvements, where needed, in the energy sector.

- III.5.A. Recommendation: Implement an intra-agency initiative to enhance measurement, impact, and reporting of job quality in energy workforce investments.
- III.5.B. Recommendation: Lead an interagency effort to increase the use of job quality mechanisms for energy sector jobs.

Strategy III.6. Define success, set benchmarks, refine the strategy.

- III.6.A. Recommendation: Apply consistent evaluation processes relevant to workforce imperatives across critical DOE investments.

These recommendations represent a broad, structural strategy for DOE to build an energy workforce infrastructure guided by core principles and information necessary to meet the needs of workers and employers in the near, mid, and long terms. Many of these strategies are **instrumental in nature**—e.g., establishing a set of guiding principles for all DOE workforce activities; establishing job quality metrics, documenting job quality, and using the data to inform future resource allocation; and bolstering the capacity of the Office of Energy Jobs. Other strategies are **programmatic in nature**—e.g., investing in K-12 programming, investing in sectoral workforce development initiatives, and piloting programs to stand up particular models.

The recommended infrastructure applies to traditional or legacy energy subsectors as well as new subsectors and those yet-to-be developed. As the EWAB continues its work, additional information and analysis will support instrumental and programmatic recommendations in priority areas.

Introduction

The Department of Energy is uniquely positioned to address the challenges of a 21st Century energy workforce, but it must rapidly expand and update its workforce strategy to succeed.

As outlined in the Department’s recent report to Congress,² DOE’s workforce investments between 2011 and 2022 overwhelmingly focused on degreed science occupations, with 80% of DOE workforce funding targeted to undergraduate and graduate students, and 12% targeted to students and faculty at minority-serving educational institutions including historically Black colleges and universities and tribal colleges and universities. Seventy percent of these investments were focused on disciplines related to nuclear technology, 16% on “cross-cutting science” disciplines (largely high-performance computing), 3% on manufacturing/industry, 3% on fossil energy, 2% on buildings, 2% on vehicles, and 1% or less for each of the remaining technologies: solar, electric grid, wind, clean energy cross-cutting, bioenergy, distributed energy resources, hydrogen fuel cells, water power, fusion energy, and geothermal technology.³

This pattern of investment has been consistent with the Department’s responsibilities for most of its history to ensure national nuclear security and advance research and development of energy technologies. But the landscape has changed.

Climate change adaptation, technological advances, shifting consumer demand, geopolitics, and public-sector investment are driving a rapid and accelerating transformation of our economy and of the energy sector. Amidst these massive shifts, energy employment is booming and the occupational mix in the sector is changing.

The Biden Administration is both driving and responding to the sector’s transformation, harnessing the power of the public sector to boost domestic manufacturing, improve supply chain resilience, strengthen global competitiveness and security, and meet bold climate goals. Accordingly, the Department of Energy’s mission has fundamentally expanded from a primary focus on research and development (R&D) to a dual focus of R&D with massive deployment of infrastructure and energy efficiency technologies. DOE alone will deploy \$62 billion for clean energy infrastructure under the Bipartisan Infrastructure Law; \$67 billion for clean energy research and development, National Laboratory infrastructure improvements, and innovation hubs under the CHIPS and Science Act; and \$350 billion under the Inflation Reduction Act in new loans or loan authorities. These investments drive even greater private investment in the sector.

As the U.S. undergoes an energy transition, electrifies some legacy systems and decommissions others, expands efficiency and conservation, deploys carbon capture technologies, and recycles scarce resources, the country will need a larger energy workforce, with an expanded mix of occupations, and with updated skills. Energy workers in the coming years will also be needed to respond to weather extremes and natural disasters, fill positions in the growing fields of cybersecurity and artificial intelligence, and overcome energy supply chain disruptions by onshoring manufacturing.

Will energy employers be able to attract and retain enough workers to fill these critical jobs? Will workers have opportunities and resources to develop the skills required? Will the new jobs be high-quality jobs with career-track potential? Will workers dislocated by the energy transition be supported to connect to

good-quality jobs that leverage their skills? And will these jobs be accessible to populations who have long been underrepresented in good-quality energy careers?

These are the new challenges DOE must address to ensure the nation can develop, deploy, operate, and maintain a secure energy infrastructure, harnessing the strengths, resources, expertise, and value of all industries within the ecosystem to enable full sector-based strategies.

Fortunately, the Department already commands resources critical to implementing a 21st Century energy workforce strategy. These unique strengths include most notably:

- Highly regarded STEM education infrastructure and activities, especially related to nuclear energy;
- Research and development investments that catalyze critical technology and science education through the National Laboratory complex;
- A birds-eye view of the industries in the energy sector, the changes underway, and a unique position to see workforce needs, especially across industries;
- An Office of Energy Jobs that 1) is well-positioned to work across the Department and with other federal agencies in executing a forward-looking workforce strategy and 2) provides external stakeholders with key information on workforce needs and sectoral workforce priorities;
- Strong working relationships and the power to convene key stakeholders, including:
 - Energy sector employers and trade associations,
 - Labor unions,
 - Tribal governments,
 - Research universities,
 - Community and technical colleges, historically Black colleges and universities (HBCUs), tribal colleges and universities (TCUs), and other minority-serving institutions (MSIs),
 - Workforce intermediaries,
 - State and local government agencies, and
 - Federal agencies (particularly those overseeing the public workforce system, education system, and energy and climate investments);
- An annual analysis of the energy workforce, with national, state, and energy subsector details (U.S. Energy and Employment Report) and future-looking Energy Workforce Needs Assessment;
- Deployment of hundreds of billions in federal competitive funding opportunities that require community benefit plans: a framework that encourages recipients to collaborate with community and workforce partners, to pay attention to the quality of the jobs on their projects, and to invest in inclusive workforce development that translates to having skilled, diverse workforces on the projects and shared economic prosperity from these investments;
- Strong international relationships with other energy ministries to learn and share innovative approaches and best practices; and

- The unique influence of DOE over the energy sector, rooted in its credibility, investments, relationships, technical expertise, and “bully pulpit” power to shape decisions of a range of energy sector stakeholders.

To guide this effort, the Department established the 21st Century Energy Workforce Advisory Board (EWAB or Board) under the Bipartisan Infrastructure Law to address the rapidly evolving workforce needs of the nation’s energy sector. (More on the Board in Appendix 1.) The Board was charged with reviewing the Department’s workforce development efforts and recommending a strategy that:

1. Meets the current and future industry and labor needs of the energy sector;
2. Provides opportunities for students to become qualified for placement in traditional energy sector and emerging energy sector jobs;
3. Identifies areas in which the Department can effectively utilize the technical expertise of the Department to support the workforce activities of other federal agencies;
4. Strengthens and engages the workforce training programs of the Department and the National Laboratories in carrying out the Equity in Energy Initiative of the Department and other Department workforce priorities;
5. Develops plans to support and retrain displaced and unemployed energy sector workers; and
6. Prioritizes education and job training for underrepresented groups, including racial and ethnic minorities, Indian Tribes, women, veterans, and socioeconomically disadvantaged individuals.

(1 through 6 above are taken directly from the full statute.)⁴

The workforce needs outlined in the full statute are interconnected and the strategies to address them are necessarily interdependent. Two critical through lines connect all of the Board’s strategic recommendations:

1. The importance of DOE leveraging its unique capacity to support and drive the workforce trajectory of the entirety of the energy workforce ecosystem, addressing new technology, emerging technology, and legacy systems; and
2. The fundamental requirement for energy jobs to meet the needs of energy workers, a task which requires attention to the systems and structures that impact job quality and serve as barriers to those who have been historically excluded from quality employment in the energy sector.

Key terminology used in this report

A note on key terminology

Throughout this report, we use several terms to refer to populations of workers and communities that are the focus of this strategy's aim to create inclusive access to energy careers: **disadvantaged communities, socioeconomically disadvantaged communities, underserved populations, underrepresented populations, and dislocated workers**. It is important to emphasize that these terms are not hollow descriptors; instead, they offer a level of specificity to highlight the importance of these workers to the energy workforce and reflect a deep commitment to necessary structural change. To that end, this report leads with a set of definitions of these and other key terms. We highlight the terms **disadvantaged communities, socioeconomically disadvantaged communities, underserved populations, underrepresented populations, and dislocated workers** throughout the report to regularly refer the reader to those important definitions.

Definitions for these and other key terms

- **Clean energy technologies**
Clean energy technologies include those aligned with net-zero emissions. This includes renewable energy, nuclear, non-fossil energy efficiency, zero-emission vehicles, and carbon capture, utilization, and storage. Net-zero emissions refers to achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions prevented or taken out of the atmosphere.⁵
- **Community benefits agreements (CBAs)**
Agreements signed by community groups or coalitions and a project developer, identifying the community or labor benefits a developer agrees to deliver in return for community support or workforce availability for a project. Community coalitions can comprise stakeholder groups that would be impacted by a project, including neighborhood associations, faith-based organizations, worker-serving organizations, environmental groups, labor unions, child care providers, and others. Community benefits agreements help ensure that measurable local benefits will be given to a community. They are enforceable, legally binding contracts for all parties. They typically specify responsibilities, reporting, and remedies.
- **Community benefits plans (CBPs)**
Community benefits plans are required by the DOE as part of all Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) funding opportunity announcements (FOAs) and loan applications, and are based on a set of four core policy priorities: engaging communities and labor; investing in America's workers through quality jobs; advancing diversity, equity, inclusion, and accessibility through recruitment and training; and implementing Justice40 (see Justice40 definition below).
- **Community workforce agreements (CWA)**
Community workforce agreements are project labor agreements (PLAs; see definition below) that include community-oriented commitments relating to equitable workforce development, social justice, small business support, and/or other issues. Negotiating a CWA brings building trades unions and the trades council together with the project user/owner, the general contractor, and community

organizations to jointly develop the terms of the project. As with PLAs, CWAs generally help prevent delays, maintain workplace safety, and ensure high-quality construction products, all of which help protect taxpayer investment in the project.

- **Demand-side investments**

This refers to demand for skills, job creation, and retention. For example, an investment in the expansion and upgrading of a manufacturing facility to produce a component in the supply chain of a clean energy technology will create demand for skilled workers. The investment in the facility is, thus, a demand-side investment.

- **Disadvantaged communities (DACs)**

Communities that experience disproportionately high and adverse economic, human health, climate-related, environmental, and other cumulative impacts.⁶ A community is defined either geographically (a group of individuals living in geographic proximity such as a census tract), or based on a common condition (such as migrant workers or Native Americans).⁷ DOE's working definition of "disadvantaged" is based on cumulative burden and includes data for 36 indicators collected at the U.S. Census tract level.

- **Dislocated worker**

A dislocated worker is defined in the Workforce Innovation and Opportunity Act as "an individual who— (A)(i) has been terminated or laid off, or who has received a notice of termination or layoff, from employment, including separation notice from active military service (under other than dishonorable conditions); (ii) (I) is eligible for or has exhausted entitlement to unemployment compensation; or (II) has been employed for a duration sufficient to demonstrate, to the appropriate entity at a one-stop center referred to in section 121(e), attachment to the workforce, but is not eligible for unemployment compensation due to insufficient earnings or having performed services for an employer that were not covered under a State unemployment compensation law; and (iii) is unlikely to return to a previous industry or occupation; (B) (i) has been terminated or laid off, or has received a notice of termination or layoff, from employment as a result of any permanent closure of, or any substantial layoff at, a plant, facility, military installation or enterprise; (ii) is employed at a facility at which the employer has made a general announcement that such facility will close within 180 days; or (iii) for purposes of eligibility to receive services other than training services described in section 134(c)(3), career services described in section 134(c)(2)(A)(xii), or supportive services, is employed at a facility at which the employer has made a general announcement that such facility or military installation will close; (C) was self-employed (including employment as a farmer, a rancher, or a fisherman) but is unemployed as a result of general economic conditions in the community in which the individual resides or because of natural disasters; (D) is a displaced homemaker; or (E) (i) is the spouse of a member of the Armed Forces on active duty (as defined in section 101(d)(1) of title 10, United States Code), and who has experienced a loss of 4 employment as a direct result of relocation to accommodate a permanent change in duty station of such member; or (ii) is the spouse of a member of the Armed Forces on active duty and who meets the criteria described in paragraph (16)(B)."⁸

- **Equity**

Consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment.⁹

- **Good jobs**

As per the Good Jobs Principles developed by the Departments of Labor and Commerce, a “good job” is one that provides fair, transparent, and equitable pay that exceeds the local average wage for an industry; delivers basic benefits (e.g., paid leave, health insurance, retirement/savings plan, access to affordable, reliable, and high-quality child care/long-term care, and transportation); provides workers with an environment in which to have a collective voice; helps the employee develop the skills and experiences necessary to advance along a career path; provides predictable scheduling, and a safe, healthy, and accessible workplace devoid of hostility and harassment; has employees properly classified with the limited use of independent contractors and temporary workers; and protects workers’ statutory right for a free and fair choice to join a union under the National Labor Relations Act (NLRA).

- **Job quality/quality job**

Job quality refers to a combination of characteristics of a job that provides workers with an experience of their work being valued and respected, having a voice in one’s workplace and the opportunity to shape one’s work life, and having accessible opportunities to learn and grow. Quality jobs afford workers the opportunity to build the material security and confidence that allow planning for the future and participating in a community as a valued member.¹⁰ In its guidance for community benefits plans, DOE provides a definition of a “good job” that identifies several specific factors contributing to job quality, including factors related to pay, benefits, predictable scheduling, a safe, healthy workplace, and protection of rights for a free and fair choice to join a union, among other factors.¹¹

- **Justice40**

The Justice40 initiative, created by Executive Order 14008 on Tackling the Climate Crisis at Home and Abroad, establishes a mandate that 40% of the overall benefits of certain federal investments flow to disadvantaged communities and directs all federal agencies to review programs for inclusion in this initiative.

- **Minority-serving institutions (MSIs)**

These are universities and colleges that serve a significant percentage of students from minority groups, including historically Black colleges and universities (HBCUs), Hispanic-serving institutions, tribal colleges and universities (TCUs), and other minority institutions as educational entities recognized by the U.S. Department of Education’s Office for Civil Rights (OCR), and identified on the OCR’s Department of Education accredited postsecondary minorities’ institution list.

- **Project labor agreements (PLAs)**

A PLA is a pre-hire collective-bargaining agreement with one or more labor organizations that establishes the terms and conditions of employment for a specific construction project. PLAs are permissible pre-hire agreements under section 8(f) of the National Labor Relations Act (29 U.S.C. 158(f)), which authorizes the use of these agreements between labor organizations and employers engaged primarily in the building and construction industry. These pre-hire agreements help secure the skilled and trained workforce required to complete a high-quality project on schedule. PLAs generally prevent labor-related delays on projects by preventing strikes and lockouts. They establish project wage rates and typically include language related to worksite health and safety. PLAs can also encourage increased veteran participation, apprentice utilization, local hiring, and the employment of women and people from disadvantaged communities.

- **Sectoral workforce development**
A workforce development strategy tailored to regional economies and/or particular industries, or clusters of occupations within those economies, aiming to enhance employment conditions for the mutual benefit of workers and employers.¹²
- **Socioeconomically disadvantaged communities**
Communities that face economic hardship and social challenges due to factors such as low income/persistent poverty, limited access to education and health care, high unemployment rates, inadequate infrastructure, and racial and ethnic segregation.¹³
- **Supply-side investments**
This refers to activities that grow the supply of labor and workers with critical skills. This includes activities such as career awareness-building, recruitment, entry-level training, upskilling, on-the-job training, and supports to assist workers in accessing training or being retained and successful in the jobs.
- **Underrepresented populations**
An underrepresented population refers to a subgroup of the population whose representation is disproportionately low relative to their numbers in the general population. For instance, women were underrepresented in the energy workforce (26%) compared to their representation in the overall workforce (47%) in 2022.¹⁴ Similarly, Black and African American workers in 2022 were underrepresented in the energy workforce (9%) compared to the overall workforce (13%).¹⁵
- **Underserved communities**
Populations sharing a particular characteristic, and/or geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders, and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality.¹⁶
- **Workforce intermediaries**
Organizations or collaboratives that bring together partners in the workforce system to identify workforce needs; plan, develop, and implement strategies to address those needs; and raise funds to support these strategies.¹⁷

Acronyms

- AFL-CIO: American Federation of Labor and Congress of Industrial Organizations
- AIAN: American Indian and Alaska Native
- ARP: apprenticeship readiness program
- BIL: Bipartisan Infrastructure Law
- BIPOC: Black, Indigenous, and people of color
- BWI: Battery Workforce Initiative
- CBA: community benefits agreement

- CBO: community-based organization
- CBP: community benefits plan
- CHIPS: Creating Helpful Incentives to Produce Semiconductors (Act)
- CTE: careers in technical education
- CWA: community workforce agreement
- DAC: disadvantaged community
- DOC: Department of Commerce
- DOE: Department of Energy
- DOEd: Department of Education
- DOI: Department of the Interior
- DOL: Department of Labor
- EJE: Office of Energy Justice and Equity
- EVITP: Electric Vehicle Infrastructure Training Program
- EWAB: Energy Workforce Advisory Board
- FOA: funding opportunity announcement
- GGE: greenhouse gas emissions
- HBCU: historically Black colleges and universities
- ICERES: Institute for Construction Employment Research
- IMT: industrial manufacturing technician
- IRA: Inflation Reduction Act
- MC3: Multi-Craft Core Curriculum
- MSI: minority-serving institution
- NABTU: North America’s Building Trades Unions
- NCTF: National Climate Task Force
- NREL: National Renewable Energy Laboratory
- OEJ: Office of Energy Jobs
- OIE: Office of Indian Education
- OTJ: on the job
- PLA: project labor agreement
- RPS: renewable portfolio standards
- STEM: science, technology, engineering, and mathematics
- TCU: tribal colleges and universities
- USEER: United States Energy and Employment Report
- WIOA: Workforce Innovation and Opportunity Act
- ZEV: zero-emission vehicle

Strategic Recommendations

The Board proposes DOE adopt three high-order strategic recommendations, beginning with a set of fundamental principles drawn from the Board’s combined experience, assessment of workforce development best practices, and discussions with industry stakeholders. Per Congress’s direction for the EWAB to develop a “21st Century” workforce strategy, these recommendations are forward-looking, comprehensive, and envisioned to be considered by the Department for years to come.

This report recommends that DOE undertake a set of strategic actions to meet the workforce needs of the energy sector over the next several decades. While all of the recommendations carry equal importance, there are several the Department should address with haste to build the infrastructure necessary to carry out the overall strategy and to meet critical near-term needs of the sector. These recommendations are designated by a yellow stopwatch icon. The Board advises that DOE focus its efforts to make considerable progress on these near-term recommendations within the 12-month period following the submission of this report.



The following recommendations are the culmination of eight public meetings and the convening of four subcommittees over the course of 10 months.



I. Issue an Agency Directive adopting the following principles for all DOE workforce activities.

I.1. **Begin with analysis that gathers crucial data, including on labor market demand and supply, track record on what the Department is doing, as well as equity and quality in energy jobs.**

Traditional workforce analysis focuses on whether and how many workers have the skills needed to meet market demand. But leading with education and training continues the myth that the workforce “problem” lies in individual skills deficiencies. Such outdated analysis places the burdens of job quality and equity on workers. It is critically important to first understand whether and how energy jobs meet the needs of workers and their communities, especially those who have historically been excluded from good jobs. This involves engagement with both workers/labor unions, education institutions and training providers as well as employers to understand labor market demand and supply. Building a 21st Century energy workforce requires understanding and acting on the systemic and structural drivers of poor job quality, occupational segregation, and demographic underrepresentation, coupled with building an infrastructure of recruitment, work supports, skills development, hiring, and retention that addresses the impacts of current and historic racism, sexism, and discrimination.

I.2. Prioritize broad occupational training for careers, rather than task training for unique jobs.

Infrastructure deployment investments create jobs and thus heighten demand for people to be trained immediately. But whether those training programs support access to short-term jobs or prepare people for careers with security and advancement potential is a policy choice. Efforts to meet short-term demand by training for minimal skills leads to high employee churn, low wages, and weak economic mobility. DOE should drive long-term, career-building workforce development by educating and incentivizing energy employers to invest in long-term employment and career-track training structures. These strategies are more efficient because they leverage existing skills sets and infrastructure by upskilling current workers. They include developing non-proprietary credentials that are broadly recognized and actually adopted by industry, documenting skills through certification, requiring skills through licensing, and addressing the long-term conditions for decent work through labor and job quality standards.

I.3. Break down silos across workforce efforts that focus on specific technologies or tasks.

Instead of funding a project here and a project there, coordinate approaches and resources across energy subsectors or skills clusters. Focus on sector projects that meet workforce needs at scale. Identify sector-wide and agency-wide workforce goals for skills development, inclusion, and job quality. Embed those goals in all DOE-funded and supported workforce projects.

I.4. Leverage, partner with, and boost the capacity of existing workforce and education infrastructure, including union sponsored apprenticeship, pre-apprenticeship, and labor-management partnerships, to impact job quality and equity.

Partner with existing workforce infrastructure—National Labs; TCUs, HBCUs, and other MSIs; more than 1,400 public and private community colleges; over 27,000 registered apprenticeships; the network of pre-apprenticeship programs, the K-12 and adult education systems; labor-management and tribal-union partnerships; high road training partnerships; and the vast network of workforce development boards and their funded service providers. Strengthen their capacity to address challenges of inclusion and job quality in skills development.

I.5. Use every tool in DOE’s toolbox to incentivize employer commitment to direct hiring, retention, and career path strategies.

The traditional “train and hope” approach—that is, providing education and training and sending trainees into the job market hoping they get picked up—doesn’t work. Such strategies ignore the societal and structural issues that impede worker success, placing the onus of overcoming such deeply rooted barriers largely on workers. An effective workforce strategy requires formal and sustained business mechanisms and employer commitment to hiring,

retention, and career development. It works through structures like joint training partnerships and apprenticeships. It includes earn-while-you-learn opportunities, undergraduate and graduate student employment, paid internships, and on-the-job training. It means commitments to recruit and retain local and priority populations, and strategies to upskill journey-level and incumbent workers with documentation of portable skills development. And it requires employer partnership and investment to address social and structural barriers to employment (systemic racism, sexism, and discrimination; lack of child, elder, and family care, transportation, housing, and health care; and many others) that disproportionately impact workers who are already underrepresented in the energy workforce.

I.6. Focus on partnerships over standalone programs.

Siloed programs are inefficient and lead to disconnected, inconsistent results. Strategic workforce development starts with focused, tripartite partnerships—government; labor unions, workers and their communities; and employers. These are the stakeholders who can develop industry consensus, set and document skills standards, and map industry needs. Most important, these are the stakeholders who understand workforce and community needs, the barriers workers face, and job quality imperatives. Strategic partnerships with workers, employers, and communities equally represented build workforce infrastructure that is accountable to workers, employers, and communities. This looks like DOE incentivizing or encouraging strategic partnerships across stakeholders in its workforce development funding and deployment investments. In some cases, this may require different flexibilities to be given to DOE by Congress in relation to what programs can focus on.

I.7. Drive employer commitment to and investment in job quality and equity.

A workforce requires not simply education and training, but, more importantly, jobs worth having. Often overlooked in workforce strategy is the employer responsibility for and commitment to the long-term conditions for decent work. By connecting job quality and equity incentives to public funding, DOE drives employer investment in high-quality, inclusive workforce infrastructure that outlasts any single project or deployment. DOE also has a powerful influence on the trajectory of the energy sector and the actions of key energy employers. DOE can convene and partner with best-in-class employers to influence the sector's commitment to long-term, high-quality energy careers for all workers. This also looks like embedding the importance of employers' commitment to job quality in all of DOE's engagement with employers and investments.

I.8. Choose meaningful metrics—then measure early, evaluate often, and make timely adjustments to meet mission-critical goals.

Define what success looks like and determine how to measure it. Establishing outcome goals and embedding assessment mechanisms early in program design sets the stage for timely evaluation and adaptability. Setting and monitoring clear, standardized metrics is especially important to meet new and challenging goals like improving inclusion and job quality. Include measures of equitable pay that exceeds the local average wage for an industry;

essential benefits (e.g., paid leave, health insurance, retirement/savings plan, access to affordable, reliable, and high-quality child, family, and elder care, and transportation); opportunity for workers' collective voice; career-focused skills and experience development; predictable scheduling; a safe, healthy, and accessible workplace devoid of hostility and harassment; proper employment classification along with limited use of independent contractors and temporary workers; and a free and fair choice to join a union under the National Labor Relations Act (NLRA).

The implementation of the recommendations and strategies in the rest of this report should align with these core principles.


II. Institutionalize and bolster the Department's coordination of critical workforce activities internally and across federal agencies.



II.1. Recommendation: Establish the Office of Energy Jobs as a standalone office and clarify that it is charged with leadership and coordination of DOE's cohesive workforce strategy.

- i. Move the Office of Energy Jobs (OEJ) outside the Office of Policy so that it is a standalone office and clarify that its role is in leading and coordinating DOE's cohesive workforce strategy across the Department (i.e., goes beyond policy advising to include deployment of funded workforce programs). This is aimed at creating an office where workforce efforts geared towards occupations that do not require advanced degrees for implementation and deployment are overseen through a centralized, coordinated office.
- ii. Do an assessment of how much funding and staffing this office would need to implement recommendations in this report, and request that amount from Congress. The mission of this office would need significant funding to support workforce programming aimed at the vast majority of occupations needed for deployment—those related to constructing, maintaining, repairing, and manufacturing critical infrastructure. It would also need a larger staff of individuals with expertise in effective workforce development to execute these recommendations. OEJ would not necessarily execute everything in this report but would play a coordinating/influencing role across the Department, and for this there would need to be more staff to coordinate and support these recommendations.
- iii. Identify best practices for recruitment and qualifications of workforce development and labor staff when filling positions across the agency, informed by the principles outlined in Section I above. Establish an expectation that program offices engage experts in OEJ in relevant hiring decisions.

II.2. Recommendation: Lead and expand collaboration with other federal agencies implementing workforce development for critical energy sector occupations.

- i. Partner with the Departments of Education and Labor to leverage supply-side workforce development systems and relationships to support energy workforce development and education. For example, all supply-side workforce development funding opportunities that are relevant to energy occupations should be uplifted in a navigable website, rather than only listing the funding opportunities on the respective websites of each agency.
- ii. Partner with the Departments of Commerce and Transportation and the Environmental Protection Agency to leverage demand-side investments and relationships to support energy workforce development and education. In particular, DOE should coordinate more closely with CHIPS-supported projects, given the overlapping skills requirements for occupations related to semi-conductors, solar modules, and batteries. Additionally, the other infrastructure agencies' investments require many of the same workers, so more coordination to understand gaps and strategies to fill them is essential. A long-term goal could be aligning funding opportunities across these agencies to support shared workforce needs.
- iii. Foster intentional connections between demand-side investments at DOE and supply-side workforce investments across the federal government. For example, encourage energy employers to partner with DOL's workforce grantees that support **underrepresented populations** and **disadvantaged communities**, such as Women in Apprenticeship and Nontraditional Occupations (WANTO), Job Corps, YouthBuild, and Pathway Home grantees. This looks like putting incentives into competitive FOAs to encourage applicants to make partnerships and engage with these supply-side investments.
-  iv. Partner with the Department of the Interior, as well as the Departments of Labor, Education, and Health and Human Services, and other agencies to provide resources and technical assistance to accelerate tribal governments' pooling or braiding of funding across agencies to support cohesive workforce development planning and interventions.



II.3. Recommendation: Make information on how DOE funding can be used for workforce development more usable and accessible.

- i. Clarify, uplift, and streamline information on allowable uses of DOE's funds for workforce development. Do this while concurrently developing a website that includes relevant supply-side workforce development funding opportunities across the federal agencies, described above.
- ii. Leverage the community benefits plan framework to render it more impactful in fostering workforce development partnerships and employer investment in workforce development. Specifically, collect information on employers interested in applying to DOE competitive deployment projects and make this information publicly accessible and navigable during the period that employers are developing CBPs. (Include contact information and fundamental workforce demand data around projects.) Once projects are selected (and before awards are made), make proposed CBPs public and navigable. When final awards are made, make final

CBPs public and navigable. These steps allow workforce and education stakeholders to know which energy companies to contact, when there is an opportunity to collaborate in recruiting, training and supporting the workforce for the project, and who is a point of contact within the company.

III. To support DOE's industrial strategy to revitalize the U.S. energy and manufacturing sectors, integrate six interdependent strategies into DOE's work to increase cohesion, effectiveness, and planning for the future.

Strategy III.1. Compile and maintain the data required to project workforce needs and prioritize investment in the energy workforce.

III.1.A. Recommendation: Prioritize data that informs a cohesive, effective energy workforce strategy for the Department.



- i. Request a continuous source of funding for the Energy Workforce Needs Assessment, a projection-focused companion report to the United States Energy and Employment Report (USEER). Establish a regular cadence for updating and publishing the Energy Workforce Needs Assessment, perhaps every two years. This report should assess and project occupational demand by geography and timeline, assess gaps in effective workforce training infrastructure relative to strategic occupational growth, and map transition-related dislocation, among other objectives. Consider making the underlying data public and usable for external researcher purposes.
- ii. Add analysis on critical topics to the annual USEER, which likely requires conducting an additional survey. Include measures of quality, education and credential requirements of energy jobs, occupational segregation, and demographic disparities across key occupations. Assess the jobs impacts on energy communities and **dislocated workers** affected by the clean energy transition.



- iii. Assess the existing workforce development capacities, research, and activities across all the National Labs as they relate to the energy workforce. Develop a concerted strategy for how the Department utilizes the Labs to support workforce development for the energy sector.
- iv. To identify future critical gaps and opportunities for DOE's workforce strategy, request funding for OEJ (at a minimum of \$8 million to start) to lead analysis on additional critical topics, including:
 - o The impact of new energy technologies on the workforce (e.g., change in skills requirements related to cybersecurity developments);
 - o Barriers to the energy workforce (e.g., assessing the barriers facing workers with criminal legal system involvement, workers with disabilities, and women); and

- Career pathways that are meaningful and opportunities to construct new pathways (e.g., opportunities for weatherization work that lead to careers; opportunities for advancement in manufacturing);
 - Workforce analyses that provide meaningful direction on workforce needs and the implications of labor standards in policy areas related to DOE's liftoff reports.
- v. Use the data to prioritize critical needs and inform the Department's resource allocation.

Discussion and rationale

The projected explosion in demand for energy sector workers over the next decade calls for a 21st Century energy workforce strategy that can meet the growing need. It also calls for better research to understand the current and future energy workforce, quantify and project demand occupations, and measure the quality of jobs in the sector.

The Department's USEER provides a baseline of information about the current energy workforce and identifies changes over time in occupational mix, demographics, and selected elements of job quality (such as union representation and coverage by CBA or PLA), disaggregated by technology, industry, and to some degree occupation. It documents trends in energy employment and captures employer perspectives on employment projections and hiring difficulty.¹⁸ A companion report provides state-level data.¹⁹

A comprehensive set of job projections and related skills development needs for energy occupations does not yet exist, but a variety of existing DOE resources can help target key occupations, identify gaps, and inform resource allocation. The Department of Labor, academic and industry sources, and independent research entities can also shed light on the scope and scale of future energy workforce demand.²⁰

DOE can engage and fund experts from public and private colleges and universities, including TCUs, HBCUs, and other MSIs; the National Labs; and independent research institutions to explore the impact of new energy technologies, assess and project occupational demand by geography and timeline, document job quality, concretize career pathways, assess gaps in training infrastructure, and identify skills overlaps where demand is being driven by federal investment.

Strategy III.2. Continue, and in some cases, expand DOE's investment in training engineers and scientists.

III.2.A. Recommendation: Build on DOE's and the National Labs' leadership in STEM education.

- i. Continue funding (at approximately the same relative levels) training for undergraduate and graduate students through the National Labs and university-based centers, including TCUs, HBCUs, and other MSIs.
- ii. Continue funding for DOE collaboration with faculty on curricula development in key science and engineering disciplines, and expand for emerging fields in the energy transition.

- iii. Define success and measure the impact of these investments, especially for students from **underrepresented and socioeconomically disadvantaged populations**. This should entail, at a minimum, as related to these populations, outreach efforts, completion of training, receipt of certifications, and obtaining and maintaining employment in a good-quality related job.
- iv. Improve usability to maximize the DOE STEM website's function as the agency's online hub for STEM education resources.

III.2.B. Recommendation: Maximize the role played by community and technical colleges, TCUs, HBCUs, and MSIs in developing a diverse pipeline of engineers and scientists.



- i. Facilitate connections between community and technical colleges, TCUs, HBCUs, and MSIs with emerging energy employers, sector initiatives, and DOE workforce resources. Consider funding R&D collaboration/partnerships involving MSIs with leading R1 institutions in various research fields.
- ii. Facilitate a pilot project to connect participants in entry-level energy technical training programs (i.e., weatherization) to associate degree programs or registered apprenticeship programs in science and engineering, with the aim of creating meaningful career pathways. Note: this requires implementation funding.



- iii. Explore/pilot an initiative to bolster access to critical energy-related engineering careers through registered apprenticeship. For example, such a program could create a pathway for graduates of two-year postsecondary engineering-related programs to enter into earn-while-learn programs that also earn credit towards four-year degrees.
- iv. Set stretch targets for the inclusion of TCU/HBCU/MSIs hosting DOE programs and/or create a task force/advisory committee on how to build more relationships with these institutions, the strategies for which are likely to vary by institutional type.

III.2.C. Recommendation: Expand DOE STEM K-12 programs and partnerships, especially in disadvantaged communities.



- i. Assess DOE and National Labs' elementary, secondary, and CTE STEM outreach efforts to K-12 educators, counselors, students, and parents. Do this broadly but with special attention paid to schools in **disadvantaged communities**. Deepen investment, where gaps exist. (Include this in the survey of National Labs.)
- ii. Work with stakeholders (e.g., Department of Education, educators, counselors, parents, students, state education agencies, and CTE directors) to expand the use of career and technical education programming in K-12 settings with connections to employers, geared towards high-need, in-demand energy subsectors. There is especially an opportunity to fund pre-apprenticeship programming with direct articulation and advanced placement to registered apprenticeship programs.

Discussion and rationale

The evolving energy system will require more scientists, engineers, and researchers. Both DOE’s historic approach to supporting the training of engineers and scientists and an expansion of efforts to promote diversity, equity, and inclusion of this workforce will be vital to transforming and modernizing the 21st Century energy system.

The Department can bolster its STEM workforce development programming and activities related to outreach and targeted investment to improve access to degreed, salaried, and/or managerial energy jobs by **underrepresented populations**.²¹ DOE can also leverage the contributions of community and technical colleges, TCUs, HBCUs, and other MSIs in building a diverse workforce with advanced skills. More than 400 community colleges, for example, now offer engineering degrees at the Associate of Science level. Community and technical colleges, TCUs, HBCUs, and other MSIs have a broad geographic footprint and serve more demographically diverse populations than many four-year institutions.

Strategy III.3. Strengthen and expand a cohesive, sector-focused skills development infrastructure with direct connection to critical trade, technical, and operations jobs.

III.3.A. Recommendation: Build new sector initiatives, support existing sector partnerships, and build up the capacities of stakeholders and workforce intermediaries to execute these strategies.



- i. Build the capacity of unions, employers, workforce intermediaries, and internal DOE staff to effectively engage in sector initiatives with technical assistance, training, and staff development. Develop a roadmap for how to make this happen.



- ii. Establish a set of job quality, inclusion, and effectiveness guidelines for all DOE-sponsored or funded sector initiatives, e.g., initiatives will document a long-term plan for job quality in the targeted sector or occupations.
- iii. Identify and prioritize an initial set of four to five energy subsectors or technical and operations occupations with projected rapid growth, e.g., cybersecurity, advanced nuclear, energy storage, hydrogen, etc. Convene labor and employers in each of the targeted subsectors to seed the development of new sector partnerships modeled after—and improving on—the Battery Workforce Initiative.
 1. Within DOE, build the capacity of the OEJ to kick-start sectoral workforce strategies in high-priority subsectors or industries, where no other entity would otherwise drive the development of a cohesive workforce strategy.
 2. Invest in a variety of external workforce intermediaries to 1) carry out sectoral workforce initiatives started or facilitated by DOE and to 2) connect workers (especially from **underrepresented and disadvantaged populations**) to training and careers and provide support services for workers in a sector or region. (This could include the National Labs, labor-management partnerships, or nonprofit

workforce organizations. Regardless of institution type, investing in workforce intermediaries to do one or both of these functions requires a serious assessment of the institution’s capacity to carry out DOE’s workforce principles, convene key worker and employer organizations, and hold partners accountable to job quality and inclusion priorities.)

- iv. Following the initial cohort, fund ongoing support for DOE-initiated sector strategies, bringing together industry partners, labor, CBOs, TCUs, HBCUs, and other MSIs, and community colleges to develop and maintain comprehensive, sustained training infrastructure and curricula for emerging key technologies.



- v. Fund curriculum development, instructor development, and training equipment for existing sector-based partnerships targeted toward energy-critical industries and new technologies. Assess gaps in effectiveness of these partnerships and provide support, where needed. As a near-term action, document and assess this work as part of BWI and make adjustments accordingly to the plans of future initiatives.

- vi. Prioritize programs that are aligned with career pathways. Fund the development of stackable and portable credentials that are widely recognized and adopted industry-wide. Ensure sector initiatives do not just look to develop industry recognized credentials and document skills needs, but also foster activities that scale best practices to recruit, train and retain **underrepresented and disadvantaged populations**. Start with building this into the Battery Workforce Initiative.

III.3.B. Recommendation: Deepen investment in registered apprenticeship.



- i. Partner with DOL to fund activities to maximize use of registered apprenticeship in skilled construction trades, advanced manufacturing, and other critical and developing energy occupations. This includes funding activities to assist employers and workforce intermediaries in establishing or growing registered apprenticeship programs, and critically to significantly improve access to information for workers, especially those from historically marginalized backgrounds or with low historic participation in related RAPS, on how they can connect to registered apprenticeship programs. This likely requires Congressional action to increase flexibility in authority to use funds across agencies and greater DOE input into resource allocations related to RAPS in critical energy occupations.



- ii. Request funding to pilot an initiative in partnership with DOL to provide funding for curriculum upgrades, train the trainer initiatives, and equipment in key trades for market forward technologies that are still risky for apprenticeship programs to fund themselves.
- iii. Encourage entry points to energy careers but always prioritize entry points that have a structure in place to help people connect to or continue in a broader career. For example, build on existing programs that fund training for solar installation to instead fund training for broader energy careers, e.g., electricians. Or fund training for HVAC, glazing, and other construction trades careers, rather than funding activities to train people just for weatherization jobs which often lack connections to long-term quality employment. Likewise,

promote add-on certifications for existing occupations (e.g., EVITP) rather than training for near-term task needs (e.g., short-term training for jobs in electric vehicle infrastructure installation). In many cases, this requires authority from Congress to alter what existing workforce funding streams can be used for.



- iv. Strongly incentivize the use of CBAs or PLAs that include registered apprenticeship requirements in DOE funding opportunities and procurement, to the extent allowable under the appropriate funding authority and with exceptions where this would be difficult to do (i.e., Tribal Reservations). Encourage embedding inclusive goals, commitments, and activities in these project-specific workforce agreements.

Discussion and rationale

Growing the skilled and technical workforce required by the energy transition calls for a level of attention and investment that matches DOE’s historic investment in degreed science and technology occupations.

In the U.S., 56% of the labor force age 25 and older do not have a college degree, and 20% of those workers have a high school diploma or less.²² Of the 19 million total jobs projected under BIL, CHIPS, and IRA (which includes not just jobs in energy but is unfortunately the most relevant source of data currently), about 70% are craft or technical occupations that do not currently require a degree.²³ These jobs are mostly construction, manufacturing and production, operations, and maintenance occupations.²⁴ Some are skilled trades that have pathways through the apprenticeship system, while others are in technical occupations that do not currently have an apprenticeship program.

Non-apprenticed occupations

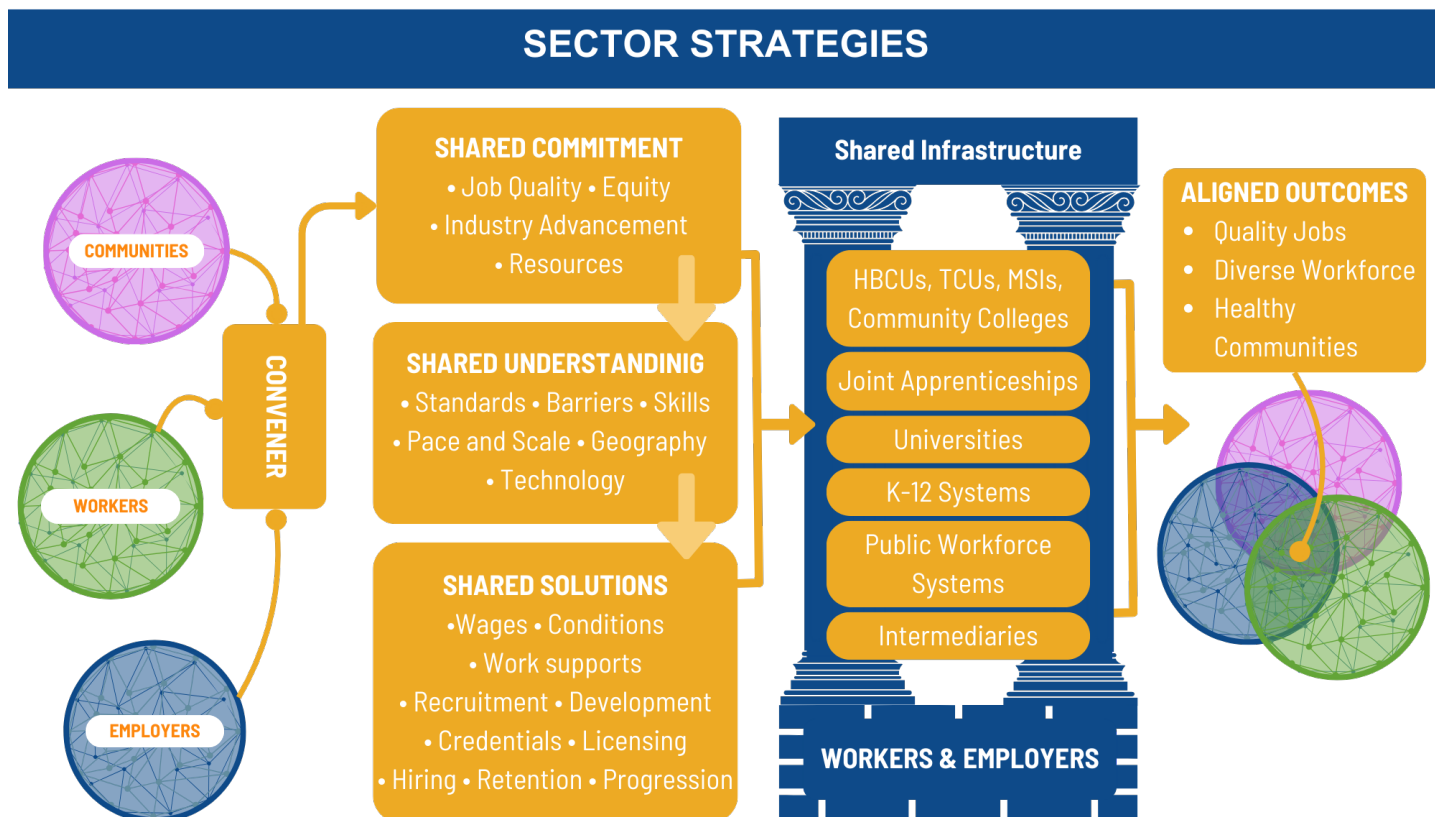
For non-apprenticed occupations, sector strategies are key to developing scalable training infrastructure that meets demand-side and supply-side needs and can adapt to changing technology. As with apprenticeships, workforce development works best for workers and employers when training is carefully calibrated and directly connected to real-world demand for workers, is customized to specific industry and worker needs, and connects trainees to high-quality jobs.²⁵

Today, many other jobs critical to the 21st Century energy system that do not require a bachelor’s degree lack a comprehensive training infrastructure that meets these parameters. Energy workers in these fields don’t have access to non-proprietary, stackable credentials that document their skills. Instead, they rely on employer-specific, on-the-job training that is not documented and does not transfer across employers.²⁶ This makes employment “sticky,” limiting workers’ ability to change employers to obtain higher wages, better working conditions, or build long-term career paths. In other cases, external training programs offer credentials that are nominally accepted but not required by industry. In these cases, workers invest time, talent, and resources in obtaining credentials that don’t actually connect to hiring and wage progression mechanisms for career-track, family-supporting jobs.

Sector-based interventions address these deficiencies, convening key industry actors to design and implement comprehensive, industry-wide training infrastructure at scale for critical occupations. At their best, sector workforce development strategies focus on specific industries or occupations; they engage both the demand side (employers) and supply side (workers) of the sector to understand the needs of each; they have a clear

connection to high-quality, target jobs in the sector; and they build structural capacity (infrastructure) to maintain employer and worker engagement in program design and implementation. They leverage private funding and coordinate with public workforce and education resources, and pivot to adapt to change (new technology, economic shocks, and evolving worker needs). And they have the capacity to engage employers on job quality (when the jobs are not good quality) and prioritize inclusive outcomes.

Fig. 1



Rather than making scattered investments in disconnected, “one-off” programs, DOE can leverage its relationships and convening power to catalyze efficient, sustained, sector infrastructure that can address both the pace and magnitude of the energy transition. The nascent Battery Workforce Initiative is a model example of a sector strategy coordinated by DOE in collaboration with the Department of Labor, the AFL-CIO Working for America Institute, and other organizations “to speed up the development of high-quality training, starting with existing examples to develop consensus on core training needs, and then develop training for use by companies and local training providers.”²⁷

Apprenticed occupations

Registered apprenticeship programs are the gold standard in training, ensuring a supply of highly skilled and adaptable workers for employers through debt-free, often multi-year programs that create family-supporting

careers, attainable by workers without a college degree. The critical best practice characteristics of apprenticeship include:

- Joint employer and labor development of training curricula customized to industry needs;
- Articulation agreements with target pre-apprenticeship programs that include direct or preferred hire of graduates of the pre-apprenticeship program;
- Industry-recognized credentials (in the form of a journey card);
- Certification by the federal DOL and/or state labor agencies;
- Industry funding of training;
- Calibration of the number of apprentices to the number of jobs;
- Progressive wages tied to skills acquisition;
- Combined on-the-job training and classroom learning (often provided by local community colleges); and
- Continuous learning opportunities through journey upgrade programs.

Apprenticeship programs are most common in the construction trades, but they are also present in advanced manufacturing, where they will play an increasingly important role in training workers. Since 2021, more than 59,000 apprentices have participated in 2,900 registered apprenticeship programs in advanced manufacturing occupations.²⁸

Apprenticeship training for occupations such as Industrial Manufacturing Technician (IMT)²⁹ offers a training model that is responsive to industry and may be implemented by partnerships that can include business associations, community and technical colleges, joint employer-union programs, state apprenticeship offices, and workforce intermediaries. For example, the Manufacturers Association of South Central Pennsylvania offers the IMT to 11 manufacturing employers.³⁰ In Lancaster, California, the BYD electric bus manufacturing company facility (with some 750 unionized workers) collaborated with SMART union Local 105, the California Labor Federation, Jobs to Move America, and Antelope Valley College to jointly design and offer an IMT apprenticeship program that has enrolled 144 frontline workers in five cohorts.³¹

Strategy III.4. Break down barriers and build on-ramps to high-quality energy jobs, especially for disadvantaged communities, underrepresented populations, displaced and unemployed energy workers, veterans, and youth.

III.4.A. Recommendation: Continue and amplify DOE investment across STEM programs in education institutions serving disadvantaged and underrepresented populations.

- i. See recommendations III.2.
- ii. Increase targeted investment in STEM curriculum and advanced technology in HBCUs, TCUs, and MSIs.

- iii. Request increased funding and conduct targeted outreach for well-paid graduate and post-graduate training research positions for **disadvantaged communities and underrepresented populations**.
- iv. Convene stakeholders—graduate students from **underrepresented populations**, HBCUs, TCUs, MSIs, energy employers, and community resource organizations—to develop a plan to increase paid internships with clear career pathways and to increase student and early career access to mentorship and communities of interest.

III.4.B. Recommendation: Partner with the Department of Labor to increase investment in proven on-ramps to quality apprenticeship for disadvantaged communities and underrepresented populations, and support retention and completion efforts in registered apprenticeship.



- i. Request or direct funding where allowable to establish and scale high-quality pre-apprenticeship programs with articulation agreements for preferred or direct entry into high-quality registered apprenticeships.



- ii. Go further to leverage CBPs to encourage employer investment in work supports for workers in training, including pre-apprentice participants and apprentices, with special emphasis on child, family, and elder care. Do this by making applications with these commitments more competitive and, as a near-term step, make it clear to applicants how project funds can be used to support these activities.

- iii. Map apprenticeship readiness program (ARPs) and energy-critical joint apprenticeship programs in **disadvantaged communities**; identify gaps and target investment to increase access and capacity.



- iv. Increase technical assistance to connect DOE FOA applicants involving projects with large-scale construction work to pre-apprenticeship and apprenticeship programs in **disadvantaged communities** to facilitate connection to high-quality jobs and development of meaningful CBPs. This could be done by augmenting funding for the Community Workforce Readiness Accelerator for Major Projects (RAMP) initiative to facilitate these connections.



- v. Invest in apprentice mentorship programs and wrap-around services, including flexible caregiving supports, to improve retention among **underrepresented populations**. Similar to above, this could be accomplished by providing implementation funding to RAMP locations to support the programs their workforce collaboratives deem vital to accomplish their goals.




- vi. Leverage the American Climate Corps and Job Corps infrastructure to create more on-ramps to critical clean energy careers for young people. Embed more relevant workforce training and service programs that DOE supports into the ACC so that participating young people can better access those programs. Map more widely opportunities that DOE does not fund, such as the above mapping of pre-apprenticeship and registered apprenticeship programs. Create



more training and service opportunities for ACC members, e.g., as a near-term action, fund relevant service opportunities through AmeriCorps.

- vii. Allocate sufficient funding to provide technical assistance support to workforce intermediaries and employers so they can increase their capacity for recruiting and hiring workers with disabilities into energy-focused inclusive apprenticeships. Such technical assistance would include but is not limited to providing reasonable accommodations, using inclusive hiring practices, planning for accessible information and communication technology, and establishing accountability and continuous improvement mechanisms.

III.4.C. Recommendation: Increase DOE technical assistance to support effective, inclusive place-based workforce strategies.

- i. Increase technical assistance to match pre-apprenticeship, apprenticeship, sector, and high road workforce partnerships with FOA applicants to facilitate development of PLAs and CBAs.
- ii. Provide funding for expert organizations with track records of success to deliver technical assistance to tribes, community-based organizations, and environmental justice organizations to help them engage in the development and enforcement of quality CBAs.
-  iii. Provide technical assistance and deploy place-based activities to improve adoption of project-specific workforce agreements with provisions aimed at inclusive workforce development. For example, these activities should aim to bolster goals, commitments, and partnerships into project-specific workforce agreements (e.g., PLAs, CBAs) related to recruitment, training, and retention of **underrepresented populations** and **disadvantaged populations**.

III.4.D. Recommendation: Strengthen incentives or requirements for energy employers receiving DOE funds on large-scale deployment projects to invest in inclusive, effective workforce development practices.

-  i. Make public the workforce commitments connected to DOE deployment investments, including commitments to job quality; inclusive recruitment and hiring; neutrality agreements; child, family, and elder care and other work supports; and other workforce strategies. If legal reasons prevent this, establish a plan going forward for how the Department can have the ability to disclose those commitments in future rounds of funding.
-  ii. Identify critical strategies that should be required when encouragement through CBPs has proven insufficient. Start by looking at strategies that were not meaningfully adopted into CBPs when encouragement alone was found to be insufficient and where it makes sense to do so (i.e., workforce development and formula funds should not have the same encouragements in a CBP as large-scale deployment projects seeking funding through competitive programs). Then, look at legal authorities to more strongly incentivize adoption in competitive projects.

Most notably and as an example, this would likely include switching to a requirement that projects provide flexible, high-quality child care as well as family and elder care supports for workers when applications seek a certain investment amount.

III.4.E. Recommendation: Target resources to workers and communities impacted by and vulnerable to dislocation as a result of the energy transition.



- i. Participate in the Interagency Working Group on Coal and Power Plant Communities to identify and lead strategies to mitigate the impact of job loss, accelerate re-employment for **dislocated workers** in the energy transition, and target transition efforts to communities impacted by dislocation in the sector. In order to support transition pathways and identify additional opportunities for workers and community representatives impacted and projected to be impacted by job loss to participate in DOE projects, identify and coordinate workforce transition opportunities with the Office of the Undersecretary for Infrastructure (S3) and other DOE offices that have flexible funding and are driving deployment investments in the clean energy transition.



- ii. With regard to anticipated or announced coal plant retirements, develop a strategy to support re-employment and industrial planning; engage workers and their unions early around planned retirements.



- iii. Continue the work of the IWG on Coal and Power Plant Communities and Economic Revitalization to identify subsectors and specific communities vulnerable to dislocation as far in advance as possible. Develop a Departmental plan, including the funding needs, to support planning around transitioning fossil energy workers.

- iv. Support the IWG on Coal and Power Plant Communities and Economic Revitalization by funding a set of pilot projects to convene community partnerships in transition-vulnerable communities around workforce planning. Provide technical assistance to ensure robust worker, community, public sector, and employer participation. Document the work of these partnerships to develop guidance on best practices for early action transition plans that address impacts on workers and communities, impacts on local/regional tax bases, and impacts on downstream employers, and that connect these communities to clean energy employers and investment opportunities.
- v. Instead of focusing solely on rapid response workforce interventions, which occur after dislocation is announced, work with DOL to develop and fund an early-action transition planning program, with robust supports for workers like those provided under Trade Adjustment Assistance. An early action program driven by worker, employer, and community organizations can incorporate best practices from rapid response (peer counseling, career mentorship, co-location of services, etc.) and services like those offered to displaced workers eligible for Trade Adjustment Assistance. It can also address long-term economic development and planning that benefits communities, historic inequity and occupational segregation, and transition-related stresses on public services and resources.

- vi. Partner with DOL to develop a resource documenting transferable skills of workers/ occupations in declining energy sectors. Convene worker representatives, employer representatives, and other subject matter experts to inform the work. Crosswalk transferrable skills with those required in growing energy subsectors. Identify gaps and upskilling opportunities, including information on the time and resource investment required for workers to transition across subsectors.
- vii. Increase investment in communities impacted by the energy transition whenever possible.
 1. Deploy clean energy projects in impacted communities.
 2. Expand and an enhance programs like the Title 17 Clean Energy Financing Program to “finance projects that retool, repower, repurpose, or replace energy infrastructure that has ceased operations or enable operating energy infrastructure to avoid, reduce, utilize or sequester air pollutants or greenhouse gas emissions.”³²

Discussion and rationale

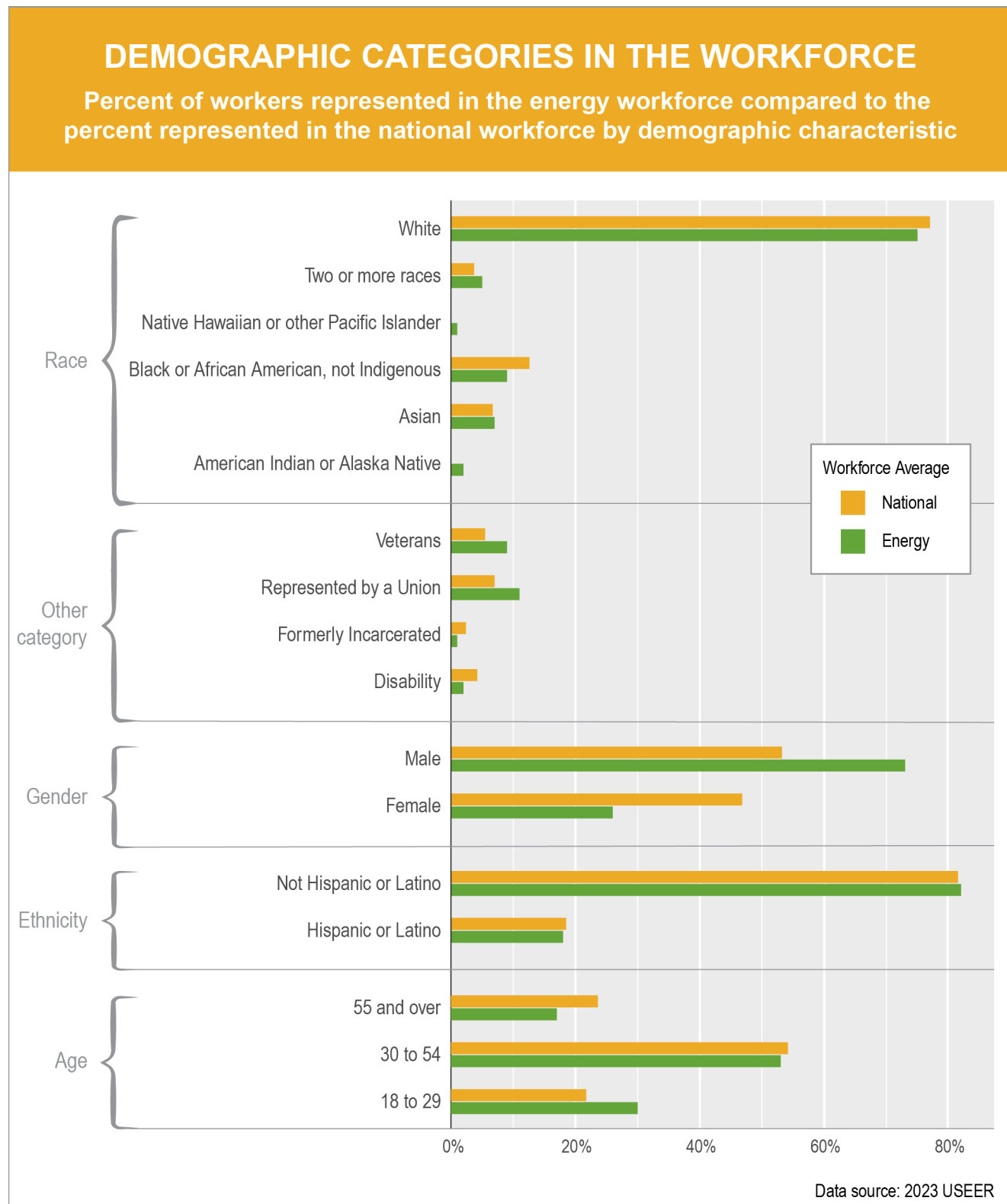
The Department’s 2023 USEER paints a demographic portrait of the current energy workforce that reveals a number of disparities. Women are significantly underrepresented, comprising just 26% of U.S. energy workers, despite making up 47% of the workforce. Women made notable gains in the post-Covid recovery, increasing their employment in energy by 7.8% and accounting for half of all new energy jobs added in 2022.³³ The bulk of the increase was in electric power generation jobs, due to women’s overall increase in labor force participation during the period, industry shifts from male-dominated coal generation, and the expansion of occupational categories where women are somewhat better represented (professional and business services employment in the electric power generation industry and utilities). Even in electric power generation, however, women still make up less than a third of the workforce.³⁴ Women, thus, represent a significant untapped pool of new energy workers.

Representation of people of color in the sector is better than that of women. Twenty-eight percent of the energy workforce is made up of workers that are not white, compared to 23% of the national workforce. But representation of Black, Hispanic or Latino, American Indian, and Alaska Native workers varies across industries and occupations, leaving significant room for improvement in many areas. Black workers are underrepresented across all energy segments and make up just 9% of the overall energy workforce, compared to 13% of the total workforce.³⁵

Hispanic or Latino workers’ representation in energy (18%) is near the population’s representation across all sectors (19%), and Asian workers’ representation in energy jobs is consistent with the total workforce at 7%. American Indian and Alaska Native (AIAN) workers make up 2% of the energy workforce compared to less than 1% of the total U.S. workforce.

Disabled workers and formerly incarcerated workers are both underrepresented in the current energy workforce. Two percent of energy sector workers requested accommodation for a disability, compared to 5% of workers in the total workforce. One percent of the energy workforce is formerly incarcerated, compared with 2% of the total U.S. workforce.

Fig. 2



Veterans make up 9% of workers in the energy field, compared to 5% of the total workforce, with 10% representation in the motor vehicles and fuels subsectors. The current energy workforce skews younger than the total workforce. Workers under 30 make up 29% of the energy workforce; 82% are age 55 or younger.

(See Figure 2 above for a visual comparison of energy workers by demographic relative to their participation in the total workforce.)

Looking forward, demographic changes across the total population will have a powerful effect on the workforce, with one-fifth of Americans reaching age 65 by 2030, overall population growth slowing, and Hispanic, Black, Asian, multiracial, and racial groups other than white projected to make up more than 50% of the U.S. population by 2050.³⁶

As employers look for workers to power the energy transition, it will be crucial to attract and retain women, BIPOC workers, veterans, workers with disabilities, **dislocated workers**, young workers, and workers coming out of incarceration. It will only happen, however, with understanding of and action on the barriers that currently limit employment for **underrepresented populations**.

Barriers to employment, education, and training in energy careers begin long before the point of hire. Historic racism, gender discrimination, ableism, trauma, and the resulting disparities in wealth, health, education, justice, environmental burden, and infrastructure investment have an immense impact on occupational outcomes. Here is a sample that workers may face:

- **Educational barriers**

The locations of academic institutions, their cost, the opportunity cost of lost wages, opaque financing systems, family debt, English-only (or limited language) curricula, limited educational resources in urban centers and rural communities, learning modalities that exclude some students, and lack of resources for TCUs, HBCUs, and other MSIs can all limit access to education.

- **Workplace barriers**

Structural barriers at work include schedules (early, late, and irregular shifts) that preclude family obligations, location and inaccessibility of worksites, remote and itinerant work, gear and tools that may not fit women or workers with disabilities, not enough employer-based training and upskilling, and the absence of appropriate bathrooms and changing facilities and/or inaccessible facilities and equipment.

- **Infrastructure barriers**

Inadequate housing, transportation, broadband access, health care, and food insecurity may be obstacles to employment in energy careers.

- **Child care and other forms of caregiving**

Child, family, and elder care have emerged as critical barriers to employment. Disproportionate responsibility for family care, and an insufficient supply of affordable, accessible, high-quality care, keep women out of the workforce or limit their ability to pursue a wide range of employment opportunities.³⁷ Given the shift structure and location of energy sector jobs in construction, manufacturing, and operations, as well as the low pay for early career researchers, scientists, and developers, it is critical to address child, family, and elder care in order to attracting and retaining the new energy workforce.

- **Information barriers**

Many workers don't know about pathways to energy employment. They may be unaware of the necessary preparation for STEM professions, pre-apprenticeship and apprenticeship opportunities, and avenues for employment in energy industries.

- **Poor-job quality**

Energy employers must compete for talent with other growth industries across job quality measures. In some instances, low-job quality and lack of resources and conditions supporting decent, family-sustaining work inhibit recruitment and retention.

These barriers compound the underrepresentation of women, young workers, and workers from **disadvantaged communities** who have been historically excluded from access to good jobs. (See Job Quality Strategies III.5, below.)

DOE is well positioned to address these barriers through its grants and contracts, supported programs, and partnerships, and through its influence on energy sector employers. As the energy sector competes with other growth industries to harness the talent of the 21st Century workforce, it will be important to increase the quality and visibility of energy jobs and overcome barriers to entry. It is important to note that most of the strategies here apply to both clean energy and traditional energy subsectors, including coal, oil, and gas, as well as mining.

Interventions

Several model interventions demonstrate paths to overcome structural barriers.

To address common barriers to employment, CBAs and CWAs are important—and currently underutilized—tools to improve the availability of work supports for workers and people in training programs closely tied to DOE-funded projects. Remediation of structural and infrastructure barriers requires a system of work supports targeted to identify and fill gaps in ways that meet community, industry, and occupation-specific needs. Common work supports provide new entrants (and sometimes incumbent workers) access to resources like child, family, and elder care; transportation; housing assistance; and books, tools, and equipment. In just one example, attaching child care subsidies to apprenticeship training increased the likelihood that registered apprentices completed their training—completion rates for women and people of color increased by 21%, while completion rates for white men increased by 37%.³⁸

Targeting pre-apprenticeship programs with direct or preferential entry into registered apprenticeship programs to **underserved populations** can build on-ramps to apprenticeships in energy-related fields. In a report commissioned by North America's Building Trades Unions (NABTU), the Institute for Construction Employment Research (ICERES) found that union-affiliated pre-apprenticeship programs like those using the Multi-Craft Core Curriculum (MC3) have a strong track record of improving inclusion of **underrepresented populations** in construction apprenticeship.³⁹ The best programs incorporate multiple strategies such as mentorship, wrap-around services, post-placement follow-up services, and articulation agreements with apprenticeship programs for preferred-hire or direct-hire.⁴⁰

As apprenticeship expands, it will be important to ensure that programs are high quality, address barriers in recruitment and retention, and connect apprentices to work-adjacent wrap-around services.⁴¹ Although the

DOL observed a 73% expansion in the number of apprenticeship programs between 2009 and 2021, the completion rate was less than 35%. Completion rates are higher where apprenticeships are well-established and co-driven by workers, as in the union construction sector. The ICERES reports a 41% overall completion rate for construction registered apprenticeship: 44% of apprentices complete joint labor-management programs compared to just 33% in employer-only programs.⁴² Looking at 21 years of apprenticeship data in the construction industry, ICERES found that joint programs delivered improved completion rates for all worker groups. Women benefited more than men, with 10.4% better completion rates for women in joint programs compared to employer-only programs, but just 8.6% better for men.

Where registered apprenticeship is not available, sector strategies—and their cousins high road partnerships—are important mechanisms to address barriers to employment. Like STEM education, pre-apprenticeship, and apprenticeship, sector initiatives and high road partnerships are well positioned to break down barriers for **underrepresented populations** when they have effective preparatory on-ramps, offer worker-informed wrap-around services (directly or in structured partnership with the broader workforce system), provide mentorship, convene supportive communities of interest, and connect workers directly to high-quality jobs.

Strategy III.5. Document the state of job quality and drive improvements, where needed, in the energy sector.



III.5.A. Recommendation: Implement an intra-agency initiative to enhance measurement, impact, and reporting of job quality in energy workforce investments.

- i. Define a set of job quality metrics, starting with measures of the eight components outlined in the DOC/DOL Good Jobs Principles: recruitment and hiring; benefits; diversity, equity, inclusion, and accessibility (DEIA); empowerment and representation; job security and working conditions; pay; and skills and career advancement.
- ii. Develop a plan to add available data on these metrics to the Department’s USEER.
- iii. Uplift real models and best practice actions companies have taken to deliver upon the components of the Good Jobs Principles that can serve as examples for other businesses within the sector.
- iv. Explore ways to collect more job quality data—such as workers’ receipt of essential benefits, detailed pictures of wages, and employer investment in training and upskilling—to be embedded into the annually produced USEER.
- v. Train Department staff and contractors across all DOE program offices and the National Laboratory Complex on job quality definitions and mechanisms so that there is an understanding that job quality should be embedded in all DOE investments. Start with the Workforce Development Community of Practice, run by the Office of Energy Jobs.
- vi. Explore ways to require—rather than encourage—strong-job quality in Department deployment projects, in addition to in direct workforce development investments. Make requests of Congress for this authority, if that is needed to accomplish this action.

- vii. Capture and report job quality and improvement benchmarks in all DOE workforce programs and funded energy investments. Make this information available in a public dashboard.



III.5.B. Recommendation: Lead an interagency effort to increase the use of job quality mechanisms for energy sector jobs.

- i. Continue convening and expand workforce program leaders' collaboration across federal agencies impacting critical energy sector investments.
- ii. Coordinate the design, implementation, and evaluation of job quality mechanisms and tools in joint workforce projects (see: DOL Good Jobs Toolkit, DOL/DOC Good Jobs Principles, DOC Job Quality Toolkit, and DOE CBP Toolkit) across agencies; share best practices and replicate successes.
- iii. Partner to fund and/or implement high road sectoral workforce strategies that place an emphasis on raising job quality in priority sectors where needed.

Discussion and rationale

Variations in job quality can threaten recruitment and retention. Further, workers are particularly vulnerable to the disruptions of the energy transition. Observing fluctuations in technology and employment, young workers may hesitate to pursue employment in the energy field. Meanwhile, when new renewable energy jobs are created, rapid adoption of new technology too often takes place without certification or licensing standards, leading to the de-skilling of work and the creation of low-wage, short-term jobs. Workers in these fields may find they have nowhere to go once initial installation of the energy technology is complete. This approach wastes the skills workers develop and discourages long-term retention in the energy workforce.⁴³

There is no substantial baseline of information on job quality across the energy sector. The average wage for all projected jobs created under BIL, CHIPS, and IRA (including jobs not in the energy sector) is \$2.50 per hour higher than the national average.⁴⁴ Projected jobs in many categories are more likely to have health coverage, retirement benefits, and union membership than the national average. But in a number of categories, especially newer areas of employment, job characteristics fall below national averages on these measures, reflecting gaps in workforce standards and the absence of other job quality drivers in particular occupations or locations. Beyond these measures, occupational and industry data show that wages, safety performance, rates of internal promotion, and other important elements of job quality vary both within and across occupations.

In short, the Department can't assume that the changing economy will generate the high-quality jobs that will attract and retain the workforce needed to realize the goals of a transition to a net-zero economy.

There is another path. The Department of Energy is uniquely positioned to raise job quality, where necessary, for the energy workforce. There is both an obligation to improve job quality to attract the workers needed by the energy transition and, simultaneously, a historic opportunity to improve job quality for millions of workers. There are examples of good-quality jobs in the energy sector that DOE can uplift, including from legacy businesses within the industry. While elevating job quality benefits all workers, it is particularly important for **dislocated workers** and **disadvantaged communities**.

High-quality jobs offer workers fair recruitment and hiring practices; family-sustaining wages and benefits (health insurance, retirement plans, family care support, paid leave, etc.); active recruitment, retention, respect, and promotion of **underrepresented populations**; the right to form and join unions free from interference; respect for worker voice in organizational culture and decision-making; worker engagement in ensuring a safe and healthy workplace; and high-quality, worker-centered tools and resources to advance in their field.⁴⁵ In the current moment of industrial transition, job security and career longevity are particularly critical factors for attracting and retaining a skilled energy workforce.

Implementation

While proven mechanisms exist to improve job quality—and thus drive recruitment, retention, and equity—a focus on job quality is relatively new in workforce development. Defining, measuring, improving, and reporting on job quality requires skills and resources that are only just beginning to be used among traditional workforce development practitioners and are even further outside the expertise of most agency staff and contractors, state and local government partners, employers, community colleges, and university systems. These stakeholders need support to understand their agencies’ roles and responsibilities in the implementation of strategies to measure and improve job quality. A wealth of good examples exists, including within the sector itself, for DOE and its partners and stakeholders to draw on.

Siloed efforts to implement job quality strategies agency by agency, program by program, or occupation by occupation, however, are likely to yield slow and uneven results. The Department can consolidate its internal efforts and partner with the Departments of Labor, Commerce, Education, and other federal agencies and sector stakeholders to advance coherent job quality initiatives. Several promising efforts are already underway.

Intra-agency coordination

The creation of the Office of Energy Jobs (OEJ) has been an important step to drive job quality. Among other efforts, OEJ has convened an internal Energy Workforce Strategy Council and a Workforce Development Community of Practice focused on effective, inclusive workforce development strategies. These forums bring together staff and offices across DOE to coordinate existing workforce development programs and build new strategies. Staff across DOE offices express enthusiasm for more intra-agency coordination and consistency, especially around newer areas such as defining job quality, capturing job quality data, embedding labor standards and community benefits requirements in programs and solicitations (as opposed to encouraging a wide range of strategies), and developing evaluation and accountability mechanisms.

The Department includes job quality mechanisms in many FOAs, as required by their authorizing statutes, and has developed templates to facilitate wider adoption of these strategies.⁴⁶ DOE also offers matching and technical assistance under certain FOAs to help applicants connect with key partners and build collaborative relationships.

Interagency coordination

In 2022, DOE and DOL entered into a memorandum of understanding “to promote cooperative efforts between DOE and DOL ... to create and support pathways to millions of high-quality, good-paying energy infrastructure and supply chain jobs with the free and fair chance to join a union. This cooperative effort will

emphasize efforts to attract, train, and retain a diverse and skilled workforce—including bringing in people who have not had the opportunity to attain high-quality energy infrastructure and supply chain jobs while also supporting workers displaced by the energy transition.”⁴⁷ DOE staff working on workforce issues also regularly meet with other agencies’ workforce staff, in Commerce, Transportation, Education, EPA, and Interior, to identify and execute cross-agency activities.

Strategy III.6. Define success, set benchmarks, refine the strategy.



III.6.A. Recommendation: Apply consistent evaluation processes relevant to workforce imperatives across critical DOE investments.

For investments that are principally focused on workforce development:

- i. Identify outcome goals and benchmarks for workforce investments across the Department.
- ii. Build on the data collection recommendations in the Department of Labor’s Job Quality Toolkit to design a consistent data collection and reporting methodology for all DOE workforce development programs and supported projects.
- iii. Request funding from Congress to incorporate process and performance evaluations of funded partner workforce outcomes.

For broader DOE investments, such as deployment projects grants and loans:

- iv. Strongly enforce the requirement (and make required where not currently) that deployment projects input their payroll records into LCPTracker. Use data available in LCPTracker to measure and report the impact of DOE’s investments on **underserved workers** and communities in terms of jobs, including racial and ethnic minorities, Indian Tribes, women, veterans, and **socioeconomically disadvantaged communities**.
- v. Using that baseline data, set goals for the Department’s investments to improve upon the hiring and retention of **underrepresented populations**, especially for women per the significant underrepresentation of this demographic group in the energy workforce.

For both types of investments, as it relates to workforce outcomes:

- vi. Set a cadence to review and report on progress toward benchmarks, and a process to adjust programs, resources, and strategies accordingly.

Discussion and rationale

With the shift in DOE’s principal focus on research and development to a dual focus on R&D with massive deployment of infrastructure and energy efficiency technologies, now is an ideal time for the Department to chart a path forward that reimagines the definition of success in its workforce efforts. This includes assessing how success is measured and tracked. Before us lies the largest expansion of energy jobs in a generation:

methods for evaluating the shifting workforce and assessing DOE's effectiveness in training workers, broadened access for **underrepresented populations**, and improving job quality must grow, too.

The Department is already implementing several strategies identified in this report: It has

- Created the Office of Energy Jobs to prioritize high-quality energy jobs, especially union jobs, and inclusive access to those jobs;
- Launched the forward-looking and innovative Battery Workforce Initiative;
- Integrated community benefits plans as requirements in all DOE competitive funding opportunities under BIL and IRA (CBPs have some degree of labor standards and workforce development incentives);
- Provided informative resources, such as the Tribal Energy Atlas;
- Deepened strategic partnerships with other federal agencies;
- Coordinated efforts through an internal workforce strategy group (Energy Workforce Strategy Council and raising capacity through the Workforce Development Community of Practice);
- Fostered partnerships with labor, employers, and workforce partners for workforce planning; and
- Expanded analysis in the USEER of demographic, job quality, unionization, and employer recruitment data and is launching a forward-looking Energy Workforce Needs Assessment that will project demand-side data on the energy workforce.

To increase its effectiveness in achieving its 21st Century workforce goals, DOE's Office of Energy Jobs can align these internal efforts. DOE can partner with other federal agencies to better leverage existing workforce and education infrastructure, focusing resources, relationships, and expertise within those agencies on shared goals. And while it is too early to measure new initiatives against goals, DOE is ideally positioned to develop metrics, measure progress, evaluate programs, and report on the effectiveness of its efforts.

Looking Ahead: What is Needed to Inform the Board's Work for its Next Report to the Secretary of Energy

The statute establishing the EWAB directs the Board to submit a report to the Secretary “biennially...until the date on which the Board is terminated.” The following are requests of the Department that will allow the Board to develop an informed set of recommendations for the Department’s workforce strategy for its next iteration.

Within one year of submission of this report to the Secretary, the Department should provide the Board with:

- An analysis of workforce development efforts relevant to the energy sector that are funded by DOE and involve the National Labs.
 - Additionally, a strategy from the Department on how to leverage the National Laboratories Complex effectively towards a comprehensive workforce development strategy for the energy workforce.
- The initiation of a plan for how the Department will kick-start sectoral workforce development initiatives, beginning with specific strategies that reflect this report’s recommendations as related to the Battery Workforce Initiative.
- A plan for breaking down barriers and improving hiring in the energy sector for certain **underrepresented populations**, starting with people with criminal legal records and women.
- A briefing on how the research and analysis work recommended here progressed, including identifying what data is mission critical.
- An assessment of funding and staffing needs for a centralized jobs office to begin implementing priorities in this report.

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Appendix 1: The EWAB

The 21st Century Energy Workforce Advisory Board (EWAB or Board) was established under the Bipartisan Infrastructure Law to advise the Secretary of Energy as the Department addresses the rapidly evolving workforce needs of the nation's energy sector.

EWAB members worked through subcommittees to focus on four topic areas of critical importance to a 21st Century workforce strategy:

- Identifying and Prioritizing the Scope and Scale of Industry Training Needs
- Combating Barriers to Energy Employment
- Measuring and Addressing Job Quality
- Evaluating the Effectiveness of Existing Energy Workforce Programs

To develop recommendations for a 21st Century Energy Workforce Strategy, the Board reviewed information on key topics: decarbonization goals; major clean energy investments including the Bipartisan Infrastructure Law, the CHIPS Act, and the Inflation Reduction Act; anticipated macro-level trends in the demand, composition, and structure of energy markets and supply chains; security and resilience requirements; and social and policy changes. Members paid special attention to data in the Department's 2023 United States Energy and Employment Report (USEER). The Board examined the Department of Energy's organizational structure and programs, focusing on the Department's direct investments in workforce programs and initiatives across multiple DOE offices. It also received presentations and conducted interviews with staff working on these programs. The Board welcomed public comment over the course of eight public meetings prior to the drafting of this report, and Board members reached out through their networks to gather additional data, expertise, and insight into energy sector workforce demand, barriers, and strategies.

The Board is composed of individuals with expertise in workforce development, traditional and emerging energy industries, energy workforce training programs, secondary and postsecondary education institutions, apprenticeship, organized labor, and bringing underrepresented groups, including racial and ethnic minorities, women, veterans, and socioeconomically disadvantaged individuals, into the workforce.

Chair

- **Missy Henriksen**, *Executive Director, Center for Energy Workforce Development*

Members

- **Dr. Deena Ahmed**, *Chief Strategy Officer, Our Next Energy, Inc. (ONE)*
- **Amanda Cage**, *President and CEO, National Fund for Workforce Solutions*
- **Maureen Conway**, *Vice President and Executive Director of the Economic Opportunities Program, the Aspen Institute*
- **Becky Ervin**, *Assistant Director, International Skilled Trades Department, UAW*

- **Sarita Gupta**, *Vice President of U.S. Programs, Ford Foundation*
- **Dr. Tom Kriger**, *Director of Education and Research, North America's Building Trades Unions (NABTU)*
- **Chris Levesque**, *President and CEO, TerraPower*
- **Dr. Daniel (Dan) Marschall**, *Research Professor, George Washington University Institute of Public Policy*
- **Dr. Girard Melancon**, *Board Member and Past Board President, National Council for Workforce Education*
- **Kay Seven**, *Co-Chair, National Indian Employment Training Conference and Director, Adult Education at Nez Perce Tribe*
- **Dr. Jermaine Whirl**, *President, Augusta Technical College*
- **Allison Ziogas**, *U.S. Labor Relations Manager, Ørsted*

The EWAB convened in public meetings on September 18, October 31, November 20, and December 11, 2023, and on January 22 and February 20, 2024. Additional information and official records of the proceedings of the 21st Century Energy Workforce Advisory Board and information on future activities may be found at <https://www.energy.gov/policy/21st-century-energy-workforce-advisory-board-ewab>.⁴⁸

Appendix 2: Selected examples related to Strategic Recommendation III

III. To support DOE's industrial strategy to revitalize the U.S. energy and manufacturing sectors, deploy a cohesive, forward-looking workforce plan, built on six interdependent strategies.

NOTE: Appendix 2 is not intended to provide a comprehensive list of effective programs, but rather to highlight illustrative examples of recent or ongoing efforts relevant to energy occupations.

Boosting access to STEM careers among underrepresented populations

Office of Indian Energy College Student Internship Program

“The U.S. Department of Energy (DOE) Office of Indian Energy, with support and coordination from Sandia National Laboratories, offers a college student internship program for current full-time undergraduate and graduate students who are familiar with Native American culture and tribal issues. Interns support tribal energy projects and assist a cross-disciplinary team to perform specific technical tasks in the field and at DOE's Sandia National Laboratories.”⁴⁹

The Office of Energy Justice and Equity offers a variety of programs serving students and faculty of MSIs including the Stem Pipeline Student Partnership Program

“The Minority STEM Pipeline Division Student Partnership Program offers talented undergraduate and graduate students 10-week summer internships with the U.S. Department of Energy (DOE) and its national laboratories. The program reaches out to minority students across the country at minority serving institutions...to get students excited about and prepared for STEM and energy careers at the DOE, other federal agencies or the private sector.”⁵⁰

Building the capacity of HBCUs, TCUs, other MSIs, and community colleges

Manufacturing and Energy Supply Chain (MESC) Industrial Assessment Centers Expansion

In November 2023, the Department's Office of Manufacturing and Energy Supply Chain announced the selection of 17 new Industrial Assessment Centers (IAC) centers: three colleges/universities; two technical schools; nine community colleges; and three union/joint employer union organizations.

In 2024, MESC announced a planned series of solicitations to “fund a wide range of workforce training institutions, from community and technical colleges and trade schools to union training programs (including labor-management training programs), apprenticeships, and related internships. These new IACs will comprise new training programs as well as expanded and enhanced existing programs, all of which will work with

employer partners to provide hands-on learning for participants alongside technical assistance to strengthen SMMs' operations."⁵¹

Sector strategies

The Department's **Battery Workforce Initiative (BWI)** set out to address the challenge and opportunity of unprecedented demand for skilled workers in battery manufacturing, a sector projected to grow by nearly 20 times from 2021 to 2030. BWI is a partnership between DOE (led by the Office of Energy Jobs), DOL, the AFL-CIO Working for America Institute, Li-Bridge Alliance members, and other stakeholders to develop a sectoral workforce strategy to advance the development of training by sharing non-proprietary requirements for high-demand occupations. The initiative includes employer-based testing and validation programs that will test the effectiveness of draft training for high-priority job positions. The draft training will be used to develop a DOL-approved credential that will be shared with community colleges and other training providers.⁵²

In 2024, BWI completed the first skills profiles and curriculum outlines for cell manufacturing production and maintenance occupations.⁵³

The **Electric Vehicle Infrastructure Training Program (EVITP)** is a collaboration of stakeholders in the electric vehicle sector, automakers, EVSE manufacturers, educational institutions, utility companies, electrical contractors, electricians, first responders, and educational institutions. Since 2012, the collaborative has designed, updated, implemented, and certified comprehensive training in EVSE installation for state-licensed or state-certified electricians across the U.S. and Canada.⁵⁴

In 2024, EVITP and MUST Workforce solutions "announced a partnership between the two organizations aimed at supporting an inclusive workforce for the rapidly growing electric vehicle (EV) industry. This collaboration seeks to provide EVITP Training & Certification for existing qualified electricians and to engage traditionally underserved and marginalized communities through career exploration with connectivity to long-term, good paying careers in the electrical field through a unique 'Electric Fast Track' paid career exploration program initially launching in Michigan and North Carolina....As part of the Siemens Foundation's new Everyone Charging Forward™ initiative, EVITP and MUST Workforce Solutions are meeting this moment by providing EVITP Training & Certification for existing qualified electricians, engaging career explorers with EV related curriculum and through [Skillfusion](#), and providing paid 'Electric Fast Track' career exploration in the electrical industry with local partners affiliated with the International Brotherhood of Electrical Workers (IBEW) and the National Electrical Contractors Association (NECA) contractors."⁵⁵

Apprenticeship recruitment, retention, and mentorship

Oregon Tradeswomen's pre-apprenticeship program includes direct-entry agreements with joint labor-management apprenticeship programs—Plumbers and Pipefitters (UA Local 290) and Electricians (NECA/IBEW ETC). ICERES reports that half of Oregon Tradeswomen pre-apprentices are BIPOC women, and three-quarters are very low income.⁵⁶ "In 2018, 78% of program participants entered a registered apprenticeship program or started employment in the skilled trades."⁵⁷

2nd Call, a community-based violence prevention/intervention organization, partners with building trades apprenticeship programs to connect communities to apprenticeship. 2nd Call offers mentorship, pre-apprenticeship, and trauma-informed care to help system-impacted individuals succeed in construction apprenticeships and careers.⁵⁸

Hire 360 partners with developers, contractors, and unions to connect youth, **underrepresented populations**, and local residents to quality construction jobs using multiple strategies including recruitment, MC3 pre-apprenticeship training, investment in minority-owned and women-owned businesses, and strategies to advance socially responsible hiring.⁵⁹

Helmets to Hardhats (H2H) “was created by the Center for Military Recruitment, Assessment and Veterans Employment. H2H is a 501(c)(3) nonprofit joint labor-management driven entity that connects transitioning active-duty military service members, veterans, National Guard and Reservists with skilled training and quality career opportunities in the construction industry.”⁶⁰ H2H reports having supported the transition of over 40,000 military personal to civilian construction careers since 2003.⁶¹

Other exemplary projects include:

- Chicago Women in Trades⁶²
- Nontraditional Employment for Women (NEW)⁶³
- Tradeswomen, Inc.⁶⁴
- Rising Sun Center for Opportunity – Building Decarbonization/Opportunity Build/Climate Careers⁶⁵
- High Road Construction Careers Initiative (CA)⁶⁶

Energy sector community benefits agreement

In May 2022, New Flyer, a leading manufacturer of electric buses, signed a community benefits agreement (CBA) with Jobs to Move America (JMA) and Greater Birmingham Ministries (GBM). The CBA established a set of goals and mechanisms to remove barriers to hiring and promotion and increase investment in workers and communities. Commitments include:

Forty-five percent of new hires and 20% of promotions at each facility of individuals from groups who have historically been underrepresented or underserved and have had limited access to good jobs in American manufacturing. This includes people of color, women, and veterans. New Flyer and JMA and GBM (JMA and GBM together, the “Coalition Partners”) will work together to develop more robust training programs, focused on increasing access to employment and career advancement for these historically disadvantaged groups...⁶⁷

Additional commitments include:

- A designated community organization to assist employees in making and resolving complaints through New Flyer’s internal complaint process about perceived harassment or discrimination;
- Participation by the Coalition Partners in identifying employees to participate on New Flyer’s environmental health committee in Anniston, which regularly discusses employee safety matters;
- Independent safety training by an external expert;
- New Flyer will extend the hiring protections for systems-impacted people (so-called ‘ban the box’ rules) that it already follows in California and Minnesota to applicants in Anniston, Alabama;
- A commitment to increase Spanish bilingual capacity in New Flyer’s outreach, recruitment, human resources, training materials, and workplace communications; and

- Provisions to allow employees to attend a semi-annual debt clinic hosted by a Coalition Partner at the New Flyer Anniston facility during non-work time.⁶⁸

By 2023, the CBA partners had established an independent advocate process, managed by the Alabama State Chapter of the NAACP, for workers with complaints about discrimination and harassment and an on-site safety training, half of which was held on paid time. Direct hires outpaced staffing agency hires, and fair chance hiring practices delayed background checks until post-offer, likely reducing chilling effects on applications. The partners developed as a first step to a registered apprenticeship program.⁶⁹

In 2024, under a first collective bargaining agreement between New Flyer and newly organized members of IUE-CWA Local 83700, the parties bargained “raises between 15 and 38 percent by 2026, cost-of-living adjustments, and enhanced retirement benefits.”⁷⁰

(For illustrative examples of CBAs outside the energy sector, see PowerSwitch Action’s Policy Toolkit on Community Benefits Plans.)⁷¹

Work supports

General

The Department of Transportation has included a checklist for “strong transportation workforce and labor” plans for DOT projects. The checklist provides information on how applicants for DOT grants can put together strong workforce and labor sections in funding applications. Language from the DOT checklist includes:

“Are you planning on funding supportive services and direct cash assistance that can help people facing systemic barriers to employment participate and thrive in training, apprenticeship, and employment? Supportive services include including child care; housing; emergency cash assistance for items such as tools, work clothing, application fees, and other costs of apprenticeship or required pre-employment training; transportation and travel to training and work sites; car repair; and services aimed at helping to retain underrepresented groups like mentoring, support groups, and peer networking. Note that state highway formula funds can be used for these kinds of services.”⁷²

Child care

The **Apprentice Related Child Care Program**, managed by the Oregon Department of Transportation and the Oregon Bureau of Labor and Industries through the Highway Construction Workforce Development Program, offers apprentices generous subsidies for child care—up to \$2,500 per month.⁷³ Research on this program indicates that the child care subsidies substantially increased the likelihood that registered apprentices completed their training; completion rates for women and people of color increased by 21%, while completion rates for white men increased by 37%.⁷⁴

The **Mississippi Low-Income Child Care Initiative** is an organization that focuses on single Black mothers and offers comprehensive support for the women with whom they work. The Initiative partners with workforce centers across the state to create pathways for advanced education and job training for single moms. They connect job seekers with job training and child care, and with caseworkers to help navigate and apply for assistance.⁷⁵

Care That Works in Massachusetts offers nontraditional-hour care by contracting with providers who agree to open at 5:00 or 5:30 a.m. The pilot—a partnership between labor unions, child care providers, and the city of Boston —pays a fixed amount to providers that adds to the standard weekly rate that families pay themselves or through the child care subsidy program. The providers are paid at a higher rate to work these longer or more difficult hours, an integral part of ensuring that there are providers willing to participate and meet the needs of workers.⁷⁶

The **Department of Commerce** has taken bold moves around childcare, requiring applicants for the nearly \$40 billion in new federal subsidies for CHIPS projects above \$150M to essentially guarantee affordable, high-quality child care for workers who build or operate a plant. They must provide a plan for access to child care for facility and construction workers through on- or near-site child care, pre-arranged agreements with existing child care providers, child care subsidies, or other similar measures.

The **National Institute of Standards and Technology (NIST)** offers a workforce planning guide on CHIPS implementation that includes child care.⁷⁷

The **Childcare for Every Family Network** has released a toolkit to help communities influence the way CHIPS investments are used to support equitable access to child care in ways that are aligned to systems-building goals. The Network develops strategies for organizing in key geographies, providing clear, community-informed guidance to employers and helps their partners work with their federal delegations and employers.⁷⁸

Dislocated workers

Contra Costa Refinery Transition Partnership

The California Workforce Development Board, under its High Road Training Partnerships Initiative, funded the development of the Contra Costa Refinery Transition Partnership, a “regional partnership between frontline workers and communities, labor and workforce research and policy experts, local government, workforce and economic developers, equity advocates, and other stakeholders...to develop a vision and plan for high road economic development and diversification in Contra Costa County.”⁷⁹

Project partners have developed a shared understanding of the core challenges facing the county related to refinery transitions. They identified shared priorities to guide economic development planning, built a common understanding about the impacts of the energy transition on the region, and collaborated to develop a strategy that will result in a high road transition. Their work resulted in the published report *Fossil fuel layoff: The economic and employment effects of a refinery closure on workers in the Bay Area*⁸⁰ and in a forthcoming economic development and research synthesis report. The partnership’s work also helped drive the development of California’s Displaced Oil and Gas Worker grant program pilot,⁸¹ the County’s Just Transition Economic Revitalization Program,⁸² and the development of a Green Empowerment Zone to build “upon the comparative advantage provided by the regional concentration of highly skilled energy industry workers by prioritizing access to tax incentives, grants, loan programs, workforce training programs, and private sector investment in the renewable energy sector.”⁸³

Energy sector project labor agreement

The **Ørsted Offshore Wind Project Labor Agreement** represents the first national offshore wind sector memorandum of understanding (MOU) with North America’s Building Trades Unions (NABTU). The MOU

was signed by Ørsted Americas, Inc., and NABTU in 2020 for the buildout of offshore windfarms from Maine to Florida—projects with the collective potential to produce 1760MW of electrical power. The onshore portion of the projects include port upgrades, onshore transmission lines and substations, in-port construction of windfarm components such as concrete platforms and appurtenances, and the staging and marshalling of offshore wind turbines. To date, Ørsted and the Building Trades have negotiated more than 12 PLAs across the northeast region covering the onshore portion of Ørsted's project and creating more than 800 full-time equivalent jobs.

In May 2022, Ørsted negotiated and signed an industry-leading PLA, the National Offshore Wind Agreement (NOWA), with NABTU, covering offshore construction activities including cable installation, foundation installation, wind turbine erection, offshore substation hook-up and commissioning, and cable jointing works. Under this PLA, South Fork Wind, Revolution Wind, and Sunrise Wind are expected to generate more than 1,200 jobs offshore.⁸⁴

The NOWA and 12 northeast regional PLAs represent a portfolio-wide partnership with organized labor that provides certainty and predictability for employers and for workers. The partnership leverages a robust network of union training facilities to deliver training required for offshore wind registered apprenticeship training programs. The NOWA PLA requires minimum ratios of apprentices to journey-level workers, targeted local hiring (zip code-based), and implementation of diversity goals for underrepresented workers (including women, BIPOC, and environmental justice community members). It establishes a project-based Workforce Equity Committee to monitor and support workforce diversity and priority community hiring goals. It provides a direct connection to pre-apprenticeship training programs.⁸⁵

To date, Ørsted has committed \$12.4 million to programs that support workforce development among both construction workers and aspiring future members, including:

- \$10 million to found the National Offshore Wind Training Center, which is now in operation in Brentwood, New York, under the leadership of the Long Island Federation of Labor and Nassau-Suffolk Building and Construction Trades Council;
- \$1 million in Rhode Island to create a Global Wind Organization Basic Safety Training Center at Community College of Rhode Island and to provide offshore working credentials to more than 165 New England union workers who will be well-positioned to work offshore on Revolution Wind and future projects;
- \$1 million to provide offshore working credentials to New York union workers. Those workers will be well-positioned to work offshore on Sunrise Wind and future projects;
- \$300,000 to support pre-apprenticeship training for South Albany residents through the Multi-Craft Apprenticeship Preparation Program (MC3); and
- \$150,000 to support pre-apprenticeship training for eastern Connecticut residents through the Connecticut State Building Trades Training Institute.

(For additional examples in utility and power generation, see the Tennessee Valley Authority Construction and Maintenance Agreements and the Southern Company Maintenance and Modification Agreement.⁸⁶)

Appendix 3: Occupational projection resources

There is an abundance of examples of work, both within and outside the DOE, on workforce projections in the energy sector by technology, occupation, and geography. Within the DOE, NREL has published a series of reports, referenced below, on projections of job growth for various clean energy technologies such as offshore and land-based wind, solar, and hydropower. NREL also reports clean energy job projections by state, through 2030. Beyond the DOE, the U.S. Bureau of Labor Statistics publishes 10-year employment projections by industry and occupation for various energy generation industries.⁸⁷

Outside of the federal government, there are academic, non-governmental, and private-sector studies on occupational projections for the energy sector as a whole and for different technologies such as wind, solar, hydropower, batteries, clean hydrogen, direct air capture (DAC), and carbon capture and storage (CCS). Empirically, most of these resources report projected change in jobs by occupation, technology, and sometimes geography, based on several scenarios, and emphasize the level of training necessary for each occupation within industries. The time horizon of projections varies between 15 to 25 years.

Some reports also recommend strategies for effective and equitable workforce development. For instance, NREL reports recommend strategies such as DEI-focused partnerships to increase employment opportunities for various demographics, or increasing the visibility of and strengthening apprenticeships and internship pipelines. However, in terms of job quality, the only indicators that most of these resources explore—if any—are estimated wages and employer-reported DEI practices. Given how strong an emphasis DOE and EWAB place on job quality in the growing energy sector, future studies commissioned by the DOE should explore measures of job quality as determined by the good jobs principles detailed by DOL and DOC.

Appendix 3.a: Federal resources

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