ENERGY JOBS

A GUIDING DOCUMENT

JPMorganChase

CENTER FOR HOUSTON'S FUTURE

Resiliency Workforce Collaborative

BLACK ARROW
TALENT FOR THE JOBS OF TOMORROW

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1. Introduction-Background and Context

1.1 Houston's Resiliency Workforce Collaborative

JPMorgan Chase's Resiliency Workforce Collaborative (RWC) was launched in Houston in December 2022 to improve disaster resilience, increase career opportunities, and create talent pipelines. At core the collaborative exists to ensure that more community members are qualified for and secure good, well-paying jobs and careers.

Center for Houston's Future (the Center, CHF) and Upskill Houston, in support of an expanding clean hydrogen industry, in 2022 saw a likely rapid increase in demand for skilled labor to support that growth, and from 2022-2024 engaged with Accenture on a pro bono basis to identify the most efficient pathways to fill those jobs. High value/high demand positions were forecasted, and required skills were assessed. Key to Accenture's analysis was to map skills from existing positions against the needs, and then to identify pathways to fill the gaps efficiently. Since that initial analysis, we have recognized that the expected hydrogen jobs have overlapping skills requirements with a range of other energy jobs, and the lessons learned apply broadly across the energy industry.

Key to both initiatives is how to move more people into better jobs. JPMorganChase (JPMC) generously funded Center for Houston's Future for 2025 to connect our work with the goals of the RWC. With support from Black Arrow Group, the Center has worked with RWC and other stakeholders, building on the work with Accenture to identify what steps each set of stakeholders—employers, contractor organizations, CBOs, training/education providers, and job seekers—can take to make these opportunities a reality. This "playbook" outlines our findings and recommendations.

1.2 Changing economic landscape and policy climate around hydrogen

As the work progressed, the reality around hydrogen jobs changed. Federal tax incentives and grants that had been expected to drive unprecedented growth in hydrogen and clean energy transition projects began to stall. Projects to upgrade existing facilities and to build new facilities, supported by once-in-a-generation funding opportunities, became uncertain and subject to delay or cancellation.

Our findings, however, are applicable across the energy ecosystem and beyond. Demand for energy can be cyclical, but companies must expand and infrastructure must evolve to meet long-term growth in consumer and industrial demand for energy. None of this progress is possible without a skilled workforce ready to meet the challenge. We must creatively source and reinvigorate where we find the talent to fill these jobs. The findings, challenges, and opportunities that emerged from the years of research on this project can be applied across the entire energy ecosystem.

The Houston region stands at a pivotal moment in its economic evolution. As the recognized Energy Capital of the World, Houston is uniquely positioned to lead the nation in shaping the future of energy across all sources. With its existing energy infrastructure, skilled talent, and deep industry expertise, Houston has the tools to drive this transformation.

Strategic public and private collaboration and investment can catalyze the opportunity to grow the economy and uplift local communities. The region's investment and commitment to jobs in our energy value chain over the next decade and beyond will spearhead job growth in parallel to and in support of already planned capital investment.

In spite of changes in the financial incentives and urgency for hydrogen-specific projects, there is always a need for a project-ready workforce, especially as nuclear, geothermal, and carbon capture markets develop. This playbook provides tools and resources to directly address this jobs challenge. It presents a practical approach to developing new sources of talent needed for Houston's energy jobs of the future.

By aligning industry, education, and community stakeholders around a common vision, it outlines a clear pathway to build strong talent pipelines, expand access to high-quality jobs and careers, and maintain the region's global leadership in energy. This document, which includes creation of an employer-focused council as an option, among a series of recommendations employers can take to lead in this space, is intended to be an actionable blueprint for regional collaboration.

Houston is facing a human capital shortfall

855k

Under Qualified

Houstonians aged 25 and older do not have the minimum credentials for middle-skill jobs[1]

30%

MiddleSkilled

Roughly 921,000 Houston jobs or roughly 30% are considered middle-skill occupations[2]

180K

New Jobs

Houston's hydrogen economy has the potential to create 180K jobs by 2050[3]

Source: 1. How Can Middle-Skills Jobs Drive the Houston Economy?, GHP & JP Morgan, 2. Middle Skills

2. Our Approach

2.1 The interviews

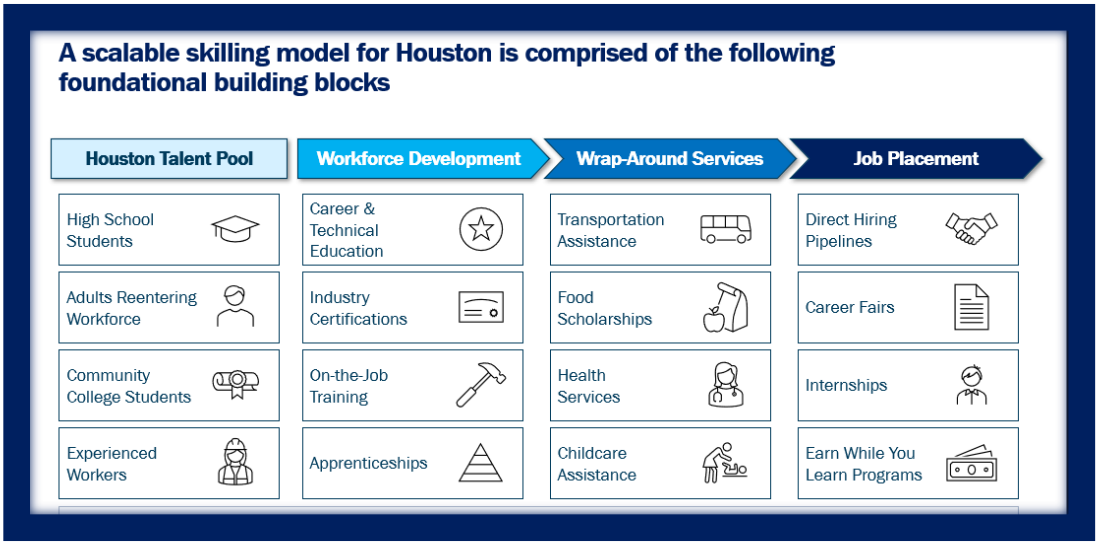
Over the first half of 2025, the Center for Houston's Future team conducted one-on-one and group interviews to gain a greater understanding of the current industry landscape. How are candidates identified and hired into this industry? What are the gaps/needs? Where are projects in the region headed? How has timing changed? We also presented the findings to a number of business-focused groups, including CHF's Hydrogen Steering Committee, Level Up, and GHP Energy Committee, and incorporated the feedback from those sessions. (See Appendix for list of companies interviewed.)

60+
Participants

30+
Unique Organizations

2.2 A model for expanding the talent pool

From 2022 to 2024, a team of experts, led by UpSkill Houston and Accenture, convened dozens of employers, educators, nonprofits, and training providers to identify what it would take to stimulate investment in entry-level skilled crafts in the clean energy industry. The core strategy that emerged is a skills-based methodology to connect the supply of talent with industry demand. This approach focusses on the specific competencies required for success rather than traditional degrees and credentials.



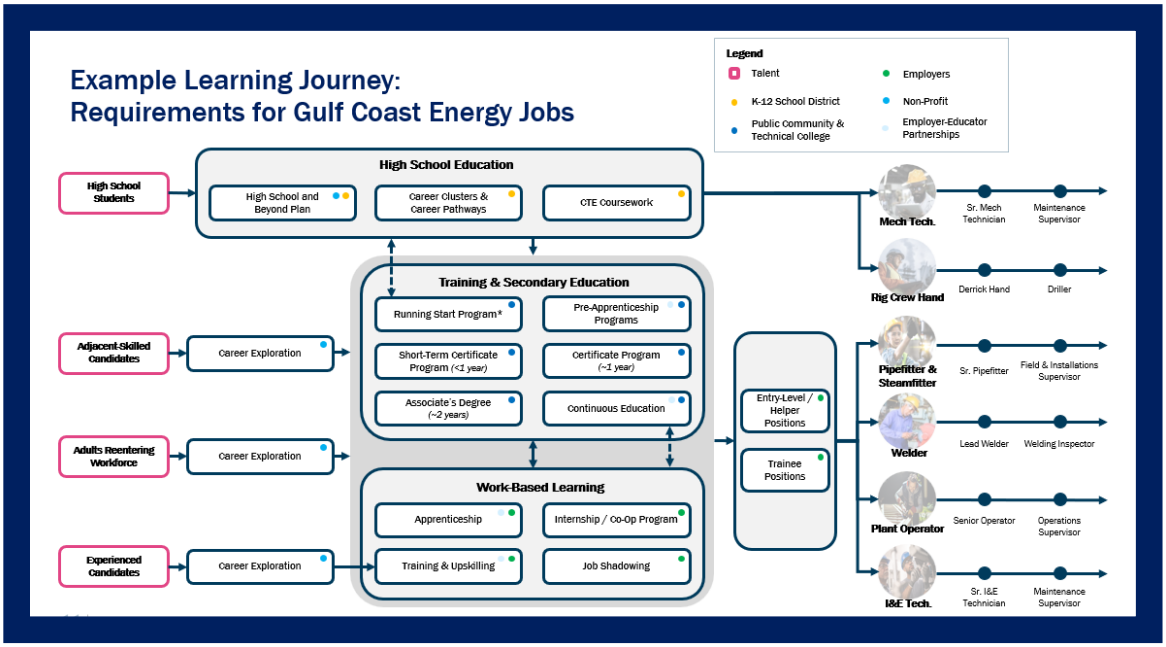
Credit/ Accenture

Step one was to identify priority energy jobs and pinpoint high-demand, middle-skilled roles that are both critical for industry growth and offer stable, well-paying careers.

Next was to identify common occupations that possess a strong foundation of transferable skills. That analysis of the Houston workforce identified numerous personas/roles that possess skills that position them for energy careers. These include roles like carpenters, electricians, and food service managers, among others. We particularly targeted workers in construction and extraction, installation, maintenance and repair, management, office and administrative support, sales, and transportation and logistics.

Our team of experts conducted skills-matching analyses to identify natural career pathways and specific skill gaps to be addressed. A key finding of the skills-matching analyses is that the identified personas demonstrate remarkably high skill transferability to priority jobs. This confirmed that a large talent pool already exists that could be accessed by this employer base.

Learning journeys were designed to serve as practical roadmaps for individuals to bridge any remaining skills gaps. These pathways outline specific milestones—such as industry certifications, associate's degrees, or apprenticeships—needed to qualify for entry-level energy roles. The economic impact of this approach is profound: completing a learning journey can boost earnings potential by up to 60%. This is not merely a wage increase; it represents a pathway to generational wealth building, creating stability for families and strengthening the economic fabric of the Houston region. An example learning journey is shown.



Credit/ Accenture

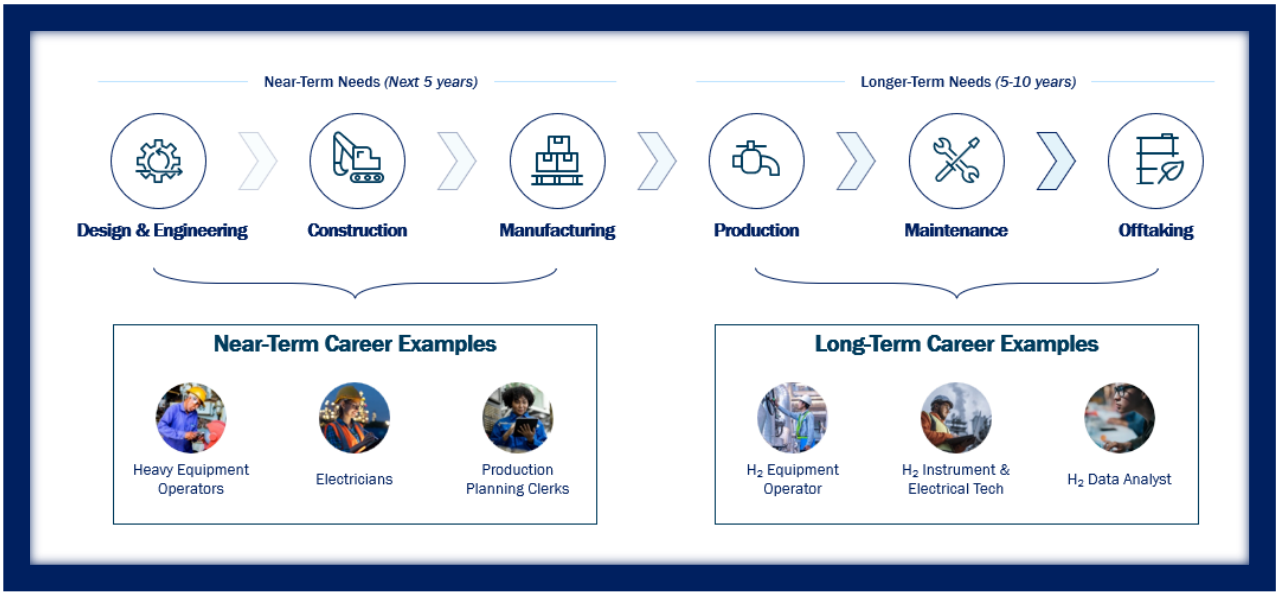
This skills-based strategy provides the 'what' and 'how' of our approach and aligns with the goals of the RWC. Our work in 2025 built on this foundation to develop the specific goals and actions to bring this ecosystem to life, outlined in the next sections.

3. Key Takeaways

As mentioned, these takeaways maintain a focus on good jobs. In the nine-county Gulf Coast region, 2.6 million residents –36% of the population—are considered economically vulnerable in 2025. Of this target population, **72% do not possess a bachelor's degree**, highlighting the critical need for accessible, skills-based pathways into middle-skilled careers.

Using these takeaways, employers can focus on targeting workers in occupations with highly transferable skills, including:

- Construction and Extraction
- Installation, Maintenance, and Repair
- Management
- Office and Administrative Support
- Production
- Sales
- Transportation and Logistics



Credit/Accenture

By understanding and focusing on the existing skills in these occupations, we can create pathways for more efficient and effective upskilling. Harnessing the potential of this target population is critical if we are to deliver on the promise of shared prosperity.

3.1 The following are the key takeaways from our ongoing work on energy jobs.

3.1.1 Core skills

Core skills are cross-cutting, and many are transferable from other sectors (welding, I&E tech, mechanical, safety, among others). They also apply more broadly to other energy jobs.

3.1.2 Dynamic market

Workforce urgency fluctuates based on industry needs and federal policy driving industry demand. This dynamic energy market also reacts to global interdependencies.

3.1.3 Funding uncertainties

Other funding needs have increased as the workforce component in federal funding (community benefits) has been eliminated. There is a leadership and funding vacuum for workforce development that local efforts must fill.

3.1.4 Workforce readiness

Soft skills, work-based learning, and apprenticeships will remain essential, especially for entry-level roles.

3.1.5 Wraparound services

Funding for community based organizations has been erratic, reduced or eliminated. This reduces their ability to support trainees with needed services.

3.1.6 Capital projects

There is a critical need for coordination between capital project owners and contractors to ensure consistent signaling of skills needed and safety expectations.

3.1.7 Education partnerships

K-12 and postsecondary partnerships are essential to communicate that hydrogen and other energy jobs are attractive and attainable career opportunities and to deliver the skills training necessary to achieve those.

3.1.8 Worker expectations

There are often gaps between graduate expectations and employer reality, including communication, reliability, and applied problem-solving.

3.1.9 Mobility and logistics

Fuel cell technicians and stationary hydrogen systems represent emerging talent needs for demand-side deployments (transportation, logistics, ports, and mobility), which also support other energy fields.

3.1.10 Shift change

A large retiring workforce presents a vast amount of mentorship opportunities, but knowledge transfer remains a challenge, as well as ways to get into the classroom.

4. Recommendations and Actions

4.1 High level recommendations

4.1.1 Meet jobs demand in real time

- Identify In-demand occupational descriptions
- Align skill and certification requirements
- Monitor project timelines in emerging areas of demand side need

4.1.2 Collaborate with CBOs

- Integrate wraparounds into training to ensure student success
- Mandate services wherever possible
- Give CBOs a voice at the table for workforce council
- Formalize relationships where possible

4.1.3 K12 /education pathway improvement

- Bring energy jobs to the classroom as part of
- The clean energy transition
- Local economy
- Decarb effort and daily lives
- Accelerate instructor certification programs (adjunct CTE instructor licenses)

4.1.4 Mature worker knowledge transfer

- Partnerships between employers and colleges to co-fund retirees
- Create retiree-to-trainee mentorship model in schools
- Capture critical knowledge through digital tools

4.1.5 Marketing/messaging solutions

- Utilize playbook as backbone of work
- Create messaging campaign to attract new stakeholders
- Create a regional energy skill transfer pathway map
- Promotion of energy roles as logical next career step

4.1.6 Navigable certification pathways

- Partner with employers, OEMs and training providers to build short term certification pathways
- Clearly demonstrate examples of entry-level expectations
- Remove barriers between institutions

4.1.7 K12 – Postsecondary pipelines

- Build structured partnerships between:
- School districts and early college high schools
- Community colleges and training providers
- Contextualize energy opportunities and specific outcomes

4.1.8 Curriculum standardization

- Common credential requirements

- Safety standards and onboarding practices
- Role expectations by phase (construction, commissioning, workovers)

4.1.9 Apprenticeships

- Develop and expand apprenticeship and pre-apprenticeship opportunities
- Offer entry level on-the-job training
- Include mentorship, evaluations, and structured wage progression
- Pre-apprenticeships and work-ready focus

4.1.10 Council creation

- Stand Up a Regional Energy Workforce Leadership Council with RWC
- Include employers and EPCs, community colleges and universities, workforce boards, local governments, CBOs, labor, and philanthropy
- Focus on strategy, data-sharing, and curriculum alignment

4.1.11 Investment and funding opportunities

- Leverage philanthropic & state funding
- Prioritize project readiness to meet work needs
- Focus investment on roles with high demand and short training cycles
- Source private funding opportunities

4.1.12 Demonstrate return on investment for all of the above actions

5. Proposed Implementation and Strategy

5.1 Overview:

Stakeholder Group	Key Takeaway
Industry	Broad industry consensus will be needed to align on energy skills, coursework, and employment standards. The most immediate focus for industry is on student and community engagement by developing relationships with educators and non-profits.
Educators	Educators are confident in their ability to develop courses and curricula that prepare students for success in target roles but need support from partners to align on learning goals, get quality instructors, and work with students and families to enroll.
Non-Profits	Many non-profits are also capable skilling partners. As new content is developed, it will be crucial to understand each non-profit's skilling capabilities to determine how they can supplement learning and expand program reach to new populations.

5.1.1 Action: Build agile and aligned training pathways

Address **misaligned education pathways** and meet compressed project timelines. Training programs must become flexible, efficient, and directly relevant to employer needs.

Action initiatives:

Workforce Boards

Standardize and establish core competencies for credential requirements and safety standards for skills portability.

Employers/HR

Expand apprenticeship opportunities and other OTJ learning opportunities: Develop and scale "earn as you learn" models, including both federally registered and industry-recognized apprenticeships, for on-the-job training and a direct path to employment.

Training providers/CBOs

Develop stackable credentials and modular programs: Create short-term, flexible training modules that can be rapidly deployed (within six months) to skill-up workers for project-ready roles.

Example areas of focus:

5.1.2 Action: Pathways to success for good jobs

Streamline training programs and pipelines into the jobs that drive our economy, and provide support services to keep workers and employees in training and on the job.

Action initiatives:

Workforce Boards

Promote opportunities and outreach to employers.

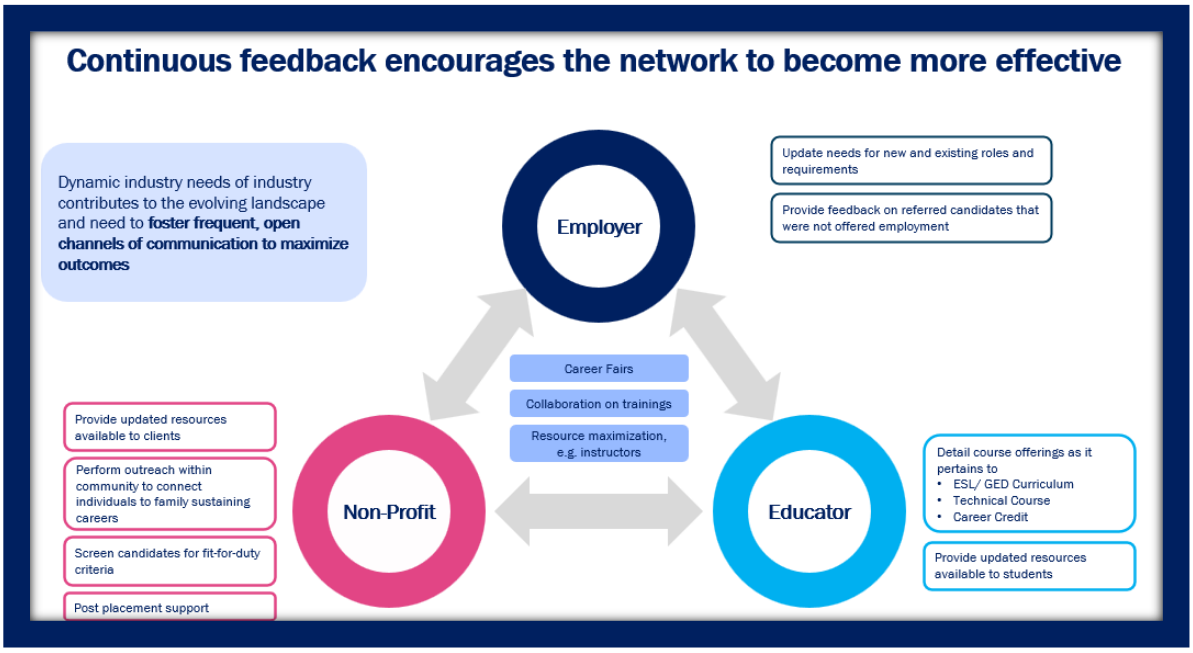
Employers/HR

Implement targeted recruitment strategies: Leverage trusted community partnerships and accessible hiring channels to reach those in targeted persona groups (veterans, unemployed individuals) not typically identified by traditional recruitment methods.

Retention: Improve retention through proven mechanisms such as formal mentorship programs, visible career advancement pathways, and the cultivation of inclusive workplace cultures where all employees feel valued and supported.

Training providers/CBOs

Integrate wraparound services: Formalize partnerships with employers to embed essential support services—like transportation, childcare, and housing assistance—directly into training programs, addressing the life challenges that can derail a learner's progress.



Credit/ Accenture

5.1.3 Action: Develop K-16+ talent pipeline learning journeys

Build out the **fragmented K-16+ pipeline**, creating a long-term talent supply through stronger connections, from early awareness in K-12 schools through post-secondary training and beyond.

Action initiatives:

Workforce Boards

Support and coordinate these actions.

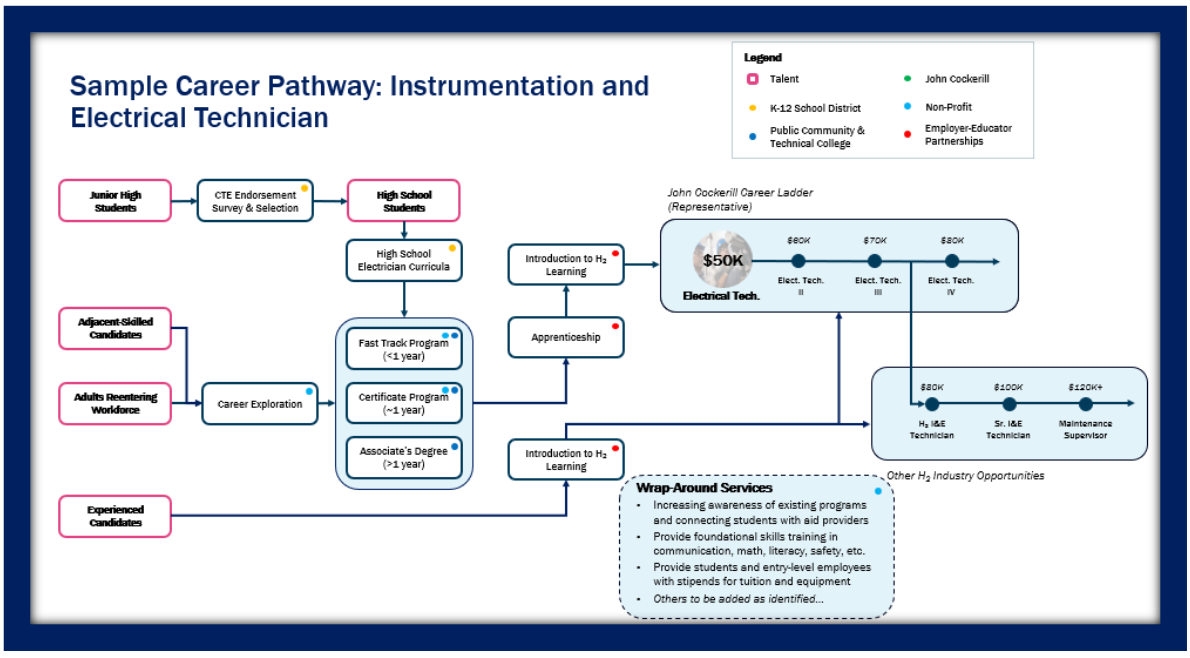
Employers/HR

Leverage the retiring workforce: Create a "retiree-to-trainee" mentorship model to facilitate knowledge transfer from experienced workers. Develop accelerated instructor certification programs for retirees to become classroom trainers and turn their decades of experience into an asset for the next generation.

Training providers/CBOs

Build structured K-12 and postsecondary partnerships: Establish clear, articulated pathways between local school districts, early college high schools, and community colleges to make technical careers more visible and accessible to young people.

Integrate existing energy curricula: Equip K-12 and college educators with industry-relevant content to teach the necessary skillsets and requirements driven by employers.



These strategic goals and action plans can be adopted and implemented by stakeholders independently or collaboratively. The most effective implementation would be coordinated and

phased for efficiency and to avoid duplication or unaligned actions. One approach to achieve that coordination follows.

5.1.4 Action: Create a regional energy workforce leadership council

To serve the region's needs, this council will include membership from:

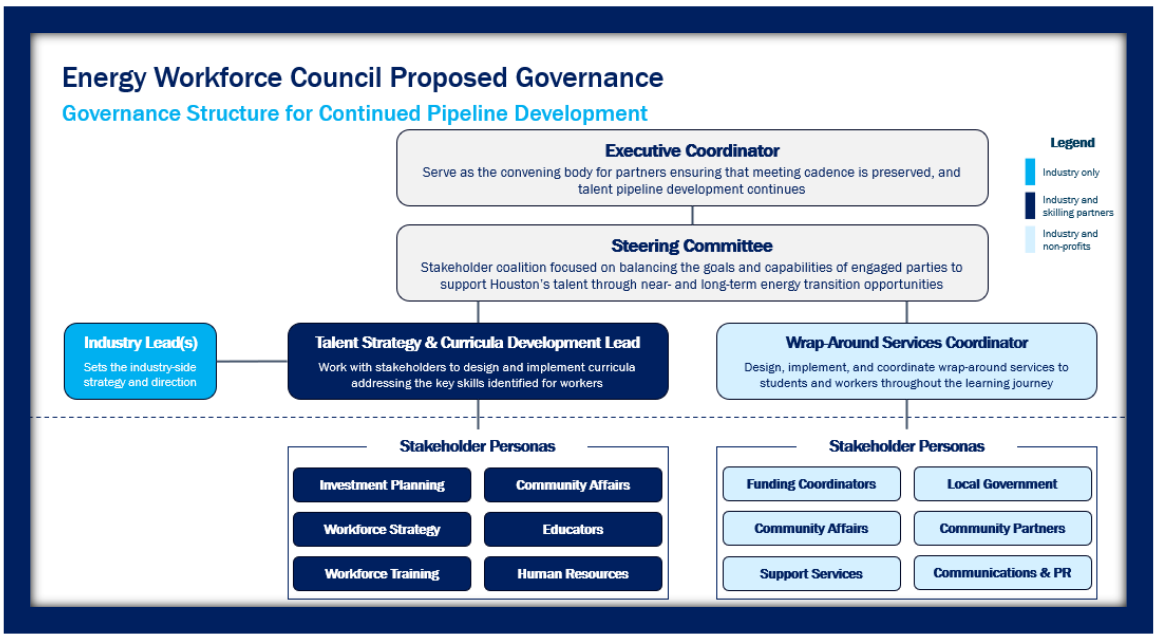
- Employers and Engineering, Procurement, and Construction (EPC) firms
- Community colleges and universities
- Regional workforce boards
- Community-Based Organizations (CBOs)
- Labor organizations
- Philanthropic partners

The council will focus exclusively on high-level *strategy, data sharing, and curriculum alignment* to ensure all partners are working toward common goals.

Each of the stakeholder groups have the ability to move forward with this work independently. However, a standalone council focused on jobs could provide valuable connectivity and coordination of efforts. Activities within this proposed council at a high level could include:

- Curriculum gap analysis
- Information sharing
- Best practices
- Fundraising methods
- Collective go-to-market strategies for talent
- Create real time learning journeys for job seekers

This would help overcome the leadership vacuum created by shifts in federal policy and a changing education and worker landscape. A central coordinating body could align stakeholders, share data, and drive a unified regional strategy. Associating this council with JPMorganChase's Resiliency Workforce Collaborative would encourage close and effective communication among the stakeholders as they advance this work.



5.2 Moving forward

The transition taking place in our economy represents a generational opportunity for the Houston region—an opportunity to reinforce its global energy leadership, drive substantial economic growth, and build more pathways to prosperity for the Gulf Coast.

This Playbook is intended to be a guide for how companies and their partners can do this in the future. It provides a blueprint for building the single most important asset required for success: a skilled and resilient human talent pipeline.

By adopting a collaborative, employer-engaged and ecosystem-based approach, the region can move beyond fragmented, reactive training efforts. Instead, we can build a cohesive system that anticipates industry needs, empowers individuals with in-demand skills, and removes breakdowns in the education to employment pipeline. This strategy ensures that as the clean energy industry grows, our communities grow with it.

The work ahead requires commitment, collaboration, and a shared sense of urgency. The call to action is clear: all stakeholders—from industry executives and college presidents to government officials and community leaders—must unite to execute this plan. By working together, we can secure Houston's position not only as a global energy capital but as a global blueprint for an equitable and prosperous energy transition.

6. Appendix and Additional Resources

6.1 RWC Member Organizations (as of December 2025)

- African American Male Wellness Agency
- Amazon Web Services
- American Aerospace Technical Academy
- American YouthWorks
- Anthropy Partners LLC
- Aspen Institute
- Avangard Innovative
- BakerRipley
- Bayou Preservation Association
- Black Arrow Group
- BridgeYear
- Capital Idea Houston
- Center for Houston's Future
- Children's Environmnetal Literacy Foundation (CELF)
- Children's Museum of Houston
- City of Houston Mayor's Office
- City of Houston Mayor's Office of Complete Communities
- Clean Energy Fund of Texas
- Compudopt
- Connective TX
- Construction Career Collaborative (C3)
- Crosswalk Center
- Dean's Professional Services
- Digital Workforce Academy
- Disrupt Gives
- East Harris County Empowerment Council
- Eight Million Stories, Inc.
- Goodwill Houston
- GovConnect
- Greater Houston Opportunity Youth Collaborative/Alliance of Community Assistance Ministries (GHOYC)
- Alliance of Community Assistance Ministries (ACAM)
- Greater Houston Partnership
- Harris County Office of County Administration
- Harris County Department of Economic Equity and Opportunity
- Harris County Department of Education
- Harris County Resources for Children & Adults
- Harris Health System
- Hope Over Hurt
- Houston Advanced Research Center (HARC)
- Houston Area Urban League
- Houston Arts Alliance (HAA)
- Houston Ballet
- Houston Center for Contemporary Craft
- Houston Food Bank
- Houston Grand Opera
- Houston Land Bank
- Houston Public Works
- Houston-Galveston Area Council (H-GAC)
- Equiliberty Community Impact
- Imagine Excellence, Inc.
- Impact Hub Houston
- JP Morgan Chase & Co.
- Launch Point
- Memorial Assistance Ministries (MAM)
- Momentum Education
- National Center for Urban Solutions
- NFL Player's Association
- National United States Armed Force Museum
- Neuhaus Education Center
- NPower
- PVAMU
- Resilient Cities Catalyst
- Rockwell Fund
- Ser Jobs
- She's Happy Hair
- South Union CDC
- Texas Economic Development Corporation (TxEDC)
- Texas Southern University
- The Harris Center for Mental Health and IDD
- The Metropolitan Transit Authority of Harris County - METRO STAR Vanpool
- The Women's Resource
- TRIO Education
- TXRX Labs
- UH Energy
- United Way Greater Houston
- University of Houston-Downtown
- Union Pacific Railroad
- UT Austin
- Vanderbilt University
- Volunteers of America (VOA Texas)
- Wesley Community Center
- William Stamps Farish Fund
- WorkFaith Connection
- Workforce Solutions
- Working Partner
- WorkTexas
- Writers in the Schools
- YMCA Houston

6.2 Acknowledgements

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Thank you to the following companies interviewed for this project:

- UHD
- Houston Area Urban League
- Port Houston
- University of Texas at Austin
- United Way
- Gulf Coast Workforce Board
- Harris County
- Lee College
- Houston City College
- Lyondell Basell
- Woodside
- API
- University of Houston
- GTI
- HARC
- MHI
- John Cockrell
- Resiliency Workforce Collaborative
- Honeywell
- Honda
- Stantec

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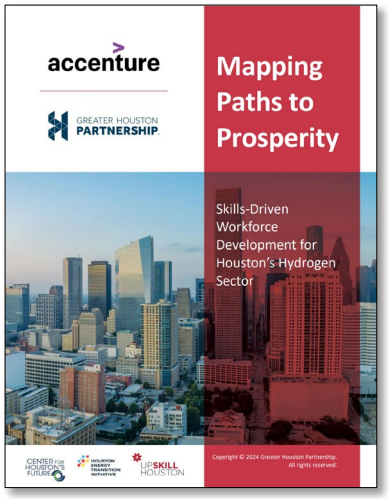
- ABB
- Accenture
- Ad Astra
- Air Liquide
- Alliance of Community Assistance Ministries (ACAM)
- Alliance of Community Assistance Ministries (ACAM)
- API
- BASF
- Bechtel
- Bloom Energy
- BP
- Brazosport College
- Bridge Year
- Calpine
- Capital IDEA Houston
- Center for Houston's Future
- Channelview ISD
- Cheniere
- Chevron
- Community Assistance Center (Montgomery County)
- Construction & Maintenance Education Foundation CMEF)
- Deer Park ISD
- Dow
- Dream It. Do It.
- East Harris County
- East Harris County Manufacturers Association
- ECHO Learning
- EDPR
- Emerson
- Exxon
- Family Houston
- Family Ties, Family Resource
- Fluor
- Fort Bend Womens Center
- Galena Park ISD
- Goodwill CTA Houston
- Goose Creek ISD
- Greater Houston Partnership
- Gulf Coast Workforce
- Harris County Office of County Administration
- HIF Global
- Higher Ed Texas
- Houston Community College
- Houston Energy Transition Initiative
- Houston Food Bank
- Houston Gulf Coast Building & Construction Trades Council
- INEOS
- John Cockerill
- JP Morgan Chase

KBR	Performance Contractors	Texas Building Trade	Wesley Community Center
La Porte ISD	Port of Houston	Texas School Alliance	Women's Home
Lamar State College Port Arthur	PowerSchool	The Competency Alliance	Women's Resource Center of Greater Houston
LaPorte ISD	Region 4 Education Service Center	The Women's Resource	Wood
Lee College	S&B Engineers	Turner Industries	Workforce Solutions
Linde	San Jacinto College	United Way	Worley
Lone Star College	SER Jobs	University of Texas PETEX	
LyondellBasell	Sheldon ISD	UpSkill Houston	
Marek Brothers	Shell	Urban League	
Mitsubishi Chemical	Siemens Energy	Volunteers of America	
NextDecade	Skilling America		
Pasadena ISD	SLB		

6.3 Mapping Pathways to Prosperity Whitepaper



accenture

GREATER HOUSTON PARTNERSHIP

Mapping Paths to Prosperity

Skills-Driven Workforce Development for Houston's Hydrogen Sector

CENTER FOR HOUSTON'S FUTURE

HOUSTON ENERGY TRANSITION INITIATIVE

UPSKILL HOUSTON

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Executive Summary

Introduction

Houston is positioning itself at the forefront of the clean hydrogen economy, actively driving initiatives to cultivate a workforce with the skills necessary to support and advance the hydrogen ecosystem.

Accenture, in collaboration with the Greater Houston Partnership and its UpSkill Houston initiative, local hydrogen-industry employers, and educational institutions, has crafted a thorough workforce development strategy to meet the needs of the emerging hydrogen economy. The program prioritizes empowering disadvantaged communities (DACs) through an employer-driven, user-centered approach emphasizing skill transferability. This approach is adaptable to other initiatives and geographies, as the accompanying report details.

Building Tomorrow's Workforce

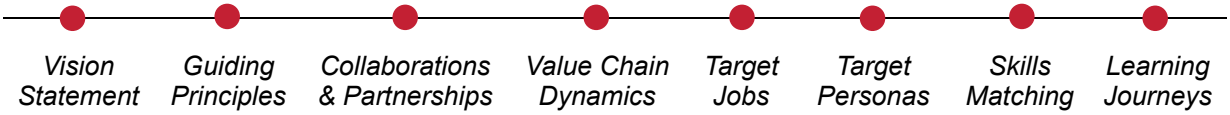
Investing in skills-based workforce and talent development is paramount for industries to keep up with advancing technologies, stay competitive and foster innovation. With a highly trained and adaptable workforce, companies can achieve increased productivity and efficiency, driving growth and success in today's ever-evolving business landscape.

Houston in Focus

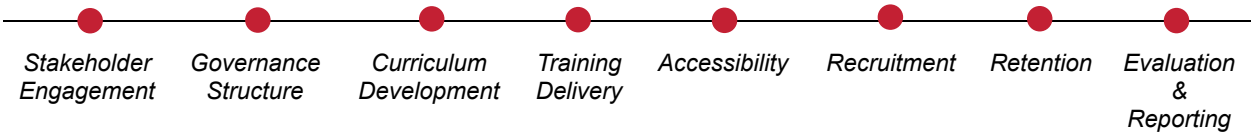
This section details the talent development strategy and implementation framework to engage Houston's DACs in its emerging hydrogen economy. The framework is flexible and can be adapted to various contexts for other initiatives.

Houston Overview: Houston's position as an industrial hub, combined with its extensive pipeline network and port infrastructure, make it an ideal candidate for leading the hydrogen economy in the US. The region anticipates a substantial increase in hydrogen demand by 2050, which presents a unique opportunity for job creation and economic growth.

Talent Development Strategy: The strategy targets high-demand, middle-skilled hydrogen jobs for DACs and identifies personas from DACs based on skill transferability and factors that might indicate a readiness or motivation to switch careers. It then aligns DAC personas to each target job through a skills-matching process and outlines tailored learning journeys to provide clear pathways from education to employment.



Implementation Framework: The framework outlines a collaboration model for community organizations to deliver targeted job training in Houston, improve accessibility, recruit and retain employees from DACs, and monitor program progress.



Looking Ahead: Expanding Our Vision

The Houston initiative is a model for inclusive workforce development in the energy sector. The program paves the way for the city's transition to a clean hydrogen economy and serves as a blueprint for other regions and industries aiming to foster a skilled, diverse workforce. Future plans include expanding the program's reach to other regions and applying the framework to other workforce initiatives.

Introduction

Houston, Texas, known as the Energy Capital of the World, is embracing a significant development in the energy industry. The city was selected to receive a $1.2 billion grant from the Department of Energy [1] to bolster its hydrogen economy, marking a major milestone towards establishing Houston as a key hydrogen hub. This development reflects a broader trend in the energy industry towards renewable and low-carbon products, underscoring the growing need for a workforce skilled in new and emerging technologies, especially in areas like hydrogen-based energy solutions.

Workforce development plays a crucial role in addressing the challenges associated with shifting towards more sustainable and low-carbon energy sources and in supporting Houston's economic growth. As the city's industrial landscape evolves, so do the skill requirements for future workers. This change underscores the importance of implementing comprehensive workforce development programs that are in tune with the current and anticipated needs of the economy.

The transition to a new energy paradigm highlights a skills gap between the current workforce and the skills required for the energy sector's continued development [2]. This gap is widened by the rapid pace of technological advancement and the ever-evolving demands of the industry, which may threaten the timely implementation of sustainable industrial practices and risks increasing economic inequality for those who do not have access to the training needed to acquire these new skills, potentially further marginalizing some communities [3].

To address this issue, Accenture, the Greater Houston Partnership, and a consortium of companies and educational institutions have launched a workforce development strategy aimed at enabling individuals from DACs to secure jobs in the emerging hydrogen economy. The program seeks to bridge the skills gap by providing training and skills development tailored to the needs of Houston's communities and fit for the energy industry's future.

This white paper delves into the strategies and methodologies driving our workforce development initiative. It aims to provide an adaptable framework for workforce training and skills development that can be tailored and applied to other regions or organizations facing similar challenges. The goal is to ensure that employees are not only equipped to meet current industry demands but are also prepared for the challenges and opportunities of the future. This approach is not just about filling jobs; it is about building sustainable careers, enhancing individual livelihoods and contributing to the broader economic and social development of communities.

In summary, this paper highlights the importance of strategic planning, collaboration, and investment in human capital as a key driver of economic growth and sustainability.

Building Tomorrow's Workforce

The Importance of Workforce Development

Workforce development is crucial in adapting to the rapid technological advancements, globalization and demographic shifts that impact the job market and demand for new skills. It prepares individuals for emerging job opportunities, ensuring organizations and economies remain resilient, competitive and innovative. Prioritizing workforce development leads to enhanced business continuity, economic growth and community well-being. It fosters a culture of continuous learning, enabling organizations to stay ahead of change. Moreover, a skilled workforce drives productivity, innovation and economic advancement, while also improving individual living standards and uplifting communities.

Future-readiness and Resilience

Organizations that prioritize workforce development are not just investing in skills; they are investing in resilience. In an era of rapid technological advancements and changing market demands, workforce development ensures that employees possess the skills to adapt to new technologies and methodologies. This readiness secures jobs and ensures that the workforce can pivot in response to disruptions, thereby maintaining resilience in the face of economic fluctuations, technological changes and global challenges. Training and continuous learning opportunities prepare workers for future roles, making the economy more agile and less susceptible to shocks [4].

Economic Implications

Investing in workforce development is about more than closing the skills gap and reducing unemployment. It is about increasing labor market participation, a key driver of economic growth. These factors are all interconnected, and by investing in workforce development, we can create a cycle of growth ultimately leading to higher GDP growth rates. Moreover, a well-trained workforce attracts investment, as companies seek regions with a capable and adaptable labor pool, further stimulating economic development and innovation. For businesses, this translates to enhanced competitiveness in the global market [4].

Organizational Productivity and Innovation

At the heart of every successful organization is its people. By fostering a culture of continuous improvement and learning, organizations can enhance productivity, efficiency and quality of work. Employees with access to training and development opportunities are more likely to introduce innovative solutions, streamline processes and adapt to new market demands quickly. This gives organizations a competitive edge while also enhancing job satisfaction and promoting employee retention, which helps in reducing turnover costs [4].

Community Enrichment

Beyond the economic and organizational benefits, workforce development plays a significant role in community enrichment. By providing individuals with the skills needed for well-paying, stable jobs, workforce development initiatives reduce poverty and increase social mobility. Educated and employed individuals are more likely to contribute positively to their communities, support local economies and participate in civic activities. By fostering community enrichment, we can build a powerful cycle of progress that leads to a more engaged, productive and prosperous society [4] [5].

Skills-Based Approach

A skills-based approach emphasizes abilities over traditional qualifications, fostering agility and inclusivity in talent management. It addresses critical areas such as recruitment, diversity and the alignment between education and employment, setting the stage for long-term growth and competitiveness.

Agility and Adaptability

In today's fast-paced and ever-changing economic landscape, organizations require a workforce that can quickly adapt to new technologies, processes and market demands. Focusing on skills rather than traditional credentials fosters an environment of lifelong learning, ensuring employees remain agile and can pivot in response to industry trends or disruptions. This agility is crucial for maintaining relevance and competitiveness [6].

Improved Recruitment and Retention

By prioritizing skills and competencies in hiring and development programs, companies can grow their talent pools, attracting a broader array of candidates. This approach also aids in retention, as it values employees for their abilities and provides clear pathways for growth based on skill acquisition. This alignment between an organization's needs and an employee's skill development fosters a more engaged and loyal workforce [7].

Diversity and Inclusion

A skills-based approach naturally leads to more diverse and inclusive workplaces. By focusing on what individuals can do rather than solely on their educational background or previous job titles, employers are more likely to attract a varied set of candidates, including those from underrepresented communities [8].

Bridging the Gap between Education and Employment

Traditional education-to-employment pathways often leave gaps in skills that are critical for job performance. A skills-based approach encourages closer collaboration between educational institutions and employers to ensure curricula align with real-world needs. This direct link helps students and job seekers acquire the specific competencies required in the workforce, making the transition from education to employment smoother and more efficient [9].

Long-term Growth and Competitiveness

For organizations and economies alike, a skills-based workforce is a cornerstone of long-term growth and global competitiveness. By continuously developing the skills of their workforce, organizations can innovate, improve productivity and adapt. This drives economic growth and ensures that workers can participate in more fulfilling, high-quality jobs, contributing to a more robust and equitable economy [10].

Houston in Focus

Driving the Transition

Houston's Position in H_2

Houston, Texas, is a recognized epicenter in energy and heavy industry, and it is now looking towards a future in hydrogen. The Gulf Coast surrounding Houston boasts a well-established pipeline network and port infrastructure, providing a solid foundation for efficient hydrogen transportation and storage. By 2050, Texas' demand for clean hydrogen alone is expected to surge to 21 MT – a substantial increase from the current 3.6 MT demand for traditionally produced hydrogen. Of this anticipated demand, 11 MT will cater to local consumption, and an additional 10 MT is intended for export [11]. The hydrogen ecosystem is projected to spark the creation of 180,000 direct, indirect and induced jobs [11].

Accelerating the Clean Hydrogen Transition Across the US Gulf Coast

The potential of clean hydrogen is evident, with estimates suggesting it could add $100 billion to Texas' GDP by 2050 [11]. The Gulf Coast, which is already responsible for one-third of the US' hydrogen production [12] and possesses most of the country's 1,600-mile hydrogen pipeline network [13], is well-placed to be a leader in this transition. Further bolstering its position, the region was recently selected to receive a $1.2 billion grant from the US Department of Energy to enhance hydrogen infrastructure [14].

Workforce Development and Community Inclusion

The region's hydrogen vision centers around inclusivity, with Houston dedicated to ensuring that all parts of the community benefit from the hydrogen economy. Following the guidelines of the federal Justice40 program, which stipulates that 40 percent of the benefits from climate and clean energy investments are directed to DACs, Accenture and the Greater Houston Partnership have been collaborating with hydrogen employers, local colleges and non-profits to establish an employer-led workforce development program to expand access to training and job opportunities in the emerging hydrogen sector. This initiative has set the strategy for structured learning pathways, stackable credentials and earn-as-you-learn programs, supplemented by support services from existing non-profit organizations.

"The Gulf Coast region, with Houston as its epicenter, is primed to leverage the world's largest concentration of existing hydrogen assets to deliver economic growth and good paying local jobs while reducing significant amounts of emissions from industrial and other sectors," said Brett Perlman, CEO of Center for Houston's Future, which worked with Accenture and the Partnership's UpSkill Houston initiative to create a blueprint for ensuring residents from historically disadvantaged communities have the opportunity to move into jobs in the hydrogen space. "We appreciate Accenture's innovative way of approaching this work. Going forward, public-private partnerships among communities, business and academic institutions are integral to success."

While those efforts are underway to ensure an inclusive hydrogen economy through workforce development, there is a broader collaboration to solidify Houston's position as a leading hub in the sector – the HyVelocity Hub.

Talent Pipeline Strategy

Vision Statement

Recognizing the growing significance of the hydrogen economy and the need for skilled labor in this sector, our vision is to connect Houston's disadvantaged communities with opportunities in the growing hydrogen economy by fostering a skilled workforce led and shaped by employer demands and needs.

"Connect Houston's disadvantaged communities to demand-driven hydrogen economy opportunities through employer-led skilled workforce development."

Guiding Principles

Our guiding principles were defined by Houston's specific goals, stakeholder feedback from employers and community colleges, and compliance with the DOE and Justice40 initiative's requirements and constraints.

Employer-Led

An employer-led approach centers on businesses driving the workforce program's direction, ensuring that training aligns with real-world job requirements. It leverages employers' insights and expertise into skill demands and workplace trends to effectively tailor education and training for DAC members.

Collaborative Approach

A collaborative approach brings together stakeholders, including businesses, educational institutions and community organizations, to pool resources and expertise. This collaboration enhances a comprehensive workforce program that tackles the various barriers disadvantaged communities face.

Skills as Assets

Viewing skills as assets emphasizes the value of practical, job-ready competencies that anyone can bring to the workplace. It focuses on recognizing and enhancing these skills through the program to improve employability and self-sufficiency.

Diversity and Inclusivity

Diversity and inclusivity ensure that the workforce program reaches and benefits all segments of disadvantaged communities, regardless of background, gender or ability. This principle advocates for equal opportunity and representation in training and employment outcomes.

Community-Driven Economic Engagement

Engaging local residents directly in the region's economic drivers ensures their active involvement in shaping and benefiting from local economic development.

User-Centered Approach

A user-centered approach prioritizes the individual experiences and needs of those in disadvantaged communities, ensuring the program is tailored to their specific circumstances. This method focuses on understanding the unique challenges, aspirations and lifestyles of these individuals, creating a workforce program that is not only accessible but also resonates with their personal and professional goals.

Scalability and Flexibility

Scalability and flexibility refer to the workforce program's ability to adjust its size and methods to meet changing demands and to expand its impact across different regions or sectors. It allows the program to

adapt to industry trends and the evolving needs of disadvantaged communities.

Lifelong Learning

Lifelong learning promotes the idea that education and skill acquisition are ongoing processes, essential for adapting to the changing job market. It encourages continuous personal and professional development, ensuring long-term employability for those from disadvantaged communities.

Continuous Evolution

Continuous evolution calls for regular reassessment and updates to the workforce program, integrating feedback and new information to remain relevant and effective. This principle is about being responsive to technological advances, labor market shifts and the dynamic needs of disadvantaged communities.

Collaborations and Partnerships

Our approach focused on engaging local industry employers with a stake in the hydrogen economy, educational institutions with experience in related fields and non-profit organizations serving DACs.

Collective Impact and Strategy Formation

Houston's consortium of stakeholders, including employers, educational institutions and non-profits, guided the development of the workforce strategy. Their collective input is invaluable in forming a comprehensive, industry-aligned and community-focused program united by a common goal for the greater benefit of Houston.

Engaging Houston-Area Industry Employers

Our collaboration with key hydrogen value-chain employers offered insights into the hydrogen industry's future in Houston and the specific skills needed for workforce development. Through group discussions and 1:1 interviews, employers outlined critical aspects of the value chain and job standards, ensuring the program aligns with industry demands.

An external steering committee of industry experts was formed to provide insights on the hydrogen sector's value chain, key jobs and required skills. This group also reviewed and validated the program's findings, ensuring alignment with industry needs.

The steering committee consisted of hydrogen subject matter experts and human resources professionals from major players such as *Air Liquide, Bloom Energy, bp, HIF, Linde, Calpine, Chevron, Dow, Shell* and *SLB*.

Partnering with Educational Institutions

Local community colleges have extensive experience in industry-specific curriculum development and strong connections to Houston's communities. Their in-depth understanding of best practices for engaging with DACs ensures that outreach efforts are well-informed and impactful.

We engaged with colleges that function as feeder institutions for many of Houston's industrial employers to understand their outreach initiatives for DACs, collaborations with employers in curriculum development, and materials about emerging hydrogen jobs.

Consulted Institutions: Brazosport College, Houston Community College, Lee College, Lone Star College, San Jacinto College

Involving Non-Profit Organizations

Non-profits like United Way and Workforce Solutions (the public workforce system) are essential in understanding and addressing community needs. Their experience in community engagement and knowledge of Houston's DACs informs strategies for community upliftment. These partnerships ensure that the program not only trains individuals but also supports them holistically, considering their broader needs and challenges.

We collaborated with United Way and Workforce Solutions to understand the unique challenges that Houston's DACs encounter, which may prevent them from engaging in training programs or obtaining and maintaining employment, and to learn about the initiatives of their partner organizations that are tackling these challenges.

Consulted Non-Profits: United Way of Greater Houston, Gulf Coast Workforce Solutions

Other Strategic Partnerships

Collaborating with labor representatives, government agencies and industry

associations ensures a comprehensive approach to workforce development. Involving labor union representatives aligns the program with workforce needs, emphasizing worker rights and compliance with labor regulations. Partnerships with government agencies enhance alignment with economic goals, providing funding and policy support to increase the program's scalability and credibility. Engaging networks from industry associations and chambers of commerce extends industry support, broadening the program's reach and securing sector-wide endorsement.

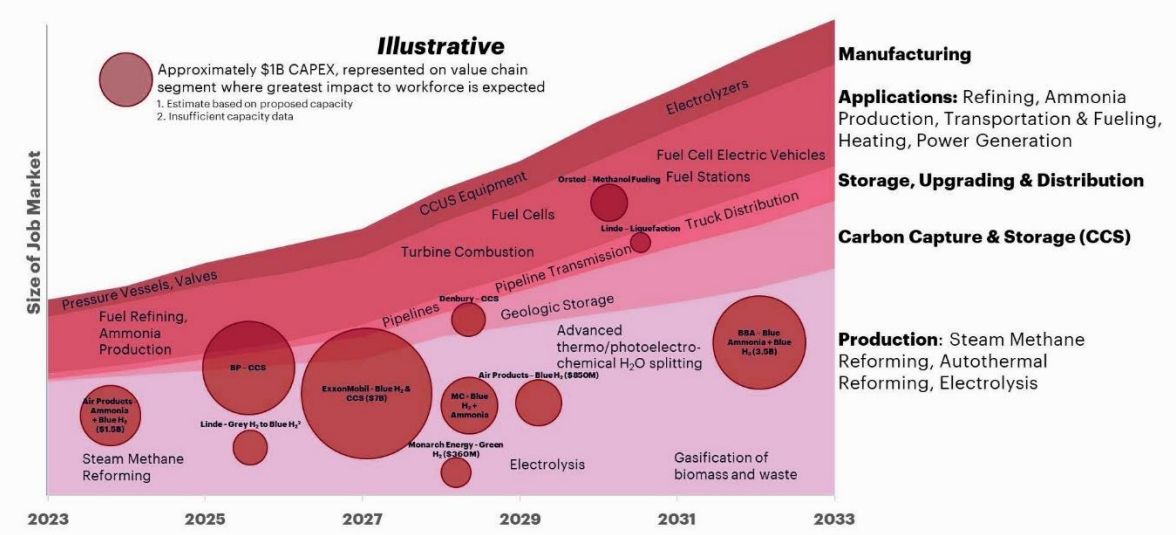
Value Chain Dynamics

We evaluated the various segments of Houston's hydrogen value chain and projected the workforce size for each segment over the next ten years, estimating the impact of publicly announced capital projects and how the evolution of the hydrogen economy will affect workforce demand and the specific job roles that will be required.

Comprehensive Value Chain Analysis

We assessed Houston's hydrogen economy over a ten-year period, examining its potential growth and the types of jobs that will be required to support that growth, as shown in *Figure 1*. Our analysis included the current state of the industry and the projected impact of approximately $20 billion in capital investments over the coming decade on the job market, specifically on middle-skilled positions critical for the industry's expansion. The occupational requirements for the engineering, procurement and construction (EPC) industry and electricity production for electrolysis are not included in this report, although advancing low-carbon hydrogen will also have a positive and sustaining impact on those related workforces. As with any such projections, employment and revenue figures are subject to significant uncertainties.

Figure 1: Relative Size of Middle-Skilled Job Market Across Houston's H_2 Value Chain [15] [16]



Assumptions

	Present	Mid-term	Long-term
H_2 Landscape	Majority of H_2 produced through steam methane reforming for internal refinery needs and ammonia production, supported by conventional industrial equipment.	CCUS projects boost blue H_2 and ammonia production, with emerging green H_2 projects and applications.	Sustained production of H_2 from hydrocarbons, supporting conventional applications. Green production expands alongside new industrial, energy storage and transportation applications.
Workforce Dynamics	Limited applications and stable operations require few directly employed in H_2 production-associated manufacturing or distribution. Carbon capture (CCUS) impact is minimal.	Escalating use of CCUS in generating blue H_2 and ammonia prompts a gradual workforce increase across the value chain. CCUS and distribution are significantly impacted, while manufacturing sees an uptick due to H_2-specific equipment production. Workforce needs for new H_2 applications begin to emerge.	Houston remains a production and distribution hub with significant workforce gains. Alongside that growth, some workforce reshuffling occurs as newer technologies gain ground.

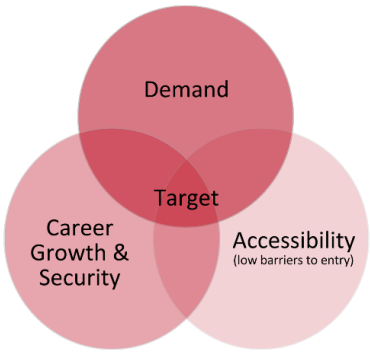
Target Jobs

We identified the most relevant jobs for DACs considering their projected demand, accessibility, career growth and stability. Our research on these jobs was validated through discussions with industry experts and by employing AI-driven data scraping of job postings and public professional social media profiles.

Establishing Evaluation Criteria for Priority Jobs

To narrow down the list of hydrogen jobs to those we would focus on, we created a framework to evaluate demand, growth potential and accessibility, as shown in *Figure 2*. This approach enabled us to prioritize roles based on current market needs and future trends and is centered around three categories of criteria, including:

Figure 2: H_2 Jobs Selection Categories



Demand:

- Indicates current and future job market needs.
- Ensures more job openings and better employment chances for DACs.

Accessibility:

- Focuses on attainability for those without advanced education.
- Includes middle-skilled jobs with good pay and benefits, offering economic and career mobility.

Career Growth and Security:

- Offers long-term employment and economic stability.
- Includes roles with advancement potential.
- Reduces risk of layoffs or job obsolescence.

Developing a Composite Scoring System

We created a composite scoring system incorporating various proxy criteria to represent demand, accessibility and career growth opportunities, as shown in *Figure 3*. The weighting of these criteria was calibrated to select jobs which would offer the best chances of success for those in DACs, as shown in *Figure 4*.

Top Priority Hydrogen Jobs

The use of a weighted average approach helped us identify the top ten key roles crucial for driving Houston's hydrogen economy. Half of these roles, as shown in *Figure 5*, are technical in nature, with the other half in planning and scheduling, and analytics and compliance. Notably, they represent approximately 30 percent of Houston's current workforce in the industrial gas sector and are projected to have a high labor demand-to-supply deficit in the region, with 20,000 openings within ten years across all industries [17].

Skills, Education and Credential Analysis

With the priority jobs identified, we assessed the qualifications these positions demand. Through AI-driven data scraping, we aggregated the typical requirements for entry-level roles to understand the necessary skills, education and credentials that Houston-area employers seek. This helps us to understand the gap between what employers require and what our target communities possess.

We also assessed hiring pathways through an analysis of online job postings for each

role, including the often-overlooked “hidden job market,” and how the requirements for our target jobs compared to the credentials of those offered by local institutions. This analysis identified potential mismatches between job requirements and candidate qualifications, highlighting where employers might be overlooking viable candidates.

Accompanying data and analysis can be found in *Appendix A: Target Jobs*.

Figure 3: Middle-Skilled Jobs Across Houston’s H_2 Value Chain [15] [16]

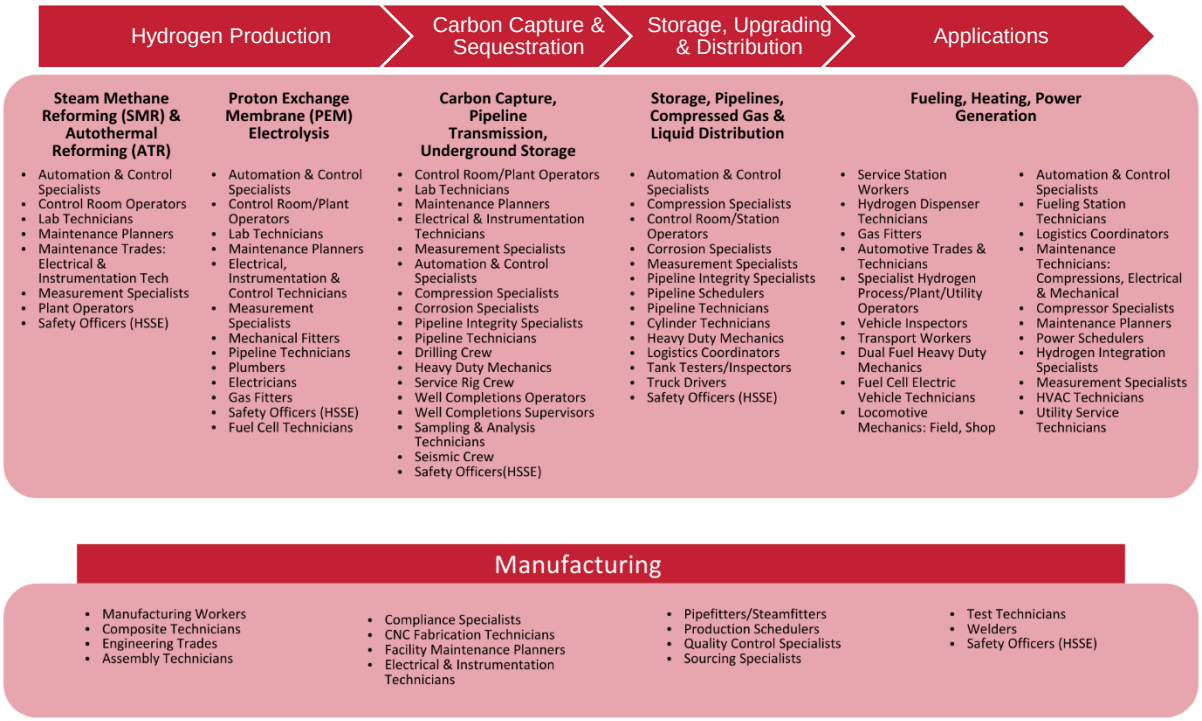


Figure 4: H_2 Job Selection Criteria [17]

	Prioritization Criteria	Prioritization Rationale	Weight	Weight Rationale	Data Source
Demand	**Applicability across Houston's H_2 Value Chain**	Broadly applicable jobs offer greater stability due to transferable skills and knowledge across multiple applications in the value chain.	20%	Jobs that are applicable across the hydrogen value chain are often more stable and offer greater opportunities for career growth and advancement as they are less vulnerable to economic downturns or changes in consumer demand.	Accenture analysis
Demand	**Projected Growth Rate in TX** (2018-2028)	A high projected growth rate suggests increasing demand for skills and expertise, creating more opportunities for career growth and higher salaries.	15%	Job outlook data is from an industry agnostic data set for all of Texas and should not be heavily indexed to determine Houston's H_2 roles.	LaborInsights (Texas Workforce Commission)
Demand	**Number of Jobs in Houston**	More jobs available means more employment opportunities and variety for job seekers, increasing the likelihood of finding a suitable job according to their skills and experience.	10%	Job outlook data is from an industry agnostic data set for all of Houston and should not be heavily indexed to determine Houston's H_2 roles.	LaborInsights
Growth & Security	**Career Growth Opportunity**	Career growth potential can help individuals from disadvantaged communities move up the social ladder, acquire new skills and gain new responsibilities for better-paying jobs and a higher standard of living.	20%	Career growth potential is essential for individuals from disadvantaged communities as it can provide economic empowerment, social mobility, positive role models for others to aspire to, and community development through contributions to the local economy.	Accenture analysis
Growth & Security	**Average Salary in Houston**	Competitive salary jobs can help individuals and families break the cycle of poverty and improve their quality of life.	10%	All jobs were above the average Houston income and therefore this data point is deemphasized.	LaborInsights (BLS)
Growth & Security	**Risk of Automation**	Automation risk is crucial for job seekers from disadvantaged communities as they may face job displacement, lower wages and reduced benefits.	5%	Selected jobs are entry-level middle-skilled, and it is assumed that job seekers will be able to advance to a point at which the risk of automation is less significant relative to other factors.	LaborInsights
Access	**Time of Attainment** (Avg Years for Edu + Exp)	Jobs with shorter prerequisites have a lower barrier to entry, making them more accessible to those in disadvantaged communities.	20%	People in disadvantaged communities may have limited financial resources and may be more likely to rely on government assistance or other forms of support while training for a job, which can lead to increased financial stress and can make it harder for individuals and families to meet their basic needs.	Accenture analysis

Figure 5: Target Jobs for Houston's H_2 Economy [17]

Better

		Technical					Planning & Scheduling		Analytics & Compliance		
	Prioritization Criteria	H_2 Mechanical Technician	H_2 Plant/Control Room Operator	H_2 Instrument & Electrical Technician	H_2 Welder	H_2 & CCUS Rig Crew Hand	H_2 Scheduler (Pipeline, Trucking, Production)	H_2 Maintenance Planner	H_2 Data Analyst	H_2 Safety Officer/OHS Technician (HSSE)	H_2 Regulatory Analyst and Compliance Specialist
Demand	Applicability across Houston's H_2 Value Chain	High	High	High	Med	Low	Med	High	High	High	High
Demand	Projected Growth Rate in TX 2018-2028	11%	-19%	8%	13%	19%	17%	13%	20%	16%	14%
Demand	Number of Jobs in Houston 2020	1,350	4,750	2,970	18,090	7,130	4,200	11,260	1,165	1,200	5,650
Growth & Security	Career Growth Potential	High	High	High	High	High	High	High	High	Med	Med
Growth & Security	Average Salary in Houston	$70K	$75K	$80K	$65K	$56K	$92K	$85K	$73K	$70K	$86K
Growth & Security	Risk of Automation	Low	Med	Med	High	High	Low	Low	Low	Low	Low
Acc.	Time of Attainment	1.0	0.0	1.0	.5	0.0	1.5	2.3	2.3	1.5	3.0

Relative Importance

Projected growth rate encompasses all related industries. While operators overall might experience a decline due to factors like automation and remote operations, this does not necessarily reflect the growth expected in H_2 -specific applications.

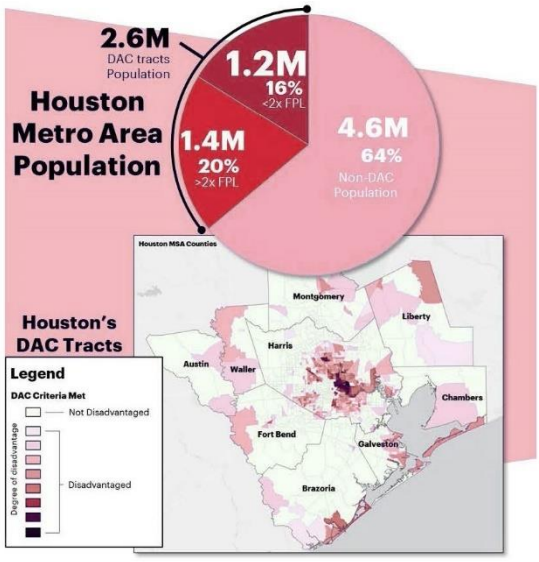
Target Personas

We analyzed Houston's DACs' educational attainment, occupations, geographic population densities and veteran status to identify effective strategies to engage these communities for targeted hydrogen industry jobs.

In-Depth Community Analysis

We leveraged data from the Climate and Economic Screening Tool and the Census Bureau to identify 2.6 million residents across over 400 census tracts that meet Justice40 criteria, which makes up 36 percent of the nine-county Houston Metropolitan Statistical Area (MSA) population, as shown in *Figure 6*. To address variables in census processes and account for DAC tract households that do not make less than two times the federal poverty line, we examined households that meet this criterion to help understand how many are most in need. This narrowed our focus to 1.2 million residents, representing 16 percent of the Houston MSA population.

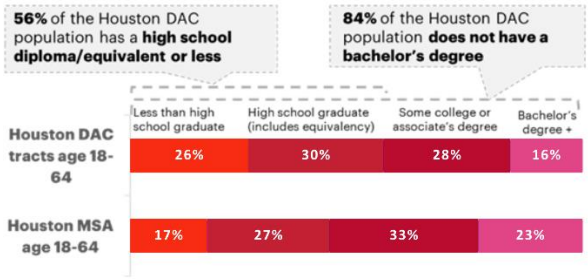
Figure 6: Houston's DAC Population [18] [19]



Identifying Burden Indicators and Educational Background

We identified common burden indicators in Houston's DACs to inform our understanding of the community's unique challenges and needs. Some of the most common burden indicators for Houston-area DACs are low educational attainment, linguistic isolation, proximity to hazardous facilities and housing impact due to climate hazards [19] [20]. The data revealed that 56 percent of Houston's DAC target population had attained a high school diploma or less, while 84 percent did not possess a bachelor's degree, as shown in *Figure 7*.

Figure 7: Educational Attainment in Houston [21]



Veteran Inclusion

Houston's DAC veterans represent a population with advanced or higher education and highly transferable skills to many of the target hydrogen roles, including logistics, heavy equipment operation and regulatory compliance [22]. 5.2 percent of those in Houston's DACs are veterans, totaling 135,000, and 59 percent are of working age (18-64), as shown in *Figure 8*. In addition, Houston's DAC veterans have an average annual income significantly above the average income in the Houston MSA and in DAC tracts, as shown in *Figure 9*.

Figure 8: Houston Veteran Education [23]

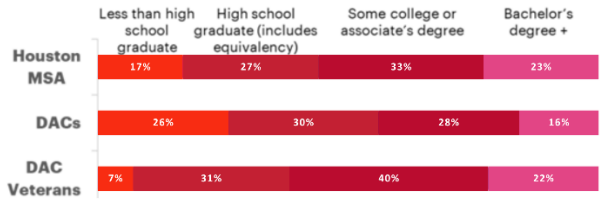
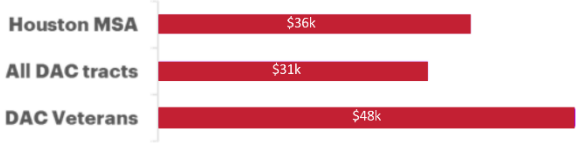


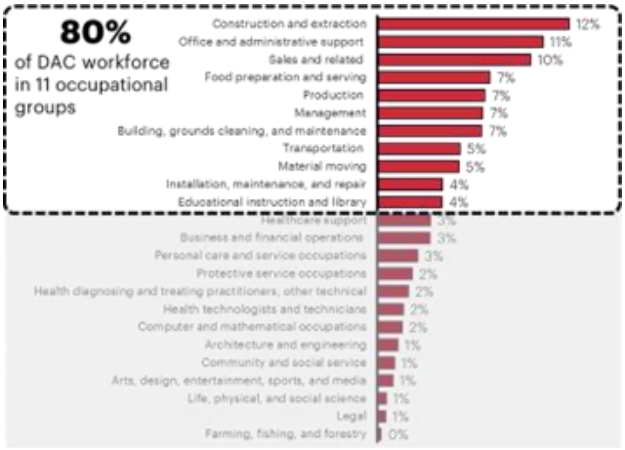
Figure 9: Houston DAC Veteran Annual Income, Per Capita [23]



Occupational Assessment

In Houston's DACs, 80 percent of the target population works in eleven key occupational groups, as detailed in *Figure 10*. This indicates the variety of skills they likely have.

Figure 10: Houston DAC Occupational Groups [24]



Weighted Persona Selection

We adopted a three-pronged approach for persona selection, focusing on skill transferability (detailed in the next section), prevalence within the DACs and motivational factors like relative salary and career growth potential versus target hydrogen jobs, as shown in *Figure 11*. This approach aims to maximize opportunities for DAC members with relevant skills, support the largest number of people in need and create incentivized career paths with lasting benefits.

Figure 11: DAC Persona Selection Categories

Out of the 150 most commonly held jobs in Houston's DACs, we selected 25 DAC target personas based on our criteria shown in *Figure 12*. These personas, such as carpenters, electricians and food service managers, demonstrated high skill transferability, ranging from 53 percent to 92 percent, highlighting the potential for these individuals to adapt quickly to hydrogen-related roles. This selection does not preclude an individual from other occupations from transitioning to hydrogen; our analysis suggests that these personas would have the most accelerated trajectory for transitioning, but there are transferable skills from every occupation that can be built upon.

Notably, the average salaries for these personas were lower than the median salary for target hydrogen jobs, suggesting a significant financial uplift for DAC members transitioning into the hydrogen industry, as shown in *Figure 17*, and demonstrating the ability for a skills-based workforce development approach to maximize opportunities for those in DACs. Personas and related information can be found in *Appendix B: Target Personas*.

Figure 12: DAC Persona Selection Criteria [17] [24] [25]

Prioritization Criteria		Prioritization Rationale	Weight	Weight Rationale	Data Source
Skills Match	**Skill Transferability to H_2 Jobs**	Leveraging existing skillsets reduces time and resources needed for hydrogen job training, narrowing skill gaps for higher completion rates and career longevity.	50%	Skill transferability addresses the skills gap, lowers the barrier to entry to DAC community members and contributes to the timely development of an H_2 workforce in the near- to short-term.	SkyHive, Accenture analysis
Mass Target	**Projected Growth Rate in TX** (2018-2028)	Identifying commonly held jobs within DAC communities reveals representative candidate pools.	25%	Capturing the most inclusive occupational information that will be representative of the largest percentage of DAC members possible is critical to community engagement and uplifting.	US Census Bureau
Incentives & Impact	**Average Salary in Houston**	Lower salary levels may provide greater motivation for career change as an increase in salary can have a more significant impact.	10%	Income is a significant component of the Justice40 DAC criteria and contributes to the identification of the community members most in need. Jobs with salaries >$65k were excluded from consideration.	LaborInsights (BLS)
	Risk of Automation	High and medium automation risk jobs threaten job security and career outlook, risking displacement and loss of income for DAC community members.	5%	Job outlook data is a composite of equally-weighed factors that impact retention and long-term growth potential.	LaborInsights
	Projected Growth Rate in TX (2018-2028)	Employment change and growth rates of DAC jobs affect job security and outlook. Negative changes risk displacement and loss of income, while positive changes may not require new career opportunities.	5%	Job outlook data is a composite of equally-weighed factors that impact retention and long-term growth potential.	LaborInsights (Texas Workforce Commission)
	Outsourcing Risk	Outsourcing risks job security and outlook for DAC members, potentially causing further marginalization.	5%	Job outlook data is a composite of equally-weighed factors that impact retention and long-term growth potential.	Accenture analysis

Skills Matching

We created a list of key skills for Houston's hydrogen sector jobs and compared them to the estimated skill proficiencies of target personas. This comparison highlights accessible job opportunities in the future H_2 economy for DAC members, indicating to employers and communities alike the alignment of existing skills with industry needs while emphasizing the areas where further training and upskilling is needed.

Identification of Skills for Target Jobs

We compiled a comprehensive list of key skills and proficiencies for entry-level target jobs based on AI analysis of job postings, stakeholder interviews and desk research, as shown in *Figure 13*. This list spanned technical, management and industry-specific skills, and we used a 0-3 scale to rate the necessary proficiency of each skill for our target jobs, where 0=no proficiency, 1=entry-level, 2=intermediate and 3=experienced.

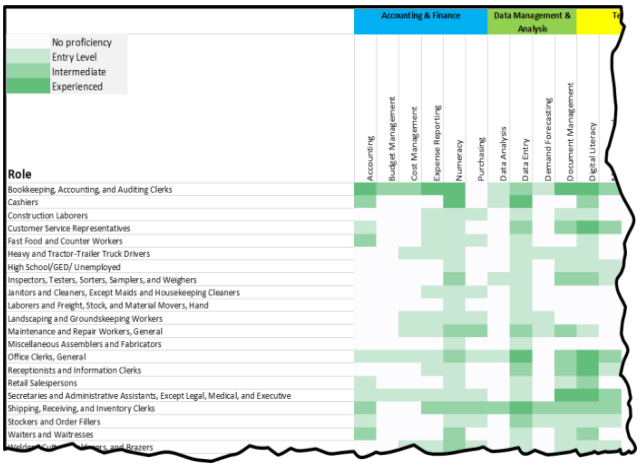
Assessing Skills of Target Personas

We evaluated the skill sets of DAC target personas using the same 0-3 scale, assessing their expected proficiency for each skill based on their occupation, as shown in *Figure 14*. This assessment helped us create profiles that highlighted their strengths and identified areas for further development.

Figure 13: Skills Inventory

Accounting & Finance	Accounting Budget Management Cost Management Expense Reporting Numeracy Purchasing
Data Mgmt & Analysis	Data Analysis Data Entry Demand Forecasting Document Management
Technology & Software	Digital Literacy Microsoft Excel Microsoft Power BI Python SAP SQL Tableau Software
Project & Time Mgmt	Coordination Project Management Scheduling Time Management
Operations Mgmt	Inventory Management Logistics Production Planning Supply Chain Management
Training & Development	Training Training Program Development
Occupational Health and Safety	Emergency Response Hazard Analysis Hazardous Materials Identification System Incident Investigation Occupational Safety and Health Act Safety Safety Auditing Safety Training Workplace Safety Planning Risk Assessment
Regulatory Compliance	Compliance Auditing Internal Audit Regulations Enforcement Regulatory Compliance
Technical Skills	Chemical Processing Cleaning Electrical Wiring Electronic Repair Equipment Calibration Equipment Maintenance Heavy Equipment Repair Hydraulics Instrumentation Maintenance Management Mechanical Equipment Maintenance Pipefitting Soldering Testing Welding
Tools & Equipment Operations	Forklift Operation Hand Tool Operation Heavy Equipment Operation Machine Operation Physically Fit
Quality Control and Assurance	Quality Assurance Quality Control
Interpersonal Skills	Adaptability Collaboration Communication Customer Service Interpersonal Responsibility Supervision Teamwork
Problem-Solving Skills	Problem Solving Reading Comprehension Troubleshooting
Hydrogen-Specific Skills	Hydrogen General Knowledge Hydrogen Policy Hydrogen Production Processes Hydrogen-Safe Materials, Coatings, and Sealants Hydrogen Safety Hydrogen-Maintenance Hydrogen Value Chain

Figure 14: Skill Proficiency Assignment



Skills Matching Process

In our skills matching process, we aligned DAC personas with target jobs by comparing their skill profiles to job requirements. We focused on matching personas to jobs where they had a higher percentage of skills at or above the minimum required proficiency, quantifying the compatibility with match percentages, as shown in *Figure 15*.

This alignment highlighted individuals' suitability for specific hydrogen industry roles based on their current skills, while also identifying the need for additional training to fully bridge any skill gaps. We then took into consideration stakeholder input to refine which personas align to each target job. Additional information can be found in *Appendix C: Skills Matching*.

Figure 15: Skills Matching

DAC Target Job \ Priority H_2 Job	Hydrogen Data Analyst	Hydrogen Regulatory Analyst and Compliance Specialist	Hydrogen Safety Technician	Hydrogen Instrument & Electrical Technician	Hydrogen Mechanical Technician	Hydrogen Process Plant Operator	Hydrogen Rig Crew	Hydrogen Welder	Hydrogen Maintenance Planner	Hydrogen Scheduler (Pipeline, Trucking, Production)
Bookkeeping, Accounting, and Auditing Clerks	62%	50%	37%	35%	37%	35%	31%	37%	42%	55%
Cashiers	32%	29%	22%	19%	20%	20%	21%	19%	19%	30%
Construction Laborers	40%	43%	51%	62%	70%	63%	75%	62%	47%	40%
Customer Service Representatives	43%	38%	31%	27%	29%	30%	29%	28%	27%	41%
Fast Food and Counter Workers	41%	39%	35%	33%	36%	35%	40%	34%	33%	42%
Heavy and Tractor-Trailer Truck Drivers	34%	36%	39%	48%	49%	47%	53%	43%	39%	40%
High School/GED/ Unemployed	15%	12%	10%	10%	11%	11%	10%	11%	11%	14%
Inspectors, Testers, Sorters, Samplers, and Weighers	29%	37%	37%	37%	38%	36%	32%	45%	32%	30%
Janitors and Cleaners, Except Maids and Housekeeping Cleaners	18%	19%	19%	20%	24%	24%	29%	24%	21%	22%
Laborers and Freight, Stock, and Material Movers, Hand	22%	20%	24%	22%	24%	24%	29%	24%	20%	23%
Landscaping and Groundskeeping Workers	28%	20%	21%	28%	30%	24%	28%	28%	22%	25%
Maintenance and Repair Workers, General	54%	48%	52%	67%	73%	63%	69%	67%	59%	55%
Miscellaneous Assemblers and Fabricators	32%	32%	37%	49%	51%	51%	53%	51%	33%	29%
Office Clerks, General	54%	42%	33%	27%	29%	30%	25%	28%	34%	47%
Receptionists and Information Clerks	38%	36%	30%	24%	25%	28%	26%	25%	27%	40%
Retail Salespersons	35%	30%	26%	24%	25%	25%	26%	24%	24%	34%
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	63%	50%	41%	36%	38%	40%	38%	36%	42%	56%
Shipping, Receiving, and Inventory Clerks	60%	45%	39%	40%	43%	43%	44%	42%	46%	67%
Stockers and Order Fillers	47%	38%	35%	38%	42%	39%	49%	38%	39%	52%
Waiters and Waitresses	44%	40%	35%	33%	36%	37%	41%	36%	33%	42%

Learning Journeys

We created educational pathways to help members of Houston's DACs acquire skills for hydrogen sector jobs, regardless of their starting point. These pathways, developed in partnership with educational and industry entities, are designed to show at a high level the milestones needed to get the necessary prerequisites for an entry-level job.

Learning Journeys for Houston's H_2 Workforce

We designed learning journeys to guide Houston's DACs through essential milestones to acquire skills and credentials for hydrogen sector jobs. These pathways are intended to illustrate a practical route to employment, as shown in *Figure 16*.

Our development of these pathways involved collaboration with educational institutions, industry partners and non-profits, ensuring alignment with educational standards, industry requirements and support services.

Tailoring to Job Requirements

The first step was to understand the specific requirements for various hydrogen roles. This involved gathering data from industry experts and job posting analyses, shown in *Appendix A: Target Jobs*.

We then evaluated the skills and education of our target personas and developed steps for further education, training and skills development. Grouping similar jobs together allowed us to create pathways applicable to multiple personas. We also considered long-term career development, providing a roadmap for future growth and advancement opportunities.

Outcome and Long-term Goals

These learning journeys aim to offer DAC members a direct, feasible route into Houston's hydrogen sector. Completing these pathways can lead to a 60 percent average increase in earnings potential compared to the average DAC persona salary, as shown in *Figure 17*.

Figure 16: Technical Learning Journey for Typical Minimum Entry-Level H_2 Job Requirements

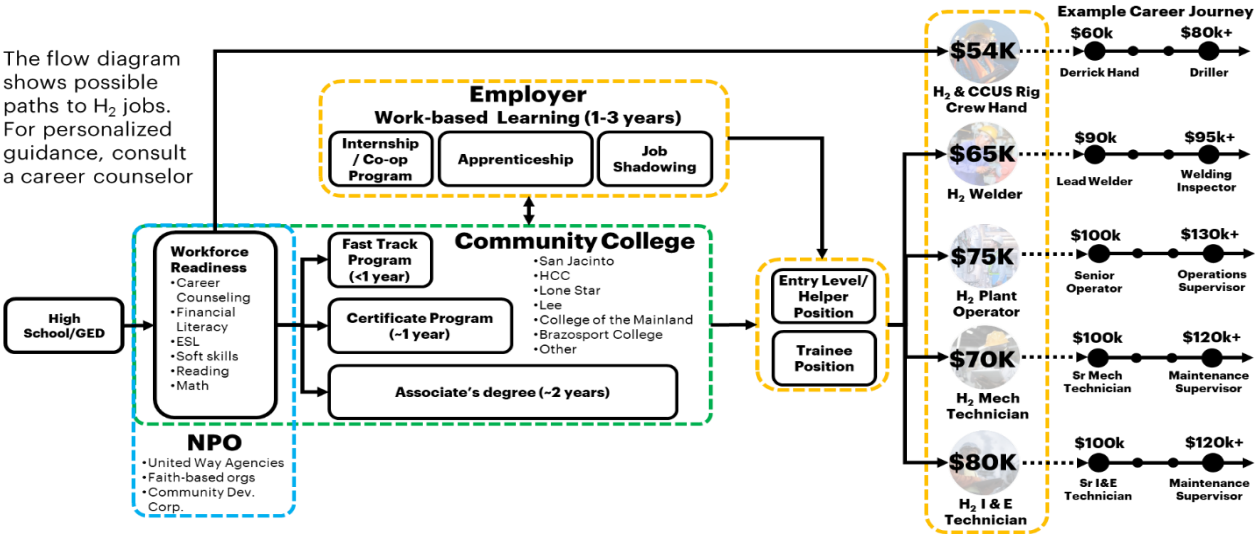
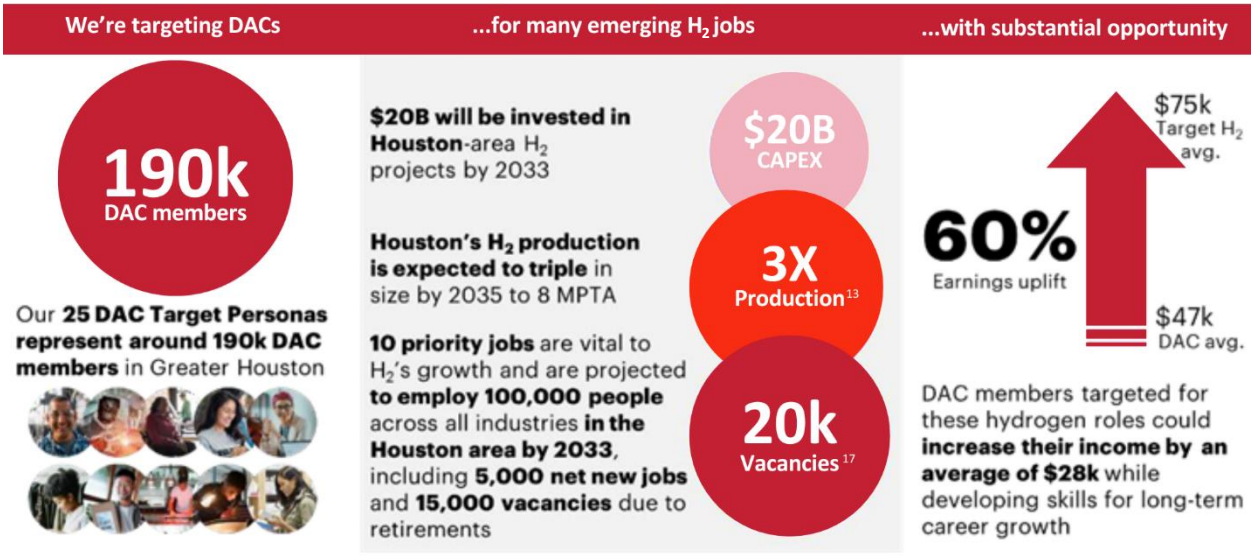


Figure 17: H_2 Jobs Represent a Major Earnings Uplift Opportunity for DACs [13] [17]



Implementation Framework

Stakeholder Engagement

Our program engaged a wide range of stakeholders, including local employers, colleges and non-profits. We identified and mapped future stakeholder roles needed for collaboration and implementation, as shown in *Figure 18*, to:

- Develop an effective governance structure,
- Ensure comprehensive curricula that address skill gaps,
- Strengthen training delivery,
- Improve education and employment access for DACs,
- Support recruitment and retention strategies,
- And improve program performance through evaluation.

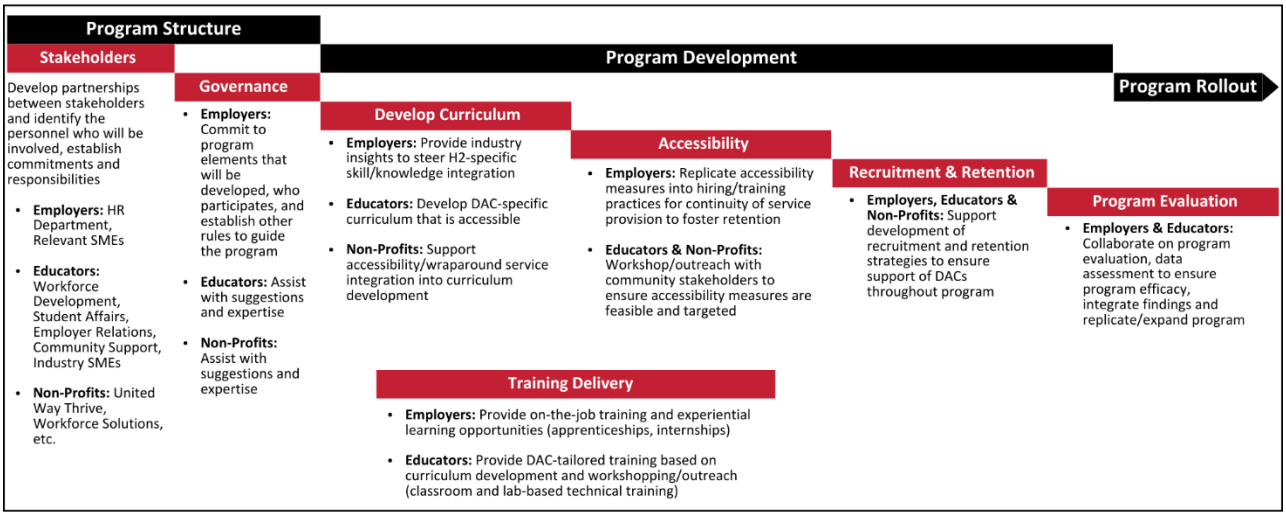
Identifying and Recruiting Stakeholders

We targeted employers expected to play a significant role in the hydrogen economy. Our focus for colleges was on institutions close to DACs and likely hydrogen job locations, prioritizing those with existing talent pipelines to the oil and gas industry. For non-profits, we chose organizations with a strong local presence and workforce development experience. The Greater Houston Partnership and Center for Houston's Future, which together comprise part of the city's chamber of commerce, facilitated the engagement of these groups.

Maintaining Involvement

We conducted bi-weekly meetings with a larger steering committee of employers during the twelve-week engagement period and organized periodic on-on-one sessions for in-depth perspectives and reviews. Smaller group meetings with educators and non-profits were held for focused discussion. All stakeholders were regularly updated on progress and final outcomes.

Figure 18: Stakeholder Roles



Governance

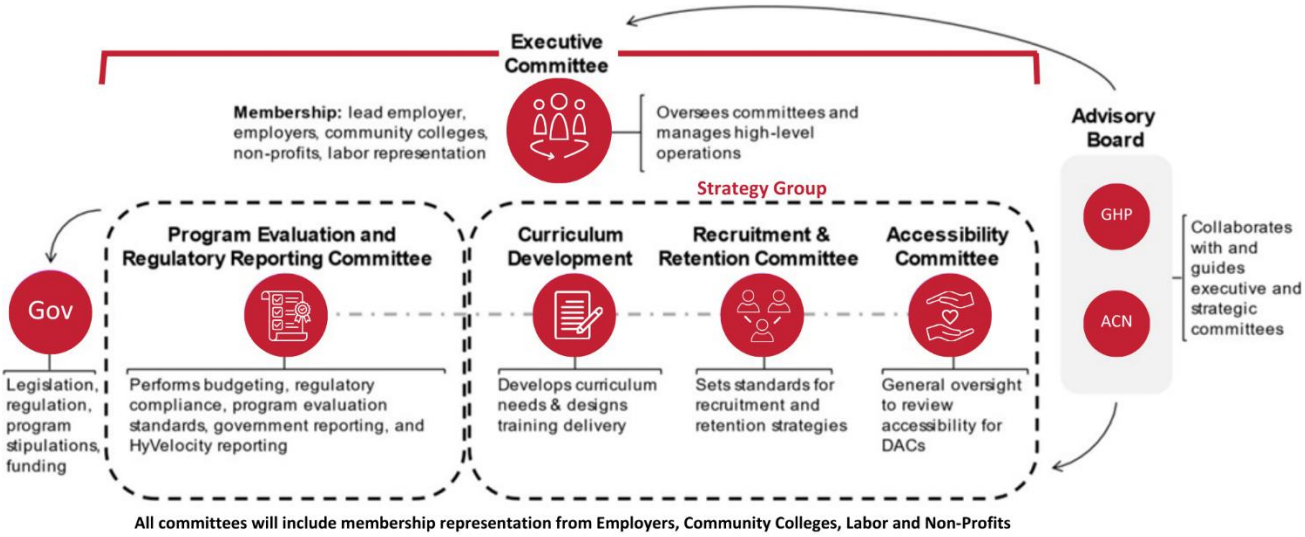
The governance model for Houston centers on an employer-led program with participation from key stakeholders, including educational institutions and non-profits, organized by the Greater Houston Partnership and its UpSkill Houston initiative.

Employer-Led Approach in Governance

The program is centered around an employer-led governance approach focused on creating talent pipelines that readily adapt to industry changes. Central to the program's success, employers offer insights into current and future skill requirements, provide on-the-job training opportunities, and are potential employers for graduates. Their involvement is pivotal in aligning training with industry demands, closing skill gaps and enhancing participant retention. Employer-led programs also provide greater control over governmental incentives, including tax breaks and grants, enabling targeted allocation to meet strategic needs.

Our governance model also emphasizes the essential roles of employers, educational institutions and non-profits in developing and implementing accessible training programs. Community colleges, using their expertise in energy and technical programs, work with employers to ensure that their curricula are updated and aligned with the specific needs of the industry. Additionally, outreach groups from community colleges and non-profits can help to actively promote these new opportunities in the hydrogen economy to address the lack of career path awareness among DAC students [26]. The key roles for successful implementation are described in the following sections, including Curriculum Development, Training Delivery, Accessibility, Recruitment, Retention, and Evaluation and Reporting.

Figure 19: Houston Program Governance Structure



Curriculum Development

We defined the fundamental skills and knowledge required for our target jobs, as shown in *Figure 21*, aiming for educational institutions and employers to collaboratively develop detailed curricula tailored to their specific needs, existing programs and processes.

Foundation and Adaptation of Existing Curricula

We first reviewed job postings and stakeholder input to identify the major skill requirements and knowledge needed for our target jobs, as shown in *Figure 20*. We then examined the existing curricula of local colleges to determine their relevance for hydrogen careers and gaps in hydrogen-specific content. Our analysis revealed that much of the necessary content for related positions and hydrogen-specifics for our target jobs may be considered the “last mile” of training and is not readily available. This evaluation provided a foundation for identifying the specific skills and coursework required for the hydrogen learning journeys.

Figure 20: H_2 Job Skill Requirements [16]

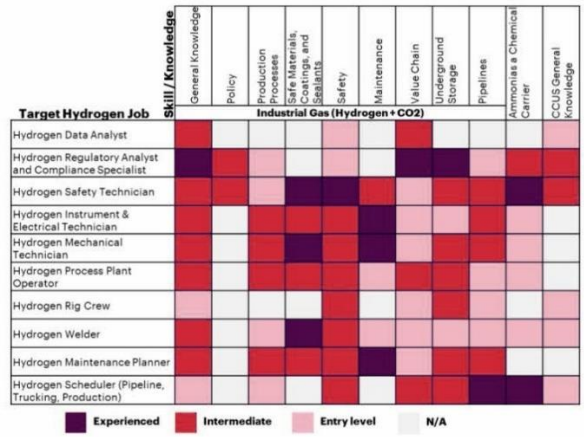


Figure 21: H_2 Skill Definitions

Skill/Knowledge Definitions		
Industrial Gas (Hydrogen + CO2)	General Knowledge	Knowledge of properties, uses and production of gases used in various industries, including grey, green and blue hydrogen
	Policy	Knowledge of laws and regulations regarding industrial gases, including related regulations, standards and codes such as environmental
	Production Processes	Knowledge of PEM, SMR, ATR and CCUS processes
	Safe Materials, Coatings and Sealants	Knowledge of materials that can handle industrial gases safely, including selection, design and maintenance of materials
	Safety	Knowledge of safety procedures and precautions when handling industrial gases
	Maintenance	Knowledge of maintenance practices and procedures to ensure safe and efficient operation of gas systems
	Value Chain	Knowledge of the entire industrial gas value chain, including energy sources, production, storage, transportation and distribution
	Underground Storage	Understanding of appropriate well completion solutions for hydrogen, storage site capacity and maintenance, tank/cavern/reservoir maintenance, and general knowledge of hydrogen properties
	Pipelines	Knowledge of pipelines used for the transportation of industrial gases, including equipment operation and maintenance
Ammonia as a Chemical Carrier		Understanding ammonia’s use as a carrier of hydrogen in energy storage and transportation, including its production and transport
CCUS General Knowledge		Understand capturing, utilizing and storing carbon dioxide emissions from industrial processes or power generation

Timing and Deployment of New Curricula

As the program moves forward, the timing and rate of need for new hydrogen roles will be assessed in relation to the evolving value chain. Educators and employers will use this information to schedule the deployment of new curricula, considering both the time required for program completion and the pace of industry demand. According to Lone Star College, development typically takes between six months to two years, depending on resource availability, complexity and scope relative to existing curricula and the necessity of alignment with industry standards and regulations, as shown in *Figure 22*.

Figure 22: Lone Star Community College's Workforce Program Development Process [27]

Process Steps and Feedback Loop

Needs Analysis: Conducting thorough research to understand the skills and knowledge required for target hydrogen jobs.

Curriculum Framework Development: Creating a framework that includes core courses, elective modules and practical training components.

Content Development and Pilot Testing: Collaborating with experts to develop course content and materials, followed by piloting and refining based on feedback.

Accreditation and Compliance: Ensuring the curriculum meets the standards set by accrediting bodies and maintaining ongoing compliance.

Regular Stakeholder Engagement: Holding meetings with stakeholders to discuss progress and make necessary adjustments, complemented by continuous feedback from students and instructors.

Training Delivery

Our training strategy stresses accessible channels for DACs with a focus on “earn as you learn” apprenticeships and shorter-duration, stackable credentials for faster career transitions.

Diverse and Engaging Training Methods

Our strategy emphasizes a blend of classroom-based learning and practical work experience delivered through multiple channels to cater to different learning styles and access requirements. This approach is backed by research from the Association for Career and Technical Education, which revealed that 81 percent of high school dropouts say relevant, real-world learning opportunities would have kept them in school [28]. The survey also found that educational experience heavily influences future work experience: participants who had impactful work-study experiences during their time in school were twice as engaged when working. Consequently, we have stressed the importance of trade programs and apprenticeships in our training approach, enhancing practical, real-world experience to create a more engaged, skilled candidate pool.

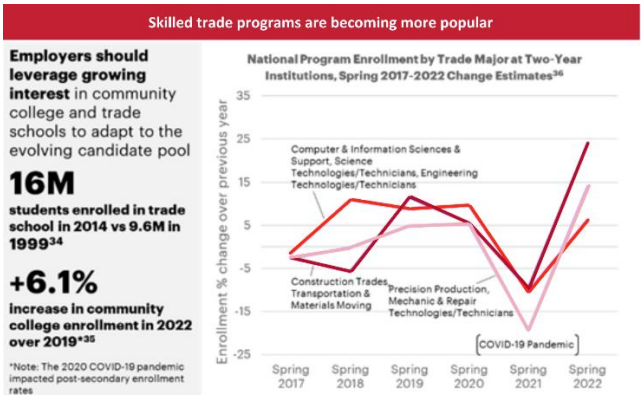
Adapting to a Changing Workforce

Recognizing the evolving preferences of the next-generation workforce, we noted that over 50 percent of Gen-Z teens are open to post-secondary education options beyond a traditional four-year degree [29], as shown in *Figure 23*.

Apprenticeship programs have shown high effectiveness, with 80 percent of US companies with such programs acknowledging their strategic value in meeting skilled labor needs [30]. The return on investment for these programs averages at 44 percent, factoring in benefits like reduced turnover, increased engagement and improved company culture [31].

Trade schools are another popular option due to relatively lower tuition and associated costs and the ability to enter the workforce faster [32]. Additionally, a 2021 study found that 25 percent of employees with associate’s degrees earn more over their lifetime than 50 percent of those with bachelor's degrees [33].

Figure 23: Trade Program Trends [34] [35] [36]



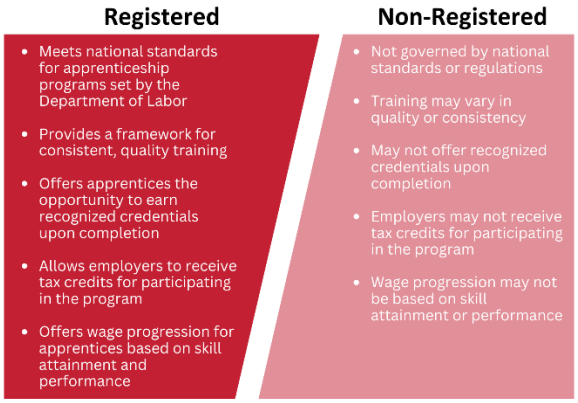
Industry Apprenticeship Precedence in Houston

There is a strong existing foundation for apprenticeship programs in the Houston area. Out of fifty local hydrogen stakeholders, fourteen had established apprenticeship programs, with twelve registered with the Department of Labor [37]. Many of these programs adhere to national standards, offering credentials and structured wage progression alongside tax incentives for participating employers, as shown in *Figure 24*. Dow’s well-established model is a great example of industry apprenticeship programs, featuring:

- Positions available for I&E Technicians, Chemical Technicians, Production & Planning Clerks, Electricians, Mechanical Technicians and Chemical Operators.
- A mix of practical, hands-on learning and classroom instruction.
- An opportunity to earn an associate’s degree upon completion, along with the prospect of full-time employment.

- A duration of over three years, with increasing emphasis on hands-on experience as time progresses [38].

Figure 24: Apprenticeship Types



Accenture's Apprenticeship Program: A Case Study

Since its inception in 2016, Accenture's apprenticeship program has grown from five to over 1,200 apprentices, 80 percent of whom did not hold a four-year degree upon hiring [39]. The "earn as you learn" structure of the six-to-twelve-month program includes formal learning, mentorship and on-the-job training across competitive technical areas including cybersecurity, application development and data, cloud, and platform engineering, which demonstrates Accenture's commitment to upskilling and hiring based on skills and experience, not just credentials.

Accessibility

Our program emphasizes collaborative strategies to address challenges DACs have accessing the workforce, like financial constraints, language barriers and limited childcare availability, as shown in *Figure 25*.

Employer Initiatives

We found that Houston employers already employ a variety of initiatives which can benefit Houston's DACs. These include offering apprenticeship programs that allow for "earning while learning" and partnering with vocational schools and community colleges for targeted skills training. By providing flexible work arrangements for those with other commitments, mentorship programs, scholarships and financial aid, employers can further support career development. Employers can also engage these communities through job fairs, internships and work-study programs, along with offering transportation assistance and language training.

Educational Support and Partnerships

We found that many of Houston's community colleges already have well-developed outreach programs for DACs and support accessibility by offering shorter programs and stackable credentials for quick workforce entry and skill progression. Many already have partnerships with employers to offer practical experience and provide career guidance on opportunities in the industry. Community outreach can help raise sector awareness, and networking and job placement services post-graduation further assist in securing industry jobs. We found that this is a program which many two-year institutions may struggle with due to budget constraints and the number of students served.

Non-Profit Contributions

Houston's non-profits can collaborate with employers and educators to offer valuable data and insights into DACs. They provide wraparound services, as shown in *Figure 26*, and advocate for workforce development policies in these communities.

Figure 25: Enabling Role of Stakeholders for Accessibility [40]

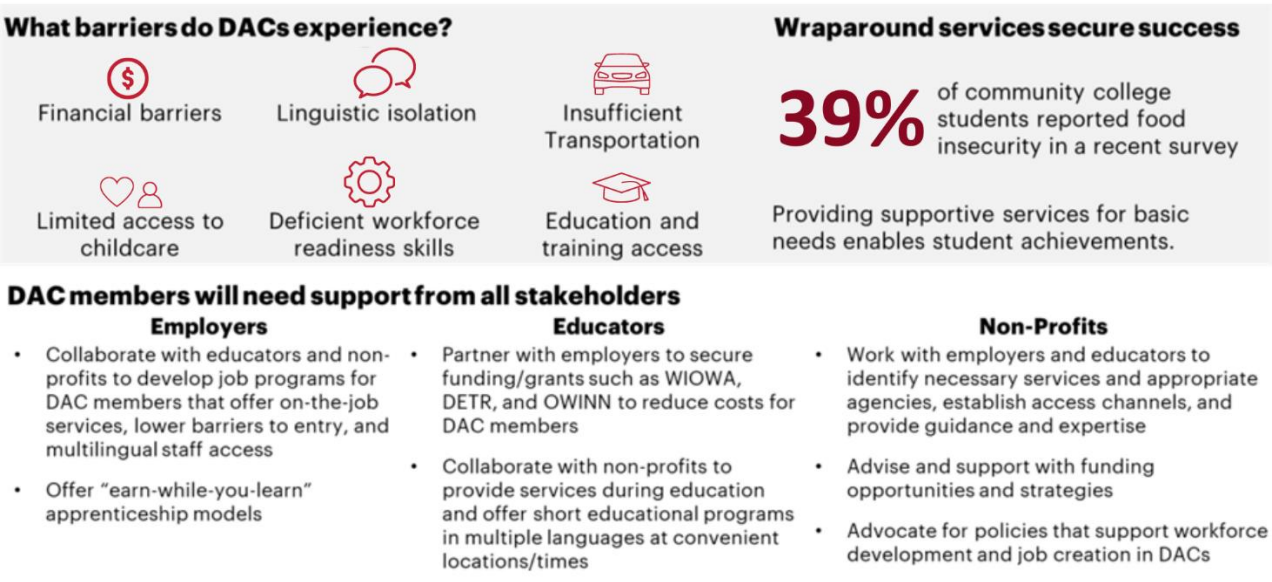
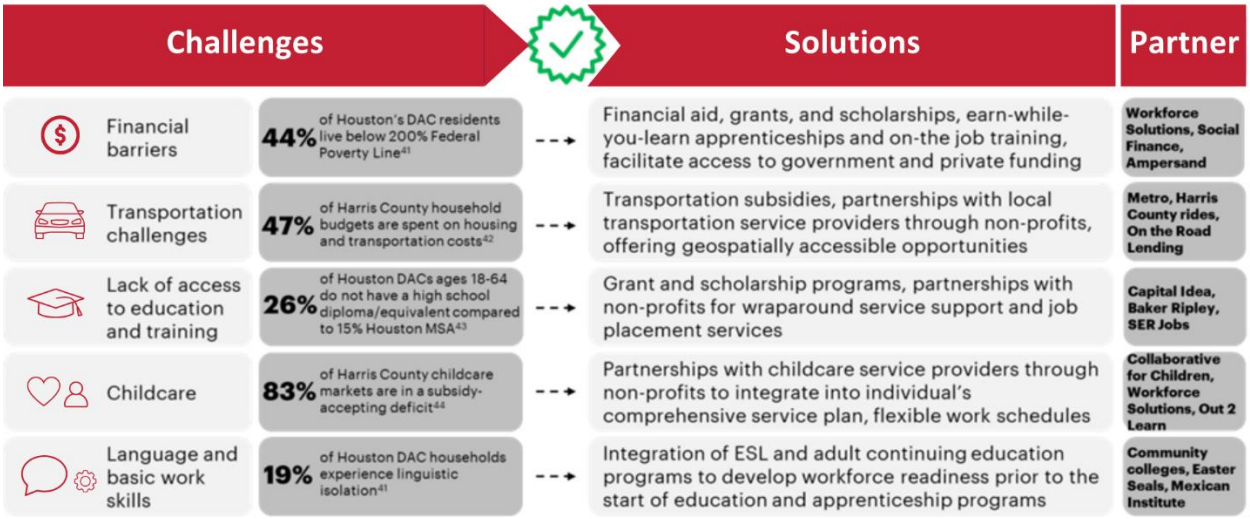


Figure 26: Houston DAC Challenges and Community Resources [41] [42] [43] [44]



Recruitment

Our recruitment strategy is based on tailored outreach and inclusive hiring, leveraging various channels and community partnerships to attract diverse candidates and promote equitable job opportunities.

Targeted Outreach and Community Partnerships

Our recruitment initiatives are focused on areas with significant DAC populations, including our target personas, high school students, the unemployed, veterans and ALICE (Asset Limited, Income Constrained, Employed) individuals through a variety of channels, as shown in *Figure 27*.

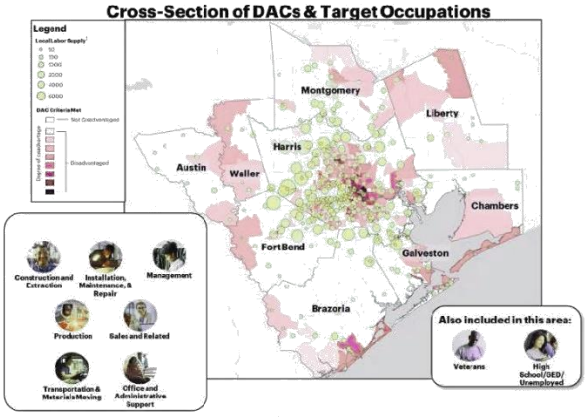
Figure 27: Community Outreach Channels

Channel	Impact
Targeted Social Media Advertising	Tailored messaging through social media advertising can connect organizations with diverse candidates from disadvantaged communities.
Targeted Local Media Advertising	Advertising in local media outlets builds credibility and reaches candidates without access to online job boards.
Targeted Job Fairs	Job fairs connect organizations with a diverse range of candidates seeking employment, especially for low-skilled or entry-level positions.
Community Events	Informal community events build trust and establish relationships with potential candidates from disadvantaged communities, including places like faith-based organizations.
Event Sponsorship	Sponsoring important events demonstrates commitment to DE&I while providing opportunities to connect with potential candidates.

Geographical Considerations in Recruitment

We have identified areas with high concentrations of our target personas, focusing our outreach and partnerships there to enhance candidate engagement and improve our hiring success, as shown in *Figures 28 and 29*.

Figure 28: DAC Persona Geographic Density [45]



Developing Accessible Hiring Channels

For each target, we plan to evaluate the current hiring methods, such as online portals or through contractor and apprenticeship conversions, to help us understand if these channels have limitations that restrict access and how we can bridge the gap.

Figure 29: Recruitment Partners [46]

Working with organizations that can **connect employers to specific DAC populations** can **improve targeted recruitment and bolster DE&I efforts**

Diverse Challenges

Many non-profits serve specific populations and can offer **valuable insights for targeted hiring efforts**.

Targeted Groups*

- Asset Limited, Income Constrained, Employed (ALICE)
- Veterans
- Unemployed
- Single Parents
- Homeless
- Minorities
- LGBTQ+
- Immigrants & Refugees
- People with Disabilities
- Highschool

*non-exhaustive

Employers

Job opportunities, internships and training, and professional development programs

Diverse/ qualified candidates, better retention/ satisfaction

Non-Profits

Community connections and social/economic barrier expertise

Employment access for underserved communities, stronger relationships/ partnerships

Workforce Solutions

Over 12 months:

- 219,000 candidates hired by employers
- Improved basic education for 21,000 candidates
- Provided $165M in financial aid for education
- Worked with 23 of our potential stakeholders

Retention

Our retention strategy focuses on mechanisms that can address systemic barriers and workplace inequalities, ensuring long-term career growth and advancement for DAC members, as shown in *Figure 30*.

Figure 30: Retention Strategy Mechanisms

Mechanisms to improve retention include…

Continuous Feedback – Regular feedback will boost engagement and reinforce learning.
Mentorship – Mentorship supports professional development and builds relationships with senior employees.
Visible Career Advancement – Visible career advancement motivates new hires when they see peers advance.
Inclusive Workplace Culture – Retain disadvantaged employees by fostering a sense of belonging and respect for diversity.
Ongoing Training and Professional Development – Retain disadvantaged employees by supporting their growth and advancement.

Continuous Feedback for Engagement and Growth

Implementing a continuous feedback system is crucial for retention, as it shows employee value and aids in personal growth. A Gallup survey from 2021 revealed that employees receiving regular, constructive feedback are four times more engaged [47]. To embed this practice, our approach includes setting regular feedback sessions and adopting structured models like “SBI” (Situation-Behavior-Impact). Also, training managers to provide balanced feedback and fostering an inclusive culture where feedback is encouraged can significantly enhance employee engagement and performance.

Mentorship for Knowledge Transfer and Inclusion

Mentorship programs help to transfer practical knowledge and integrate new employees into the workplace culture. Fortune 500 companies widely adopt these programs, with mentorship leading to five times more promotions, according to Forbes [48]. Mentorship can also support diversity and inclusion efforts, uplifting underrepresented groups within the workforce.

Visible Career Advancement Pathways

Clear, visible career advancement pathways are vital for long-term employee retention. According to a LinkedIn survey, lack of advancement opportunities is a major reason for job changes [49]. Outlining clear career progression steps and regularly communicating advancement opportunities can motivate employees and promote longevity with the employer.

Inclusive Workplace Culture

Creating an inclusive workplace culture is essential for employee retention. It promotes a sense of belonging, lowers turnover and boosts motivation. Key steps include implementing diversity, equity, and inclusion (DE&I) initiatives, backing Employee Resource Groups (ERGs) and continuously identifying and overcoming obstacles to inclusivity.

Ongoing Training and Professional Development

Ongoing training and professional development is crucial for retaining DAC employees, necessitating diverse channels like in-person sessions, online resources, industry events and on-the-job learning. Providing financial support for advanced training, such as tuition assistance, further ensures accessibility and encourages employee growth.

Evaluation and Reporting

The Houston hydrogen workforce development program is committed to thorough program evaluation and transparent reporting to ensure the program's relevance, effectiveness and adaptability to changing industry trends, as shown in *Figure 31*.

Mechanisms for Program Evaluation and Success

Setting Measurable Goals: Clear, measurable goals will be established to track the program's progress and success.

Regular Evaluations: The program will undergo regular evaluations to monitor these goals, gathering feedback to identify areas of success and improvement.

Industry Trend Adaptation: Staying updated with industry and labor market trends ensures the program continuously provides relevant and up-to-date training, fostering an adaptable and skilled workforce.

Stakeholder Engagement: Ongoing engagement with stakeholders and participants is crucial for feedback and continuous improvement.

Feedback and Improvement: Continuously improve based on stakeholder feedback.

Figure 31: Program Evaluation Mechanisms

Establishing Key Performance Indicators (KPIs)

The program's goals and federal funding requirements guide the selection of relevant KPIs, which are crucial for federal funding eligibility, as shown in *Figure 32*. These KPIs are chosen to reflect the program's multifaceted objectives and include:

Retention Rates: Monitoring the longevity of program participants in their roles.

Full-Time Conversions: Tracking the transition of participants from training to full-time employment.

Wage Increases: Measuring the economic impact on participants' earnings.

Partner and Participant Satisfaction: Assessing the satisfaction levels of all stakeholders involved.

Placement Rate: The success rate of program participants in securing employment.

Diversity, Equity, and Inclusion (DE&I): Evaluating the program's effectiveness in promoting diversity and inclusivity.

SMART Criteria: All KPIs will be Specific, Measurable, Achievable, Relevant and Time-Bound.

Regular Review and Adjustment: KPIs will be reviewed regularly and adjusted as needed to remain relevant and aligned with program goals.

Figure 32: Example KPIs for Program Success

KPI	Definition	Value Add	Stakeholder		
			Employers	Community	Funding Agency
Retention Rate	Percent of remaining participants	Program effectiveness and engagement	✓		
Full Time Conversion	Percent converted to FTE for each employer	Proportion of participants receiving full-time employment from apprenticeship	✓		
Wage increases	Percent salary increase annually	Employer pace with market value salaries		✓	✓
Partner/ Participant Satisfaction	Qualitative insight for program improvements from different perspectives	Provides insight for program improvements from different perspectives		✓	
Placement Rate	Percent graduates employed	Program skill marketability		✓	✓
DE&I	Demographics Surveys Wage gaps	Equity measures, adherence to J40		✓	✓

Looking Ahead: Expanding Our Vision

We are eager to apply our approach to Houston's hydrogen economy and expand to other areas and initiatives. As industries adapt to the energy transition, integrating DACs into the renewable sector is key to building a capable, equitable workforce that supports sustainable growth and opens economic opportunities for all. We call on all stakeholders, partners and communities to collaborate in making Houston's hydrogen economy a blueprint for inclusive workforce development that can be adapted and scaled elsewhere. For involvement opportunities, please contact us.

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Accenture

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to help our clients reinvent and build trusted, lasting relationships. We measure our success by the 360° value we create for our clients, each other, our shareholders, partners and communities. Visit us at www.accenture.com.

UpSkill Houston

The Greater Houston Partnership's UpSkill Houston initiative is a nationally recognized, employer-led collaboration that focuses on talent-driven economic development in the greater Houston region. With over a decade of operation and the engagement of more than 200 key stakeholders from business, education and the community, UpSkill Houston mobilizes these stakeholders to address the skills gap and create pathways to opportunity for the greater Houston region. The initiative targets emerging industries such as life sciences, energy, aerospace and aviation, aligning education and workforce development efforts to meet the evolving skills needs of these sectors. UpSkill Houston engages employers and develops industry-led collaborations of employers, educational institutions and community organizations that develop "work-ready" pipelines of skilled talent needed by industry and the region's economy. The initiative brings education and community partners together to adapt and align their programs to meet the skills needs of the employers. It also ensures that the employers are providing relevant information on their skills needs.

Appendices

Appendix A: Target Jobs

Figure 33: Job Postings Analysis: Minimum Requirements for Houston-Area Jobs [17]

Companies Included

Oil & Gas:
- Chevron
- Exxon Mobil
- Shell
- BP
- ConocoPhillips
- Apache
- Oasis Petroleum Inc
- Cheniere Energy Incorporated

Chemicals:
- Dow Chemical
- Evonik
- HIF Global
- LyondellBasell
- Mitsui Chemicals America Incorporated
- Phillips 66

Industrial Gases:
- Air Products
- Air Liquide
- Chart Industries
- Linde

EPCs:
- Bechtel
- Brown & Root
- CBE
- KBR Plant Engineering Services
- Technip
- Wood Group

Services Companies:
- Baker Hughes
- Basic Energy Services
- Cenergy International
- Energy Transfer Company
- Energy Transfer Family Of Partnerships
- Halliburton
- Honeywell
- JV Group
- National Oilwell Varco
- Plains All American Pipeline
- RigUp
- Schlumberger
- Amer Technology Incorporated

Utilities & Renewables:
- Bloom Energy Corporation
- Calpine Corporation
- FuelCell Energy Inc
- NextEra Energy, Inc.
- Plug Power
- Sempra Energy
- Sumitomo

Current Identified Starting Point	Job Postings x Targeted Companies: Unique Postings	Education Reference %: No Edu	HS	Assoc.	Bach.	Master	PhD	Experience Min %: No Exp. Listed	0-1 Years	2-3 Years	4-6 Years	7-9 Years
Mechanical Technician (Pipefitter, Boilermakers)	255	60%	28%	13%	5%	1%	0%	33%	5%	29%	29%	3%
Plant/Control Room Operator	19	21%	74%	11%	5%	0%	0%	63%	5%	32%	0%	0%
Instrument & Electrical Technician	71	20%	46%	51%	7%	1%	1%	24%	0%	23%	45%	7%
Welder	82	29%	68%	1%	2%	1%	0%	37%	15%	18%	17%	4%
Rig Crew Hand (Roustabout)	101	42%	50%	4%	2%	6%	0%	66%	16%	6%	12%	0%
Scheduler (Pipeline, Trucking, Production) Logisticians	140	11%	13%	4%	80%	14%	1%	24%	3%	26%	34%	6%
Maintenance Planner (First Line Supervisor)	64	27%	30%	5%	52%	2%	0%	22%	3%	8%	44%	14%
Data Analyst (market, production, supply chain, etc.)	83	23%	6%	1%	73%	10%	0%	25%	5%	28%	27%	11%
Safety Officer/OHS Technician (HSSE)	45	18%	13%	2%	78%	20%	0%	29%	3%	25%	23%	11%
Regulatory analyst and compliance specialist	102	12%	13%	2%	82%	17%	2%	29%	3%	25%	23%	11%

Statistics based on job postings with a cross section of Targeted Companies, applicable Occupational SOC codes, and occurrence within the 12 months prior to April 2023

Figure 34: Job Posting and Retirement Analysis [17]

Definitions
- Industry Agnostic Employment = current employment (supply)
- Industry Agnostic Posting = job posting within last year (demand)
- Ratio P:E =Job postings over employment
- Ratio: R:E = Retirements over employment

Insights
- High Industry Agnostic Posting to Employment ratio = high demand for labor
- High Retirement to Employment ratio = potential vacancies, opportunities for apprenticeship model
- **High ratios in either category are indicators of promising career options**

Current Identified Starting Point	Labor Supply & Demand: Industry Agnostic Employment (BLS)[1]	Industry Agnostic Postings[2]	Retiring Soon (Age 55 and Up)[3]	Ratio P:E	Ratio R:E
Welder	16,146	1,221	2,986	0.08	0.18
Maintenance Planner (First Line Supervisor)	15,068	3,514	4,418	0.23	0.29
Mechanical Technician (Pipefitter, Boilermakers)[4]	11,489	1,749	2,132	0.15	0.19
Plant/Control Room Operator[4]	9,826	160	2,219	0.02	0.23
Regulatory analyst and compliance specialist	6,064	1,605	1,550	0.26	0.26
Rig Crew Hand (Roustabout)	4,031	305	365	0.08	0.09
Scheduler (Pipeline, Trucking, Production) Logisticians	3,796	2,146	660	0.57	0.17
Data Analyst (market, production, supply chain, etc.)	2,476	562	447	0.23	0.18
Instrument & Electrical Technician	1,960	1,335	537	0.68	0.27
Safety Officer/OHS Technician (HSSE)[4]	898	400	221	0.45	0.25

1. Current Estimation from BLS/TWC or Total Amount of Social Profiles within last 3 year
2. Job Posting across all industries from the last 12 months
3. Estimation from Government Sources
4. These positions represent two SOC occupational codes

Figure 35: Online Hiring Pathway Analysis [17]

Several positions were determined to be within the "**hidden job market**," which are jobs that are not typically advertised online or through traditional job postings, **and should be reviewed to ensure they are available & accessible** to DACs

Examples of alternative hiring pathways:
- Employee referrals
- Networking events
- Contractor conversion
- Internship/Apprenticeship Conversion
- Career fairs

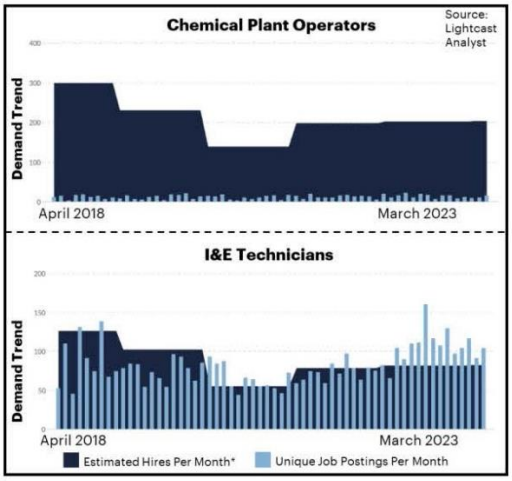
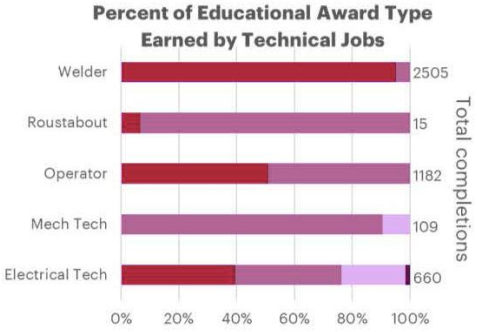


Figure 36: Education Information for Technical Jobs [17]

Assessing the credentials earned for target jobs can uncover discrepancies between job requirements and candidate qualifications, highlighting where employers may be overlooking potential candidates in the labor market



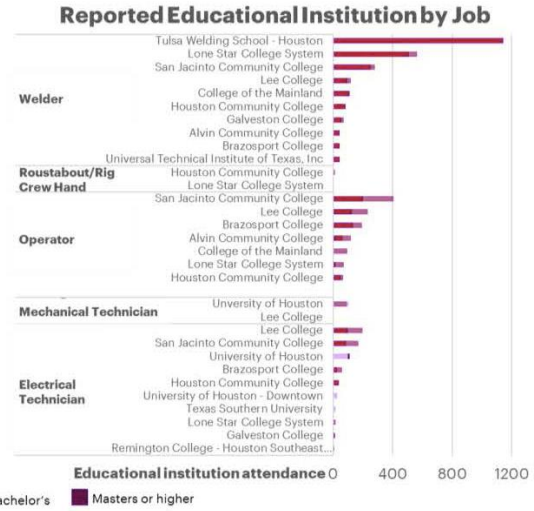
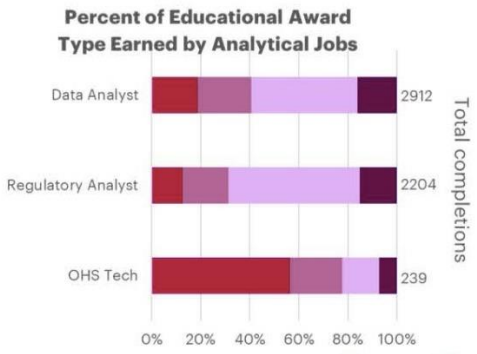


Figure 37: Education Information for Analytical Jobs [17]

Identifying institutions that grant credentials for our target jobs can help identify outreach opportunities to make these credentials more accessible to DACs



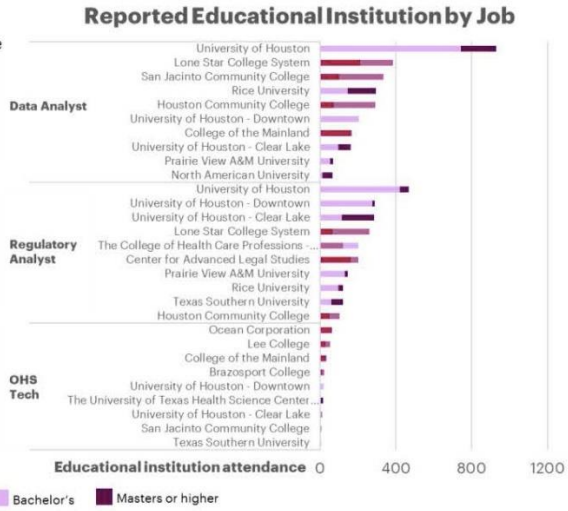
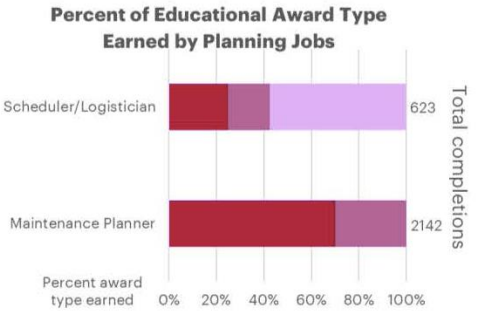


Figure 38: Education Information for Planning and Scheduling Jobs [17]

Educational pathway details, including institution-reported attendance and awards, was compiled via AI data-scraping. The tool utilizes 2021 Integrated Postsecondary Education Data System (IPEDs) data to aggregate relevant education pathways



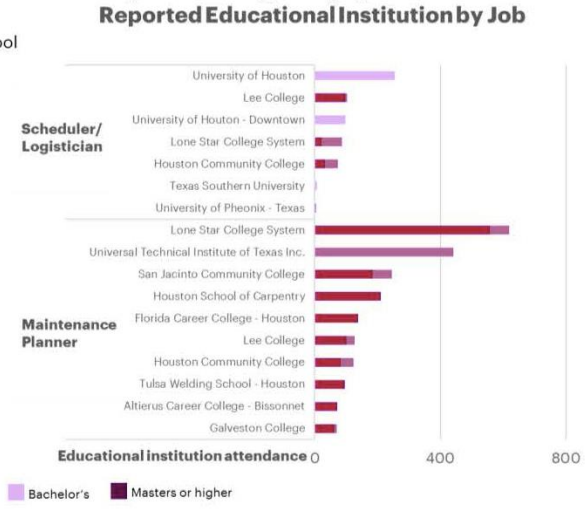


Figure 39: Target Job Education Pathways

Role	Description	Education Pathways	Specific Education
H_2 Mechanical Technician	Inspect, repair and troubleshoot for mechanical components	High school/GED Associate's degree	Certificate of Qualification: Industrial Mechanic/Millwright
H_2 Scheduler (Pipeline, Trucking, Production) Logisticians	Coordinate delivery of pipeline connections/production/trucks; ensure continuous supply by planning, analyzing, optimizing and coordinating distribution	Post-secondary certificate Associate's degree	Certification in business, commerce or related discipline
H_2 Data Analyst	Identify and collect data; clean and analyze data; interpret results; conduct predictive analytics	Bootcamps Associate's degree Bachelor's degree	Computer Engineering Information Technology Engineering Software Development Data analytics bootcamps
H_2 Operator	Oversee day to day operations of hydrogen production/chemical operations/power plant; troubleshoot equipment; issue work permits to maintenance; perform safety responsibilities with assets	High school/GED	N/A
H_2 Maintenance Planner	Develop preventive and predictive maintenance plans for the lifecycle of key electrical and mechanical equipment; track best practices for maintenance	Post-secondary certificate Associate's degree Bachelor's degree Significant experience	Certificate of Qualification: Industrial Electrician, Industrial Mechanic/Millwright or Instrumentation Technician
H_2 Instrument & Electrical Technician	Inspect, repair and troubleshoot for electrical and electronic equipment, components (AC/DC motors, programmable logic controls, wiring, etc.)	High school/GED Post-secondary certificate Associate's degree	Certificate of Qualification: Instrumentation Technician Certificate of Qualification: Industrial Electrician
H_2 Welder	Responsible for welding and joining metal components to construct, repair and maintain equipment, pipelines and infrastructure; ensure that all welding activities meet industry standards and safety regulations	High school/GED Post-secondary certificate	Certificate of Qualification: Welder
H_2 Rig Crew Hand	Operate the machine and equipment used to drill CO2 injection wells; perform maintenance, known as workovers, on CO2 wells; perform remedial treatments to ensure well integrity is maintained for the life of the well	High school/GED	Oilfield safety certifications (might be needed)
H_2 Safety Officer/OHS Technician (HSSE)	Develop and implement programs around environment, health and safety systems; monitor compliance with safety legislation; develop emergency response procedures; keep up-to-date with changes in laws, codes and standards	Post-secondary certificate Associate's degree	Occupational health and safety
H_2 Regulatory Analyst & Compliance Specialist	Analyze federal and other regulations to remain in compliance; coordinate compliance submissions to regulators; monitor new and amended laws; engage internal stakeholders to ensure alignment in regulatory applications and responsibilities	Associate's degree Bachelor's degree	Business, Accounting, Environmental and Science disciplines

Appendix B: Target Personas

Figure 40: Selected DAC Personas [17] [24] [50] [51]

		Mass Targeting		Skills Match	Incentives & Impact			
Occupation Group	Target DAC Job	DAC Population Estimate	Skill Transferability to H_2 Jobs	Average Salary (k)	Risk of Automation	Employment Change 2021-2031	Outsourcing Risk
Construction and Extraction Occupations	Carpenters	9K	76%	$45k	Med	15%	Low
	Construction Laborers	28K	74%	$37k	High	19%	Low
	Electricians	13K	78%	$53k	Low	14%	Low
	Operating Engineers and Other Construction Equipment Operators	10K	88%	$48k	High	17%	Low
	Plumbers, Pipefitters and Steamfitters	9K	87%	$56k	Low	17%	Low
	Service Unit Operators, Oil and Gas	4K	87%	$48k	High	19%	Low
Installation, Maintenance, and Repair Occupations	Automotive Service Technicians and Mechanics	5K	87%	$48k	Med	8%	Low
	Control and Valve Installers and Repairers, except Mechanical Door	1K	79%	$50k	Med	15%	Low
	Maintenance and Repair Workers, General	11K	73%	$44k	Med	14%	Low
Management Occupations	Food Service Managers	1K	82%	$59k	Low	21%	Low
Office and Administrative Support Occupations	Bookkeeping, Accounting and Auditing Clerks	11K	60%	$45k	High	6%	High
	Dispatchers, except Police, Fire and Ambulance	2K	67%	$41k	High	11%	Low
	First-Line Supervisors of Office and Administrative Support Workers	12K	81%	$62k	Low	7%	Low
	Office Clerks, General	19K	53%	$42k	High	4%	Med
	Production, Planning and Expediting Clerks	3K	82%	$52k	High	12%	Med
	Shipping, Receiving and Inventory Clerks	7K	65%	$38k	High	8%	High
	Tellers	3K	71%	$31k	High	4%	High
Production Occupations	Coating, Painting and Spraying Machine Setters, Operators and Tenders	2K	83%	$40k	Low	12%	Low
	Computer Numerically Controlled Tool Operators	2K	81%	$43k	Low	-2%	Low
	Electrical, Electronic and Electromechanical Assemblers, except Coil Winders, Tapers and Finishers	2K	69%	$39k	Med	7%	Low
	Machinists	4K	92%	$48k	Med	11%	Med
	Packaging and Filling Machine Operators and Tenders	2K	68%	$33k	High	8%	Med
	Welders, Cutters, Solderers and Brazers	8K	78%	$49k	High	13%	Low
Sales and Related Occupations	First-Line Supervisors of Retail Sales Workers	12K	74%	$48k	Low	10%	Low
Transportation and Material Moving Occupations	First-Line Supervisors of Transportation and Material Moving Workers, except Aircraft Cargo Handling Supervisors	6K	76%	$54k	Low	15%	Low

Appendix C: Skills Matching

Figure 41: Target Jobs Matched to DAC Personas [17]

H_2 Role	Avg Salary	Risk of Automation	Employment Change	DAC Job Match	Match %	DAC Population Estimate	Avg Salary	Risk of Automation	Employment Change
H_2 Instrument and Electrical Technician 	$80k*	Med	8%	Electricians	74%	13K	$53k	Low	14%
				Maintenance and Repair Workers, General	67%	11K	$44k	High	14%
				Automotive Service Technicians and Mechanics	82%	5K	$47k	Med	8%
				Computer Numerically Controlled Tool Operators	78%	2K	$43k	Low	-2%
				Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	67%	2K	$39k	Med	7%
H_2 Mechanical Technician 	$70k*	Low	11%	Construction Laborers	69%	28K	$37k	High	19%
				Plumbers, Pipefitters, and Steamfitters	85%	9K	$56k	Low	17%
				Automotive Service Technicians and Mechanics	85%	5K	$47k	Med	8%
				Machinists	92%	4K	$52k	Med	11%
				Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	83%	2K	$40k	Low	12%
H_2 Operator 	$75k	Med	-19%	Operating Engineers and Other Construction Equipment Operators	76%	10K	$48k	High	17%
				Plumbers, Pipefitters, and Steamfitters	80%	9K	$56k	Low	17%
				Automotive Service Technicians and Mechanics	80%	5K	$47k	Med	8%
				Service Unit Operators (wireline), Oil and Gas	83%	4K	$48k*	High	19%
				Packaging and Filling Machine Operators and Tenders	61%	2K	$33K	High	8%
H_2 & CCUS Rig Crew Hand 	$56k	High	19%	Construction Laborers	74%	28K	$37k	High	19%
				Maintenance and Repair Workers, General	69%	11K	$44k	High	14%
				Carpenters	76%	9K	$48k	Med	15%
				Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	82%	2K	$40k	Low	12%
				Control and Valve Installers and Repairers, Except Mechanical Door	79%	1K	$50k	Med	15%
H_2 Welder 	$65k*	High	13%	Construction Laborers	60%	28K	$37k	High	19%
				Maintenance and Repair Workers, General	65%	11K	$44k	High	14%
				Welders, Cutters, Solderers, and Brazers	78%	8K	$49k*	High	13%
				Automotive Service Technicians and Mechanics	74%	5K	$47k	Med	8%
				Machinists	82%	4K	$48k*	Med	11%
H_2 Maintenance Planner 	$85k*	Low	13%	Electricians	59%	13K	$53k	Low	14%
				Maintenance and Repair Workers, General	57%	11K	$44k	High	14%
				Plumbers, Pipefitters, and Steamfitters	66%	9K	$56k	Low	17%
				Welders, Cutters, Solderers, and Brazers	52%	8K	$51k	High	13%
				Production, Planning, and Expediting Clerks	55%	3K	$52k	High	12%
H_2 Scheduler Logistician 	$92k	Low	17%	First-Line Supervisors of Retail Sales Workers	72%	12K	$48k	Low	10%
				Shipping, Receiving, and Inventory Clerks	65%	7K	$38k	High	8%
				First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	76%	6K	$54k*	Low	15%
				Production, Planning, and Expediting Clerks	82%	3K	$52k	High	12%
				Dispatchers, Except Police, Fire, and Ambulance	59%	2K	$41k	High	11%
H_2 Data Analyst 	$73k	Low	20%	Office Clerks, General	53%	19K	$42k	High	4%
				First-Line Supervisors of Office and Administrative Support Workers	81%	12K	$62k	Low	7%
				Bookkeeping, Accounting, and Auditing Clerks	60%	11K	$45k	High	6%
				Tellers	71%	3K	$31k	High	4%
				Food Service Managers	76%	1K	$59k	Low	21%
H_2 Regulatory & Compliance Specialist 	$86k	Low	14%	First-Line Supervisors of Office and Administrative Support Workers	79%	12K	$62K	Low	7%
				Bookkeeping, Accounting, and Auditing Clerks	51%	11K	$45k	High	6%
				Operating Engineers and Other Construction Equipment Operators	57%	10K	$48k	High	17%
				First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	73%	6K	$57k	Low	15%
				Service Unit Operators, Oil and Gas	71%	4K	$54k	High	19%
H_2 Safety Officer/OHS Tech 	$70k*	Low	16%	Plumbers, Pipefitters, and Steamfitters	79%	9K	$56k	Low	17%
				First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	76%	6K	$57k	Low	15%
				Service Unit Operators, Oil and Gas	81%	4K	$54k	High	19%
				Dispatchers, Except Police, Fire, and Ambulance	63%	2K	$41k	High	11%
				Food Service Managers	77%	1K	$59k	Low	21%

Adjustment made from SME input and Accenture Analysis

Appendix D: Learning Journeys

Figure 42: Planning and Scheduling Learning Journey: Typical Minimum Entry-Level Requirements for H_2 Jobs

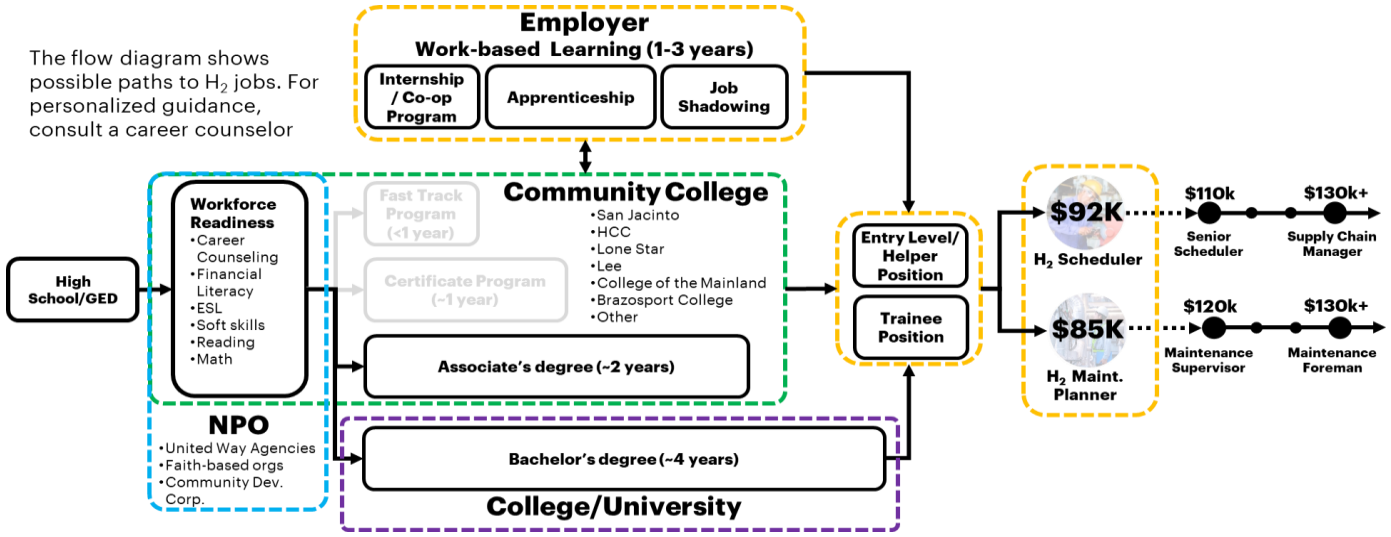
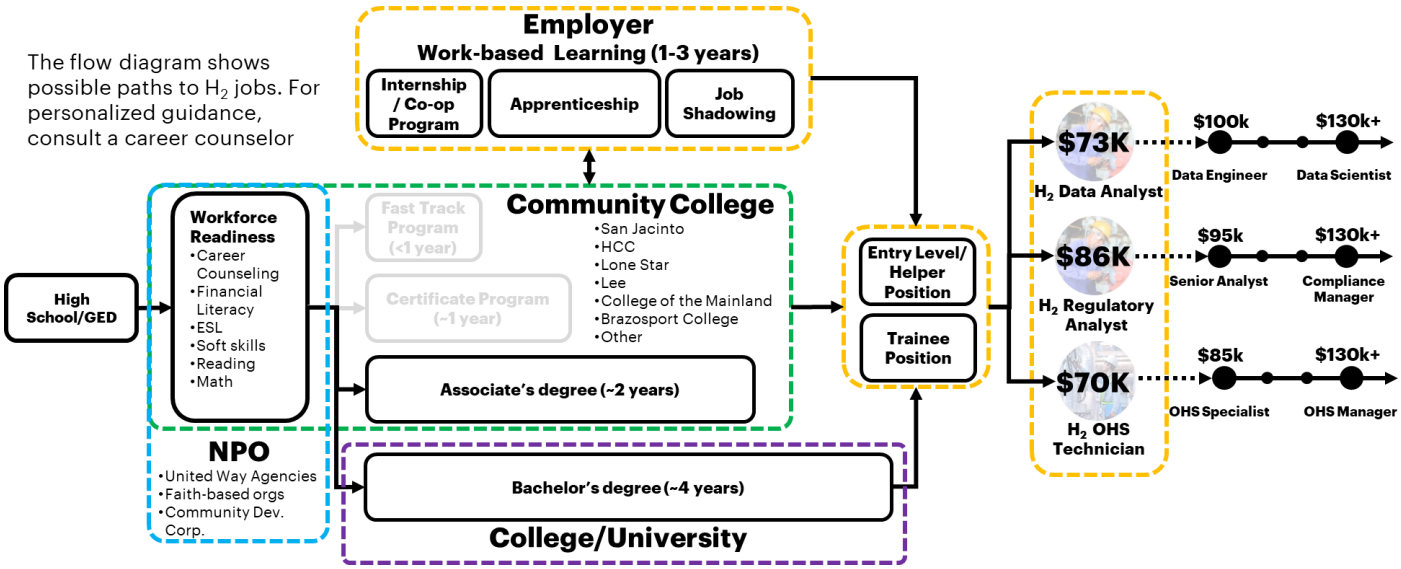


Figure 43: Analytics Learning Journey: Typical Minimum Entry-Level Requirements for H_2 Jobs



Glossary

DACs (Disadvantaged Communities): Areas identified by socioeconomic metrics that show significant disadvantages in terms of income, access to education and employment opportunities.

Hydrogen Economy: A proposed system of delivering energy using hydrogen. The hydrogen economy encompasses all aspects related to the production, transportation, storage and use of hydrogen as an energy product.

Workforce Development: Strategies and practices aimed at enhancing the skills and competencies of the workforce to meet the current and future needs of industries and economies.

Employer-Driven User-Centered Approach: A strategy in workforce development that prioritizes the demands and needs of employers while also considering the user experience of employees or job seekers in program design and implementation.

Learning Journeys: Tailored educational and training pathways designed to equip individuals with the necessary skills and qualifications for specific job roles, emphasizing a clear route from education to employment.

Skills Matching: The process of aligning an individual's skills and competencies with the requirements of available jobs, facilitating effective job placement and career development.

"Earn As You Learn": These programs enable participants to gain skills and earn income simultaneously, facilitating access to new sectors without financial hardship.

Stackable Credentials: Flexible, accumulative qualifications that allow for tailored career development, supporting stepwise progression into higher-wage positions.

Hidden Job Market: The portion of the job market not advertised publicly, often accessed through networking, speculative applications or internal referrals, representing a significant volume of employment opportunities.

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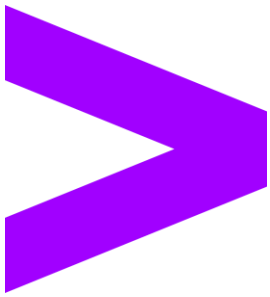

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