County of Humboldt

Redwood Coast Region Offshore Wind Workforce Assessment

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COMPLIANCE AND FUNDING DISCLOSURE

This work was undertaken in compliance with the applicable requirements of the Federal Funding Accountability and Transparency Act, 2 C.F.R. Part 200, 2 C.F.R. Part 2900, and all relevant implementing regulations, policies, procedures, and standards in effect at the time of performance, as amended.

The deliverables and activities described in this report were supported by the Workforce Innovation and Opportunity Act (WIOA), with zero (0) percent financed from non-federal sources. All work was carried out in compliance with the applicable provisions of the Workforce Innovation and Opportunity Act Subgrant Agreement (Subgrant No. AA211007), as amended, between the County and the California Employment Development Department.

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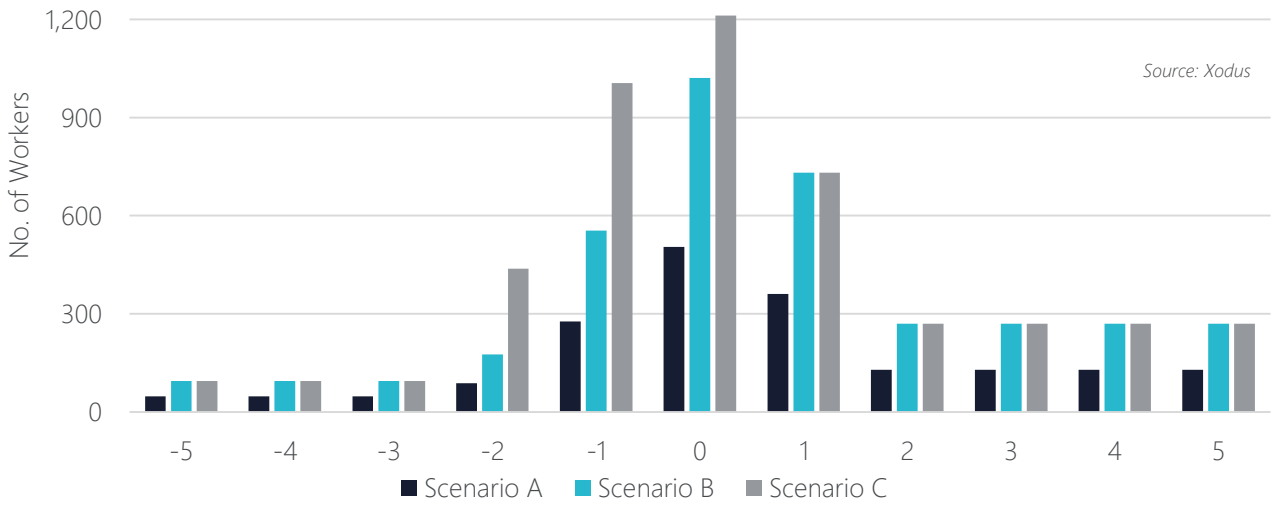
EXECUTIVE SUMMARY

This report assessed the opportunities and workforce impacts of offshore wind development in Humboldt County and the broader Redwood Coast region. This study was commissioned to evaluate the local workforce's capacity to support a growing offshore wind industry following the offshore wind lease sales in December of 2022, the anticipated development of the Port of Humboldt Bay for staging and integration (S&I), and Assembly Bill 525's identification of potential operations and maintenance sites, including Crescent City.

Three offshore wind development scenarios were considered to assess varying levels and workforce demand profiles in the region. Scenario A focuses on the development of a single 1-gigawatt (GW) project using the port as an S&I site; Scenario B analyzes the impact of two simultaneous commercial scale projects utilizing the port for S&I; and Scenario C assumes two simultaneous commercial scale projects with major component manufacturing, foundation assembly, and S&I at the Port of Humboldt Bay. The figure below shows the varying workforce required from the region for each scenario, relative to the Commerical Operations Date (COD) of the project, ranging from an annual peak demand of approximately 500 workers in Scenario A to 1,200 in Scenario C.



Workforce demand relative to commercial operations date for workers from the Redwood Coast Region in Scenarios A, B, and C, as assessed in the Workforce Assessment report

KEY FINDINGS

Job Creation: The development of offshore wind projects in the region has the potential to create anywhere from approximately 500-1200 jobs during peak construction and installation years in the Redwood Coast. Job creation is highly dependent on the scale and scope of port activity. Most of these job roles are primarily in the skilled trades, including electricians, welders, crane operators, and longshore workers. Scientific and engineering occupations will be required throughout all phases of the project lifecycle, with the longest-term opportunities arising during the operations and maintenance phase (O&M). Depending on port development timelines and future offshore wind project pipelines, the staging and integration site (S&I) and O&M site(s) could support long-term, locally based jobs in the building and maritime trades industries, given consistent project pipelines and full utilization of local ports.

Training and Workforce Gaps: There is a shortage of training and apprenticeship programs needed for building a qualified offshore wind workforce in the region. The most significant gaps are anticipated in welding, crane operations and electrical work. While workforce and training gaps in other sectors have not been quantified, the growing demand from both local construction activity and offshore wind development is likely to compound labor pressures, outpacing the region's current training capacity. A well-coordinated cross-sector workforce strategy, supported by investment in targeted training programs and apprenticeships will be critical for enabling local workforce participation. Instittutions such as Cal Poly Humboldt and the College of the Redwoods, as well as partnerships with statewide union programs, will be critical in addressing these training needs.

Workforce Transferability: Offshore wind development draws on a wide range of skills from adjacent industries such as construction, transportation, logistics, and manufacturing. However, the Redwood Coast has limited employment in these sectors. The local economy is more concentrated in occupations such as local government, education, healthcare, and hospitality, which offer fewer transferrable skillsets. As a result, strategic upskilling and training will be necessary to align the local labor force with offshore wind requirements across construction, operations and maintenance.

Challenges: Peak installation periods may bring an influx of transient workers, creating strain on local infrastructure, especially considering the region's remoteness, limited population base, and constrained transportation systems. Local governments should conduct economic impact modelling to assess potential stressors on housing, utilities and childcare. Findings can inform a strategy for investment in wraparound services that support both incoming and existing workers.

1 INTRODUCTION

1.1 Project Overview

Xodus has been contracted by Humboldt County's Economic Development Division to conduct a comprehensive assessment of the local and regional supply chain, workforce, and community related to offshore wind. This workforce assessment will focus on Humboldt County ('local') and the wider Redwood Coast region, which includes Del Norte, Mendocino, and Lake Counties, as well as Tribal Lands; (collectively defined as 'regional'). This assessment required a comprehensive understanding of residents' priorities, concerns, and perspectives regarding offshore wind development in the region, including those of Indigenous populations.

The Redwood Coast Region Offshore Wind Workforce Assessment is part of a broader set of study reports, as shown in Figure 1.1, where the final workforce and supply chain assessment will serve as the basis for developing the final deliverables of this work: a Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis and strategic recommendations.

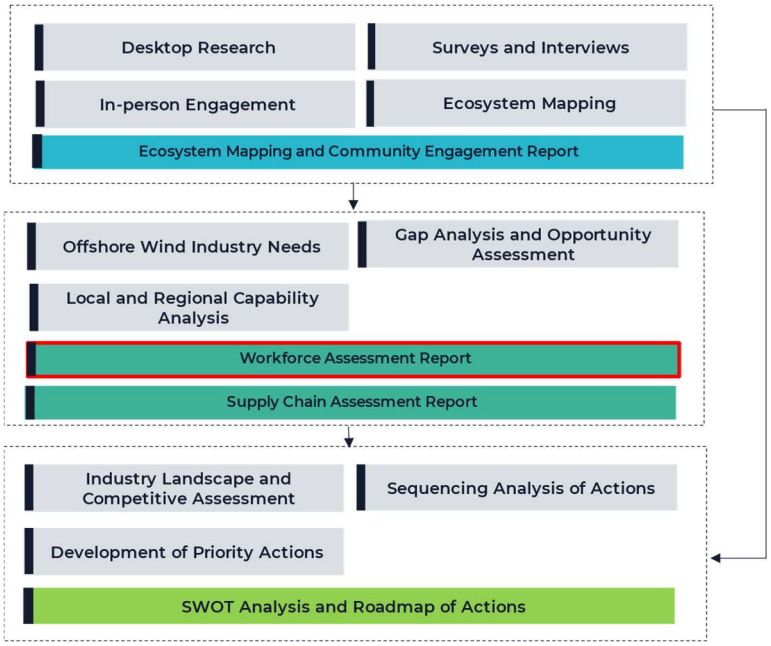


Figure 1.1 - Full scope of work tasks and deliverables

The Workforce Assessment takes a pragmatic approach to analyzing workforce opportunities in Humboldt County and the broader Redwood Coast driven by offshore wind development. This study aims to provide a set of realisticprojections to enable the County and the wider Redwood Coast region to make informed strategic decisions for workforce development. Three distinct build-out scenarios tailored to the region were used to account for the inherent uncertainties in forecasting the future development of offshore wind in any region. The scenarios consider varying levels of local content, global market dynamics, local and regional supply chain capabilities, and port development aspirations and timelines. Using realistic scenarios as the foundation of our analysis, the assessment identifies the region's offshore wind workforce needs and opportunities through a capability assessment and gap analysis. The study has been supplemented with case studies, comparing Humboldt County to other international regions with similar population demographics, economic profiles, and historical contexts to provide insight into the opportunities and challenges for post-industrial coastal communities transitioning to support offshore wind energy.

1.2 Background

The Redwood Coast refers to Del Norte, Humboldt, Lake, and Mendocino Counties. It is home to many diverse Tribal and small communities that celebrate this region's abundant natural resources. These four counties comprise a 450-mile coastal strip along the Pacific Ocean, with 110 miles of coastline in Humboldt County. Geographically isolated and surrounded by redwood forests (Figure 1.2), the region has limited transportation infrastructure, which makes access to major urban centers challenging. San Francisco is the nearest metropolitan city, 250 miles south of Humboldt County. The lack of major airports and highways, as well as distance from urban centers, contributes to the sentiment held in the community of being "Behind the Redwood Curtain." This term conveys the sense of economic and geographic isolation, as well as a positive cultural identity rooted in the region's natural beauty, ambiance, and strong community resilience.

Figure 1.2 - U.S. Highway 101, Mendocino County

The Redwood Coast comprises relatively low-populated counties, with Del Norte County representing the least populated area, with approximately 27,000 people, and Humboldt County the most populous, with 136,000 residents and a labor force of 60,000. The region has a strong Tribal presence, home to numerous Tribal nations with deep ancestral ties to the land. The Native American population in the Redwood Coast is nearly four times the state average. The strong Tribal presence is recognized throughout the community for involvement in environmental restoration, cultural preservation, and sustainable development.

Humboldt County and the broader Redwood Region have a history of boom-and-bust industrialization cycles tied to their natural resource-based economy. Having previously hosted major timber and commercial fishing industries, followed by cannabis production, the communities in the region are sensitive to the exploitation of the region and have a unique post-industrial identity. The timber industry played a significant role in the region's economic development in the 1900s, supported by its deep-water port, but it has not been a prominent economic driver since the mid-1900s. The region also saw a decline in commercial fishing in the late 20th century due to various cumulative impacts. Today, the region's economy is focused on tourism, agriculture, arts and culture, recreation, and entertainment. Despite these economic shifts, the region has faced significant economic challenges, including higher-than-average unemployment rates, lower-than-average wages, and limited economic diversification.

Figure 1.3 - Historic Port of Humboldt Bay (top), Del Norte County (bottom) (Source: Brooklyn Fox)

In 2022, the Bureau of Ocean Energy Management (BOEM) auctioned five offshore wind lease sites in California, including two off the coast of Northern California. Vineyard Offshore is developing lease area OCS-P 0562 with an estimated 1.1 gigawatts (GW) of capacity. RWE Offshore Wind is developing Canopy Offshore Wind, with a projected capacity of up to 1.6 GW. However, recent shifts in the federal administration are anticipated to delay the development of both sites by several years.

Northern California has one of the nation's most significant offshore wind energy resource potentials, and approximately 70% of all future offshore wind sites in California are expected to be in the region[1]. The 2022 lease sale has sparked excitement and hesitation among the local community, as the projects could potentially bring a significant

[1] *Beiter, P., Musial, W., Duffy, P., Cooperman, A., Shields, M., Heimiller, D., & Optis, M. (2020). The cost of floating offshore wind energy in California between 2019 and 2032 (No. NREL/TP-5000-77384). National Renewable Energy Lab.(NREL), Golden, CO (United States).*

influx of economic activity to the Region, but also pose the threat of the industry repeating a damaging boom-and-bust cycle.

Humboldt County is uniquely positioned to support offshore wind development on the West Coast. The Port of Humboldt Bay has been identified in *Assembly Bill 525's California Offshore Wind Port Readiness Report* (AB525) as one of two sites in California suited for staging and integration (S&I) of floating offshore wind projects due to its water depth, available quayside land, and vertical clearance for vessel transport, among other characteristics.

The Humboldt Bay Harbor, Recreation and Conservation District is proposing the Humboldt Bay Offshore Wind Heavy Lift Marine Terminal Project (Figure 1.4Error! Reference source not found.), which will redevelop a marine terminal in a phased approach on approximately 180 acres of land at the Port of Humboldt Bay, California. The Project will provide a new multipurpose, heavy-lift marine terminal facility to support the offshore wind industry. The port has received over $437 million through federal and state grants and has completed 15% of the design. Potential sites in Humboldt County and Del Norte County have also been identified as potential regional operations and maintenance (O&M) ports in AB 525.

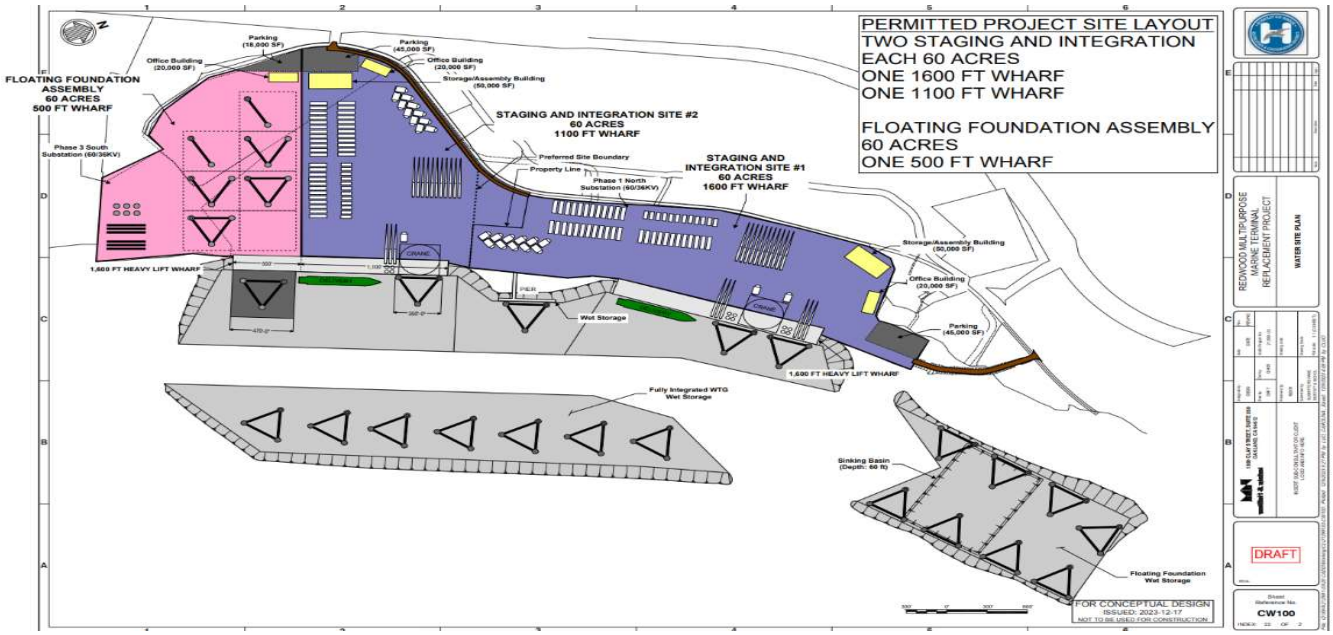


Figure 1.4 - Heavy Lift Marine Terminal conceptual site layout (Source: Moffatt & Nichol)

1.3 Scope of Study

1.3.1 Study Objectives

This study was designed to equip the County of Humboldt and other local and regional stakeholders and governments with knowledge and insight into the floating offshore wind industry workforce needs, regional workforce supply, and observed gaps and opportunities. The objectives of this study were to:

- Characterize the workforce required for the entire life cycle of an offshore wind project.
- Conduct a sequencing analysis to inform workforce demand and training requirements.
- Evaluate the local and regional workforce's capacity to support the offshore wind industry.
- Evaluate the capabilities of training programs and institutions throughout the Region and their applicability in supporting workforce development in the offshore wind industry.
- Identify gaps and areas of opportunity.

1.3.2 Report Structure

Section 2: Local and Demographic Landscape—This section analyzes local and regional demographic trends, identifies and maps existing training and educational programs, and assesses the transferability of the current workforce to offshore wind adjacency.

Section 3: Offshore Wind Workforce Assessment – Using a robust methodology, workforce requirements to support the buildout of floating offshore wind projects are characterized and quantified. Three local content scenarios are considered to indicate the workforce demand specific to Humboldt County and the broader Redwood Region.

Section 4: Gap Analysis—This section provides a local and regional gap analysis assessment. The workforce demand for the three scenarios was compared to the current labor force in the region, as classified by the Standard Occupational Classification (SOC) code.

Section 5: Case Studies—Supplemental case studies are provided to inform recommendations in the project's next phase, based on lessons learned from more advanced offshore wind markets internationally. The case studies aim to inspire and provide clear examples to the local community and governments.

Section 6: Discussion – Summarizes key themes throughout the assessment.

1.3.3 Study Overview

This report examines the workforce impacts of offshore wind at both the local level (Humboldt County) and the regional level (Redwood Coast). To differentiate opportunities and impacts specific to Humboldt County, we provide two analyses; one focused on Humboldt County and one for the Redwood Coast, excluding Humboldt County. In this study, the term "Remaining Redwood Coast" encompasses the counties of Del Norte, Lake and Mendocino, while the term "Redwood Coast region", or "Region" for short, refers to all regional counties, including Humboldt. Figure 1.5 illustrates the boundaries of our study in white, with Humboldt County shaded green and the remaining Redwood Coast counties in red.

Figure 1.5 – Map of Humboldt County and the remaining Redwood Coast Region

The scope of work was developed by the Humboldt County Division of Economic Development with input from Xodus based on the project team's deep expertise in the floating offshore wind industry. Local insights gathered through several in-person visits and extensive community engagement played a critical role in shaping the study and ensuring the final report aligned with local and regional needs.

2 LOCAL AND DEMOGRAPHIC LANDSCAPE

To assess the local and regional workforce opportunities and gaps, this report gathered information from engagement with local organizations directly involved with workforce development including members from the board of workforce development, several union representatives regionally and state-wide, economic development representatives in the community, local supply chain and small businesses representatives, and several community resilience groups. Additionally, this report sourced data from the Bureau of Labor Statistics (BLS), the U.S. Census Bureau, the California Employment Development Department, and IMPLAN.

2.1 Demographic Analysis

Demographic data trends are used to draw insights on existing workforce profiles and capacities. Unemployment rates, age, race, gender, educational attainment, occupations, and geographic location can all be used to describe the workforce profile in a region.

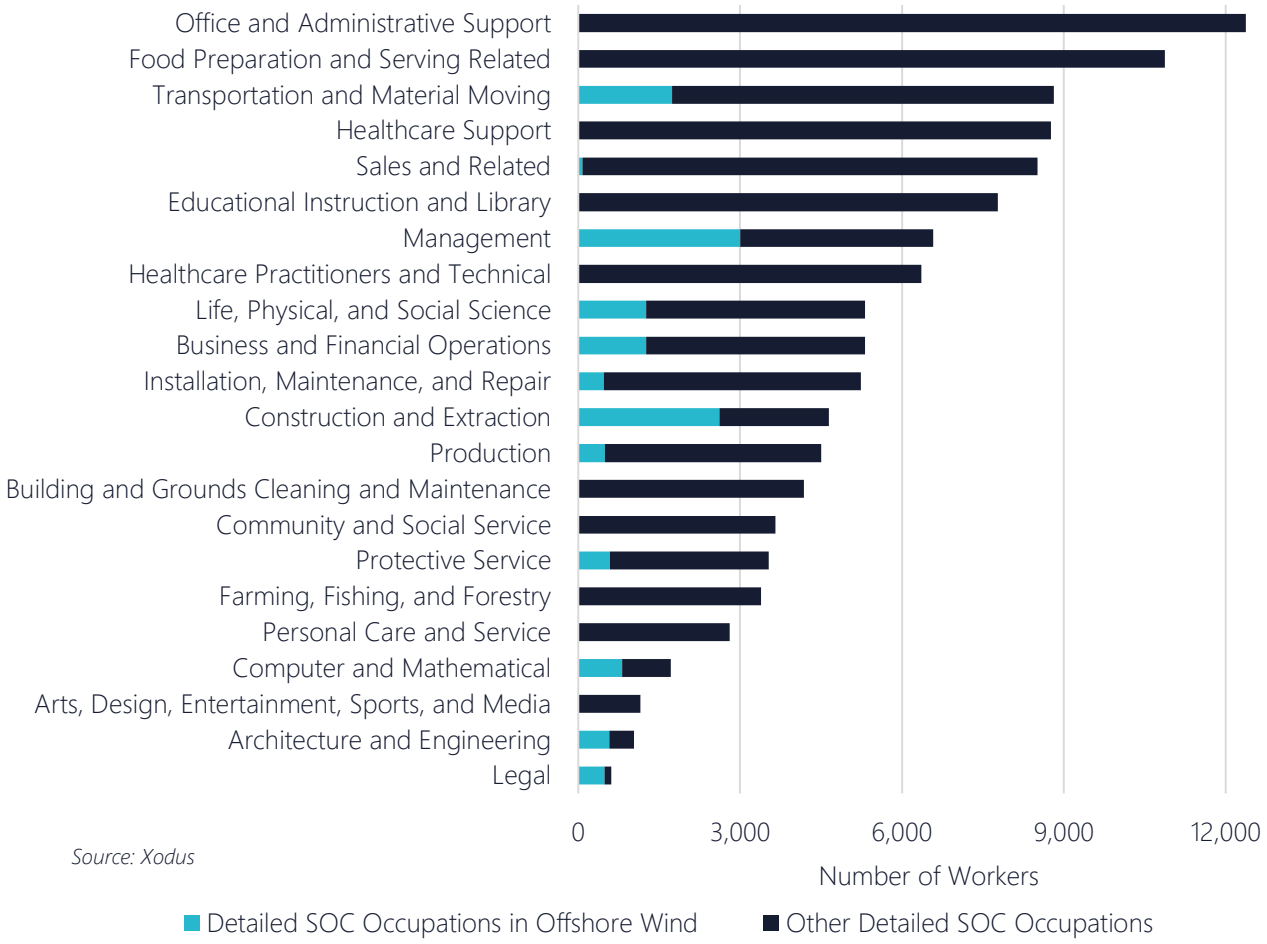
2.1.1 SOC Code Mapping

This study uses Standard Occupational Classification (SOC) codes to analyze regional occupational trends. SOC codes are a classification system that organizes workers into occupational categories to collect, analyze, or report employment statistics. The SOC system is hierarchical and organized into several levels, from major groups to detailed occupations. There are twenty-three major groups in the SOC system, each of which encompasses a wide range of related occupations and is designed to provide a high-level description of the types of work performed in the economy. Detailed occupations describe individual job titles and their associated tasks, skills and requirements.

Xodus collated employment data for each major SOC group in the Redwood Coast using US Bureau of Labor Statistics' Census of Employment and Wages data. All recorded detailed SOC codes in the region which matched SOC codes required for the offshore wind industry were highlighted in blue to illustrate the extent to which existing employment in the region has the same or very similar job roles as those demanded by the offshore wind industry (Figure 2.1).

12% of all employed individuals in the Redwood Coast are performing job roles required by the offshore wind industry, indicating a low transferability of skillsets in the region to transition to offshore wind without a career change. Most SOC groups with the highest employment in the region have very low transferability to the offshore wind industry (office and administrative support, food preparation and serving related, healthcare support, sales and related, education), further reinforcing that the region is unlikely to have the capacity to support the development of an offshore wind industry without an influx of outsourced individuals or increased training pathways and career transition services.

Of the 12% employed in job roles required by the offshore wind industry, the region has a relatively high employment in transportation and material moving, management, and construction and extraction occupational groups. These detailed job roles could translate to supporting in offshore wind construction, installation, and operational roles.



Source: Xodus

Figure 2.1 – Total employment in the Redwood Coast by major SOC group

2.1.2 Educational Attainment, Unemployment and Age Demographic

All counties in the Redwood Coast Region have a lower percentage of individuals with bachelor's degrees compared to state and national averages (Figure 2.2**Error! Reference source not found.**). This reflect the blue-collar nature of this region and presents an opportunity to build on existing strengths by expanding local apprenticeship programs and skilled trades training centers.

The lower levels of higher education attainment also indicate an opportunity to provide STEM-related career pathways. Offshore wind development could help retain and attract higher-educated individuals by creating jobs in engineering, science, business and management.

Unemployment rates in all Redwood Coast counties exceed the national average, with Lake and Del Norte also experiencing higher rates than the state average (Figure 2.3). These elevated unemployment levels highlight the region's need for new workforce opportunities and point to offshore wind as a potential to be a catalyst for economic revitalization through a broad range of jobs requiring varying skillsets.

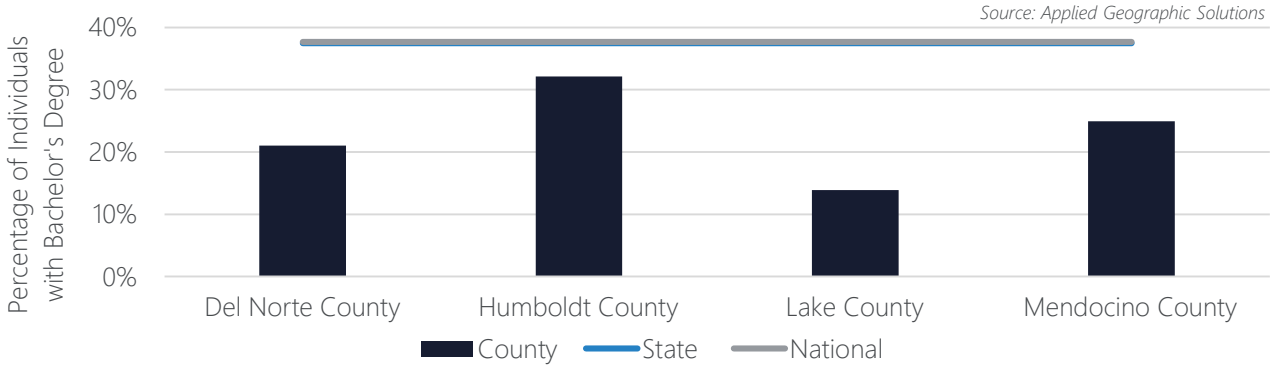


Figure 2.2 – Educational attainment in the Redwood Coast region against state and national benchmarks[2]

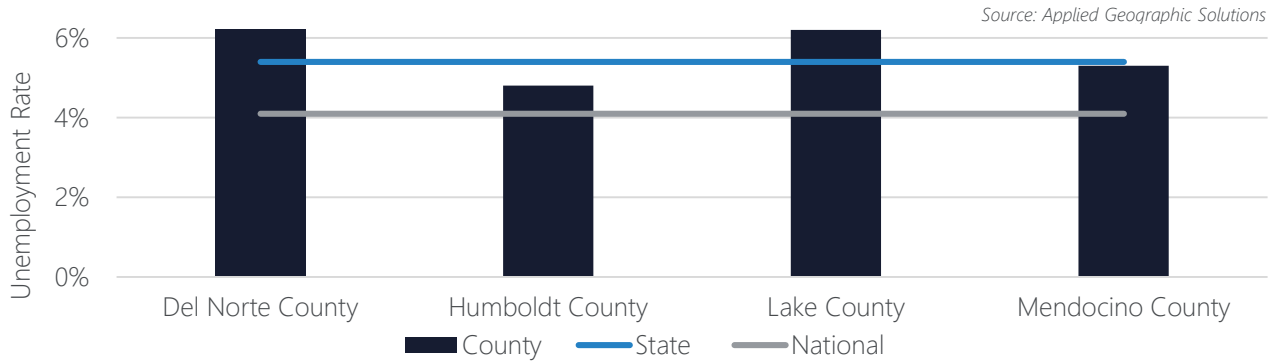


Figure 2.3 – Unemployment rate in the Redwood Coast Region against state and national benchmarks[3]

The region faces a demographic challenge, as all Redwood Coast counties have a greater proportion of elderly individuals (60+) than youth (<18) (Figure 2.4), suggesting a shrinking labor pool. In Humboldt County for example, total employment declined by 1.12% between 2022 and 2023. Meeting the workforce demands of offshore wind may therefore require attracting new residents or accommodating a transient workforce. This anticipated influx of temporary or permanent workers will increase the demand for housing, utilities, healthcare and child services. Impacts to these

[2] *Federal Reserve Economic Data (2023)*
[3] *Data sourced from the California Employment Development Department and Bureau of Labor Statistics (December 2024)*

wraparound services should be integrated into regional development and infrastructure planning, and a deeper economic impact analysis should be considered.

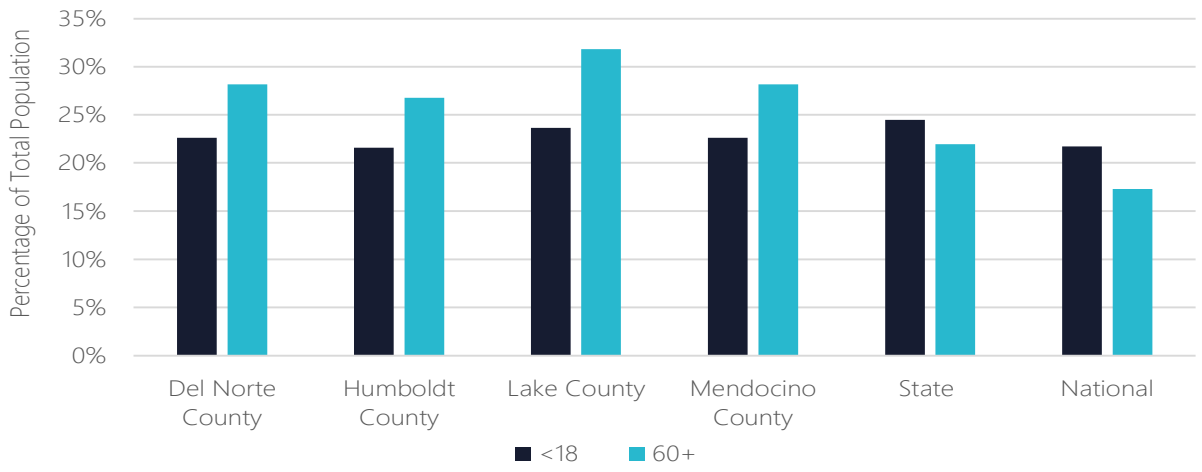


Figure 2.4 - Percentage of population made up of individuals who are 18 or younger and 60 or older by county with state and national benchmarks[4]

2.1.3 Geographic Location

While this study takes a regional approach, most near-term offshore wind opportunities will be related to activities surrounding the S&I and O&M sites at the Port of Humboldt. To assess workforce proximity, a drive time analysis was conducted to determine how many individuals in relevant occupations live within one-hour to the Port of Humboldt (Figure 2.5,Figure 2.6). Through community engagement, one hour was confirmed as the average commute time individuals would be willing to drive, which remains within the limitations of Humboldt County and where most of the economic benefits from these projects will be realized. However, individuals in more remote or sparsely populated areas reported a willingness to commute farther, especially for high-paying roles.

While the total number of individuals in relevant occupations does not directly equate to the size of a capable local offshore wind workforce, the data suggests a strong base of adjacent skills within commuting distance. The occupation groups presented in Figure 2.6 are not identical to the adjacent occupations referenced in Section **Error! Reference source not found.** due to differences in census labeling, but they provide useful comparison points.

Other counties in the Redwood Coast region are outside of the one hour drive time to the Port of Humboldt Bay. As such, if workers from those areas are to participate in port-related activities, they will require temporary

[4] *United States Census Bureau (2023)*

accommodations as a trainsient workforce, or be willing to travel longer distances, which are conditions some may accept for well-paying employment opportunities.

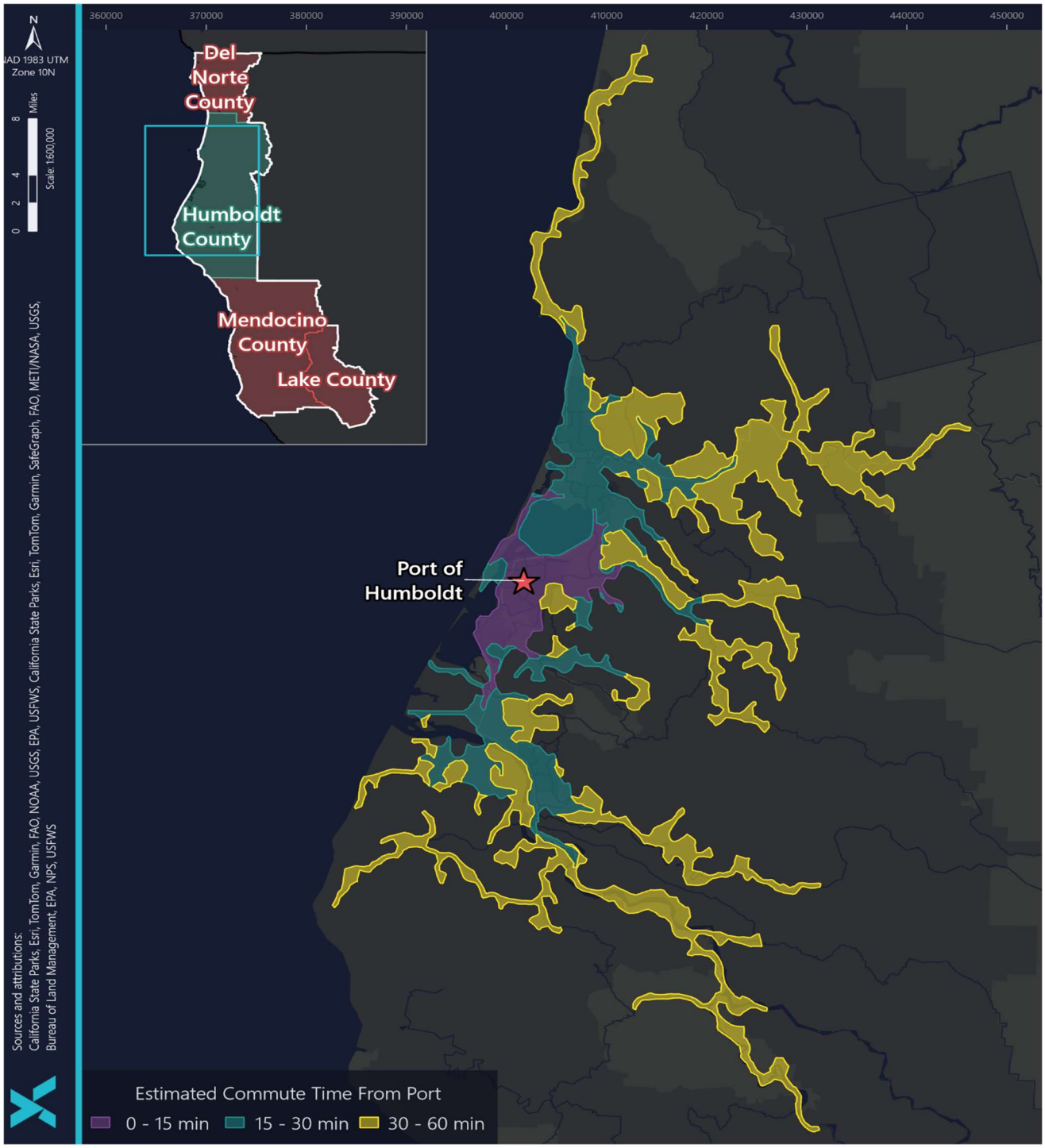


Figure 2.5 - Drive Time Analysis for commute to the Port of Humboldt.

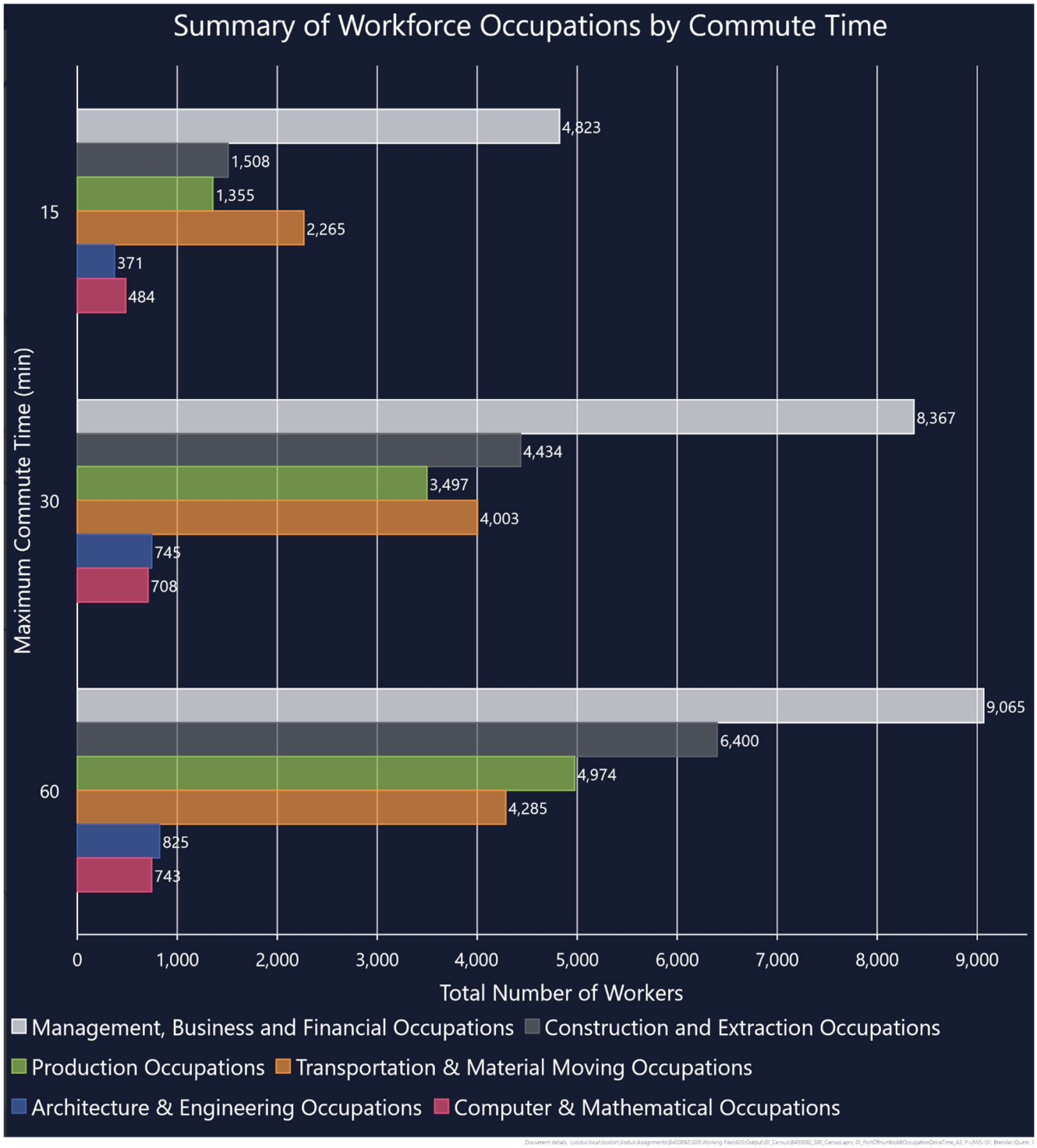


Figure 2.6 - Occupation tallies within the drive time band for occupation groups with highly transferable roles in the offshore wind industry

2.2 Existing Training Landscape

An accessible network of training programs will be critical in preparing a workforce to support offshore wind development in the Redwood Coast Region. There are a number of training programs and educational institutions in the region that provide curricula that can support the offshore wind industry (Table 2.1).

Cal Poly Humboldt and Schatz Energy Research Center have the most offshore wind specific curricula, as the research center has published several offshore wind specific studies and has authored detailed transmission planning and analysis in the region. Schatz has also recently established the Pacific Offshore Wind Consortium, which is a joint effort between research universities with the aim to enable universities, communities, and Tribal nations to share resources, co-develop best practices, and design comprehensive research programs that reflect the dynamic nature of the ocean environment.

In 2023, Cal Poly Humboldt, the Yurok Tribe, and the College of the Redwoods signed a Memorandum of Understanding to develop an initiative to ensure the highest possible local workforce utilization for proposed offshore wind projects[5]. Workforce initiatives and partnerships with these models will be critical to ensuring that underrepresented groups can capitalize on the potential workforce opportunities provided by offshore wind.

Table 2.1 - Regional training and educational programs in the Redwood Coast Region

INSTITUTION/PROGRAM	TRAINING TOPICS	PROGRAM TYPE	QUALIFICATION
Cal Poly Humboldt	Engineering, political science, environmental science	Bachelor's and Master's programs	High school diploma or GED
Career Technical Education	Construction, manufacturing, engineering	High school diploma	High school diploma
College of the Redwoods	Welding Technology, Construction Technology, Geology, Manufacturing Technology	Associate degree, Certification	High school diploma or GED
Mendocino College	Sustainable Technology, environmental studies, construction technology	Associate degree, Certification	High school diploma or GED
Trades Academy	Metal fabrication, electrical work, concrete, HVAC	High school diploma	High school diploma
Woodland Community College	Industrial Technology, Environmental Technology	Associate degree, Certification	High school diploma or GED

[5] *On March 8, 2024, the Yurok Tribal Council formally opposed floating offshore wind projects off the North Coast, citing impacts to sacred cultural sites, insufficient environmental research, and lack of federal recognition of the Tribe's unceded ocean territory and sovereign decision-making authority*

Beyond opportunities at the university, community college, and high school level, unions provide apprenticeship, pre-apprenticeship, and other trades trainings essential to sustainable workforce development. Table 2.2 highlights the existing apprenticeship and pre-apprenticeship programs intended to serve the Redwood Coast region. It is worth noting that many of these training opportunities are located outside the Region.

Table 2.2 - List of union-led apprenticeship and pre-apprenticeship programs serving the Redwood Coast Region and their respective county locations

UNION	TRAINING	PROGRAM TYPE	COUNTY
IBEW Local 551	Residential and industrial Electrical systems installation, maintenance, and safety	Apprenticeship	Sonoma
Ironworkers Local 378	Structural ironworking, reinforcing ironwork, welding, and other related services.	Apprenticeship	Solano
North Bay Construction Corps	3-month basic construction training program for seniors in their last semester of high school.	Pre-Apprenticeship	Sonoma
Operating Engineers Local 3	Heavy equipment operation, cranes, bulldozers, excavators, etc. Construction, environmental remediation, hazardous waste handling, and concrete work, among others.	Apprenticeship	Sacramento
Sheet Metal Workers Local 104	Sheet metal work, including HVAC systems, architectural sheet metal, and industrial fabrication.	Apprenticeship	Sonoma
UA Local 290	Plumbing, pipefitting, HVAC, and welding	Apprenticeship	Humboldt
Building Lives by Building Structures	Construction, carpentry, etc.	Pre-Apprenticeship	Humboldt
LiUNA Local 324	Construction, environmental remediation, hazardous waste handling, concrete work, etc. Carpentry, framing, scaffolding, interior systems, etc.	Apprenticeship	Humboldt
Carpenters Local Union #751	Carpentry, framing, scaffolding, interior systems, etc.	Apprenticeship	Humboldt
Multi-Craft Core Curriculum (MC3)	Construction, safety, etc.	Pre-Apprenticeship	Humboldt

The location of these training centers, alongside the academic training institutes, can be seen in Figure 2.7.

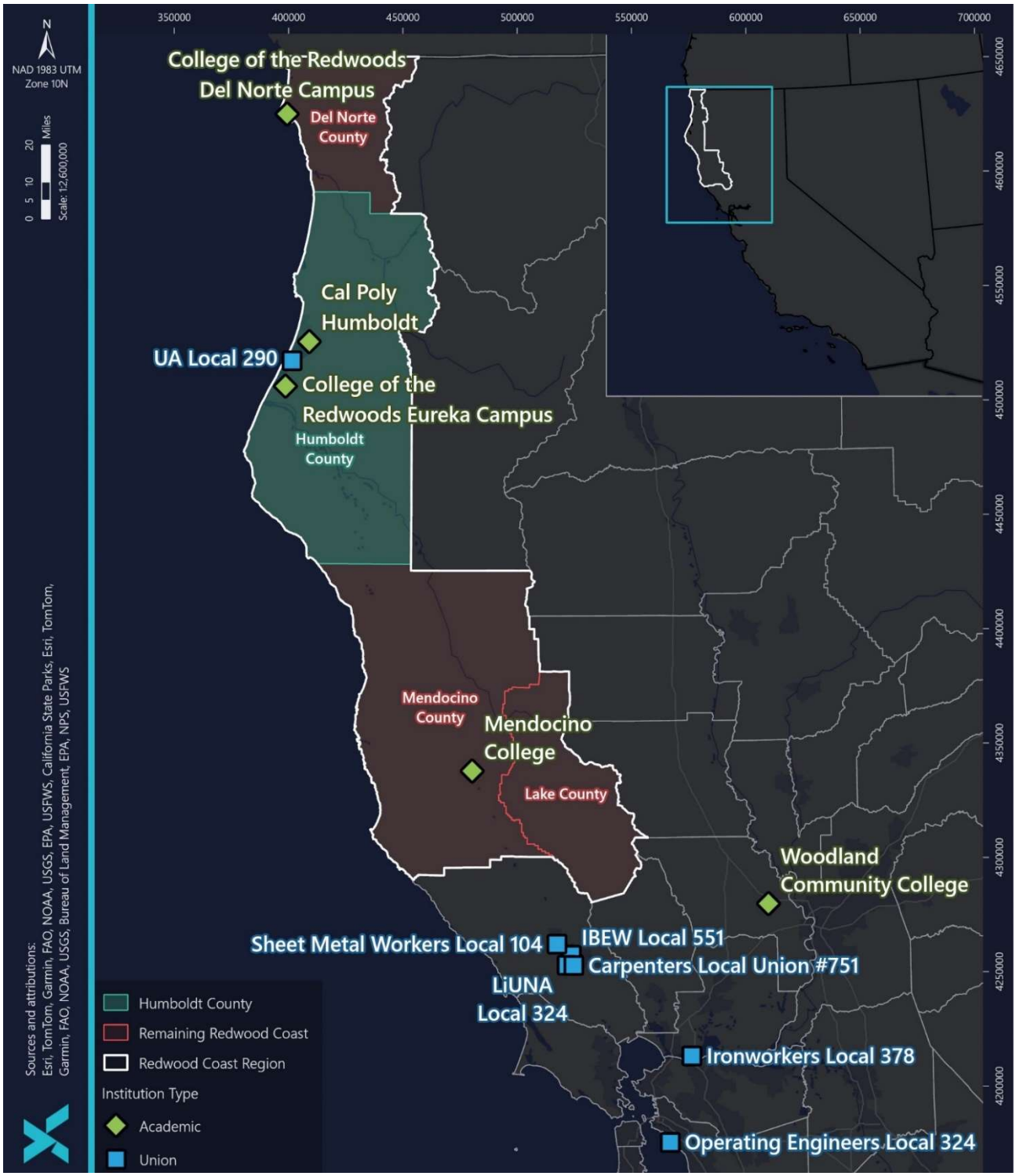


Figure 2.7 - Location of local academic and union training centers serving the Redwood Coast Region

The only pre-apprenticeship union program related to offshore wind located in the region is offered by the United Association of Plumbers and Pipefitters (UA) union. However, through engagement, several union representatives have suggested they are considering the development of a regional training facility or would be open to developing such a program given sufficient demand.

Large construction projects and those requiring federal subsidies, such as offshore wind development, port upgrades, and large transmission projects, often require Project Labor Agreements (PLAs)[6,7]. PLAs are pre-hire collective bargaining agreements negotiated between project developers and building trades councils. They establish the terms and conditions of employment for union labor and typically include provisions for local hiring, training, and participation in registered apprenticeship programs. Under a PLA, apprenticeship participation is often defined by the percentage of total labor hours that must be performed by apprentices enrolled in certified programs. In California, the Division of Apprenticeship Standards (DAS) regulates these programs by setting requirements for training quality, program registration, and the ratio of apprentices to journeymen. PLAs may strengthen these standards by incorporating higher targets for local participation and labor-hour thresholds specific to the project or region.

Additionally, the Inflation Reduction Act (IRA) offers bonus tax credits for clean energy projects that meet specific labor standards. These include an apprenticeship requirement of at least 15% of total construction hours must be performed by qualified apprentices. Additionally, any contractor or subcontractor employing four or more workers on a project is required to include at least one qualified apprentice. However, in January 2025, the Office of Management and Budget (OMB) announced a temporary pause on new federal grant and loan disbursements under the IRA, and on April 15, a federal judge issued a preliminary injuction ordering all federal agencies to resume disbursement of IRA funds nationwide.

Through discussions with local union representatives, it has been understood that these apprenticeship targets will not pose a significant roadblock, as unions have a large source of workers state-wide and nationally. However, the limited number of regional apprenticeship programs and a relatively low local unionization rate may make it challenging to source this workforce locally. Ensuring that apprenticeship requirements are utilized in smaller-scale projects, such as planned port or infrastructure upgrades or building microgrids, may increase the number of local apprentices trained, leading to a more significant workforce of local journeymen ready to support offshore wind project activity.

[6] *Building Trades Union and Vineyard Wind Sign Historic Project Labor Agreement, https://www.vineyardwind.com/press-releases/2021/7/16/building-trades-union-and-vineyard-wind-sign-historic-project-labor-agreement (Accessed 4/17/25)*
[7] *North America's Building Trades Unions and Ørsted Agree to Build an American Offshore Wind Energy Industry with American Labor, https://us.orsted.com/news-archive/2022/05/national-offshore-wind-agreement (Accessed 4/17/25)*

3 OFFSHORE WIND WORKFORCE REQUIREMENTS

3.1 Workforce Needs

The workforce demand for a typical offshore wind project begins relatively low, with an STEM- based demand for the project development activities, and peaks in the year leading up to and during when the project first delivers power, also known as the Commerical Operation Date (COD), when component supply and installation activities overlap. Figure 3.1 presents an approximate timeline and the number of workers required to develop a 1 Gigawatt (GW) floating offshore wind project by project phase, where Wind Turbine Supply and Balance of Plant Supply can generally be summarized as manufacturing-related activities. Delivering an offshore wind project requires thousands of jobs, over 60% of which are manufacturing related.

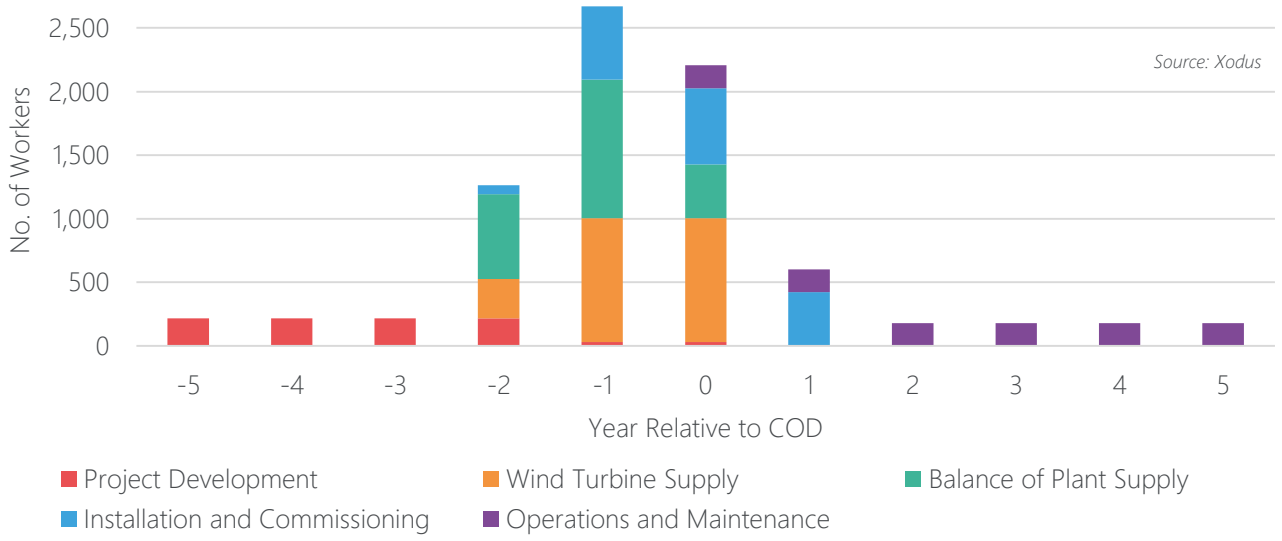


Figure 3.1 – Annual number of individuals employed for a hypothetical commercia scale floating offshore wind project by supply area

The number of workers in Figure 3.1 is not equivalent to the number of full-time equivalent employees (FTEs) that would be calculated as part of an economic impact analysis; rather, a bottom-up approach was taken to understand the headcount required at any one time. For example, the number of workers deployed offshore to support the installation of offshore wind farm components is guided by the number of crew members required to operate the vessel, the minimum number of people needed to conduct various tasks (e.g., operation of piledriving equipment or remotely operated vehicles), and the maximum number of workers that can be accommodated on vessels.

During the project development phase before COD, specialized professional roles related to permitting, project development, and engineering will be highly utilized. A smaller but highly educated workforce moves the project through phases of environmental review, federal permitting, geotechnical and geophysical review, siting, and wind farm design and development. Individuals in these specialized roles can shift from project to project if there is a robust pipeline of additional projects.

A project enters the manufacturing and installation phases in the years following the financial investment decision (FID) and preceding COD. This phase is characterized by a significant increase in demand for skilled trade specialists, standard skilled trades, technicians, non-skilled labor, managers, and engineers. The component supply and installation phases in an offshore wind farm's lifecycle will require the largest workforce and extensive qualifications and requirements. As with the project development phase, jobs in the component supply sector may shift from project to project as a continuous pipeline is developed. Unlike the project development and supply phase, however, many jobs in the installation phase of the project will be transient or part-time jobs. In contrast, the project development and manufacturing phases will have more permanent positions.

Following COD, the workforce requirements decrease significantly as the completed project shifts to the O&M phase. At this phase in the project's lifecycle, the education requirement is similar to installation and commissioning, with substantial demand for skilled trade specialists, standard skilled trades, technicians, non-skilled labor, managers, and engineers due to O&M obligations. Unlike other project phases, these roles will operate continuously for the project's life (30+ years).

The following sections summarize the workforce opportunities and the required qualifications for each supply area, providing context for understanding the offshore wind industry's workforce needs and corresponding training requirements.

Job Role Definition

Each job role was classified based on specific requirements for specialized qualifications or certifications. Table 3.1Error! Reference source not found. provides a breakdown of these job role categories and corresponding descriptions, as well as examples of industries where individuals in each category might be employed.

Table 3.1 – Descriptions of job role categories with example SOC occupations that workers in each job role category may be employed in

CATEGORY	DESCRIPTION
Building Trade Worker	A laborer involved in the construction, maintenance, and repair of buildings or infrastructure. SOC Occupations within this category include but not limited to Construction Laborers, Electricians, Operating Engineers and Other Construction Equipment Operators.
Business Professional	A professional engaged in the finance, legal compliance, and task management of an organization or project.
Manufacturing Trade Worker	A laborer engaged in the production and assembly of goods, typically within a factory or industrial setting. SOC Occupations within this category include but not limited to Crane and Tower Operators, Riggers, Structural Metal Fabricators and Fitters, Welders, Cutters, Solderers, and Brazers.
Maritime Trade Worker	A laborer engaged in the operation and maintenance of seafaring vessels and maritime infrastructure. SOC Occupations in this category include but not limited to Laborers and Freight, Stock and Material Movers, Sailors and Marine Oilers, and Wind Turbine Service Technicians.
STEM Professional	A professional engaged in the technical design and analysis of a technology or engineering project. SOC Occupations in this category include but not limited to Engineers, Managers, and Conservation Scientists.
Support Staff	A professional engaged in the administration, human resource management, and operation of an organization or project. SOC Occupations include Occupational Health and Safety Technicians.

3.1.1 Project Development

Project development encompasses the work undertaken by the wind farm developer and the services contracted before the developer's final investment decision, such as environmental review, federal permitting, geotechnical and geophysical review, siting, and wind farm design and development.

Responsibilities of the project development workforce typically include the following:

- Permitting services
- Environmental impact assessment
- Offshore environmental surveys
- Offshore geological and hydrological surveys
- Onshore environmental surveys
- Socioeconomic surveys
- Legal services
- Financial services
- Stakeholder engagement
- Community liaising
- Electrical design
- Installation design
- Construction management
- Health, safety, environment, and quality services
- Conceptual design, pre-FEED and FEED scopes

Table 3.2Error! Reference source not found. provide a breakdown of the total number of workers employed in the five or more years of the project development phase of a commercial scale floating offshore wind project. This phase can employ up to 300 analysts, engineers, and scientists. These job roles typically begin five to ten years before the COD and are maintained until the project reaches its COD. Because developers are often involved in multiple projects within a region, many of these positions may extend beyond a single project, offering longer-term employment opportunities.

Table 3.2 – Annual number of workers required by supply element and job category in the project development phase of a commercial scale floating offshore wind project

SUPPLY ELEMENT	STEM PROFESSIONAL	BUSINESS PROFESSIONAL	MARITIME TRADE WORKER	SUPPORT STAFF
Development and Permitting	6–15	6–15	–	–
Surveying	31–60	–	31–60	–
Engineering and Design	61–100	–	–	1–5
Project Management	–	16–30	–	6–15
Total	*98-175*	*22-45*	*31-60*	*7-20*

3.1.2 Wind Turbine Supply

Wind turbine supply is a labor-intensive activity that requires a sizeable and skilled workforce to ensure product delivery. Manufacturing offshore wind turbines involves specialized knowledge and certification in working with steel that meets the grade requirements for offshore use. Production also requires heavy-lift machinery, advanced testing, and precision engineering and design work.

Workers involved in the supply of wind turbines typically perform the following responsibilities:

- Crane and heavy equipment operation
- Electrical commissioning
- Engineering and design
- Fiberglass layup and laminating
- Heavy metal forming and machining
- Nondestructive testing
- Production line assembly
- Protective coating and painting
- Quality control inspection
- Rigging
- Welding

Table 3.3Error! Reference source not found. provides a breakdown of the total number of people working at various manufacturing facilities to supply wind turbines for a commercial floating offshore wind project. These individuals will be employed on an annual basis to support the broader offshore wind market, with the assumption that a manufacturing facility will only be established if there is a market demand. An annual workforce of over 1,200 individuals can be employed across three facilities, mainly consisting of manufacturing trade workers. These jobs are created once a facility opens and maintained throughout the facility's operational period.

Table 3.3 – Annual number of workers required by supply element and job category for the wind turbine supply of a commercial scale floating offshore wind project

SUPPLY ELEMENT	STEM PROFESSIONAL	MANUFACTURING TRADE WORKER	SUPPORT STAFF
Nacelle	31–60	151–250	6–15
Rotor	31–60	251–400	6–15
Tower	6–15	251–400	6–15
Total	*68-135*	*653-1,050*	*18-45*

3.1.3 Balance of Plant Supply

The Balance of Plant (BoP) supply encompasses the manufacturing, assembly, and delivery of the main components of an offshore wind farm, excluding the turbine package. These components include foundations, cables, and mooring systems. Floating foundation designs vary significantly from large semi-submersible hulls comprising columns and trusses to monopile-like spars and tubular semi-spars. Workforce needs will rely on which floating technology is chosen, as the designs vary in material and manufacturing method and require varying skillsets. For example, anchor fabrication will also rely heavily on specialized welding and ironworking skills, and it requires processing and handling large quantities of material. Mooring production is assumed to be primarily automated but still relies on welding and production personnel. Fabricating a concrete foundation demands a skill set in concrete mixing, forming, and testing, while steel foundation fabrication requires a much greater reliance on complex welding and ironwork.

Workers involved in the balance of plant supply typically conduct the following responsibilities:

- Concrete mixing and pouring
- Crane and heavy equipment operation
- Electrical commissioning
- Heavy metal forming and machining
- Nondestructive testing
- Plating
- Production line assembly
- Protective coating and painting
- Quality control inspection
- Rigging
- Scaffolding
- Welding

Table 3.4Error! Reference source not found. provides a breakdown of the total number of people employed in the balance of plant supply for a commercial scale floating offshore wind project over the operating lifetime of the manufacturing facilities.

An annual workforce of up to 1,300 individuals is employed across nine facilities, primarily comprising Manufacturing Trade Workers. Like wind turbine supply, these jobs are created once a facility opens and maintained until the facility closes, with the exception of foundation assembly, which may result in a more seasonal and project specific workforce demand.

Table 3.4 – Annual number of workers required by supply element and job category for the balance of plant supply of a commercial scale floating offshore wind project

SUPPLY ELEMENT	STEM PROFESSIONAL	MANUFACTURING TRADE WORKER	SUPPORT STAFF
Foundation (Concrete or Steel Semisub)[8]	16–30	101–250	1–5
Secondary Steel Components	6–15	61–100	1–5
Foundation Assembly	–	61–100	1–5
Offshore Substation	6–15	101–150	1–5
Onshore Substation	6–15	61–100	1–5
Array Cables	31–60	61–100	1–5
Export Cables	31–60	61–100	1–5
Anchors (Suction)	6–15	101–150	1–5
Mooring Lines (Steel or Synthetic)	6–15	31–60	1–5
Total	108–225	628–1,010	8–45

3.1.4 Installation & Commissioning

Installation and commissioning include the services contracted to construct a floating offshore wind project. Construction, staging, marshalling, and associated port services are contracted to support project installation where components are not installed directly from the manufacturing facility. Support services for offshore wind project installation include marine coordination, weather forecasting, supply of guard vessels, survey vessels, support barges, and crew transfer vessels (CTVs).

Responsibilities of the installation and commissioning workforce typically include:

- Marshalling
- Stevedoring
- Bunkering
- Crewing services
- Onshore logistics
- Meteorological forecasting

[8] *Concrete foundation requires 151-250 manufacturing trade workers, and teel requires 101-160 (reflected in min and max values). Concrete semi-submersibles do not require a foundation assembly workforce, which is reflected in the minimum total.*

- Transport services
- Towing tugs
- Marine coordination
- Crew transfer vessels
- Onshore services
- Sitework
- Scour supply, transport, and installation
- Guard vessels
- Onshore construction scopes
- Construction and building contractors
- Electrical contractors
- Port services

Table 3.5Error! Reference source not found. provides a breakdown of the total number of people employed throughout the two years of the installation and commissioning phase of a commercial scale floating offshore wind project. Approximately 800 to 1,200 individuals are employed over the two-year installation and commissioning phase, mainly consisting of building and maritime trade workers.

Table 3.5 – Annual number of workers by supply element and job category for the installation and commissioning phase of a commercial scale floating offshore wind project

SUPPLY ELEMENT	STEM PROFESSIONAL	BUILDING TRADE WORKER	MARITIME TRADE WORKER	SUPPORT STAFF
Foundation Tow Out/Hook Up	16–30	61–100	31–60	16–30
Offshore Support Services	16–30	1–5	61–100	6–15
Offshore Substation Installation	16–30	31–60	6–15	6–15
Array Cable Installation	16–30	31–60	16–30	1–5
Export Cable Installation	16–30	31–60	6–15	6–15
Anchor and Mooring Line Installation	16–30	31–60	16–30	6–15
Staging and Integration	–	61–100	16–30	6–15
Ports and Logistics	1–5	61–100	31–60	1–5
Onshore Construction	6–15	31–60	–	1–5
Total	103–200	393–605	183–340	49–120

Figure 3.2Error! Reference source not found. highlights a breakdown of onshore and offshore workers during a project's Installation & Commissioning stage[9], where the first year of installation (Year -1) is focused on receiving, storing, and installing moorings and anchors. The port's permanent workforce and engineering, procurement,

[9] *Figure 3.2 does not take into consideration weather down time or other delays that many projects face during installation and commissioning,*

construction, and installation (EPCI) teams would complete these tasks. EPCI workers will likely be sourced based on the availability of a highly skilled workforce with experience in conducting major installation activities.

In the second year of installation (Year 0), the focus shifts to installing and commissioning the foundations and turbines. Workforce demand during this phase generally peaks during summer months, as harsh weather during the winter months restricts offshore installation activity. Many workers will work on vessels, working two-week shifts during installation. Much of the EPCI workforce at the port during S&I will be unionized labor, as PLAs that are becoming industry standard in the US require specific union representation for offshore wind development. [10],[11]

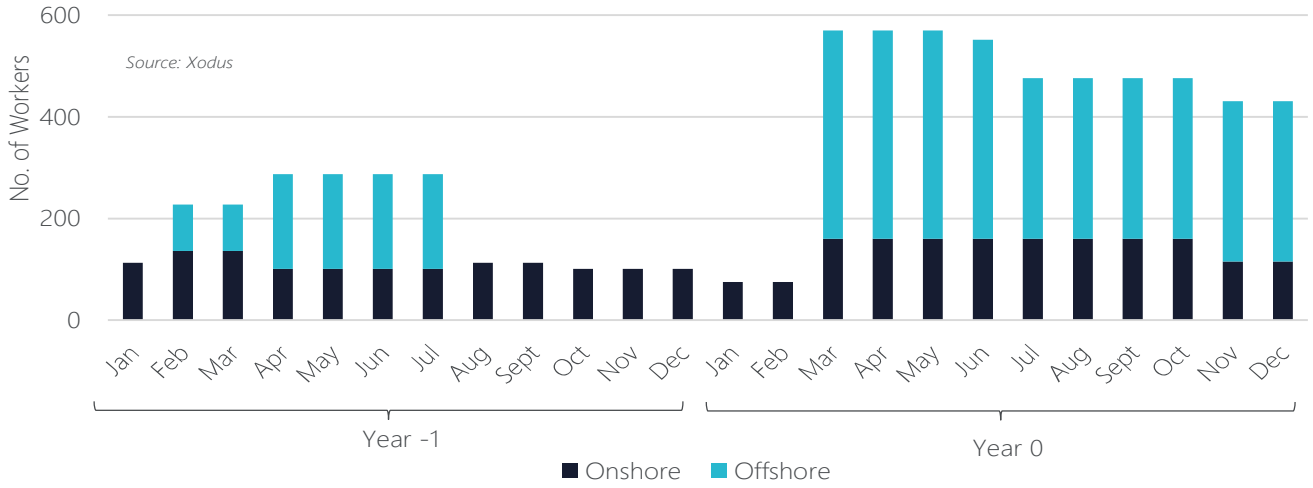


Figure 3.2 – Monthly estimated number of onshore and offshore workers over time during installation and commissioning of a commercial scale floating offshore wind project

3.1.5 Operations & Maintenance

Offshore wind farm operations require services that support the wind farm's management and optimization, including control room equipment and software to deliver asset performance, health and safety, and environmental monitoring. Various services and software are required to support marine coordination and planning, such as communications and weather forecasting. Responsibilities of the O&M workforce typically may include the following:

- Meteorological forecasting
- Electrical inspection
- Blade inspection

[10] *Massachusetts Department of Energy Resources, Requests for Proposals for Long-Term Contracts for Offshore Energy Projects, https://macleanenergy.com/wp-content/uploads/2023/08/83c-rd4-rfp-8.30.2023.pdf, (Accessed 1/28/2025)*

[11] *Connecticut Department of Energy and Environmental Protection, Request for Proposals for Offshore Wind Facilities, https://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/5f3d7ee5480fdbb085258a5500500d7c/$FILE/Final%20RFP%20(2023%20OSW)_Revised%20V3.pdf (Accessed 1/28/2025)*

- Port services as per installation support scopes
- Marine warranty surveying
- Mechanical inspection
- Structural inspection
- Equipment inspection
- ROV

Table 3.6 provides a breakdown of the total annual number of people employed throughout the twenty-five or more years of the operations and maintenance phase of a commercial scale floating offshore wind project.

Table 3.6 – Annual number of workers by supply element and job category for the operations and maintenance phase of a commercial scale floating offshore wind project

SUPPLY ELEMENT	STEM PROFESSIONAL	BUILDING TRADE WORKER	MARITIME TRADE WORKER	SUPPORT STAFF
Port Operations	1–5	16–30	16–30	1–5
Operations Base	6–15	16–30	31–60	6–15
Corrective Maintenance	6–15	16–30	16–30	1–5
Total	13–35	48–90	63–120	8–25

The distribution of onshore and offshore workforce during the O&M phase of an offshore wind project is illustrated in Figure 3.3**Error! Reference source not found.**, where the majority of the permanent workforce during the O&M phase is based onshore, focused on monitoring the wind farm and storing components. The offshore workforce is responsible for conducting routine repair and maintenance of the wind farm, with specialized crews typically mobilized in the summer months to take advantage of the calmer metocean conditions for larger, more weather-sensitive tasks such as major component replacement.

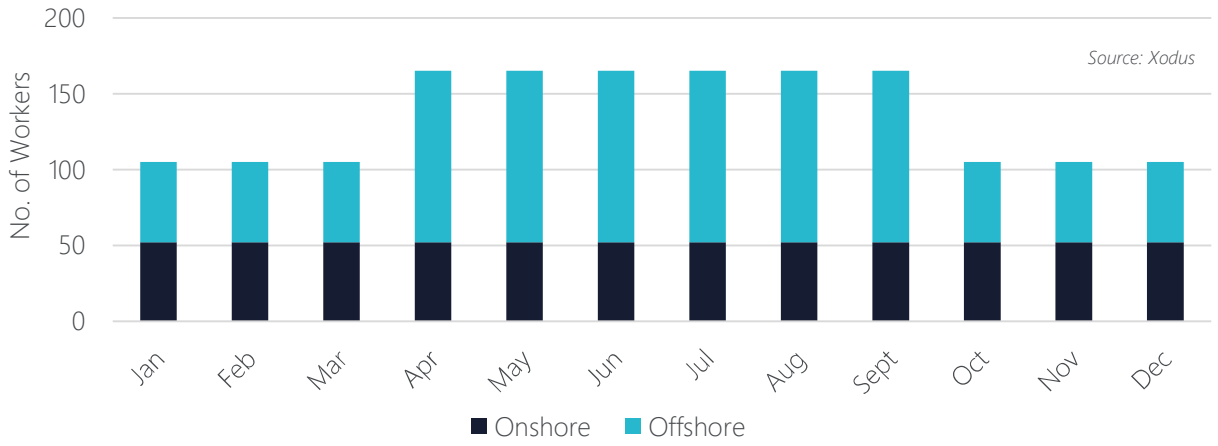


Figure 3.3 – Monthly number of onshore and offshore workers in the operations and maintenance phase of a commercial scale floating offshore wind project

3.1.6 Decommissioning

Decommissioning includes the services contracted to dismantle and remove a floating offshore wind project at the end of its operational life. As no commercial-scale floating offshore wind project has been decommissioned, it is currently unclear what the precise workforce demand will be. However, the workforce will likely mirror the one seen during the installation and commissioning phase, as a large percentage of the work will occur offshore and involve marine construction. Decommissioning activities will likely entail:

- Planning and permitting
- Turbine disconnection and removal
- Removal of mooring and anchors
- Cable removal
- Recycling and disposal
- Environmental monitoring

These workers will largely be comprised of building and maritime trade workers, as well as STEM professionals, such as marine engineers, offshore technicians, ROV operators, heavy-lift vessel operators, and recycling workers. Planning of decommissioning activities will likely take a few years, with physical decommissioning activities taking 6-18 months.

3.2 Training Needs

Many roles within the offshore wind industry require specialized training, and additional resources will be needed to satisfy these demands locally. A general training demand assessment is important to understand what training needs offshore wind will bring to the Region.

3.2.1 General Qualifications & Certifications

The U.S. offers a modular approach to gaining the certification to work on an offshore wind farm. This approach allows personnel to obtain their required training by completing field-related courses rather than a new specific offshore wind program for their respective position. Many of the general safety and skill certifications that workers will need to work at their existing professions will overlap with the requirements they will need for working on an offshore wind farm. Additional certifications will likely be required when an individual changes their work setting (i.e., working at sea, at heights, on a turbine, etc.). These more general certifications will likely overlap many positions listed in this section rather than individually for every potentially relevant job role.

Global Wind Organization Standards

The Global Wind Organization (GWO) is a non-profit organization founded and operated by wind turbine manufacturers and owners/operators. Since 2012, GWO has published a range of training standards that aim to address different needs in the wind energy industry. GWO's training standards are not meant to provide certification

for a specific job but instead provide general training/certifications to educate individuals working on/with wind turbines. These standards are usually run through local training partners, such as community colleges and local training facilities. GWO training standards can be completed within 7-10 days, with individual modules within 1-2 days. These standards are:

- Advanced Rescue Training Standard
- Basic Safety Training Standard
  - First Aid
  - Manual Handling
  - Fire Awareness
  - Working at Heights
  - Sea Survival
- Blade Repair Training Standard
- Enhanced First Aid Training Standard
- Basic Technical Training Standard
  - Mechanical
  - Electrical
  - Hydraulics
  - Installation
- Lift Training Standard
- Slinger Signaler Training Standard
- Control of Hazardous Energies Training Standard

While many of these training standards could be relevant to an offshore wind job role depending on an individual's profession, the most prominent training standard packages for wind turbine technicians are the Basic Safety Standard and Basic Technical Training Standard. For offshore wind, the "Sea Survival" module teaches participants how to act safely during offshore operations from shore to installation vessels.

3.2.2 Occupational Safety and Health Administration

The Occupational Safety and Health Administration (OSHA), part of the United States Department of Labor, is a national agency that regulates workforce and safety standards. While the United States Department of Interior (DOI) oversees health and safety for offshore wind projects, DOI will consult with OSHA and likely utilize many of its existing safety standards. These standards will likely be applied to many onshore construction and operation jobs needed during offshore wind development.

Specialized Qualifications & Certifications

Most jobs involved in offshore wind require some level of educational qualification, certification, or training. While university degrees are needed to some extent for all project phases (a Bachelor's, Master's, Juris Doctorate, or PhD), they are required at the highest concentration in the Project Development phase. In the Wind Turbine and BoP Supply phases, Installation & Commissioning phase, and the O&M phase, many workers need specific manufacturing, construction, and safety training to perform job duties. Error! Reference source not found. provides a non-exhaustive list of varying qualifications, what roles they typically apply to, and where in the supply chain they are needed.

Individuals must participate in various training and apprenticeship programs to obtain these certifications. These programs differ in length (from several weeks to multiple years) and are determined by the level of specialization required. Some specific welding certifications (such as the API 1104 Certification or the AWS Submerged Arc Welding Certification) may not be widely taught in current apprenticeship and vocational educational programs and may require additional training resources.

Table 3.7 – List of specialized certifications required for various SOC occupations across supply areas for a floating offshore wind project

SOC OCCUPATION	SUPPLY AREA	CERTIFICATION
Captains, Mates, and Pilots of Water Vessels	Project Development Installation and Commissioning Operations and Maintenance	Merchant Marine Credential
		Standard of Training, Certification, and Watchkeeping for Seafarers
		Transportation Worker Identification Credential
		United States Coast Guard (USCG) Master License
Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	Wind Turbine Supply Balance of Plant Supply	Norwegian Professional Council for Education and Certification of Inspectors of Surface Treatment (FROSIO) – Level 3t
		Society for Protective Coatings (SSPC) Protective Coating Specialist
Conservation Scientists	Project Development Installation and Commissioning	Protective Species Observation Certification
Crane and Tower Operators	Wind Turbine Supply Balance of Plant Supply	Certification of Crane Operators (CCO) Mobile Crane Operator Certification
Inspectors, Testers, Sorters, Samplers, and Weighers	Wind Turbine Supply Balance of Plant Supply	American Concrete Institute (ACI) Concrete Field-Testing Technician Level 1
		Concrete Laboratory Testing Technician – Level 1
		Magnetic Particle and Penetrant Certification
		Phased Array and Manual Ultrasonic Testing Certification
		Ultrasonic Testing Level 2
Laborers and Freight, Stock, and Material Movers, Hand	Project Development Installation and Commissioning Operations and Maintenance	Transportation Worker Identification Credential
Occupational Health and Safety Technicians	Wind Turbine Supply Balance of Plant Supply	Certified Safety Professional
		Construction Safety and Health Technician
Painters, Construction, and Maintenance	Wind Turbine Supply Balance of Plant Supply	Norwegian Professional Council for Education and Certification of Inspectors of Surface Treatment (FROSIO) – Level 3t

SOC OCCUPATION	SUPPLY AREA	CERTIFICATION
		Society for Protective Coatings (SSPC) Protective Coating Specialist
Pump Operators, Except Wellhead Pumpers	Balance of Plant Supply	American Concrete Institute (ACI) Concrete Field-Testing Technician Level 1
		CCO Pump Operator Certification
		Concrete Laboratory Testing Technician – Level 1
Rigger	Balance of Plant Supply	Ironworker Rigger and Signal Person Certification
		Qualified Rigger Certification (Level 1 and Level 2)
Sailors and Marine Oilers	Project Development Installation and Commissioning Operations and Maintenance	Merchant Marine Credential
		Standard of Training, Certification, and Watchkeeping for Seafarers
		Transportation Worker Identification Credential
Ship Engineers	Project Development Installation and Commissioning Operations and Maintenance	Merchant Marine Credential
		Transportation Worker Identification Credential
		United States Coast Guard (USCG) Master License
Welders, Cutters, Solderers, and Brazers	Wind Turbine Supply Balance of Plant Supply	6G Certification
		American Society of Nondestructive Testing Central Certification Program (ACCP) Level II Certification
		American Petroleum Institute (API) 1104 Certification
		American Welding Society (AWS) Submerged Arc Welding Certification
		AWS D1.1, D1.2, D1.3, D1.4 Certification/Endorsement
		AWS Certified Welding Inspector

Offshore wind projects typically begin development more than a decade before COD. As a result, workforce training must begin well in advance to align with project timelines. Many prospective workers may be hesitant to pursue training or make a career shift for roles that are not immediately available. Aligning training program timelines with project development is essential to maximize local workforce participation and ensure a seamless transition from training to employment in offshore wind roles. General training demand trends relative to COD are provided for a set of high-demand job roles in Figure 3.4. These selected job roles represent the two most in-demand SOC occupations across key supply chain areas.

Offshore wind projects require workers at all experience levels-from seasoned professionals ot new etrants. Senior engineering roles may offer limited local training potential, as many of these positions are filled by professionals already working in the field. However, there is a near-term opportunity to culticate junior engineering talent through CalPoly and College of the Redwoods.

Skilled trades roles in manufacturing and installation such as welders and crane operaters, require training to begin 10 or more years prior to COD, due to the complexity of the work and length of typical apprenticeship programs (often 4-5 years). In contrast, wind turbine service technicians are primarily needed during the O&M phase and their required GWO certiciation can be completed in a matter of weeks, allowing training to begin closer to COD or even after the project becomes operational.

Some roles, such as engineers, welders, and electricians are needed across multiple projece phases, and require longer training periods (4+ years), creating steady demand for training over time. Others, like construction laborers and crane operators are concentrated around installation phases, with on-the-job training opportunities, and thus training programs will be required much later in the project timline. Figure 3.4 shows that training demand for wind turbine technicians ends at year 0, however, these roles are needed consistently throughout the O&M phase, meaning training can occur anytime post-COD.

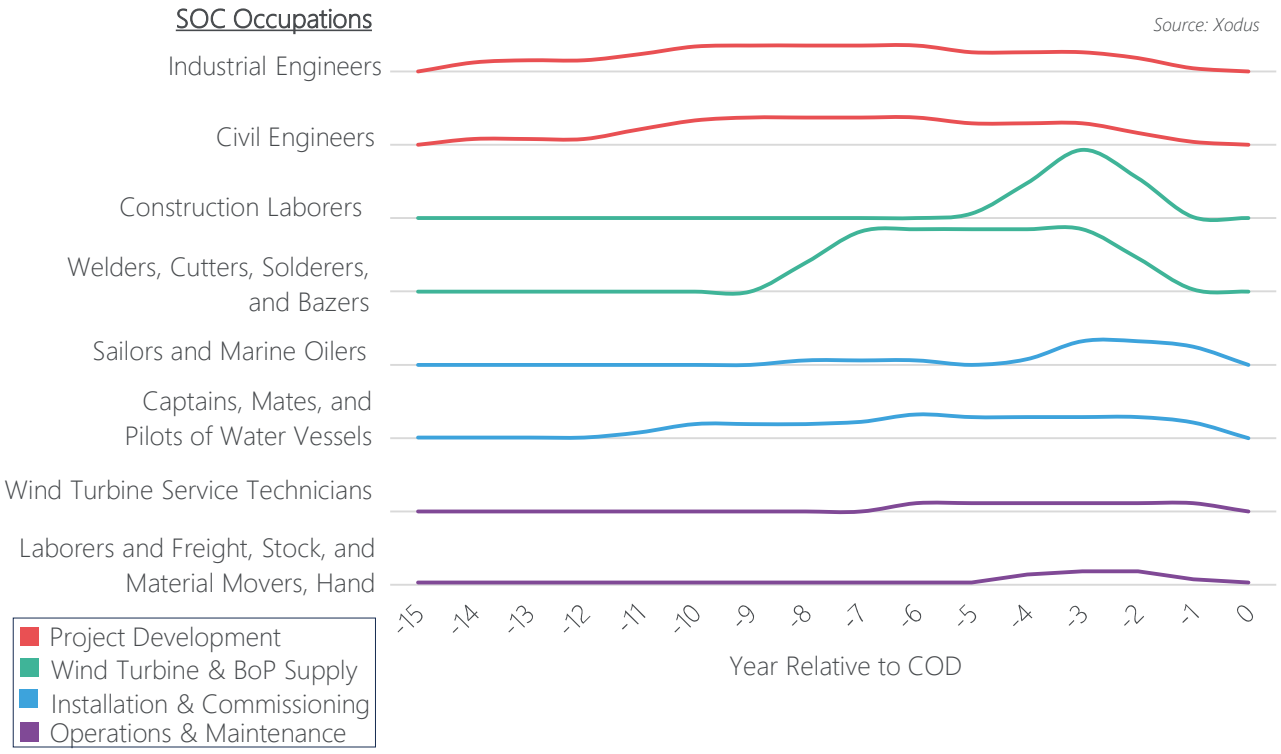


Figure 3.4 - General training demand trends for eight high-demand job roles for a commercial scale floating offshore wind project relative to COD

4 LOCAL AND REGIONAL WORKFORCE DEMAND

4.1 Offshore Wind Workforce Demand Modelling

The offfshore wind workforce demand was modelled using Xodus' in-house tool, which was developed using a bottom-up approach. The tool incorporates a temporal component that tracks workforce demand based on the products and services required each year relative to the project's COD. The workforce demand is evaluated for five years before and after the COD, as this period generally captures the full arc of workforce activity associated with each project, as seen in the previous section. The tool offers a baseline assessment of workforce demand for each project, providing a general framework adaptable to various local content assumptions and project timelines.

Each supply chain element (Project Development, Wind Turbine and Balance of Plant Supply, Installation and Commissioning and Operations and Maintenance) is flagged each year, with an in-demand or no-demand value reflecting whether workers in that supply chain element are salaried employees in that year. The workforce tool is supplemented with detailed information about each role, including, but not limited to, SOC codes associated with each role, quantity, years of experience, training requirement, union vs. non-union, prevailing wage information, and onshore vs. offshore categories. The local and regional demand is the result of the compounding impacts of several compounding project development teams, timelines, and local content scenarios.

Regional Workforce Analysis

This study takes into account which roles may have a more temporary and transient nature. This analysis aims to provide local governments and key stakeholders with important information for workforce development planning by identifying where local employment may be maximized and when outside labor will likely need to be sourced. Roles likely based in the region and brought to the region are defined:

- Likely based in the Region: This refers to job roles with long-term employment potential, including those in project development, manufacturing, O&M, or ongoing activities after installation. Job roles were identified as 'likely based in the Region' if the role was associated with an activity that occurs over a long timescale (>2 years).
- Likely brought into the Region: This refers to roles with short-term tasks and without a secured continuous pipeline, such as those which occur primarily during installation and commissioning. Job roles were identified as 'likely brought into the Region' if the role was associated with a vessel or was associated with an activity that occurs over a short timescale (<2 years).

4.1.1 Development Scenarios

Three offshore wind development scenarios were created to estimate the workforce demand in Humboldt County and the remaining Redwood Coast. For each scenario, a local content percentage was assigned for each supply element. This percentage was determined using information gathered through community outreach, local supply chain analysis, and in-house expertise of East Coast and global offshore wind projects. The scenarios provide a meaningful way to

compare varying offshore wind development pathways based on changes in the presumed timeline of the Port of Humboldt's development. While the scenarios present three realistic development outcomes, they should not be considered a prescriptive analysis of what will happen in the Region, as many future variables such as investment, market development, and local aspiration can alter development plans. Table 4.1 provides a summary of each development scenario.

Table 4.1 – Detailed Description of Scenarios Used for Analysis

SUPPLY CATEGORY	SCENARIO A	SCENARIO B	SCENARIO C
OSW Project Pipeline	1 commercial scale project	2 commercial scale projects	2 commercial scale projects
Project Development	40% of project development activities occur locally for 1 project	40% of project development activities occur locally for 2 projects (2 teams)	40% of project development activities occur locally for 2 projects (2 teams)
Manufacturing	Some secondary steel	Some secondary steel	Some secondary steel and export cable manufacturing
Installation & Commissioning	1 S&I terminal used in Humboldt, some offshore support services	2 S&I terminals used simultaneously in Humboldt, some offshore support services	2 S&I terminals used simultaneously in Humboldt, some offshore support services, and foundation assembly
Operations and Maintenance	1 O&M site developed in Humboldt	2 O&M sites developed- 1 in Humbodlt and 1 in Crescent City	2 O&M site developed- 1 in Humbodlt and 1 in Crescent City

It is important to note that while export cable manufacturing was chosen as the major component to be manufactured in the Region, this selection represents the impacts of a major component manufacturing workforce rather than predicting what exact manufacturing will happen in the region.

Detailed local content assumptions and supporting justification for each value assigned to the workforce element is provided in Appendix B.

4.2 Workforce Demand - Humboldt County and Remaining Redwood Coast

4.2.1 Scenario A Workforce Demand

Scenario A results in the lowest projected workforce demand for Humboldt County and the Remaining Redwood Coast, shown in Figure 4.1.

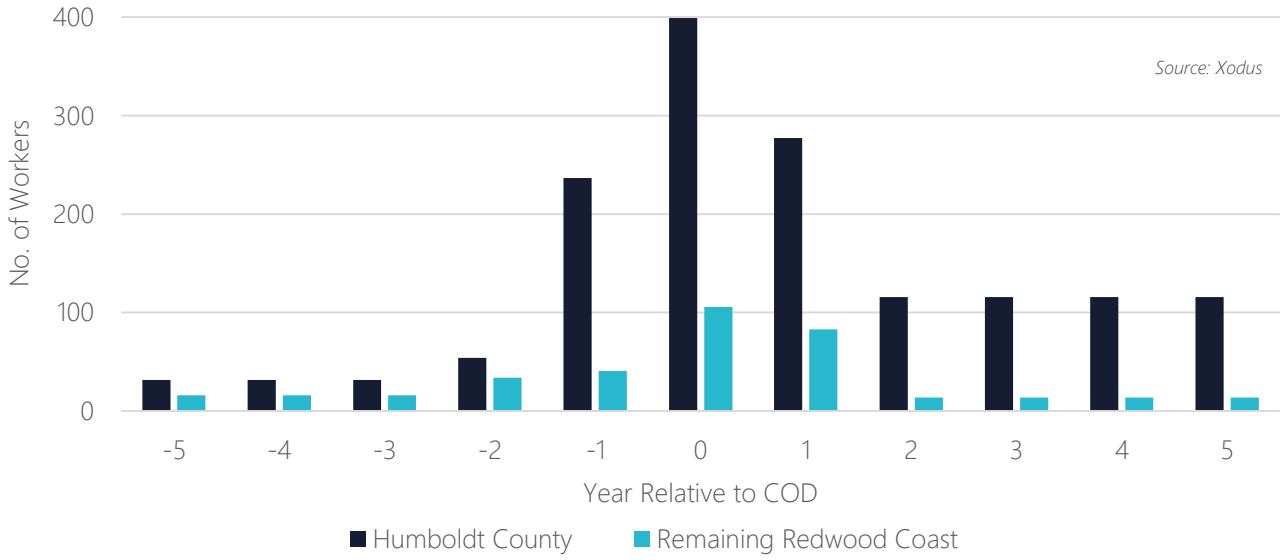


Figure 4.1 – Workforce demand relative to COD for workers from Humboldt County and the Remaining Redwood Coast in Scenario A

In the Project Development phase, it is assumed there will be relatively few workforce opportunities (<100), mainly consisting of local developer teams, local permitting teams, stakeholder engagement, and smaller-scale environmental surveys.

Scenario A assumes that some smaller supply contracts are sourced from the region, potentially including smaller secondary steel, mooring line components, and onshore substation materials. While smaller than larger Tier 1 manufacturing, these scopes still offer an important opportunity for individuals to gain experience manufacturing important components for offshore wind development.

The most significant local workforce demand occurs during the Installation and Commissioning phase, peaking roughly at 500 jobs between Humboldt and the Remaining Redwood Coast. This significant demand comes from the Staging and Integration (S&I) planned at the Port of Humboldt Bay. Much of this workforce will be based at the port, including the main S&I activity and the workforce required to operate support vessels (tugs, spotters, and guards). As the Port of Humboldt Bay is within Humboldt County, the workforce is assumed to come primarily from within the County, with

some workers commuting from the Remaining Redwood Coast. Humboldt and the Remaining Redwood Coast currently do not have strong industrial transferability with the work anticipated at the Port, and with these tasks typically being seasonal, it has been projected that these roles may likely be filled by a transient workforce (Figure 4.2).

Additionally, half of the workforce needed for the onshore construction supply chain element is anticipated to be sourced from the Redwood Coast Region, with the other half coming from the rest of the State. This assumption reflects the demand for a large construction workforce (electricians, iron workers, inspectors, pile drive operators, cement masons, etc.) to develop supporting infrastructure, such as an onshore substation, which may not yet exist regionally.

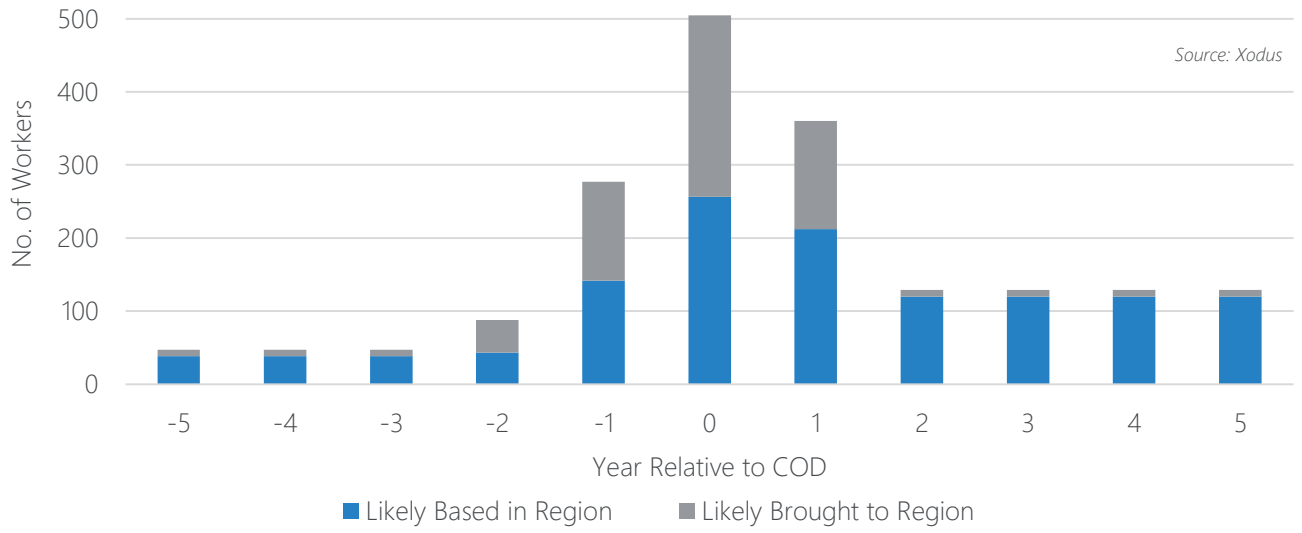


Figure 4.2 – Workforce demand relative to COD for workers likely based in the Region and workers likely brought to the Region in Scenario A

O&M activities are assumed to occur out of the Port of Humboldt. This workforce will include port operations staff, staff at the operations base, and some members of the corrective maintenance team. Most of these workers will likely be sourced from Humboldt County, given the permanent nature of many of these job roles. However, some roles may be filled by individuals within the Remaining Redwood Coast region who are willing to commute. While this annual workforce is relatively smaller than in other phases, the long duration of the O&M phase, with the potential synergies amongst multiple projects, allows this workforce to have permanent, long-term growth opportunities.

When looking specifically at the workforce demand in the Region, the largest workforce needed will be individuals who fall under the Manufacturing Trade Professional, Building Trade Professional, and Maritime Trade Worker groups (as seen in Figure 4.3). This trend is due to the large number of workers required during the Installation and Commissioning phase, which emphasizes the importance of preparing these workforces several years in advance of a project's construction. Many workers in these groups will be covered under a project's PLA and will be unionized labor.

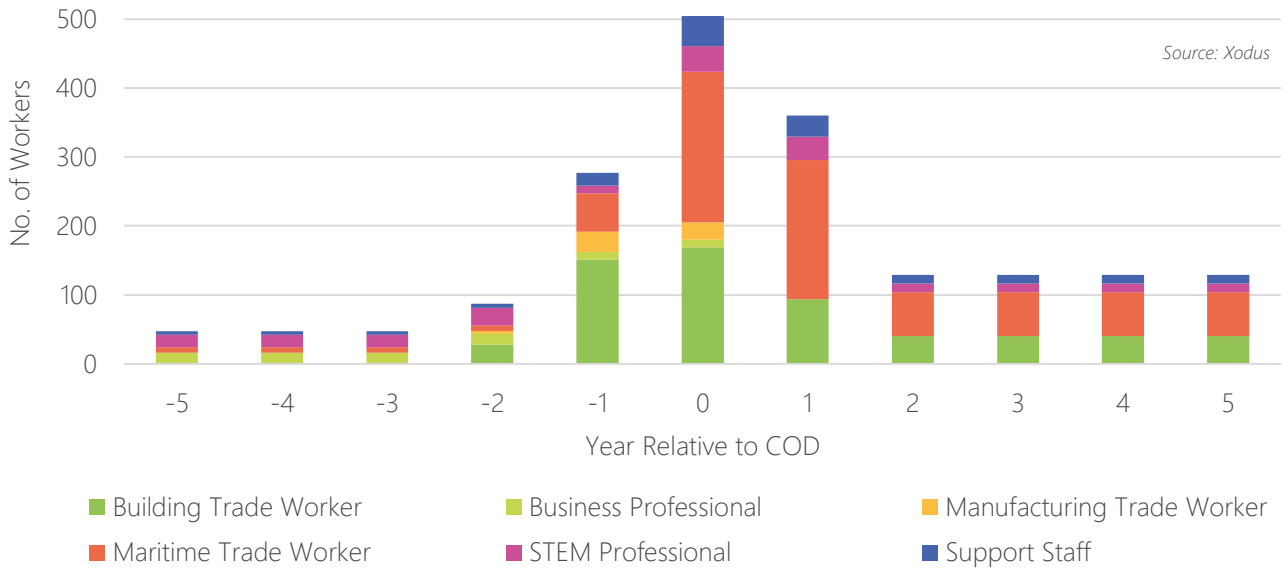


Figure 4.3 – Workforce demand relative to COD for workers from the Region in the required job role categories in Scenario A

Although it is not anticipated that a significant demand for STEM Professionals and Support Staff will be sourced regionally, these opportunities represent valuable career paths, as they are typically full-time permanent roles. Supporting existing training institutions, such as Cal Poly and the College of the Redwoods, will be critical to creating a pipeline through which to source these roles locally.

4.2.2 Scenario B

Scenario B presents the medium-case workforce demand for Humboldt County and the Remaining Redwood Coast (as seen in Figure 4.4). The increase in demand from Scenario A is primarily due to the expansion from one operational port terminal to two, enabling two projects to be installed simultaneously.

The Project Development phase offers the lowest workforce opportunity in the region, even with two projects advancing concurrently. Like Scenario A, Scenario B assumes that wind turbines and major BoP components will not be manufactured in the region, as the level of investment required makes this unlikely within the next decade. However, it does include some minor BoP supply contracts sourced locally such as secondary steel and some minor mooring components. As in Scenario A, the the greatest local workforce demand in Scenario B occurs during the Installation and Commissioning phase, peaking at approximately one thousand jobs. Scenario B also assumes that two projects will establish O&M activities at the Ports of Humboldt and Crescent City, creating two O&M bases.

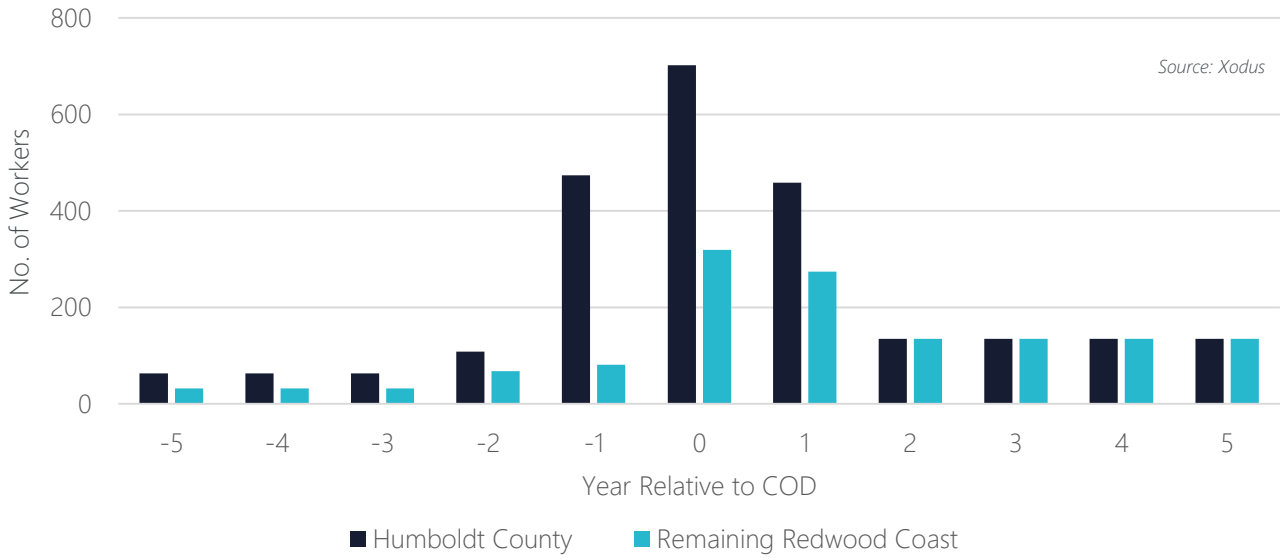


Figure 4.4 – Workforce demand relative to COD for workers from Humboldt County and the Remaining Redwood Coast in Scenario B

Establishing a base in the Remaining Redwood Coast introduces a significant long-term employment opportunity and is likely to generate the greatest regional economic benefit. As seen in Figure 4.5, the ratio of transient to permanent positions created in Scenario B remains consisten with Scenario A., with a peak demand in year 0 relative to COD, where projects are being installed in summer months.

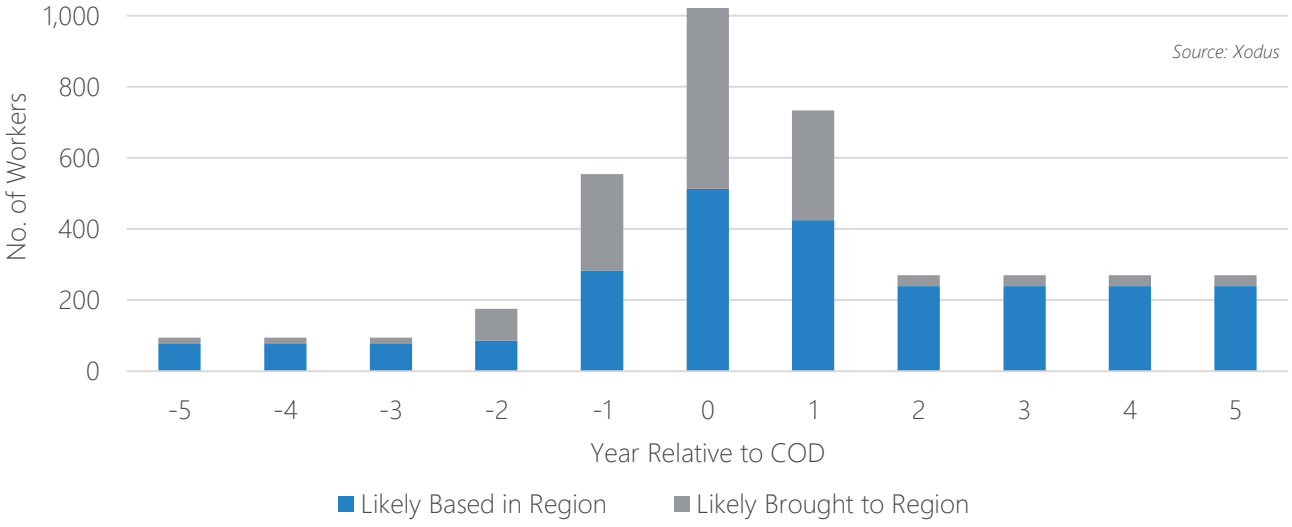


Figure 4.5 – Workforce demand relative to COD for workers likely based in the Region and workers likely brought to the Region in Scenario B

When focusing specifically at the workforce demand in the Region, the highest demand will be for workers classified under the Building Trade Professional and Maritime Trade Worker groups, as shown in Figure 4.6. This reflects the increase in labor needs during the Installation and Commissioning phase compared to Scenario A, as two projects are being constructed and installed simultaneously. Many of these roles could be filled by transient workforce during the summer, when the most intensive installation activities occur.

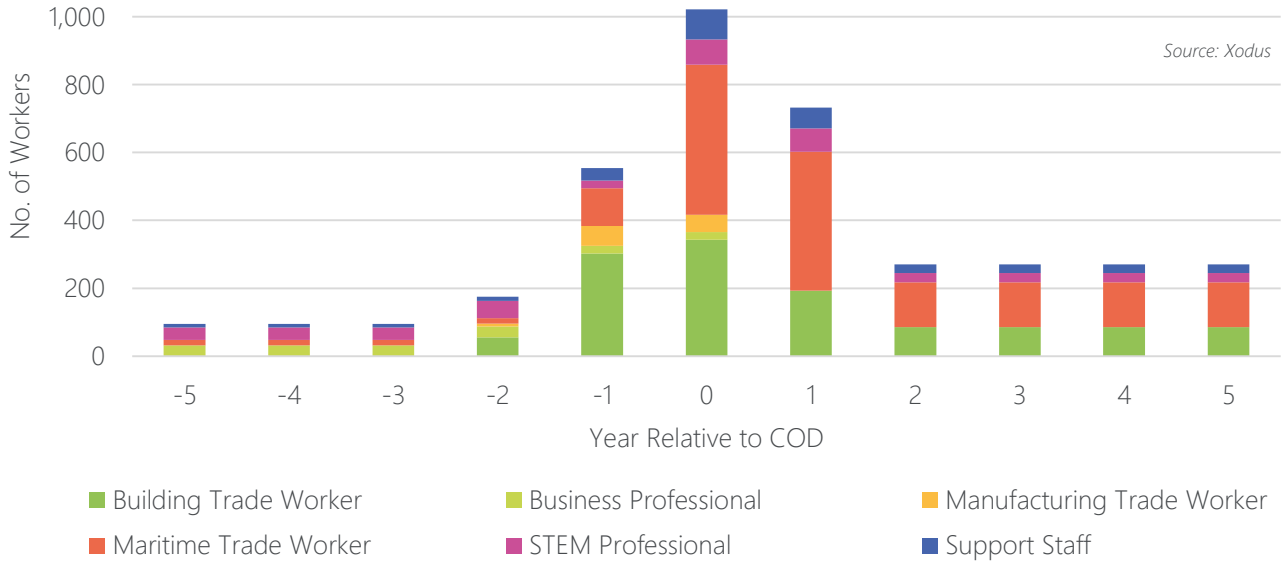


Figure 4.6 – Workforce demand relative to COD for workers from the Region in the required job role categories in Scenario B

With Humboldt County and the Remaining Redwood Coast having limited maritime industrial experience, these installation activities will likely significantly strain the local workforce. Project activities, including offshore support services, staging and integration, and ports and logistics, localized in the Port of Humboldt Bay, will require a large workforce of skilled trade specialists, standard skilled laborers, and unskilled labor to fulfill roles such as longshoremen, riggers, and welders. The Region's low supply of workers with such capabilities will require outsourced labor until the existing workforce can be expanded and upskilled.

4.2.3 Scenario C

Scenario C results in the highest workforce demand for the Region, peaking at over 1,200 employees, shown in in Figure 4.7 This increase in demand from Scenario B is due to the significant demand for workers needed locally for foundation assembly and export cable manufacturing.

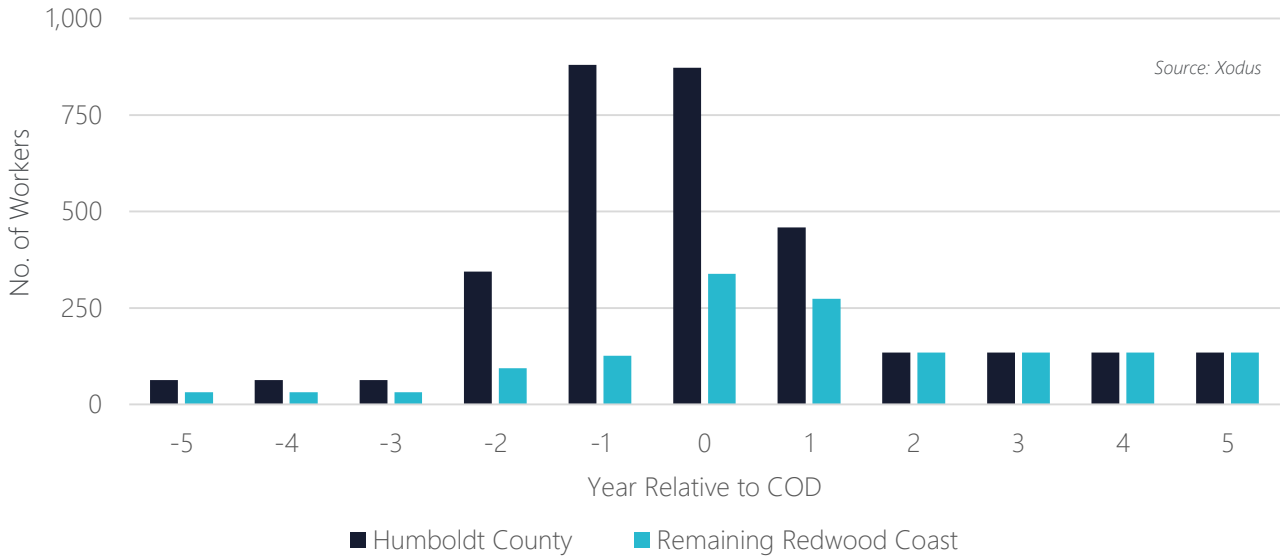


Figure 4.7 – Workforce demand relative to COD for workers from Humboldt County and the Remaining Redwood Coast in Scenario C

This increase in workforce demand is primarily observed in Humboldt County, rather than the Remaining Redwood Coast region, as foundation assembly and major component manufacturing are expected to occur at the Port of Humboldt. While export cable manufacturing was modeled for this analysis due to potential market gaps in the West Coast offshore wind market, the required relative demand would be broadly consistent for the local manufacturing of any major component.

By incorporating foundation assembly and major component manufacturing, Scenario C generates the most significant number of permanent jobs, as shown in Figure 3.18. While they were modeled against two projects for this assessment, if a local manufacturing facility were to open, these roles would be project-independent, as manufacturers can serve offshore wind projects being developed elsewhere in addition to those planned for the Humboldt WEA.

When looking specifically at the workforce demand in the Region, the largest workforce needed will be individuals who fall under the Building Trade Professional and Maritime Trade Worker groups, with a substantial increase from Scenario B for individuals within the Manufacturing Trade Professional group of over 300 positions (as seen in Figure 4.9).

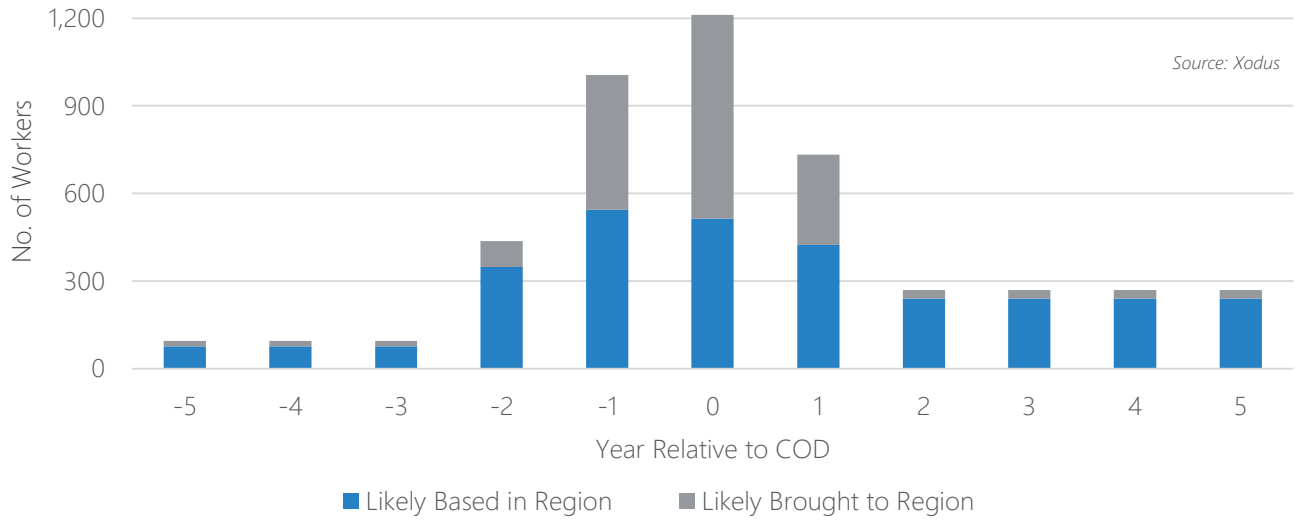


Figure 4.8 – Workforce demand relative to COD for workers likely based in the Region and workers likely brought to the Region in Scenario C

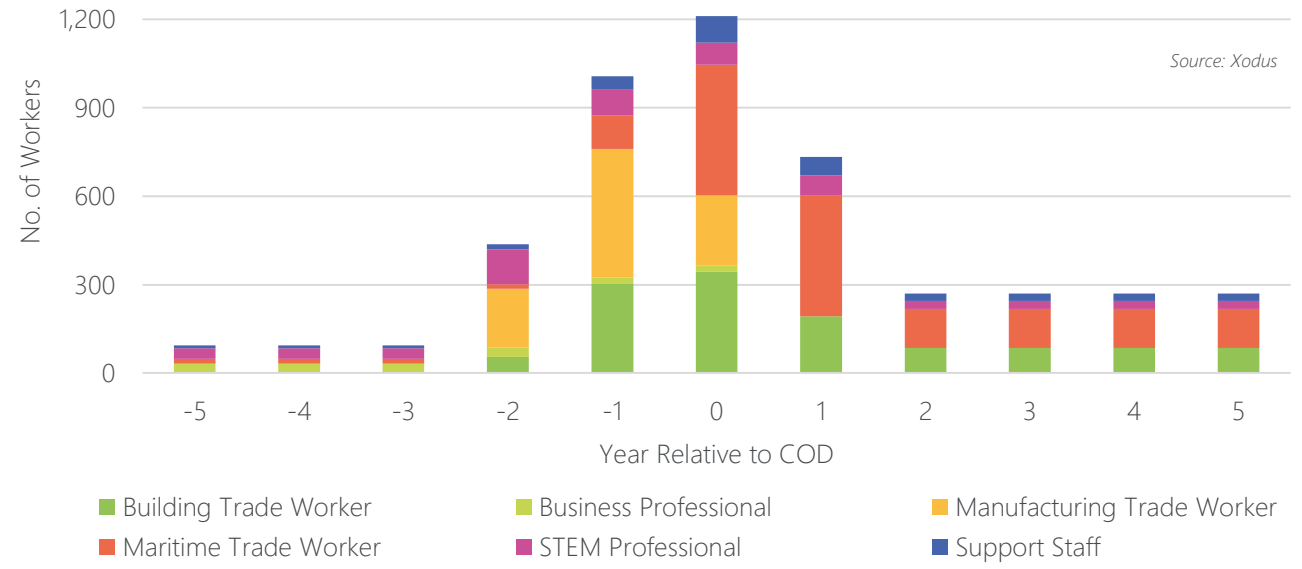


Figure 4.9 – Workforce demand relative to COD for workers from the Region in the required job role categories in Scenario C

This increase in demand for Manufacturing Trade Workers and Building and Maritime Trade Workers could strain local infrastructure, such as housing and support services.

4.2.4 Comparative Analysis

Figure 4.10 illustrates the workforce demand profiles for Scenarios A, B, and C over the course of a single offshore wind project lifecycle. The most notable differences occur in the year of commercial operation (COD) and the years immediately preceding it. Scenario C presents the highest peak workforce demand, reaching over 1,200 workers at COD, followed by Scenario B and then Scenario A.

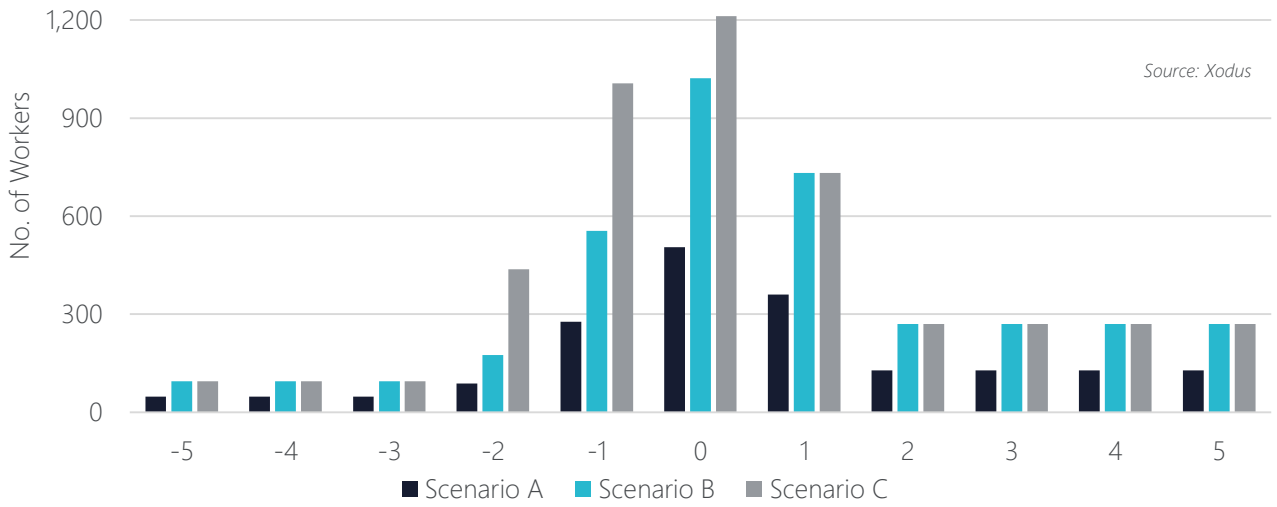


Figure 4.10 Workforce demand relative to commercial operations date for workers from the Redwood Coast Region in Scenarios A, B, and C.

These differences are driven by the level of local supply chain activity assumed under each scenario, where the introduction of a second S&I terminal in Humboldt will significantly increase workforce demand in the region (shown as the uplift in workforce from Scenario A and B). The increase in workforce demand from Scenario B to Scenario C reflects a localized foundation assembly and export cable manufacturing in the region, showin primarily from year -2 of COD through year 0.

The timing of workforce needs is generally consistent across all three scenarios, with the most significant labor demand occurring in the two years leading up to and including COD, when installation and commissioning activities are at their peak. In contrast, post-COD years (1–5) show a more stable demand pattern across scenarios, reflecting long-term O&M jobs.

5 GAP ANALYSIS

5.1 Approach

The teams developing, supplying, and installing an offshore wind project require a range of skills and certifications, with several job roles consistently needed across various project phases and activities. Several of the job roles in highest demand to support the delivery of an offshore wind project are listed in Table 5.1, along with their relevant Standard Occupational Classification (SOC) titles. SOC codes encompass multiple job roles under a single title, generally grouped by the work performed. For instance, the SOC code for Civil Engineers encompasses workers with titles including civil engineer, design engineer, engineer, geotechnical engineer, project engineer, and structural engineer. These job roles, described according to the SOC code, are thus analogs for several combined job roles with similar working experiences and requirements for education, training, or certification. Table 5.1 highlights the SOC occupation, job roles, and relevant project phases for several job roles that are most likely to be sourced from the Region.

Table 5.1 – SOC occupations and example job roles projected to be in the highest demand in Humboldt County

SOC CODE TITLE	EXAMPLE JOB ROLES
Laborers and Freight, Stock, and Material Movers, Hand	Loader Material Handler Warehouse Worker
Operating Engineers and Other Construction Equipment Operators	Heavy Equipment Operator Forklift Operator Machine Operator
Construction Laborers	Construction Laborer Construction Worker Site Work Laborer
Crane and Tower Operators	Mobile Crane Operator Overhead Crane Operator Port Crane Operator
Riggers	Gantry Rigger Heavy Lift Rigger Marine Rigger
Welders, Cutters, Solderers, and Brazers	Assembly Line Brazer Fabrication Welder Maintenance Welder
Mechanical Engineers	Design Engineer Equipment Engineer Project Engineer

SOC CODE TITLE	EXAMPLE JOB ROLES
Civil Engineers	Geotechnical Engineer Project Engineer Structural Engineer
Electricians	Control Electrician Industrial Electrician Maintenance Electrician

This report conducted a gap analysis using Sections **Error! Reference source not found.** and 4.2 results to understand potential opportunities and challenges for the Region's workforce. This analysis was examined through a Red-Amber-Green (RAG) assessment, which is defined in Table 5.2.

Table 5.2 - RAG assessment criteria for gap analysis

ASSESSMENT	CRITERIA
R	Potential workforce demand is >50% of the current labor market size
A	Potential workforce demand is between 10-50% of the current labor market size
G	Potential workforce demand is <10% of the current labor market size

It is important to note that the criteria developed for the RAG assessment were created on a curve due to the Region's low population. For example, a 5-10% increase in demand for an occupation would be significant, but it still received a "green" score in this assessment. Additionally, while occupations in high demand are graded with a red score (which carries a negative connotation), this score can be viewed as a positive, indicating that the respective occupation is in high demand and presents a growth opportunity for the Region.

This report also utilizes location quotients (LQs) to measure how the distribution of key roles in Humboldt County and the Remaining Redwood Coast workforce compares to that of the United States. An LQ is an analytical statistic that measures a region's industrial localization relative to a larger geographic unit. An LQ is computed as an industry's share of regional total employment divided by the industry's share of national total employment. For example, an LQ of 1.0 in Civil Engineers means that the region and the nation have relatively equal concentrations of civil engineers. In contrast, an LQ of 1.8 means that the Region has a higher density of Civil Engineers than the nation.

5.2 Gap Analysis

Understanding the existing workforce landscape of Humboldt County and the Remaining Redwood Coast region to serve the offshore wind industry is critical for identifying potential opportunities and challenges for offshore wind development in the region. In the following sections, a gap analysis is conducted for both regions.

Humboldt County

The anticipated S&I activities at the Port of Humboldt Bay are the most significant contributor to workforce demand in Humboldt County in Scenarios A and B. Many of these workers will be at the port and involved in the storage, logistics, turbine integration, and testing processes. As seen in Table 5.3, these activities will likely strain the local workforce, with several roles requiring over 10% of the current labor force to transition to offshore wind.

Table 5.3 – RAG assessment of top ten SOC occupations demanded in Humboldt County for Scenarios A, B, and C

SOC OCCUPATION	CURRENT EMPLOYMENT IN HUMBOLDT COUNTY	WORKFORCE DEMAND IN SCENARIO A	WORKFORCE DEMAND IN SCENARIO B	WORKFORCE DEMAND IN SCENARIO C
Laborers and Freight, Stock, and Material Movers, Hand	671	31-60	61-100	61-100
Operating Engineers and Other Construction Equipment Operators	159	31-60	61-100	61-100
Construction Laborers	376	16-30	31-60	61-100
Wind Turbine Service Technician	2	16-30	16-30	16-30
Crane and Tower Operators	12	6-15	16-30	31-60
Riggers	4	6-15	16-30	31-60
Welders, Cutters, Solderers, and Brazers	54	6-15	16-30	31-60
Mechanical Engineers	47	6-15	16-30	16-30
Civil Engineers	110	6-15	16-30	31-60
Electricians	232	6-15	16-30	16-30

Many of these roles will be unionized, as the State will likely require the signing of a PLA, which will require that a large percentage of onshore work be conducted by unionized labor[12]. With the current lack of union training facilities and unionized labor in Humboldt County, these workers will likely be sourced out-of-region, leading to an influx of workers. This anticipated workforce movement may necessitate the County's development of additional housing, infrastructure, and services to accommodate the increased demand.

To encourage a higher percentage of local workforce participation, the County should introduce apprenticeship requirements for future construction projects, such as transmission upgrades and housing projects, to train and utilize set numbers of apprentices. This would help increase the number of apprentices, incentivize unions to open training facilities, and, in turn, increase the number of local journey-level people.

If manufacturing were to occur in the County, as analyzed in Scenario C, there would likely be a workforce opportunity of roughly 200-300 jobs. Unlike employment in S&I, these roles would be largely permanent and non-unionized[13], offering long-term economic benefits. Other workforce opportunities in the Project Development and O&M phases are fewer in number but offer high-paying, long-term employment opportunities that can positively impact local communities economically.

Remaining Redwood Coast

The anticipated S&I activities at the Port of Humboldt are the largest contributor to workforce demand in the Remaining Redwood Coast in Scenarios A and B. As the Port of Humboldt is greater than an hour's commute from all counties within the Remaining Redwood Coast region, offshore wind development is anticipated to have a lower workforce impact on the Redwood Coast than in Humboldt County. However, many individuals may commute or temporarily stay in Humboldt County to work at the Port, likely during the summer.

Like S&I, manufacturing activities projected in Scenario C will likely have a significantly less economic impact on the Remaining Redwood Coast than in Humboldt County. Some individuals may choose to commute or relocate to pursue job opportunities, but this may require regional intervention to accommodate them effectively.

The top 10 in-demand job roles in the Remaining Redwood Coast vary from Humboldt County, as showin in Table 5.4, when compared with Table 5.3. This trend is due to the shift in what was assumed to occur locally, for roles in the Project Development and O&M phases projected to occur in the broader Redwood Coast. These roles, such as Wind Turbine Technician and Conservation Scientist, will be in relatively high demand and require some training and preparation.

[12] *What Developers Need to Know About Project Labor Agreements for U.S.-based Offshore Wind Projects, Black & Veatch, https://www.bv.com/en-US/perspectives/what-developers-need-to-know-about-project-labor-agreements-for-u-s-based (Accessed 1/29/2025)*
[13] *IndustriALL affiliates address organizing challenges in wind energy, IndustriALL, https://www.industriall-union.org/industriall-affiliates-address-organizing-challenges-in-wind-energy (Accessed 4/15/25)*

Table 5.4 - RAG assessment of top ten SOC occupations demanded in the Remaining Redwood Coast for Scenarios A, B, and C

SOC OCCUPATION	CURRENT EMPLOYMENT IN THE REDWOOD COAST	WORKFORCE DEMAND IN SCENARIO A	WORKFORCE DEMAND IN SCENARIO B	WORKFORCE DEMAND IN SCENARIO C
Construction Laborers	392	6-15	16-30	16-30
Mechanical Engineers	39	1-5	6-15	6-15
Conservation Scientists	11	1-5	6-15	6-15
Operating Engineers and Other Construction Equipment Operators	179	1-5	6-15	16-30
Civil Engineers	102	1-5	6-15	6-15
Occupational Health and Safety Technicians	3	1-5	6-15	6-15
Wind Turbine Service Technicians	1	1-5	16-30	16-30
Structural Metal Fabricators and Fitters	9	1-5	1-5	6-15
Architectural and Engineering Managers	32	1-5	1-5	1-5
Laborers and Freight, Stock, and Material Movers, Hand	694	1-5	16-30	16-30

If Crescent City were to establish itself as an O&M port, this would increase the demand for Wind Turbine Technicians and other maritime construction occupations. These roles would vary based on the planned O&M activities but would provide long-term job opportunities for the Redwood Coast.

6 CASE STUDIES

6.1 Approach

Two cases featuring international development proxies have been identified to support a deeper assessment of workforce development potential in Humboldt County. Grimsby and Easter Ross (Nigg and Cromarty Firth), two of the largest offshore wind ports in the UK, were selected as proxy sites due to their similar population sizes (the population of Humboldt Count is approximately 135,000 vs. Grimsby with approximately 157,000, and Easter Ross with approximately 50,000) and the substantial localized growth of the offshore wind industry.

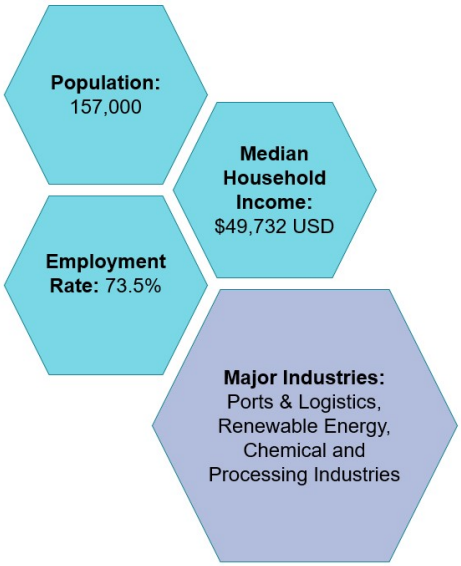
This study aims to identify key factors contributing to successful workforce development in these regions and assess the relevance and applicability of these factors and initiatives to influence similar growth in the Redwood Region. The following sections will provide context on Humboldt County, identify key characteristics and initiatives for the two case studies, and discuss how such factors and constraints may apply to the Humboldt region.

Humboldt County, California

- Population: 135,010
- Employment Rate: 51.4%
- Median household income (USD): $57,883
- Gross Domestic Product (GDP): $ 6,843,306,000
- Major Industries: Healthcare, Retail, Education

6.2 Case Study 1: Grimsby

Grimsby, located on the northeast coast of England in Northeast Lincolnshire, had a rich history as one of the world's largest fishing ports, covering the North Atlantic and North Sea regions. In 1891, over 850 fishing trawlers were based in Grimsby; today, less than 20 trawlers operate from the port. Grimsby was able to adapt to serve a critical role in the UK's seafood processing industry, handling over 40% of the UK's fish imports. Recently, it has established a significant presence in offshore wind operations and maintenance. In the wake of a shrinking fishing industry, the region transformed and leveraged its maritime expertise and strategic location on the North Sea to become a key player in the maintenance and operation of offshore wind farms. Today, large offshore wind developers, such as Ørsted, provide hundreds of direct and indirect jobs, accounting for a significant portion of the region's workforce.



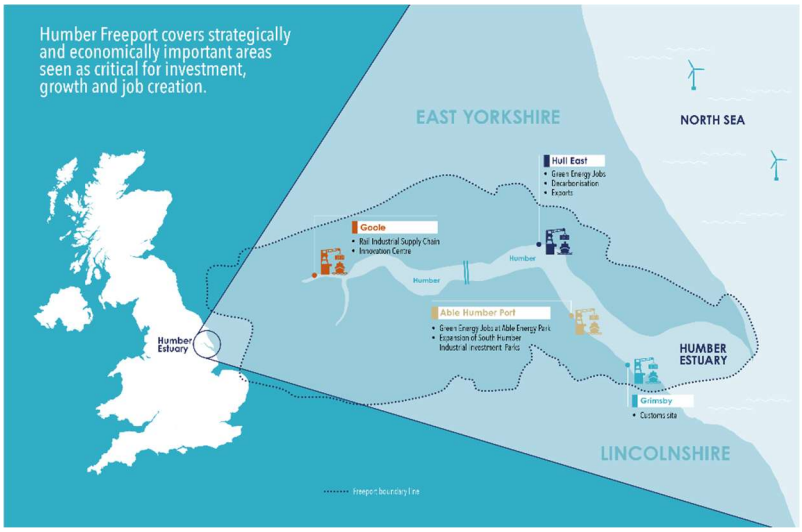


Figure 6-1 Map of Humber Free Port (Humber Freeport, 2024)

The Port of Grimsby is located near major wind farms, including Dogger Bank (5.6 GW), Triton Knoll (0.86 GW), and Hornsea (5.4 GW), and has attracted developers such as Ørsted and RWE, turbine OEMs such as MHI Vestas, and key O&M service providers such as RES and CWind. Siemens Gamesa also has established a major manufacturing presence in the port of Hull, investing over £310m in a blade and assembly facility in the region. Additionally, approximately 500 businesses in the region that utilize environmental technologies for offshore wind have invested in the area. The Humber Freeport, comprising Hull East, Goole, Able Humber Port, and Grimsby, aims to attract investment to designated regions with multiple ports and industrial sites. Businesses based within Freeports benefit from different economic regulations, including specific tax and customs exemptions. Public investment into Freeports attracts businesses to localize within the area, creating attractive job opportunities for residents. Between 2023 and 2024, over £1 billion of investment has been committed to establishing new projects within the site, creating upwards of 700 jobs, with ambitions to create more than 7,000 jobs in the region.14

Factors Contributing to Workforce Development

The decline of major industry - Once the UK's largest fishing port, the Port of Grimsby has historically played a significant role in fishing and shipping. However, the decline of the fishing industry in the late nineteenth century led to higher unemployment rates and low wages in Grimsby.[15] The recent decline of heavy industries, notably oil and steel, has similarly led to high unemployment and low levels of economic activity in the region. With current market pressures toward decarbonization, the community, workforce, local council, and government have been compelled to invest in new industries like offshore wind to drive economic prosperity.

[14] *Humber Freeport, https://humberfreeport.org/*

[15] *Growing the UK's coastal economy Learning from the success of offshore wind in Grimsby, https://green-alliance.org.uk/wp-content/uploads/2021/11/Growing_the_UKs_coastal_economy.pdf*

Proximity to major offshore wind infrastructure and projects – Grimsby's location on the Humber Estuary has become a strategic foothold for the operations and maintenance of nearby offshore wind farms. Ørsted, RWE, MHI Vestas, RES, and CS Wind have localized investment and established O&M bases at the port, drawing large support vessels to dock. The industry's visibility at the port and the creation of the first tranches of jobs in the community have helped attract and develop a local workforce.

Investment from government and industry – Grimsby has benefited from targeted public and private investment to attract, develop, and retain talent within the industry, including the establishment of the Humber Freeport and investments in infrastructure, training, and workforce development. Grimsby has also seen significant investment into its port infrastructure, with the Grimsby River Terminal recently receiving investments totaling £26m to develop its port to support both the automotive and energy industries.16 The Port of Grimsby has also received a commitment from Associated British Ports (the UK's leading and largest ports group) to develop the site to better suit offshore wind O&M, including the development of supporting infrastructure such as accommodation, training centers, and office spaces for workers.17

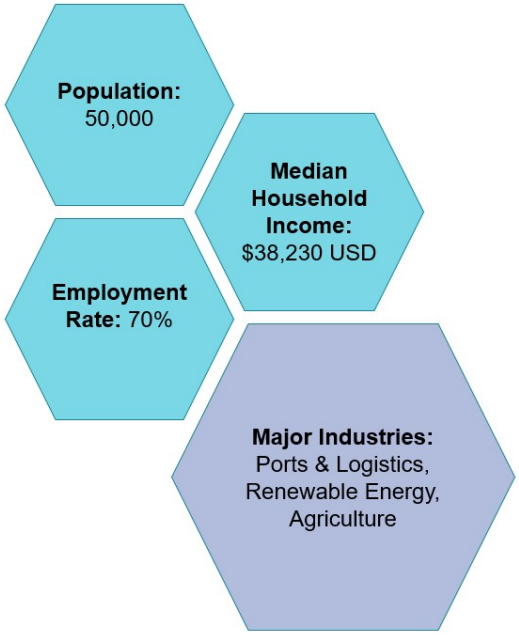
Workforce training investments – Ørsted has partnered with the Grimsby Institute and Furness College to establish an award-winning turbine technician program, which in 2023 granted 18 apprenticeships. During the apprenticeship, apprentices are provided with all the skills, knowledge, and behaviors required in the industry, and upon successful completion, they are offered full-time employment with Ørsted. Ørsted has announced that it aims to have 800 staff members out of Grimsby by 2030.18 The Grimbsy Institute has also worked with the National Skills Academy for Power to support developers with relevant skills training and apprenticeships. This includes focused investment in offshore wind, tidal, and wave power. Two major training facilities have also been established in Grimsby, with both CWind and Maersk Training offering immersive learning and upskilling opportunities.

Transferable skills – Given the prominence of the offshore oil & gas, chemicals, and marine engineering sectors in the region, several workers with transferrable skills may find direct employment in the offshore wind industry. To ensure they can transition to opportunities in offshore wind, these workers will need to be made aware of the opportunities and upskilled, with particular attention to obtaining proper certifications. There are also opportunities available for new graduates seeking to enter the industry. For example, the Grimsby Institute explicitly targets new graduates with the apprenticeships they have on offer through Ørsted and RES. The existing industrial baseline in the region also includes an existing support industry, including hotels and dining.

[16] *Graham, Grimsby River Terminal, https://www.graham.co.uk/projects/grimsby-river-terminal-associated-british-ports-grimsby-port*
[17] *Associated British Ports, Grimsby Port, https://www.abports.co.uk/locations/grimsby/*
[18] *Ørsted's offshore wind impact in the Humber region, https://orsted.co.uk/insights/our-impact-in-the-humber-region*

6.3 Case Study 2: Easter Ross - Nigg and Cromarty Firth

Easter Ross is a region in the Highlands of Scotland, encompassing the eastern part of the Ross and Cromarty district. Historically, the area's economy has relied heavily on agriculture, fishing, and, to some extent, the whisky industry. However, like many rural regions in Scotland, it has faced economic challenges due to the decline of these traditional industries.



In recent decades, there has been a significant shift towards renewable energy, with a particular focus on offshore wind, and the Cromarty Firth has grown into a hub for the burgeoning industry. The deep waters of the Cromarty Firth and the natural harbor have made it an ideal location for assembling, maintaining, and deploying offshore wind turbines. The designation of the Inverness and Cromarty Firth Green Freeport in 2024 marked a pivotal development, with plans to create over 10,000 jobs and attract more than £3 billion in investment. This initiative has solidified the area's status as a key resource in the UK's offshore wind sector; in recent years, Sumitomo Electric Industries has constructed a subsea cable manufacturing facility. This £350 million project is expected to create 330 jobs, including 156 in manufacturing.

Factors Contributing to Workforce Development

Infrastructure and an evolving energy industry – Established in 1973, the Cromarty Firth Port Authority initiated the first round of post-war modernization by developing the site to support the offshore oil and gas industry. Further investment through the 1990s focused on rig inspection, repair, and maintenance projects. However, as the industry began to decline, the Cromarty Firth Port Authority seized an opportunity to develop the site into an offshore wind hub. The Cromarty Firth Port now positions itself as a manufacturing, assembly, fabrication, marshaling, wet storage, integration, and O&M hub for offshore wind. As a result of this transition, developers and the supply chain have invested in establishing a presence in the region, creating job opportunities in the area.

Proximity to major offshore wind infrastructure and projects – Within a serviceable region, there are currently seven offshore wind farms: Moray West, Moray East, Beatrice, Caledonia, Stromar, Buchan, and Sinclair. Given its proximity to offshore wind sites, natural shelter, and existing infrastructure, the Cromarty Firth has attracted significant investment to develop regional facilities, all of which represent opportunities for the developing local workforce.

Investment from government and industry – The Inverness & Cromarty Firth Green Freeport includes the Port of Cromarty Firth, Port of Nigg, Port of Inverness, Highland Deephaven, and Port of Ardesier. The goal of Freeport is to create up to 10,250 jobs locally and secure £6.5 billion of investment over the next 25 years. The continued inward investment in the region will enable it to remain the center of Scotland's offshore wind market.

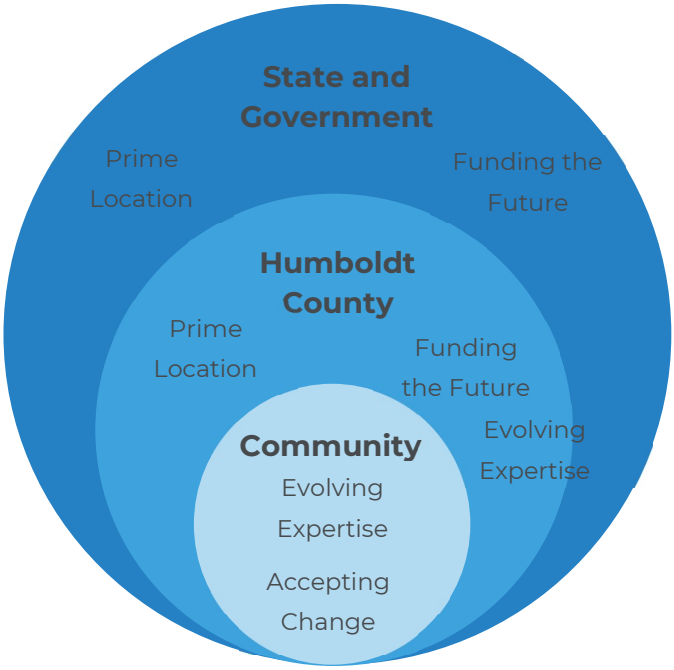
Training the local workforce – An Offshore Renewables Skills and Innovation Hub is under development by Opportunity Cromarty Firth. Additionally, the Powerhouse, a global center of excellence with Renantis, BlueFloat Energy, and Ørsted on its board, is planned for development in Easter Ross and will have applied research facilities dedicated to floating offshore wind and green hydrogen technologies. In addition to leading research, the co-located national training and skills center will be backed by developers and the government and delivered by a combination of academia and other training providers.

Transferrable skills – Just as in Grimsby, the energy industry has played a crucial role in the economy of Cromarty and Nigg. The energy industry in the region supports key skills and capabilities relating to logistics (including vessels and vessel servicing), marine engineering, marine renewables, and decommissioning. Unlike Grimsby, there is less competition in the region from adjacent industries that require skilled labor. The offshore wind industry has the opportunity not only to replace lost jobs due to the decline but also to offer the region a genuine economic growth opportunity.

6.4 Lessons Learned

6.4.1 Analysis

Having identified key themes from each Case that have influenced workforce development in each region, further analysis was applied to determine which stakeholders can affect change in the region. Three levels of stakeholders and the areas of control they have been identified: Community, Humboldt County, and State and Government. It is worth noting that all these factors and levels are interdependent and require collaboration among all stakeholders. The following section will discuss each stakeholder group and what is within their levels of control.



Community-level Actions
Accepting Change and Evolving Expertise

The community must be engaged with and supportive of the new industry for change to occur. As seen in the Grimsby, Cromarty, and Nigg case studies, industrial change has been a significant feature of the regions' history. The communities have already undergone the process of embracing a new industry and accepting change at least once before. This change has included reskilling, upskilling, and supporting the next generations to enter the new industries, all of which will be required again in the transition to offshore wind.

For change to take place within the Humboldt region, the community will need to be effectively engaged, supportive of new initiatives in the region, and willing to accept opportunities for upskilling, reskilling, and welcoming new people and businesses to the area.

Humboldt County-Level Actions
Prime Location, Funding the Future, and Evolving Expertise

Developing a skilled workforce requires substantial investment. In both the cases of Grimsby and Cromarty and Nigg, organizations were established to champion the region, focused on the scale of the opportunity in the region and the benefit the industry could bring to communities. Of course, geographic proximity to projects played a critical role, but successful development still required a vision for infrastructure, key use cases, robust value propositions, and industrial backing. Campaigns to develop Freeports in the region were led from within, with key regional and industry stakeholders backing efforts to localize further regional investment.

Both case study regions benefitted from being home to other industries with transferable skills. As a result, investment in transitioning the local workforce was specialized and targeted, ensuring effectiveness and attracting the target demographic.

Therefore, it's crucial for Humboldt County to identify the skills and capability gaps in the region, which can be filled through specialized and targeted training, as well as by drawing on resources from other regions.

State and Government-Level Actions

Funding the Future and Prime Location

Commitment to developing the workforce and infrastructure in Grimsby, Cromarty, and Nigg has come from the highest levels of authority in the country. This is best exemplified through the development of Freeports and dedicated funding for skills programs. This funding has enabled the development of new facilities and infrastructure, the establishment of operations for major developers and suppliers, and the creation of new job opportunities. As a result, these regions have become prime locations for industry and job seekers in this space.

6.4.2 Conclusion

To develop a skilled workforce in the region, Humboldt County must promote itself and the opportunities offshore wind represents for its residents. This opportunity extends to both the government and industry, offering opportunities to maximize efficiencies and benefits across these sectors. A coordinated effort to develop the workforce can find success, but it is worth noting that this will take time.

Grimsby, Cromarty, and Nigg all benefited from the presence of other heavy industries in the area before the arrival of offshore wind, particularly the oil and gas industry. Other marine engineering, manufacturing, and fabrication capabilities in the regions also existed before offshore wind development. The Humboldt region lacks these predecessors, which represents a significant challenge. Therefore, a strategic approach will be necessary to identify which capabilities are most strategic to develop, considering existing industries and skill sets.

7 DISCUSSION

The extent of the workforce impact that offshore wind will have on the Region will depend on local governments and other key stakeholders and community members addressing the critical barriers identified in this workforce assessment.

Scenarios A, B, and C highlight a range of potential workforce demands, from a relatively smaller workforce engagement in Scenario A to more substantial needs in Scenario C, which includes component manufacturing and foundation assembly. While each scenario leads to hundreds of job opportunities for the Region, it will also challenge the Regional workforce, which lacks the specialized skills and experience necessary for offshore wind, particularly in maritime and manufacturing roles. Local workforce benefits may be limited during the Installation and Commissioning of projects, as unionization requirements may lead to dependency on transient, union labor unless the local workforce is trained and upskilled.

Upcoming construction projects, such as planned upgrades to the Port of Humboldt and transmission infrastructure, provide a significant opportunity to support workforce development before offshore wind projects begin installation. These projects can create pathways for local workers to gain the experience needed for future offshore wind-related roles, particularly in the building trades. By strategically planning for workforce development during this phase, the Region can better position itself to meet long-term workforce needs and provide residents with long-term, high-paying job opportunities.

The impact of offshore wind workforce demands will vary between Humboldt County and the Remaining Redwood Coast region. While Humboldt County will gain the most from direct employment opportunities due to the Port of Humboldt Bay's location within the County, the broader Redwood Coast region will need to focus on developing training programs and partnerships to ensure that adjacent counties benefit from the influx of economic activity into Humboldt County. Del Norte County will also benefit from long-term job creation if the area within the Crescent City Harbor District develops into an O&M port.

Engagement with Tribal Nations and other disadvantaged communities is an important step in regional workforce development, ensuring that underrepresented communities benefit from offshore wind development. Leveraging existing partnerships, and developing new ones between local governments, developers, universities and training instituitions, and Tribal Nations, to build a more inclusive and sustainable workforce pipeline.

While offshore wind development presents considerable opportunities for both short-term and long-term workforce growth in Humboldt County and the Remaining Redwood Coast regions, engaging regional stakeholders, addressing workforce gaps, and ensuring equitable access to training will be crucial to fully realizing these benefits.

APPENDIX A INCLUDED AND EXCLUDED RESPONSIBILITIES

Table A.1 – Description of products and services included in and excluded from the responsibilities of an offshore wind project's workforce

WORKFORCE AREA	WORKFORCE ELEMENT	INCLUDED PRODUCTS AND SERVICES	EXCLUDED PRODUCTS AND SERVICES
Project Development	Development and Permitting	Environmental impact assessment, permitting services for SAP, COP, etc.	
	Surveying	Benthic, pelagic, ornithological, marine mammal, etc. surveys; onshore environmental and socioeconomic studies and surveys; geophysical and geotechnical surveys; hydrographic surveys; metocean surveys	
	Engineering and Design	Wind farm FEED, certification	
	Project Management	Internal and external project management, financial services, legal services	
Wind Turbine Supply	Nacelle	OEM-delivered nacelle assembly	Manufacture and fabrication of specific turbine sub-components (e.g., gearbox, generator, power take-off, bearings, yaw system, structural fasteners, etc.), supply of raw materials
	Rotor	OEM-delivered blade manufacturing	Manufacture and fabrication of specific rotor sub-components (e.g., hub castings, pitch system, fasteners, blade bearings, etc.), supply of raw materials
	Tower	OEM-delivered tower manufacturing (includes internal steel components- platforms, ladders, etc.)	Manufacture and fabrication of tower internal components (e.g., secondary steel structures, lighting, personnel access systems, etc.), supply of raw materials

Balance of Plant Supply	Foundation (Concrete Semisub)	Manufacture of primary concrete substructures	Substructure assembly, manufacture and fabrication of secondary steel components, supply of raw materials
	Foundation (Steel Semisub)	Manufacture of primary steel substructures	Substructure assembly, manufacture and fabrication of secondary steel components, supply of raw materials
	Secondary Steel Components	Foundation secondary steel components (boat landings, ladders, platforms, etc.)	Supply of raw materials
	Foundation Assembly	Assembly of primary steel substructures	
	Offshore Substation	EPC of offshore substation structure	Manufacturing and fabrication of electrical infrastructure sub-components (e.g., switchgear, transformers, converters, power compensation, auxiliary systems, etc.), supply of raw materials
	Onshore Substation	EPC of onshore substation structure	Manufacturing and fabrication of electrical infrastructure sub-components (e.g., switchgear, transformers, converters, power compensation, auxiliary systems, etc.), supply of raw materials, manufacturing of ancillary components of onshore cables
	Array Cables	OEM-delivered HV cable manufacture	Manufacture of ancillary components, supply of raw materials
	Export Cables	OEM-delivered HV cable manufacture	Manufacture of ancillary components, supply of raw materials
	Anchors (Suction)	Manufacture of primary steel structures	Manufacture of ancillary components, supply of raw materials
	Mooring Lines (Steel)	Production of mooring line	Manufacture of ancillary components, supply of raw materials
	Mooring Lines (Synthetic)	Production of mooring line	Manufacture of ancillary components, supply of raw materials
Installation and Commissioning	Foundation Tow Out/Hook Up (AHTS)	AHTS vessel crew, client and OEM reps, ROV	Vessel construction
	Offshore Support Services	Support tug crew	Vessel construction

	Offshore Substation Installation	Vessel crew, commissioning, ROV	Vessel construction
	Array Cable Installation	Vessel crew, commissioning, ROV	Vessel construction
	Export Cable Installation	Vessel crew, commissioning, ROV	Vessel construction
	Anchor and Mooring Line Installation	Vessel crew, ROV	Vessel construction
	Staging and Integration	Quayside heavy lift crane operations, onshore support crew, commissioning	Vessel construction, crane manufacture
	Ports and Logistics	Port services, marine coordination, weather forecasting and metocean data, port-owned tug vessels	
	Onshore Construction	Onshore civils, onshore substation construction, operations base construction	
Operations and Maintenance	Port Operations	Port services, marine coordination, warehousing and storage	
	Operations Base	Asset monitoring, weather forecasting and metocean data, predictive maintenance and minor repair interventions, SOV vessel crew	Vessel construction
	Corrective Maintenance	Major repair interventions excluding major component replacement, SOV vessel crew	Vessel construction, major component replacement

APPENDIX B LOCALIZATION ASSUMPTIONS

Table B.1 - Assumed localization percentages and justification

WORKFORCE AREA	WORKFORCE ELEMENT	RELEVANT SCENARIOS	HUMBOLDT COUNTY	JUSTIFICATION	REMAINING REDWOOD COAST	JUSTIFICATION	OUT OF RGION
Project Development	Development and Permitting	A, B, C, A*	40%	Includes local developer teams, local permitting and environmental firms. Likely won't include major federal permitting (SAP, COP, etc.)	10%	Unlikely for developers to open office in the rest of Redwood region, which accounts for largest workforce usage. May include minor stakeholder engagement	50%
	Surveying	A, B, C, A*	12.5%	Includes onshore and water quality surveys, but does not include G&G surveys, or major environmental surveys (pelagic, bird, bat, etc.) due to lack of assumed capability	12.5%	Includes onshore and water quality surveys, but does not include G&G surveys, or major environmental surveys (pelagic, bird, bat, etc.) due to lack of assumed capability	75%
	Engineering and Design	A, B, C, A*	-	Developer E&D team not likely to be based locally and scope usually outsourced to larger companies not found in region	-	Developer E&D team not likely to be based locally and scope usually outsourced to larger companies not found in region	100%

	Project Management	A, B, C, A*	40%	Includes local developer teams, stakeholder engagement firms.	10%	Unlikely for developers to open office in the rest of Redwood region, which accounts for largest workforce usage. May include minor stakeholder engagement	50%
Wind Turbine Supply	Nacelle Rotor Tower	A, B, C, A*	-	Turbine supply not in region due to complexity of supply current low local capability	-	Turbine supply not in region due to complexity of supply current low local capability	100%
Balance of Plant Supply	Foundation (Concrete Semisub)	A, B, C	-	Assumes use of steel semisubmersible foundations	-	Assumes use of steel semisubmersible foundations	-
		A*	90%	Assumes investment in concrete pouring facility at Port of Humboldt	10%	Accounts for commuting workforce	-
	Foundation (Steel Semisub)	A, B, C	-	Requires investment and steel manufacturing currently not found in region	-	Requires investment and steel manufacturing currently not found in region	100%
		A*	-	Assumes use of concrete semisubmersible foundations	-	Assumes use of concrete semisubmersible foundations	-
	Secondary Steel	A, B, C, A*	20%	Assumes local company wins boat landing and/or mooring components	10%	Assumes local company wins boat landing and/or mooring components	70%
	Foundation Assembly	A, B	-	Assumes foundation assembly occurs at the site of fabrication	-	Assumes foundation assembly occurs at the site of fabrication	100%

		C	90%	Assumes investment in foundation assembly facility at Port of Humboldt	10%	Accounts for commuting workforce	-
		A*	-	Assumes concrete pouring eliminates need for foundation assembly	-	Assumes concrete pouring eliminates need for foundation assembly	-
	Offshore Substation	All	-	Low potential to supply offshore substation topside and sub-structure; electrical outfitting assumed to be completed at fabrication site. Delivery to installation site could elicit some support for local marine operations and commissioning support, but this is captured under installation. Design scopes likely overseas with manufacturer or wider US-based	-	Low potential to supply offshore substation topside and sub-structure; electrical outfitting assumed to be completed at fabrication site. Delivery to installation site could elicit some support for local marine operations and commissioning support, but this is captured under installation. Design scopes likely overseas with manufacturer or wider US-based	100%
	Onshore Substation	All	5%	Low potential to supply substation electrical outfitting which would account for major workforce. Can supply foundation for substation housing	-	Low potential to supply substation electrical outfitting	90%

	Array Cables	All	-	Currently no manufacturing capability, and low likelihood of investment due to domestic and international supply	-	Currently no manufacturing capability, and low likelihood of investment due to domestic and international supply	100%
	Export Cables	A, B, A*	-	Currently no manufacturing capability, and low likelihood of investment due to domestic and international supply	-	Currently no manufacturing capability, and low likelihood of investment due to domestic and international supply	100%
		C	90%	Assumes investment in export cable facility at the Port of Humboldt	10%	Accounts for commuting workforce	-
	Anchors (Suction)	A, B, C, A*	-	Currently no manufacturing capability, and low likelihood of investment	-	Currently no manufacturing capability, and low likelihood of investment	100%
	Mooring Lines (Steel)						
	Mooring Lines (Synthetic)	A, B, C, A*	-	Assumes use of steel mooring lines	-	Assumes use of steel mooring lines	-
Installation and Commissioning	Foundation Tow Out/Hook Up (AHTS)	A, B, C, A*	-	Workforce largely focused around AHTS team which is unlikely to come from in region	-	Workforce largely focused around AHTS team which is unlikely to come from in region	100%
	Offshore Support Services	A, B, C, A*	50%	Support vessels (tugs, spotter vessels, guard vessels) can come from in region	50%	Support vessels (tugs, spotter vessels, guard vessels) can come from in region	-
	Offshore Substation Installation	A, B, C, A*	-	ESP installation vessel and crew, cable installation vessel and	-	ESP installation vessel and crew, cable installation vessel and	100%

	Array Cables Installation			crew, anchor and mooring installation vessel and crew not from region. Likely linked to manufacturing which will be out of region		crew, anchor and mooring installation vessel and crew not from region. Likely linked to manufacturing which will be out of region	
	Export Cables Installation						
	Anchors and Mooring Line Installation						
	Staging and Integration	A, B, C, A*	90%	Staging and integration occurs exclusively at Port of Humboldt	10%	Accounts for commuting workforce	-
	Ports and Logistics	A, B, C, A*	75%	Port of Humboldt is main port of utilization but not used for manufacturing	-	No manufacturing localized at Port of Crescent City	25%
	Onshore Construction	A, B, C, A*	25%	Onshore construction is conducted by both regional workforces. Due to large volume of workforce demand, likely requires outsourcing of other CA-based workers	25%	Onshore construction is conducted by both regional workforces. Due to large volume of workforce demand, likely requires outsourcing of other CA-based workers	50%
Operations and Maintenance	Port Operations	A, A*	90%	Operations for a project occurring at local O&M base in Humboldt	10%	Accounts for commuting workforce	-
		B, C	50%	Operations for a project occurring at local O&M base in Humboldt	50%	Operations for a project occurring at local O&M base in Crescent City	-
	Operations Base	A, A*	90%	O&M staff stationed at Port of Humboldt	10%	Accounts for commuting workforce	-
		B, C	50%	O&M staff stationed at Port of Humboldt	50%	O&M staff stationed at Port of Crescent City	-

	Corrective Maintenance	A, A*	12.5%	O&M staff stationed at Port of Humboldt but not including specialty demands (marine welding, AUV, component replacement, etc.)	2.5%	Accounts for commuting workforce	-
		B, C	12.5%	O&M staff stationed at Port of Humboldt but not including specialty demands (marine welding, AUV, component replacement, etc.)	12.5%	O&M staff stationed at Port of Crescent City but not including specialty demands (marine welding, AUV, component replacement, etc.)	-

APPENDIX C SCENARIO TABLES

Bolded numbers indicate workers that are likely brought to the region and thus likely do not need to be trained in the Redwood Coast.

Table C.1 - Regional workforce demand by job category and supply element for Scenario A.

SUPPLY ELEMENT	STEM PROFESSIONAL	BUSINESS PROFESSIONAL	MANUFACTURING TRADE WORKER	BUILDING TRADE WORKER	MARITIME TRADE WORKER	SUPPORT STAFF
Development and Permitting	1–5	1–5	–	–	–	–
Surveying	6–15	–	–	–	6–15	–
Project Management	–	6–15	–	–	–	1–5
Secondary Steel Components	1–5	–	16–30	–	–	–
Onshore Substation	1–5	–	1–5	–	–	–
Offshore Support Services	16–30	–	–	1–5	61–100	6–15
Staging and Integration	–	–	–	61–100	16–30	6–15
Ports and Logistics	1–5	–	–	31–60	31–60	1–5
Onshore Construction	6–15	–	–	16–30	–	1–5
Port Operations	1–5	–	–	16–30	16–30	1–5
Operations Base	6–15	–	–	16–30	31–60	6–15
Corrective Maintenance	1–5	–	–	1–5	1–5	1–5

Table C.2 - Regional workforce demand by job category and supply element for Scenario B

SUPPLY ELEMENT	STEM PROFESSIONAL	BUSINESS PROFESSIONAL	MANUFACTURING TRADE WORKER	BUILDING TRADE WORKER	MARITIME TRADE WORKER	SUPPORT STAFF
Development and Permitting	6–15	6–15	–	–	–	–
Surveying	16–30	–	–	–	16–30	–
Project Management	–	16–30	–	–	–	6–15
Secondary Steel Components	6–15	–	31–60	–	–	1–5
Onshore Substation	1–5	–	6–15	–	–	–
Offshore Support Services	31–60	–	–	6–15	151–250	16–30
Staging and Integration	–	–	–	101–150	31–60	16–30
Ports and Logistics	1–5	–	–	61–100	61–100	6–15
Onshore Construction	6–15	–	–	31–60	–	1–5
Port Operations	1–5	–	–	31–60	31–60	6–15
Operations Base	16–30	–	–	31–60	61–100	16–30
Corrective Maintenance	1–5	–	–	6–15	6–15	1–5

Table C.3 - Regional workforce demand by job category and supply element for Scenario C

SUPPLY ELEMENT	STEM PROFESSIONAL	BUSINESS PROFESSIONAL	MANUFACTURING TRADE WORKER	BUILDING TRADE WORKER	MARITIME TRADE WORKER	SUPPORT STAFF
Development and Permitting	6–15	6–15	–	–	–	–
Surveying	16–30	–	–	–	16–30	–
Project Management	–	16–30	–	–	–	6–15
Secondary Steel Components	6–15	–	31–60	–	–	1–5
Foundation Assembly	–	–	151–250	–	–	1–5
Onshore Substation	1–5	–	6–15	–	–	1–5
Export Cables	61–100	–	151–250	–	–	1–5
Offshore Support Services	31–60	–	–	6–15	151–250	16–30
Staging and Integration	–	–	–	101–150	31–60	16–30
Ports and Logistics	1–5	–	–	61–100	61–100	6–15
Onshore Construction	6–15	–	–	31–60	–	1–5
Port Operations	1–5	–	–	31–60	31–60	6–15
Operations Base	16–30	–	–	31–60	61–100	16–30
Corrective Maintenance	1–5	–	–	6–15	6–15	1–5

APPENDIX D SCENARIO A* RESULTS

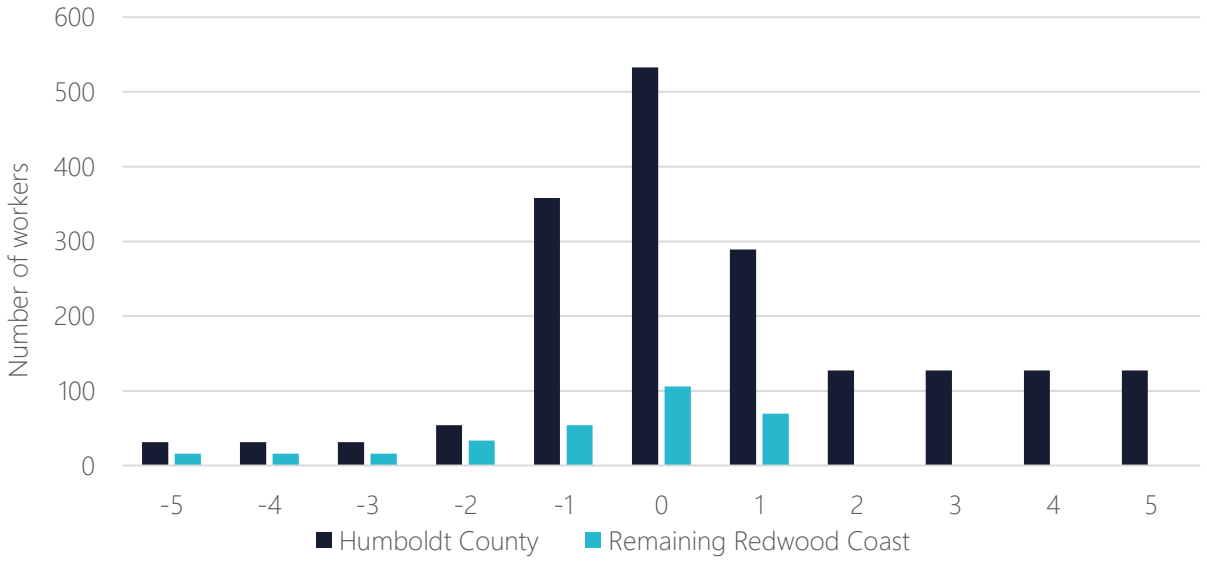


*Figure D.1 – Workforce demand relative to COD for workers from Humboldt County and the Remaining Redwood Coast in Scenario A**

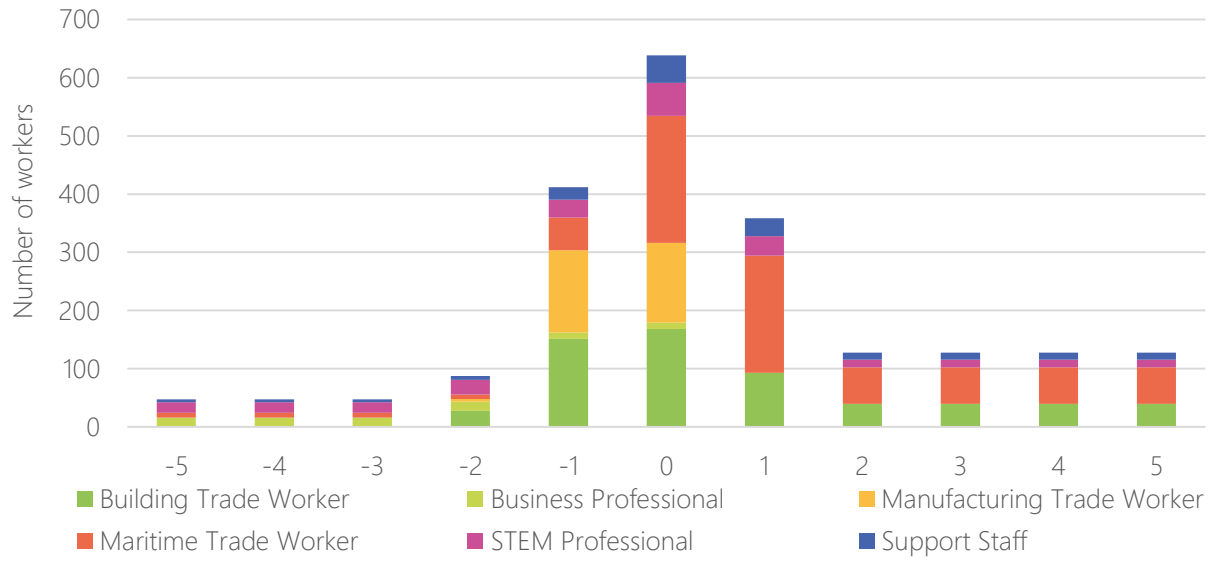


*Figure D.2 – Workforce demand relative to COD for workers from the Region in the required job role categories in Scenario A**

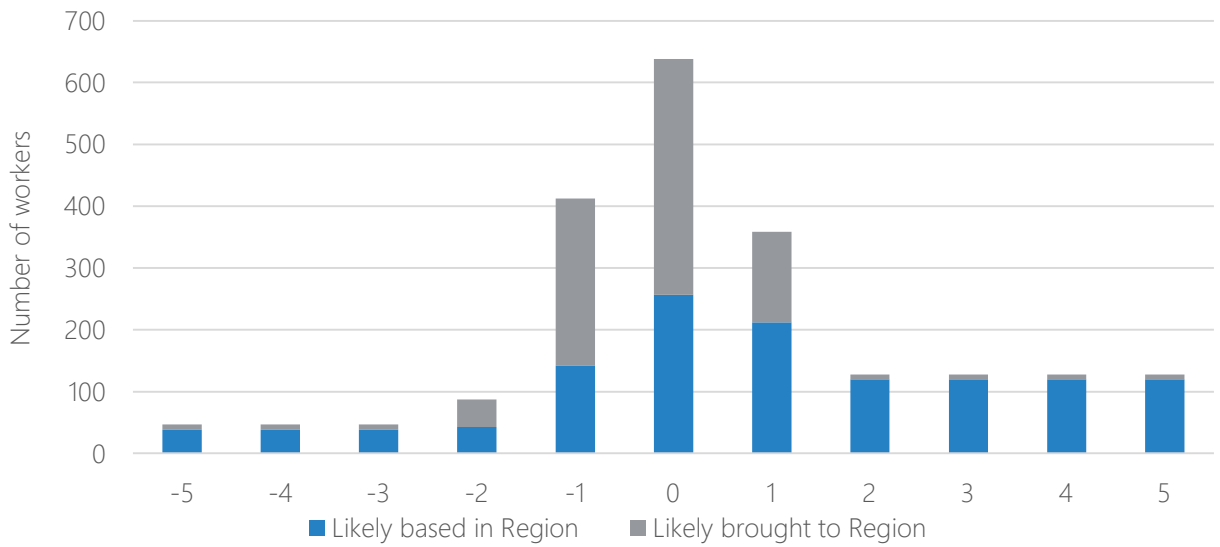


*Figure D.3 – Workforce demand relative to COD for workers likely based in the Region and workers likely brought to the Region in Scenario A**