National Wind Workforce Assessment: Current Workers to Industry

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Photo by Dennis Schroeder, NREL 55200

Acknowledgments

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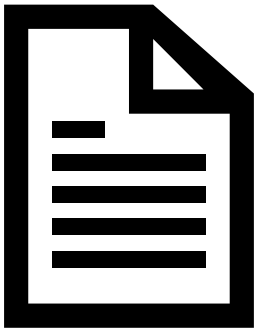
Finally, we thank the following individuals for their expert reviews including Chloe Constant, Brian Smith, and Daniel Laird. Any remaining errors or omissions are the responsibility of the authors.

How To Use

1 Read the presentation like a report



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2 Use the “Overview: Quick Click” slide to navigate through the presentation

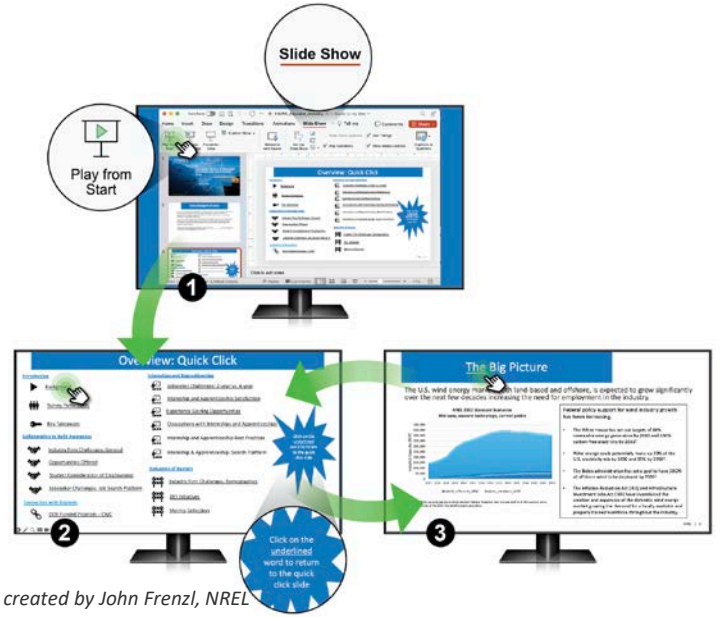


Image created by John Frenzl, NREL

Overview: Quick Click

Introduction

- Background
- Survey Participants
- Key Takeaways

Perceptions of Wind Industry (Current Workforce)

- Employee Satisfaction with Career
- Student Interest in Other Industries
- Employee Perception of Wind Industry

Hiring Challenges: Wind Industry Firms

- Industry Firm Challenges: General
- Industry Firm Challenges: Firm Size
- Industry Firm Challenges: Industry Segment
- Industry Firm Challenges: Value Chain Segment
- Industry Firm Challenges: Skilled Trades

Automation

- Implementation of Automation
- Agreement with Automation
- Automation and Workforce Needs

Connective Actions

- Actionable Steps

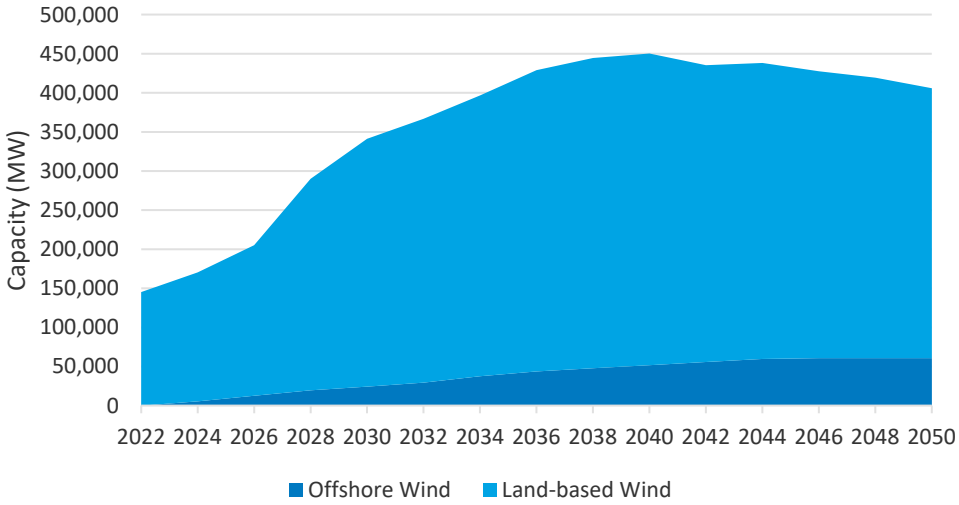
Click on the underlined word throughout presentation to return to the quick click slide.

Introduction

The Big Picture

The U.S. wind energy market, both land-based and offshore, is expected to grow significantly over the next few decades, increasing the need for employment in the industry.

NREL 2022 Standard Scenarios
Mid-case, Nascent Technology, Current Policy



Graph from Gagnon et al. (2022)

The capacity additions driven by the Inflation Reduction Act are accounted for in the current policy scenarios of the 2022 Standard Scenarios projection.

Federal policy support for wind industry growth has been increasing.

- The White House has set targets of 80% renewable energy generation by 2030 and 100% carbon-free electricity by 2035 (White House 2021a).
- Wind energy could potentially make up 20% of the U.S. electricity mix by 2030 and 35% by 2050 (DOE-WETO 2017).
- The Biden administration has set a goal to have 30 GW of offshore wind be deployed by 2030 (White House 2021b).
- The Inflation Reduction Act and Infrastructure Investment Jobs Act have incentivized the creation and expansion of the domestic wind energy market, growing the demand for a locally available and properly trained workforce throughout the industry.

National Wind Workforce Assessment in Context

An **available** and **properly trained** workforce is needed for the success of the wind industry. However, past research has indicated that there is a **disconnect** between wind industry employers, the workforce, and educational institutions, which has been referred to as **the wind workforce gap**.

Wind workforce gap: Wind energy employers report having difficulty finding qualified candidates, while the potential wind energy workforce (e.g., students and recent graduates who are not yet working in the wind energy industry) report difficulty finding jobs, and educational institutions report having difficulty placing students in jobs (Stefek 2022).

Narrowing the gap could simultaneously (Keyser & Tegen 2019).

- Reduce recruitment costs for employers
- Help educational institutions fill classrooms
- Grow the domestic wind workforce by properly communicating wind industry careers to the potential workforce.

Previous Findings

Defining the Wind Energy Workforce Gap (Stefek 2022) indicated that the top three reasons for the workforce gap include experience, education and training qualifications, and geographic locations of jobs. This report expands on these findings.

	Experience	Education and Training	Geographic Location of Jobs
Industry	Experience was noted as a challenge for more than one-quarter of all wind industry firms looking for entry- (27.6%) and non-entry-level (33%) job applicants.	More than one-quarter of responding firms indicated that "there are enough applicants, but too many applicants do not have the training or education needed for the job" (29.7%).	The third highest reason among wind firms searching for both entry- and non-entry-level applicants was that there are not enough applicants for available positions in areas where wind is being developed.
Employee	Members of the total workforce (68%) responded that gaining applicable work experience is somewhat of a challenge or a considerable challenge when trying to find work opportunities in the wind industry.	Current and potential workers identified getting hands-on training (62%) or technical training (61%) to develop skills and expertise as a challenge or obstacle when searching for relevant opportunities in the wind industry.	Finding employment opportunities where one lives or is willing to live was ranked the second highest challenge for the total and potential workforce (67%) and the top challenge for the current workforce (64%).

Intended Audience + Contents

This report presentation is intended for use by employees looking to gain insight into the wind workforce gap from the industry side and actionable steps that can be taken to help narrow the workforce gap. More information can be found in complementary resources.

This presentation includes:

- Modeled scenario of Wind Workforce through 2050 based on Business-as-Usual
- Perceptions of the wind industry from the current workforce
- Scenarios on how the workforce gap is affected by changing perceptions
- Hiring challenges for wind industry firms
- Automation and the wind workforce
- Connective actions for industry and education/training programs.

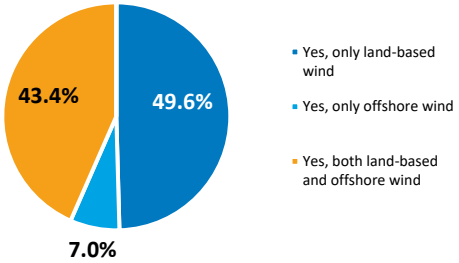
The information presented in the report originates from the 2022 survey effort conducted in partnership between NREL and BW Research Partnership, and various outside resources. To learn more about the methodology behind data collection and workforce modeling, please refer to the *National Wind Energy Workforce Assessment Methods Report: Surveys and System Dynamics Model* (McDowell and Stefek 2023).

Who Took the Survey?

Employer Survey (n=228)

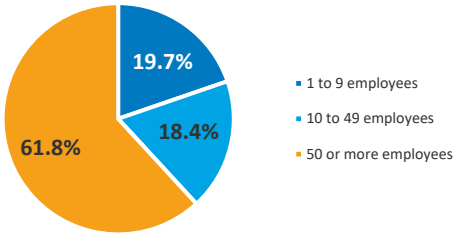
Involvement in Wind Energy Industry, 2022 (n=228)

Graph courtesy of BW Research Partnership



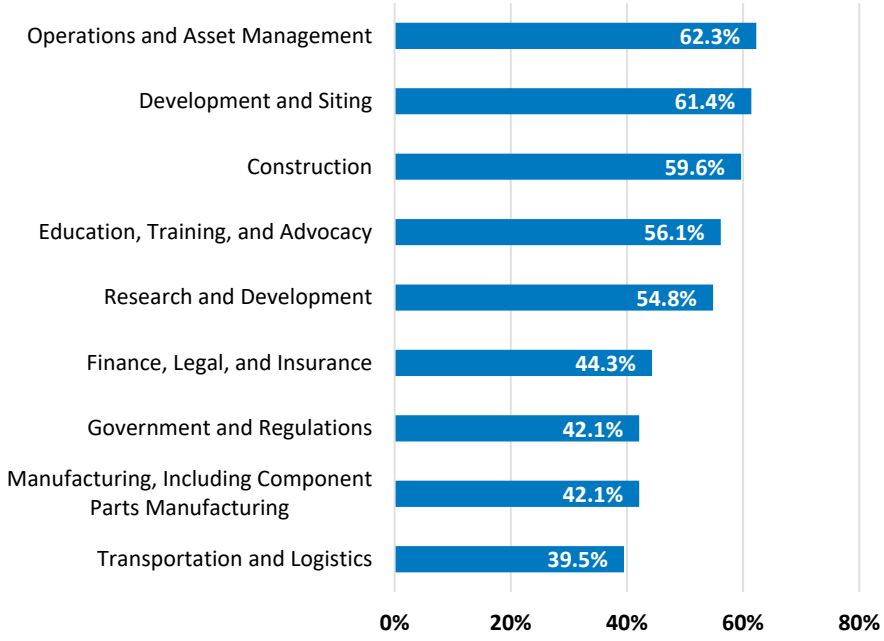
Number of Employees at Wind Energy Firms, 2022 (n=142)

Graph courtesy of BW Research Partnership



Involvement in Wind Industry Segments, 2022 (n=228)

Graph courtesy of BW Research Partnership

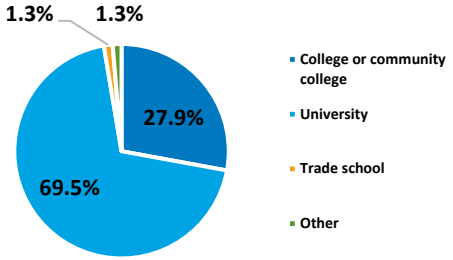


Who Took the Survey?

Student and Recent Graduate Survey (n=346)

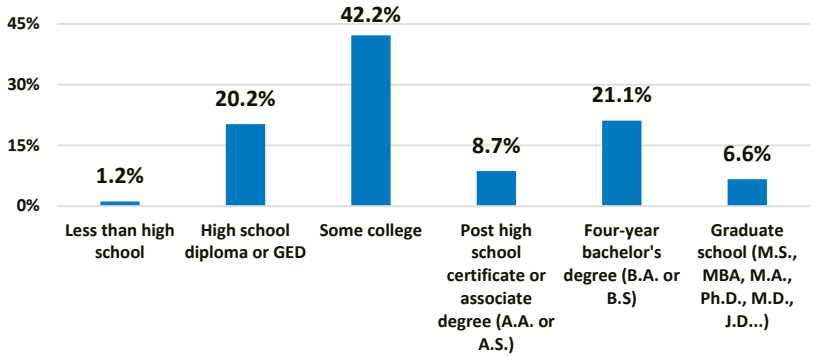
Type of School Attended, 2022 (n=226)

Graph courtesy of BW Research Partnership



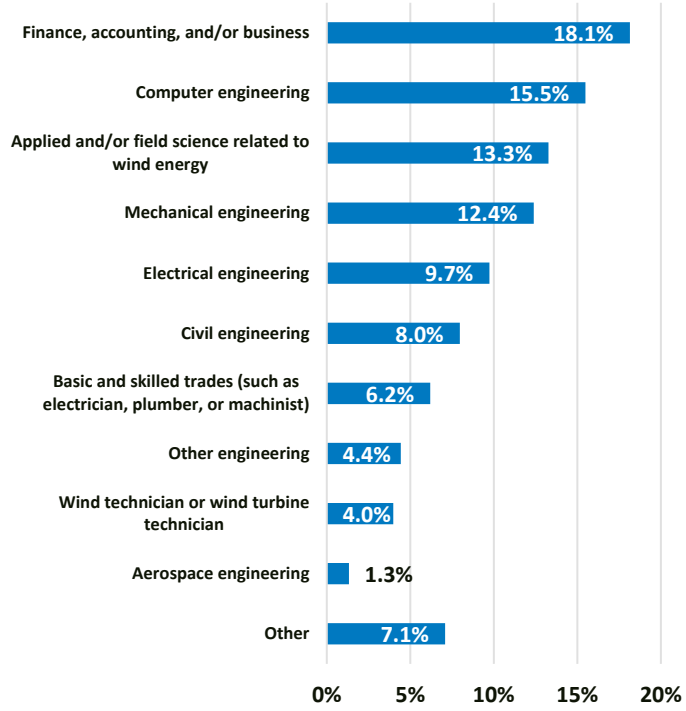
Last Educational Level Completed, 2022 (n=346)

Graph courtesy of BW Research Partnership



Degree Students and Recent Graduates were/are Working Toward, 2022 (n=226)

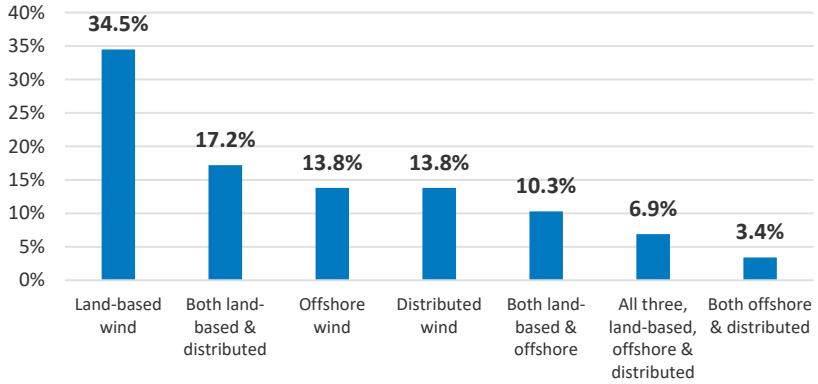
Graph courtesy of BW Research Partnership



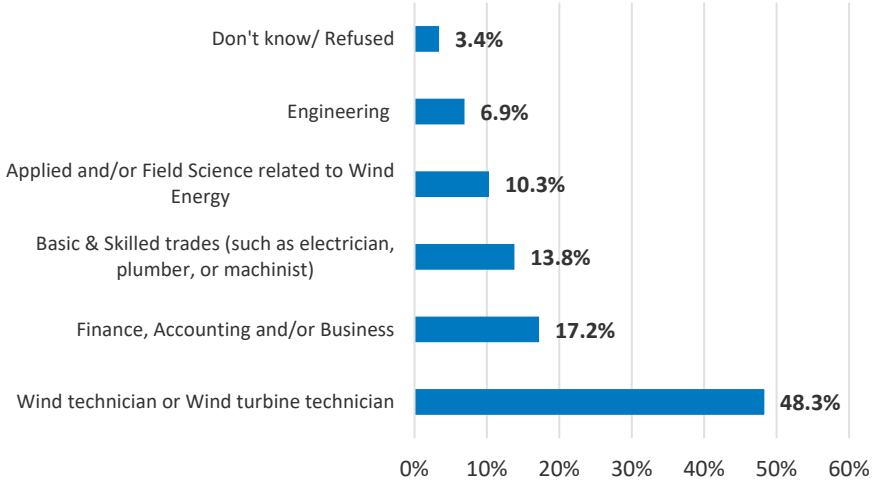
Who Took the Survey?

Current Worker Survey (n=29)

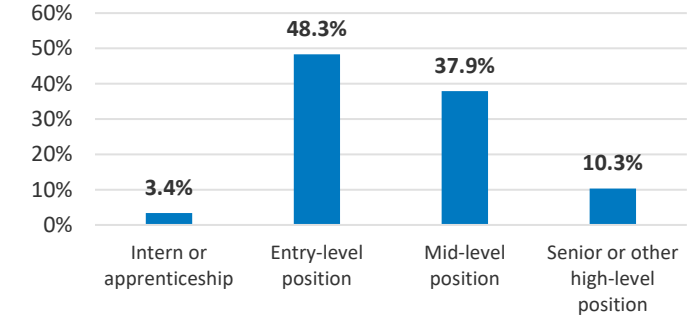
Primary Sector of Work in the Wind Industry (n=29)



Area of Study (n=29)



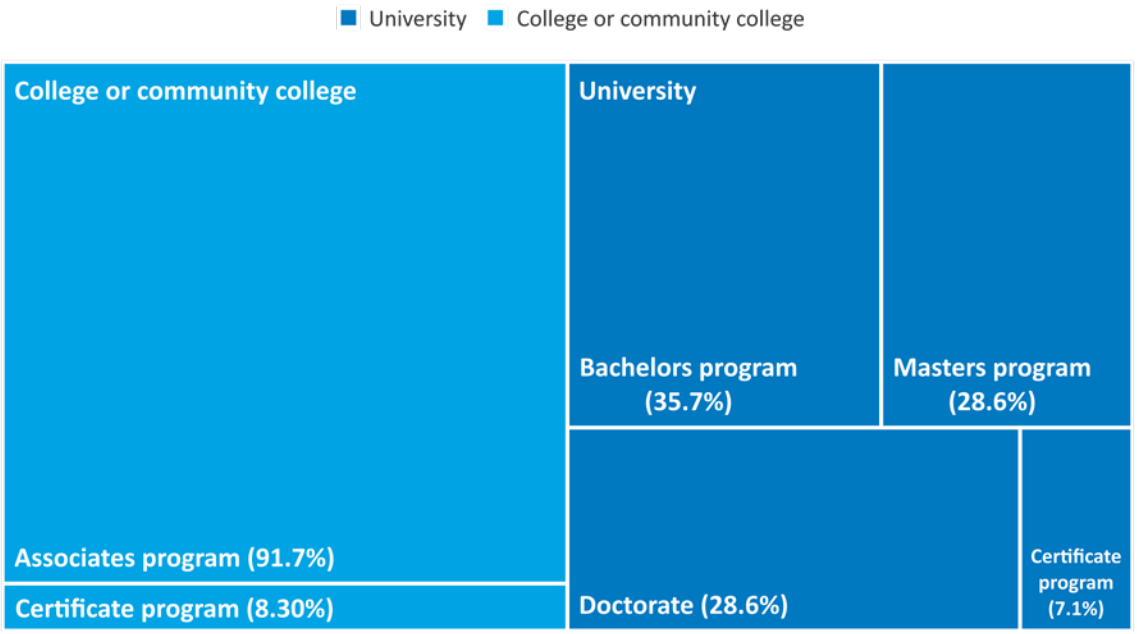
Most Recent Employment Level in the Wind Industry (n=29)



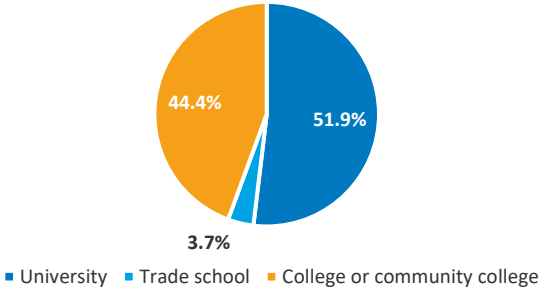
Who Took the Survey?

Educator Survey (n=27)

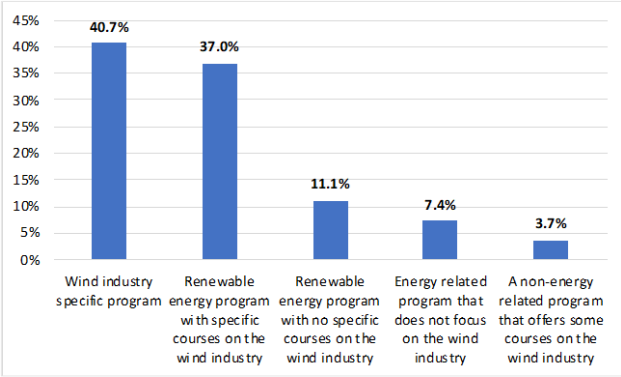
Type of Program in the School Employed (n=14, n =12)



Type of School Currently Employed (n=27)



Program Involvement With the Wind Industry (n=27)



Key Takeaways

Workforce Estimation

According to model projections under a business-as-usual (BAU) scenario, if the wind energy industry is to progress in line with NREL 2022 Standards Scenario Mid-case with nascent technology and current policy—one potential path for expansion—a larger supply of qualified and adequately trained workers will be needed to support overall workforce demand.

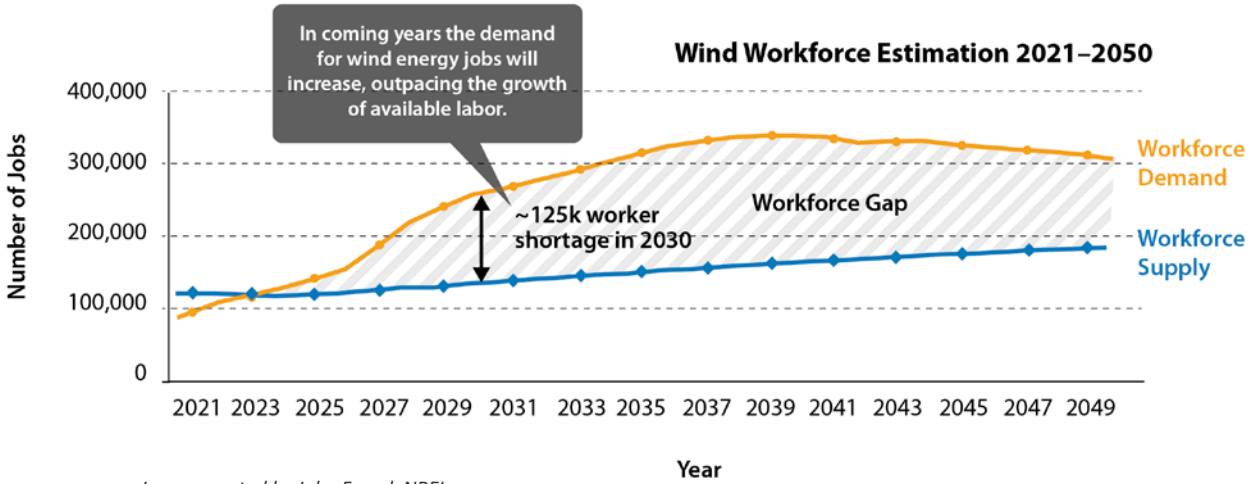


Image created by John Frenzl, NREL

2030: 134,364 FTE Supply

2030: 124,095 FTE Deficit

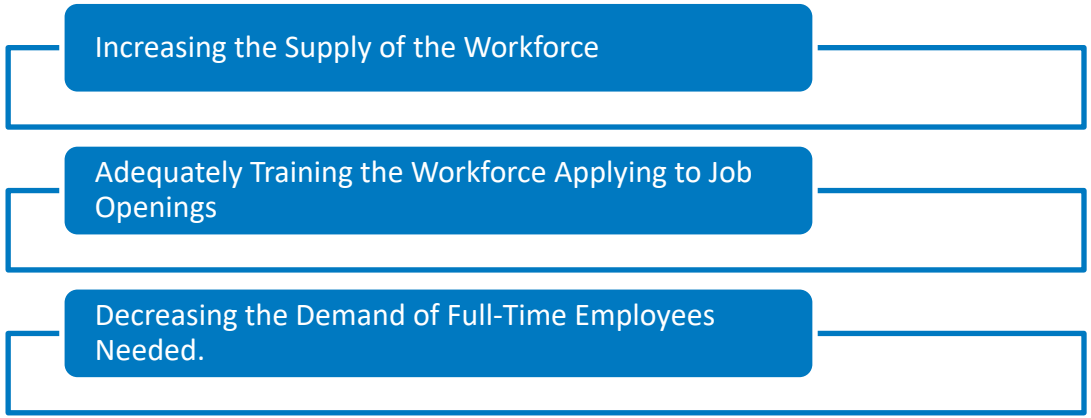
2030: 258,459 FTE Demand

Under current assumptions, the wind industry supply is expected to increase steadily through 2050; however, it is not predicted to be at the rate that is needed to meet 2030 or 2050 wind workforce demand. The workforce supply estimations are informed by current wind industry perceptions and baseline data collected through the 2022 survey effort, and results vary depending on the qualitative inputs.

Note: Information about the assumptions and data used is in the Methodology report. These projections are highly dependent on the assumption of the model and data gathered through the 2022 survey effort and should be used as a high-level estimate of scale and trend as opposed to a point projection.

Key Takeaways

Closing the gap between the workforce that is needed to meet deployment goals and the supply that is possible in the wind workforce under current assumptions will require:



This presentation will address mitigating the workforce gap by **assessing perceptions that current wind employees have of the wind industry, and hiring challenges that wind industry firms face.**

Key Takeaways

Reported perceptions of the wind industry from the current workforce:

- **Current wind industry workers** and **workers who transitioned into the wind industry** both reported being **very satisfied with their jobs**.
- The main reasons people transitioned into the wind industry were for a **better salary** and **more work life balance**.
- Student respondents also view a job in the wind energy industry as having **more positive attributes than comparable industries.**
- **Strengths** for wind are seen in **job stability** and the **opportunity to do work that fits with people's environmental priorities**.
- Perceived **weaknesses** for the wind industry included **job location, and to a lesser extent, starting entry-level wages.**
- Many of the reported top hiring challenges faced by current wind employees are also faced by students.
- To attract more qualified applicants into the wind industry and help to close the workforce gap, historical challenges in hiring and perception, such as **providing opportunities for students to get hands-on training**, need to be addressed.

Reported hiring challenges for wind industry firms:

- Overall, wind industry firms reported that the **largest challenge** for hiring **entry-level employees** is a **lack of experience**, whereas the **largest challenge** for **non-entry-level employees** is the **lack of applicants** to open job postings.
- **Small firms (1–9 employees) and offshore wind firms** need people with more **experience.** Conversely, **medium and large firms (10–50+ employees) and land-based wind firms** need more **applicants**.
- **Development and siting** had the **highest reported difficulty** hiring **non-entry-level employees**, and **manufacturing** had the **highest reported difficulty** hiring **entry-level employees**.
- Some of the greatest hiring difficulties have been reported by wind industry members for **skilled trades** occupations. **Building connections between the wind industry and organized labor unions** could offer a large opportunity for growth in the wind workforce.
- **Offshore wind firms had the greatest reported challenge with hiring** compared to companies that work in land-based wind, or both land-based and offshore wind.

Key Takeaways

Automation:

- **More than two-thirds** of the overall respondents reported that they had **implemented automation**, with the **original intentions of implementation** being **quality control, safety of workers, and to reduce operational costs** within the firm.

- Firms involved in **both land-based and offshore wind** reported that automation technologies made their firm **more productive and that they expected to continue investing in these technologies**.

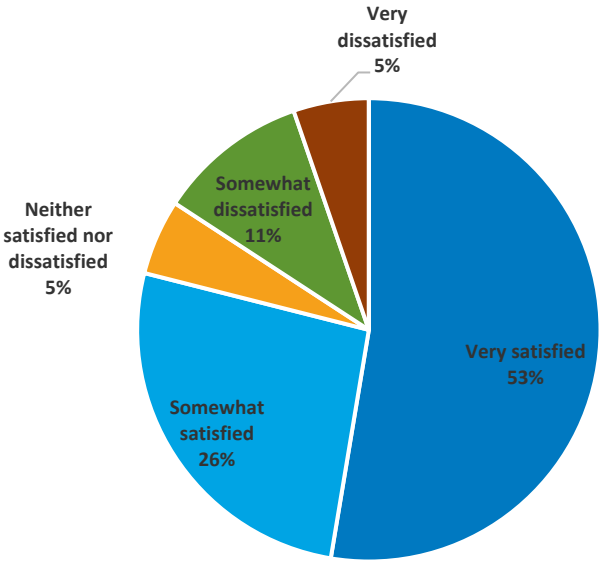
- Similarly, these firms also reported that automation technologies have allowed their firm to **better manage the lack of available workers** (54.8%) and **reduced the need to hire new workers** (61.9%).

- The top three occupations believed to be impacted from automation within wind energy firms are **operations and maintenance, accounting and administrative, and manufacturing and assembly**.

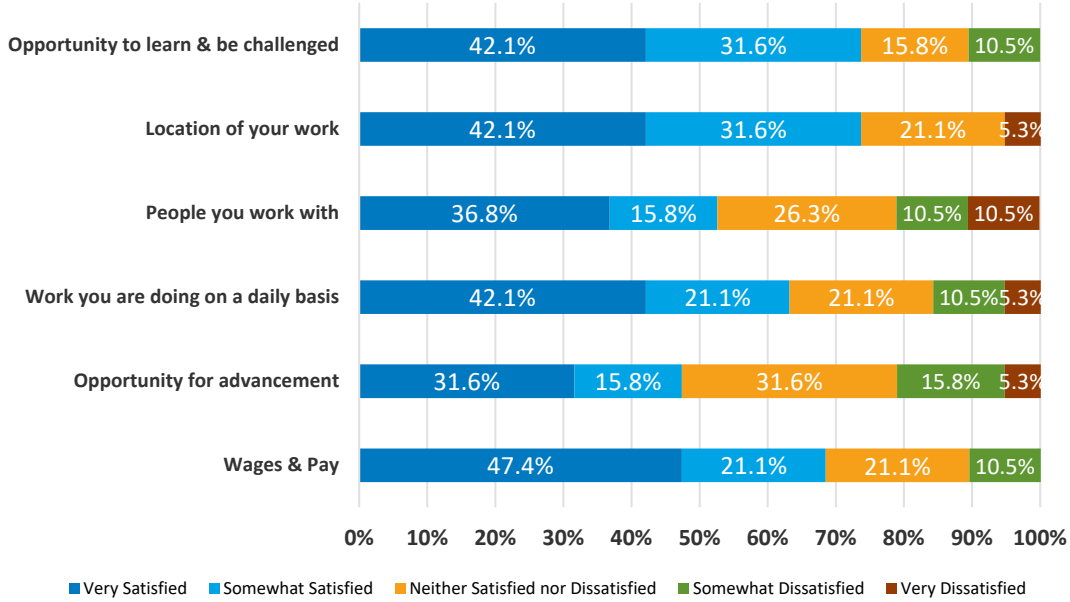
Perceptions of the Wind Industry: Current Workforce

The majority of current wind industry workers reported being very satisfied with their job in the wind industry (53%). Respondents were most satisfied with their opportunity to learn and be challenged (73.7%), the location of their work (73.7%), and their wages and pay (68.5%).

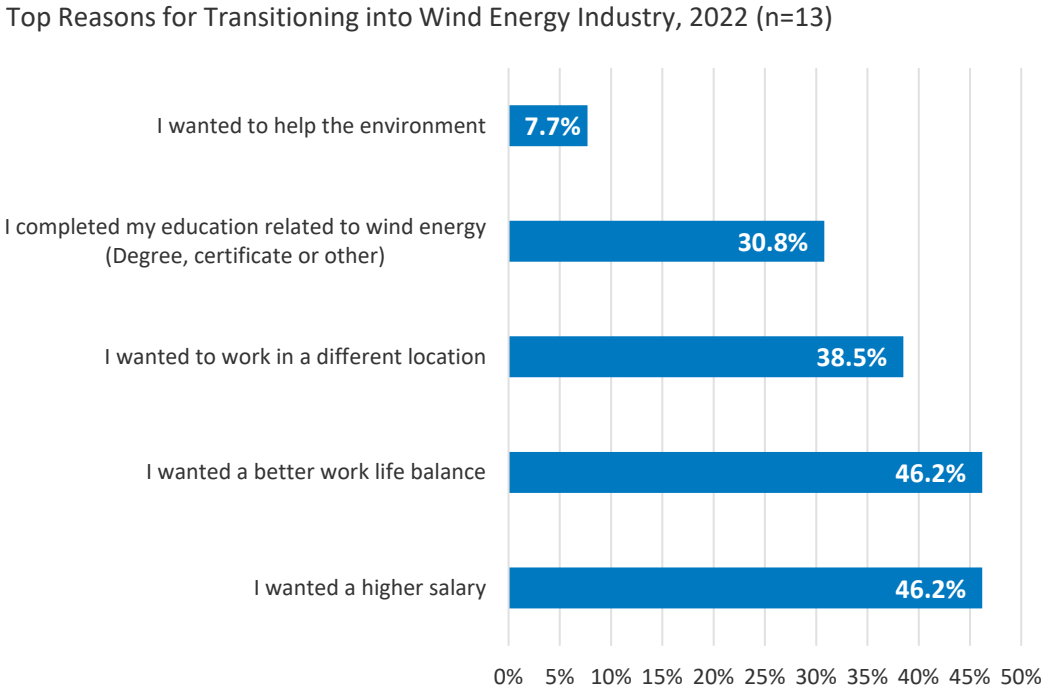
Satisfaction with Job in the Wind Industry (n=19)



Level of Satisfaction with Current Job Aspects in the Wind Industry (n=19)



Similarly, workers who transitioned from another industry also had a positive perception of their job in the wind industry. Those who recently transitioned into the wind industry reported being very satisfied (77%), or somewhat satisfied (23%) with their decision.



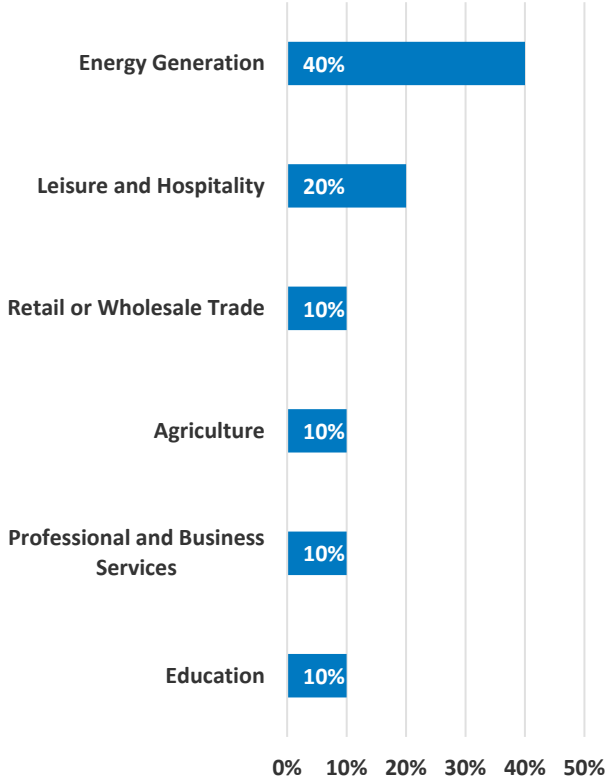
Top reasons for transitioning into wind:

1) Higher salary (46.2%)
2) Better work life balance (46.2%)
3) Wanted to work in a different location (38.5%).

Job stability is also a major concern for current workers and acts as a lever for the perception of the wind industry. Overall, 83.3% of current workers felt stable in their work.

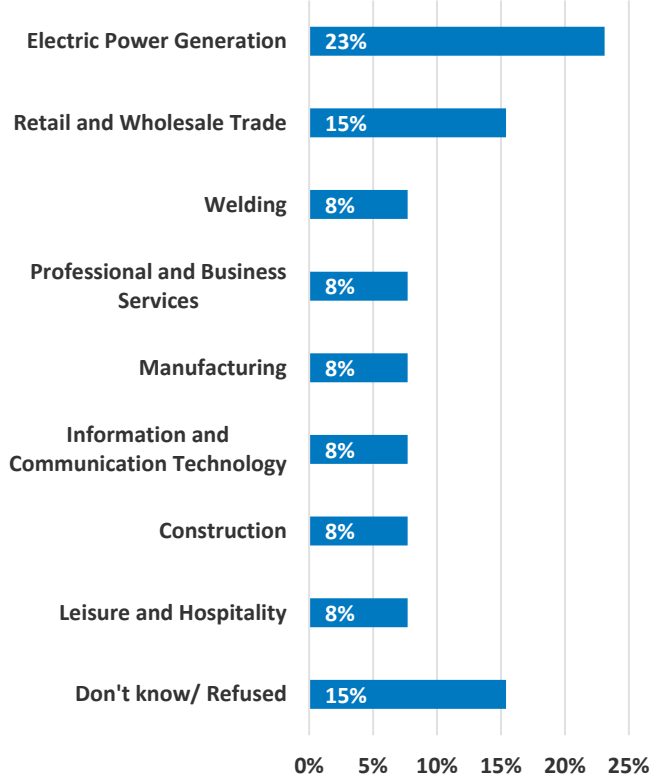
Reported Industries Where Employees Transitioned To and From Wind

Transitioning Into Wind



- Of the current employees who reported **transitioning into** the wind industry, energy generation was the most common industry to transfer from (40%).
- Of the employees who **transferred out** of the wind industry, electric power generation was the most common industry to be transferring into (23%).

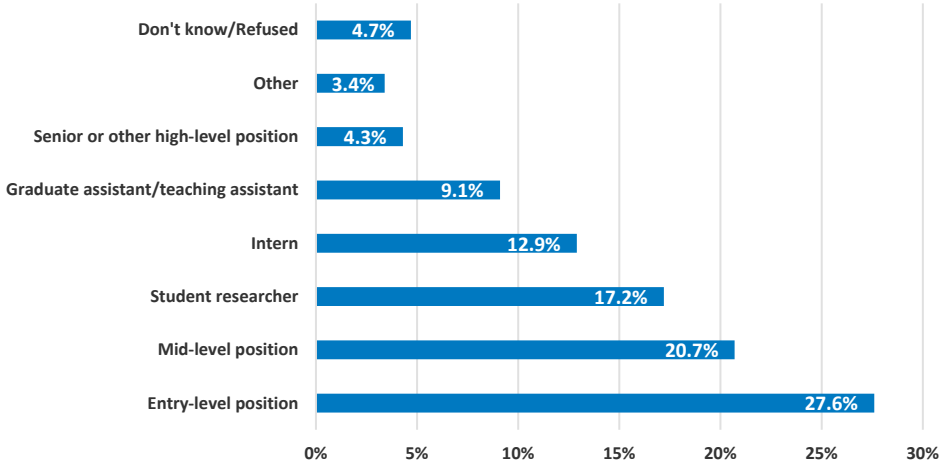
Transitioning Out of Wind



At least one in seven currently employed student respondents works in a job that includes some work in the wind industry. One-fifth of working students or recent graduates were conducting work in the distributed wind energy industry (20.7%) and/or land-based wind energy industry (20.3%). Another 15.2% of survey respondents indicated that their job involved some work in the offshore wind energy industry. Overall, the largest proportion of respondents were working in a renewable energy industry other than wind energy (30.0%), followed by an energy industry other than renewable energy, such as fossil fuels and nuclear energy (28.3%).

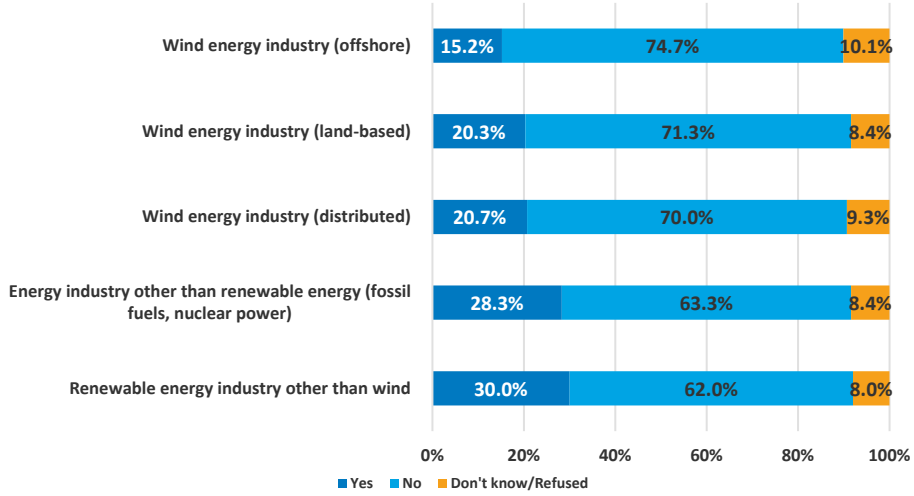
Current Occupational Categories of Employed Respondents Across Industries, 2022 (n=232)

Graph courtesy of BW Research Partnership



Work in Energy Industries, 2022 (n=237)

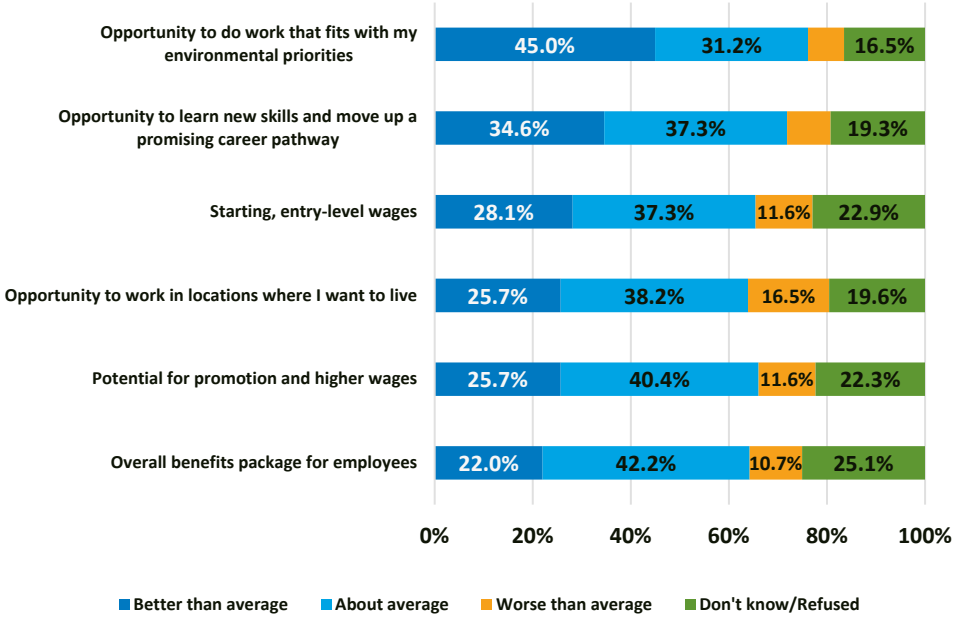
Graph courtesy of BW Research Partnership



Additionally, students looking to start a career in the wind industry reported that their perceptions of wind industry employment attributes are generally average or above average when compared to other industries.

Perception of Wind Energy Industry Employment Attributes, 2022 (n=327)

Graph courtesy of BW Research Partnership



45% of respondents perceived that employment in the wind industry was **better than average** for providing the opportunity to do **work that fits with their environmental priorities**.

16.5% of respondents perceived that employment in the wind industry was **worse than average** for providing the opportunity to **work in locations where they want to live.**

81% of students or recent graduates who work in wind reported they felt they had **stability in their job**.

Despite the overall positive perception of the industry by current workers and the potential workforce, there are still hiring and perception challenges that need to be overcome if the workforce gap is to be mitigated.

Educators reported that 89.19% of students had jobs 6 months after graduation. 47.95% of students with jobs after 6 months had them within the wind industry.

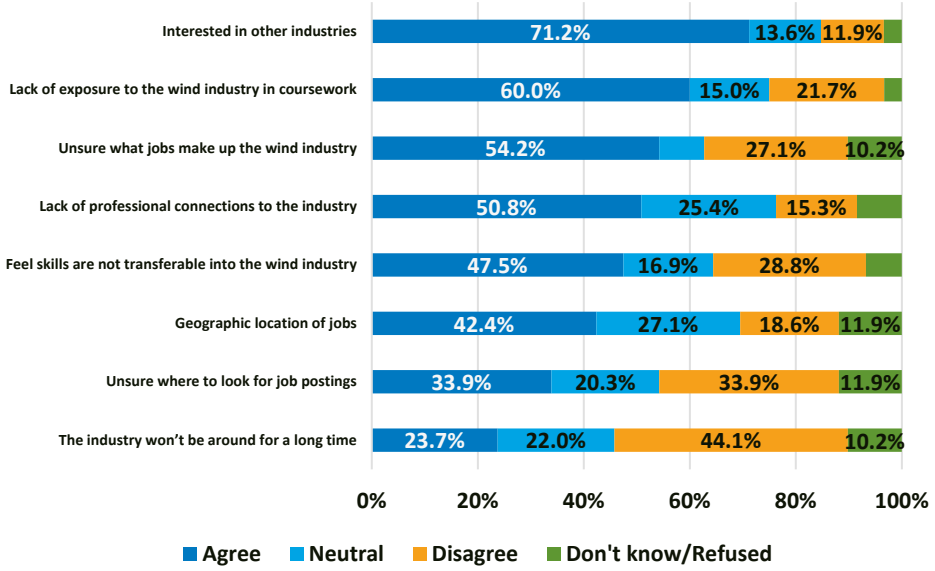
37.5% of students and recent graduate respondents have **not considered** working in the wind energy industry. 24.4% have **actively searched** for work opportunities, and 33.8% have **considered but not actively searched** for wind industry employment.

Top Three Reasons for Lack of Consideration of Employment in Wind Energy

1) Interest in other industries (71.2%)
2) Lack of exposure to the wind industry in coursework (60.0%)
3) Unsure what jobs make up the wind industry (54.2%).

Reasons for Lack of Consideration of Employment in Wind Energy, 2022 (n=33–60)

Graph courtesy of BW Research Partnership



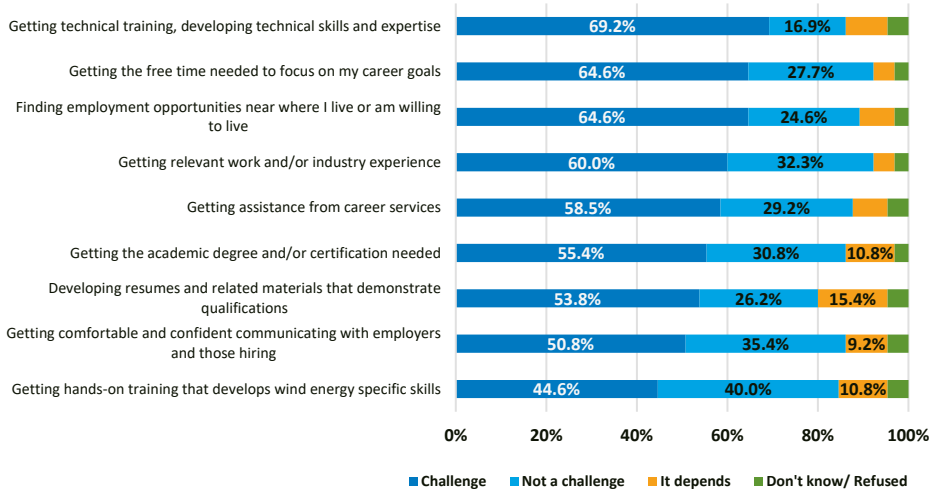
Many of the reported top hiring challenges faced by current wind employees are also faced by students. To attract more qualified applicants into the wind industry and help to close the workforce gap, historical challenges in hiring and perception need to be addressed.

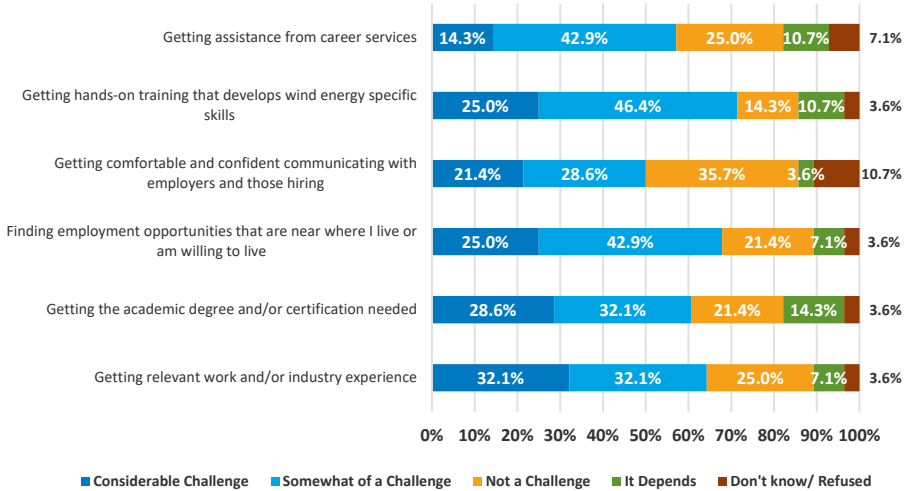
Top Three Reasons Reported For Hiring Difficulty by Students

1) Getting **technical training,** developing **technical skills** and expertise
2) Getting the **free time** needed to focus on my career goals
3) Finding employment opportunities **near where I live or am willing to live.**

Top Three Reasons Reported For Hiring Difficulty by Current Wind Employees

1) Getting **hands-on training** that develops wind energy specific skills
2) Finding employment opportunities **near where I live or am willing to live**
3) Getting relevant work and/or industry **experience.**



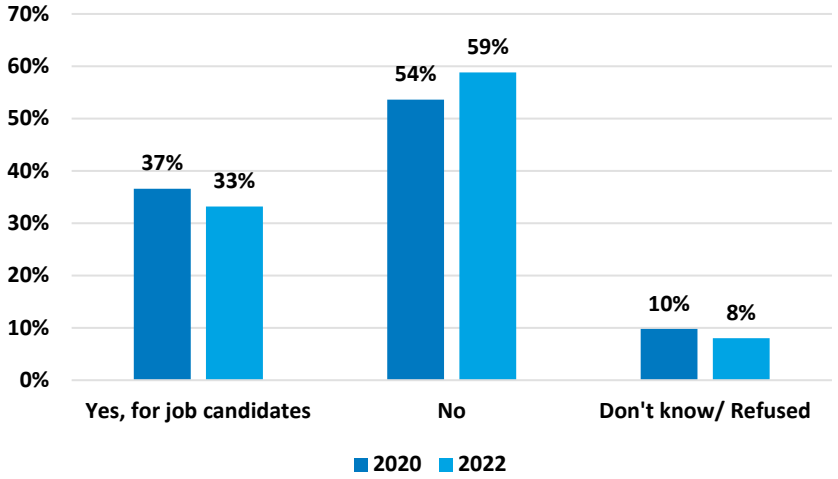


One way to help mitigate hiring challenges in the wind industry is by utilizing educational institutions for job recruitment opportunities offered through education. Creating connections between educational and training institutions and the wind industry can help build a sustainable pipeline for a utilized labor force.

In 2022, just under three in five (59%) employers reported that they did not work with U.S.- based educational institutions. Creating stronger networks with U.S.-based educational institutions for job candidates and increasing students' overall awareness and perception of wind careers could be an opportunity for wind industry firms looking to hire candidates with adequate training.

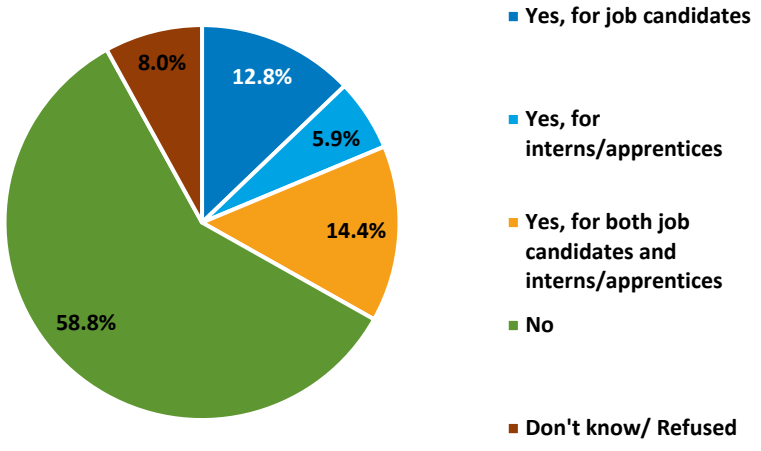
Utilization of U.S.-Based Educational Institutions by Wind Employers, 2020, 2022

Graph courtesy of BW Research Partnership



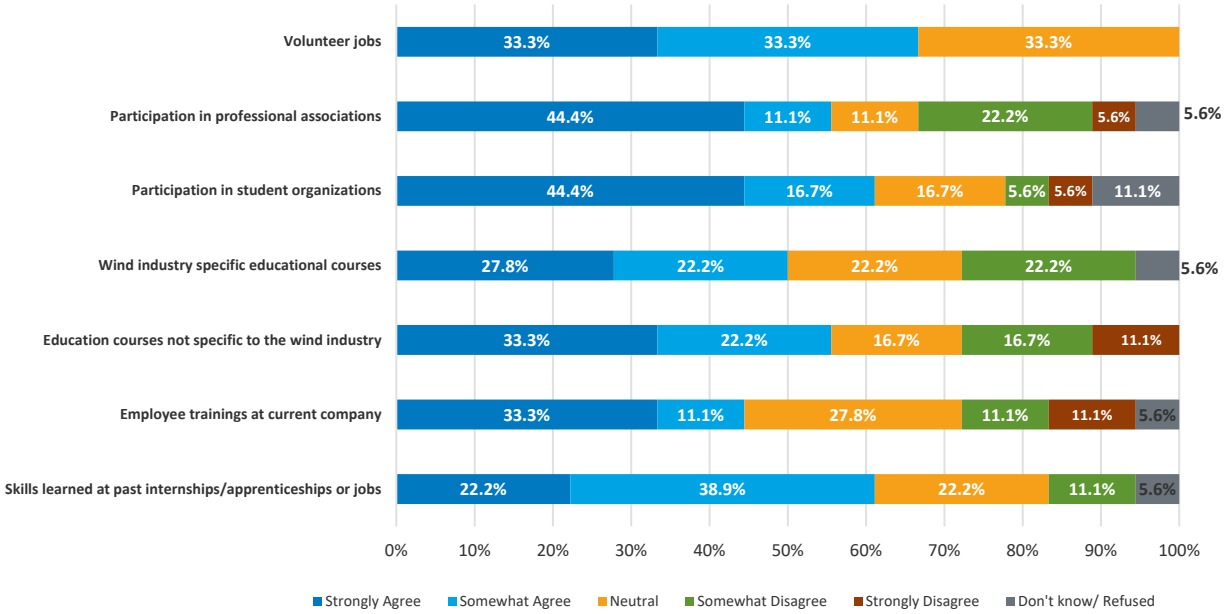
Utilization of Educational Institutions by Wind Energy Firms, 2022 (n=187)

Graph courtesy of BW Research Partnership



Additionally, current wind industry employees reported that volunteer jobs, skills learned at past internships/ apprenticeships, and participation in student organizations helped prepare them the most for their careers in wind. Wind industry firms could help to prepare the workforce pipeline through greater involvement in these avenues.

Agreement with experience gaining opportunity preparation for a career in wind industry (n=18)



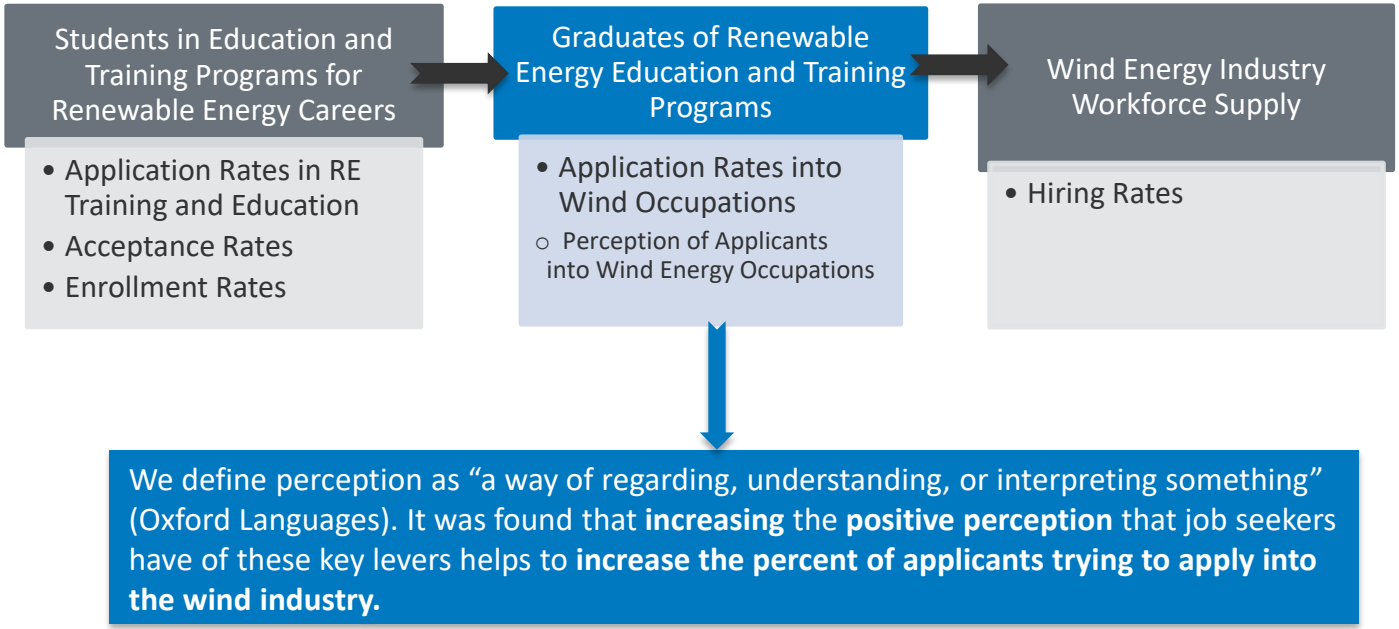
Top three reported valuable experience gaining opportunities:

1) Volunteer jobs (66.6%)
2) Skills learned at past internships/apprenticeship jobs (61.1%)
3) Participation in student organizations (61.1%).

Note: These numbers are the sum of current employee respondents who reported “Somewhat agree” + “Strongly agree.”

75% of current or recent wind employees surveyed participated in an internship or apprenticeship before entering the wind industry.

To better understand how the perception of the wind industry affects application rates into wind occupations, key levers discovered through the survey effort were implemented into the workforce estimation model. Some of the key levers that affect the perception people have of the wind industry, and therefore the application rates into wind occupations, were labor wages, job stability, and job location.

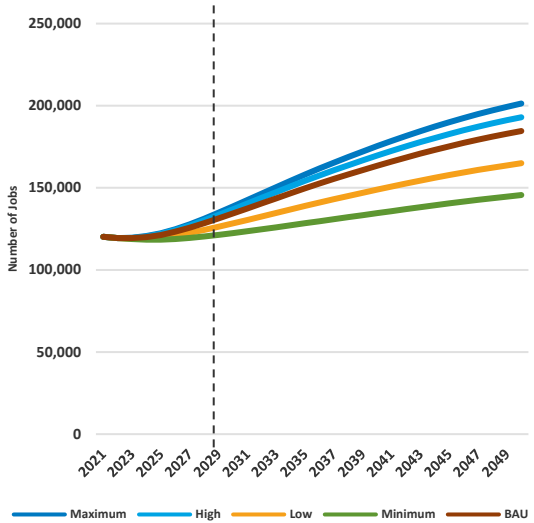


A scenario was run to evaluate how positively or negatively changing the perception that people trying to enter the wind workforce have affects the percent of people submitting wind job applications. The effects of these changes on the workforce supply and workforce gap can be found on **Slide 24**.

Workforce Estimation

Assuming that demand of the wind workforce stays constant to BAU estimations, increasing the number of applicants to wind industry jobs, and therefore the number of industry employees, can help to mitigate the gap between demand of workers needed to meet deployment projections and supply of workers available in the wind industry. According to the model, the percent the workforce gap closes will be correlated to how much the positive perception of the wind industry increases or decreases. Potential ranges are displayed below but are highly dependent on taking actions to make student perceptions of labor wages, location of jobs, and job stability more positive. Due to the general positive perception and attractiveness of the wind industry as indicated in the survey effort, decreasing the perception of the wind industry causes a greater decrease from BAU than increasing the perception.

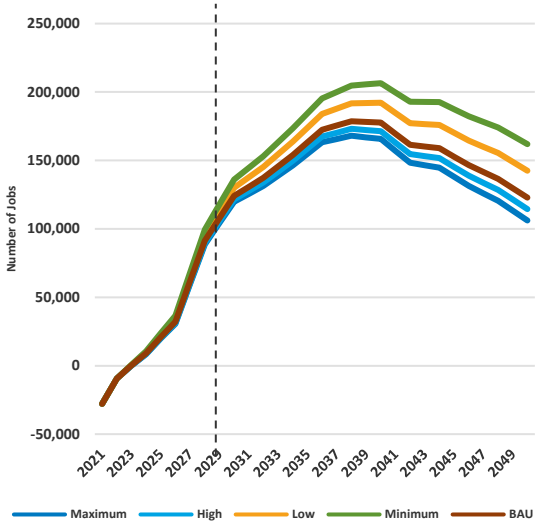
Workforce Supply Estimation: Perception Scenario



Maximum perception 2030: 138,700 Jobs
2030: Increase of 3.23% from BAU
2050: Increase of 9.06% from BAU

Minimum perception 2030: 122,422 Jobs
2030: Decrease of 8.89% from BAU
2050: Decrease of 21.1% from BAU

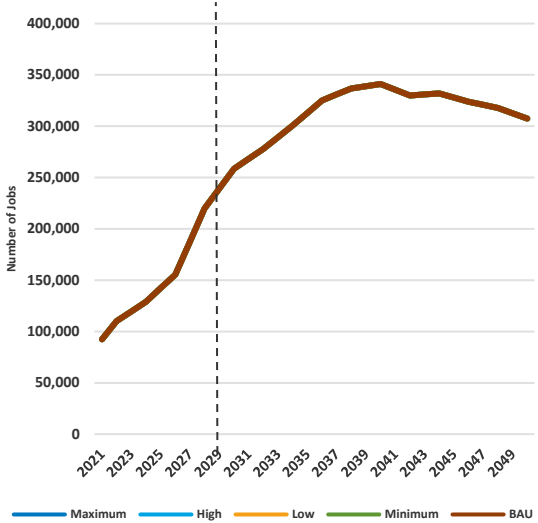
Workforce Gap Estimation: Perception Scenario



Maximum perception 2030: deficit of 119,759 Jobs
2030: Decrease of 3.49% from BAU
2050: Decrease of 13.6% from BAU

Minimum perception 2030: deficit of 136,038 Jobs
2030: Increase of 9.62% from BAU
2050: Increase of 31.7% from BAU

Workforce Demand Estimation: Perception Scenario

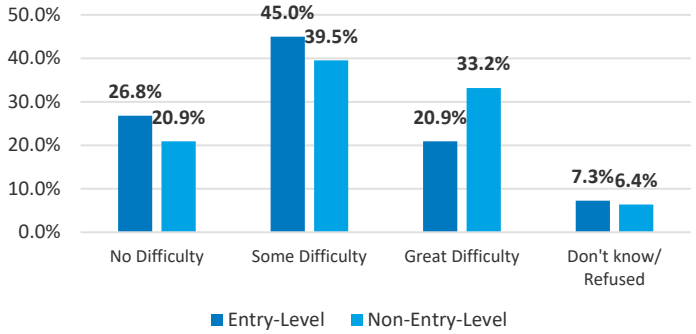


Demand stays consistent at 258,459 FTE

Hiring Challenges: Wind Industry Firms

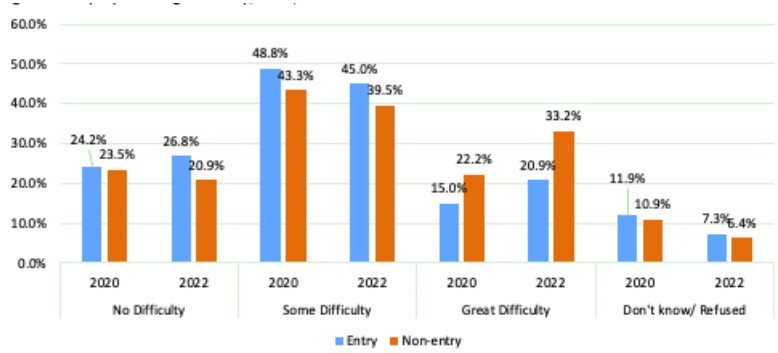
Overall, difficulty for finding and hiring employees that are qualified for entry-level and non-entry-level positions at wind energy firms remains high. Employers surveyed in 2022 reported greater hiring difficulty for entry- and non-entry-level employees than in 2020.

Level of difficulty firms have in finding qualified job applicants (n=220)



Employer Hiring Difficulty, 2020, 2022

Graph courtesy of BW Research Partnership

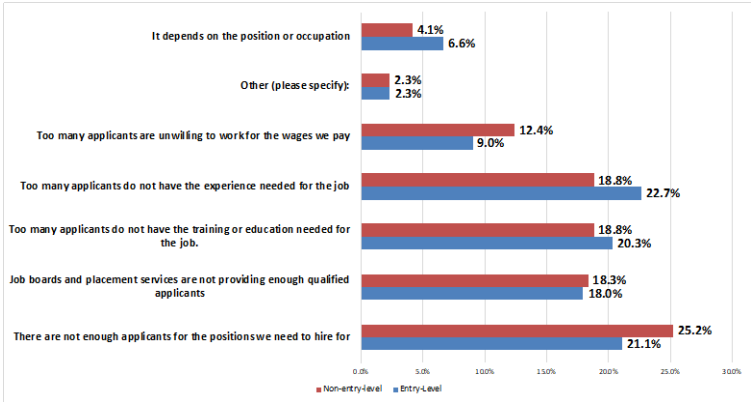


Reported Reasons for Hiring Difficulties Entry-Level vs. Non-Entry-Level

*The top reason reported for hiring difficulty of entry-level workers is a **lack of experience** needed for the job.*

*The top reason reported for hiring difficulty of non-entry-level workers is a **lack of applicants** for the position.*

Reasons for Hiring Difficulty of Entry- (n=256) and Non-Entry-Level Employees (n=218)



Note: These numbers are the sum of employer respondents who reported "some difficulty" + "great difficulty."

Employer respondents who reported their firm size to be between 10 and 49 employees indicated slightly higher levels of difficulty finding and hiring entry-level and non-entry-level employees when compared to smaller (1 to 9 employees) and larger firms (50+ employees).

Reported Difficulty for Finding and Hiring Qualified Applicants by Firm Size (n=220)

	Size of Firm	No Difficulty	Some Difficulty	Great Difficulty	Don't Know/Refused
Entry Level	1 to 9 employees (n=42)	23.8%	31.0%	19.0%	26.2%
	10 to 49 employees (n=41)	24.4%	53.7%	17.1%	4.9%
	50 or more employees (n=137)	28.5%	46.7%	22.6%	2.2%
Nonentry Level	1 to 9 employees (n=42)	16.7%	26.2%	31.0%	26.2%
	10 to 49 employees (n=41)	14.6%	36.6%	46.3%	2.4%
	50 or more employees (n=137)	24.1%	44.5%	29.9%	1.5%

- Firms that reported having 10 to 49 employees (70.8%) and firms that reported having 50 or more employees (69.3%) had **similar levels** of difficulty when hiring qualified **entry-level** candidates.
- Firms that reported having 10 to 49 employees (82.9%) reported **more** difficulty when finding qualified non-entry-level candidates than firms with 1 to 9 employees (57.2%) and firms with 50 or more employees (74.4%).
- There was a higher percentage of uncertainty around hiring difficulty for firms who reported having 1 to 9 employees.

Note: These numbers are the sum of employer respondents who reported "some difficulty" + "great difficulty."

Furthermore, employer respondents who only participate in the offshore wind industry reported the greatest amount of hiring difficulty. The difficulty faced by the U.S. offshore wind industry could be due to a lack of awareness of a new, emerging industry.

Reported Difficulty for Finding and Hiring Qualified Applicants by Wind Industry Sectors

	Wind Sector	No Difficulty	Some Difficulty	Great Difficulty	Don't Know/Refused
Entry Level	Land-Based Wind	29.0%	47.7%	15.0%	8.4%
	Offshore Wind	6.7%	40.0%	46.7%	6.7%
	Both	27.6%	42.9%	23.5%	6.1%
Nonentry Level	Land-Based Wind	17.8%	37.4%	34.6%	10.3%
	Offshore Wind	13.3%	46.7%	40.0%	0.0%
	Both	25.5%	40.8%	30.6%	3.1%

Employer respondents who only work in offshore wind reported the greatest amount of difficulty when finding and hiring qualified entry-level (86.7%) and non-entry-level (86.7%) applicants compared to land-based only wind companies and companies that work in both land-based and offshore wind.

Note: These numbers are the sum of employer respondents who reported "some difficulty" + "great difficulty."

Additionally, manufacturing had the highest reported hiring difficulty for entry-level employees (67.4%), and development and siting had the highest reported hiring difficulty for non-entry-level employees (75.4%).

Reported Difficulty for Finding and Hiring Qualified Applicants by Value Chain Segment

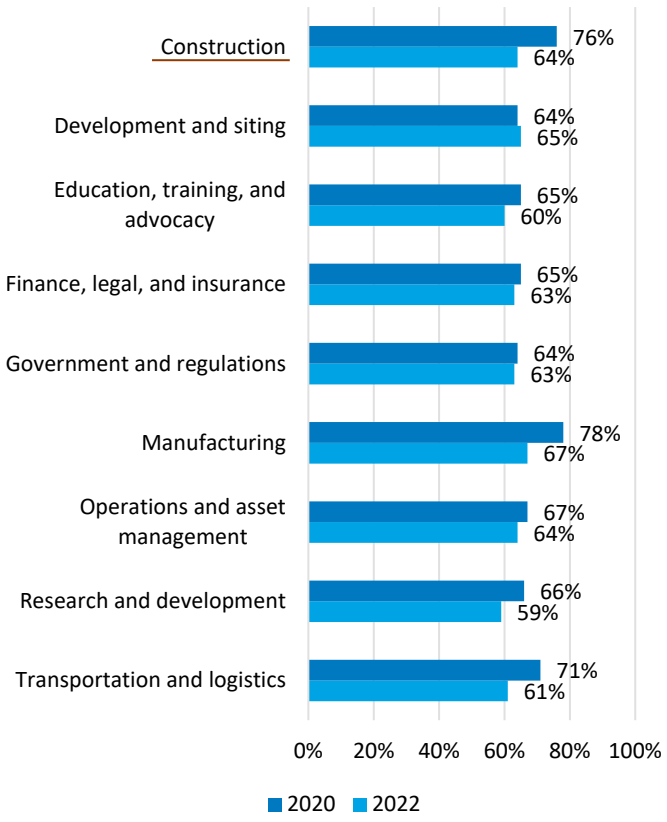
Entry Level	No Difficulty	Some Difficulty	Great Difficulty	Don't Know/Refused
Operations and Asset Management	30.1%	43.4%	20.6%	5.9%
Finance, Legal, and Insurance	33.0%	46.4%	16.5%	4.1%
Transportation and Logistics	37.5%	42.0%	19.3%	1.1%
Development and Siting	33.0%	42.0%	22.0%	3.0%
Construction	33.1%	42.3%	21.5%	3.1%
Government and Regulations	31.9%	45.1%	17.6%	5.5%
Education, Training, and Hiring	31.7%	40.7%	19.5%	8.1%
R&D	32.8%	41.0%	18.0%	8.2%
Manufacturing	30.4%	43.5%	23.9%	2.2%

Nonentr-Level	No Difficulty	Some Difficulty	Great Difficulty	Don't Know/Refused
Operations and Asset Management	23.5%	39.7%	32.4%	4.4%
Finance, Legal, and Insurance	25.8%	39.2%	32.0%	3.1%
Transportation and Logistics	31.8%	40.9%	25.0%	2.3%
Development and Siting	21%	41.0%	34%	4.0%
Construction	26.9%	45.4%	24.6%	3.1%
Government and Regulations	20.9%	42.9%	29.7%	6.6%
Education, Training, and Hiring	21.1%	39.0%	33.3%	6.5%
R&D	24.6%	41.8%	27.0%	6.6%
Manufacturing	28.3%	44.6%	25.0%	2.2%

Note: The numbers above are the sum of employer respondents who reported "some difficulty" + "great difficulty."

Reported Difficulty for Finding and Hiring Qualified Applicants by Value Chain Segment

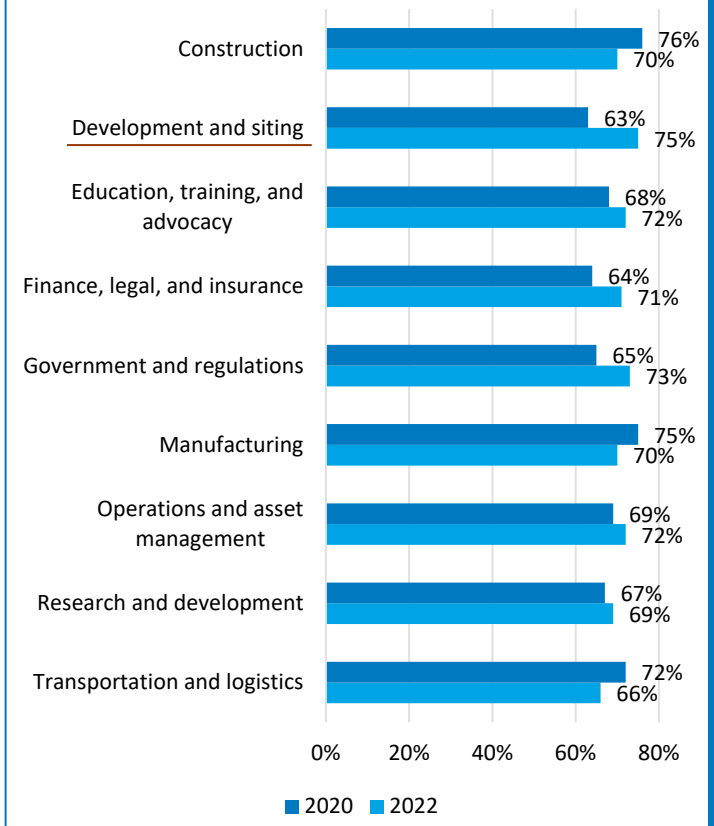
Entry-level



Graph courtesy of BW Research Partnership

- Construction saw the greatest decrease in reported hiring difficulty for entry-level employees between 2020 and 2022.
- Development and siting saw the greatest increase in hiring difficulty for non-entry-level employees between 2020 and 2022.

Non-entry-level

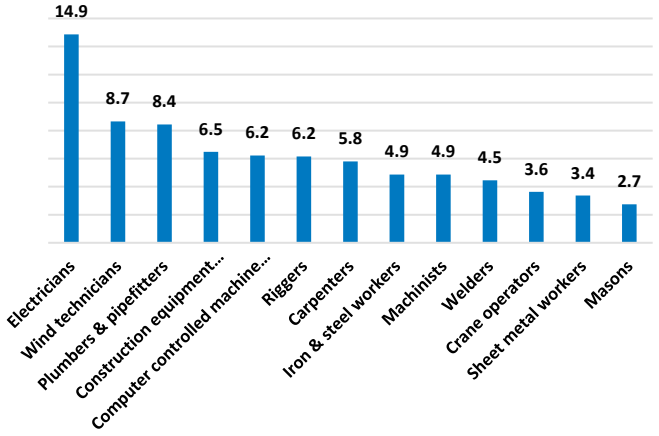


Graph courtesy of BW Research Partnership

Some of the greatest hiring difficulties have been reported by wind industry members for skilled trades occupations. With 24.7% of wind industry firms reporting representing workers from organized labor unions, building connections between industry and organized labor unions could offer a large opportunity for growth in the wind workforce.

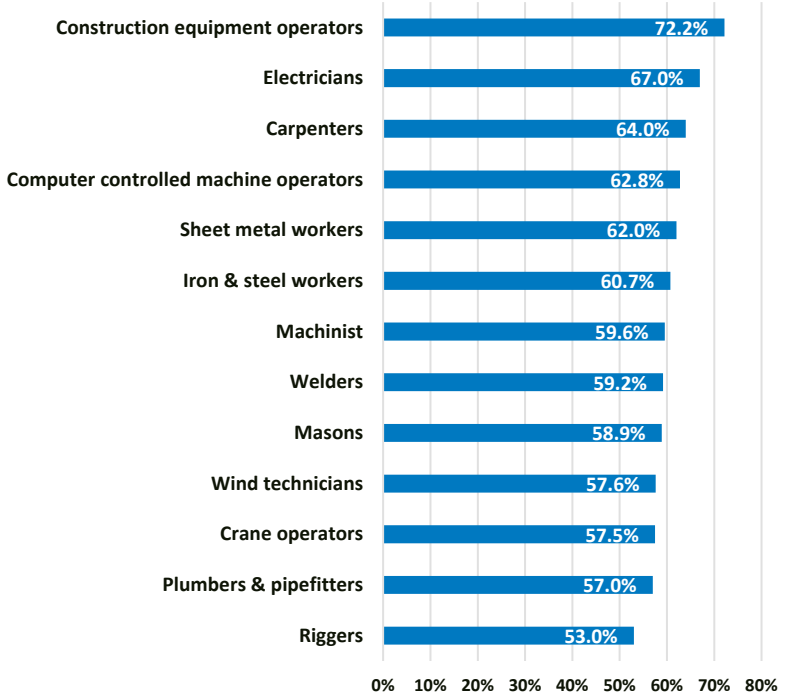
Average Number of Trade Workers Employed at Wind Energy Firms, 2022 (n=183–190)

Graph courtesy of BW Research Partnership



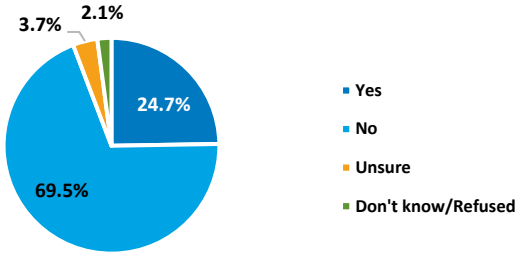
Occupations with Apprenticeships at Wind Energy Firms, 2022 (n=73–118)

Graph courtesy of BW Research Partnership



Wind Energy Firms with Workers Represented by an Organized Labor Union, 2022 (n=190)

Graph courtesy of BW Research Partnership

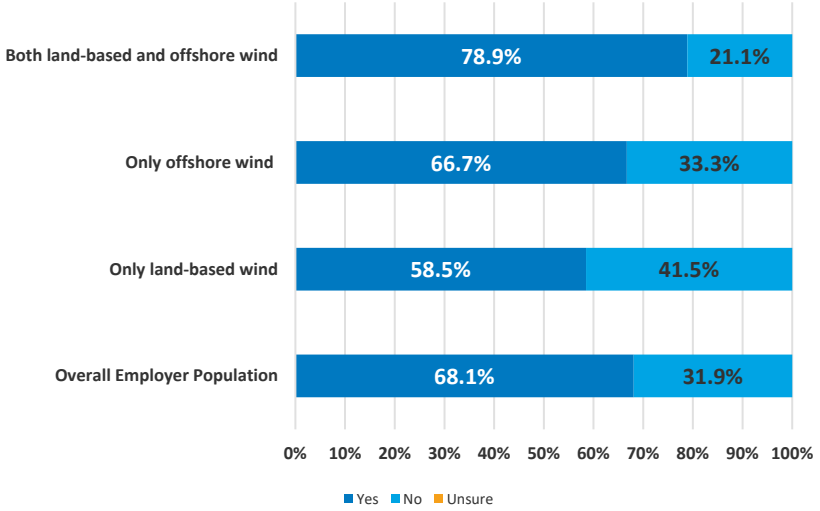


Automation

More than two-thirds (68.1%) of the respondents reported that they had implemented automation. Automation was defined in this survey effort as incorporating processes that use software, hardware, or other technologies used to automate tasks, improve quality control, and reduce work hours in tasks. When asked why they implemented automation technologies, the most prevalent reasons were for quality control, safety of workers, and to reduce operational costs within the firm. Additionally, 50% of respondents indicated that automation technology usage is expected to increase in the next three years.

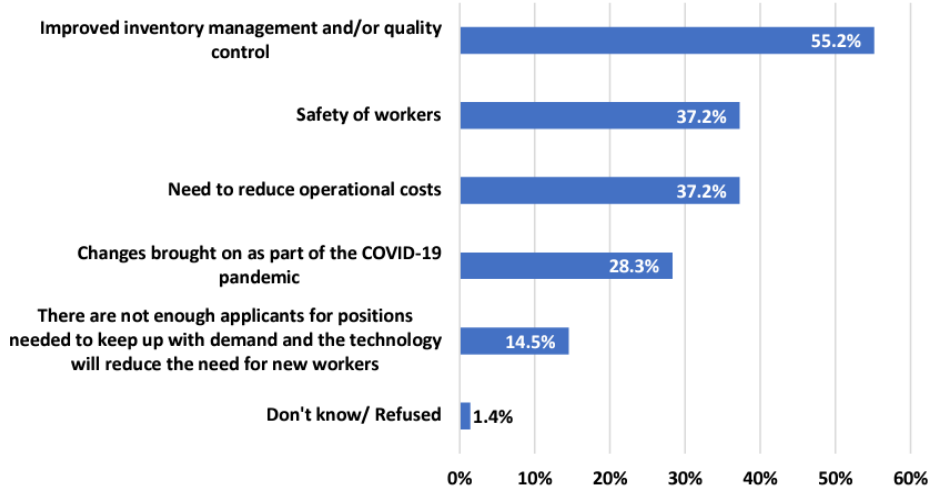
Implementation of Automation Technologies at Wind Energy Firms (n=216)

Graph courtesy of BW Research Partnership



Reasons for Implementing Automation Technologies at Wind Energy Firms (n =145)

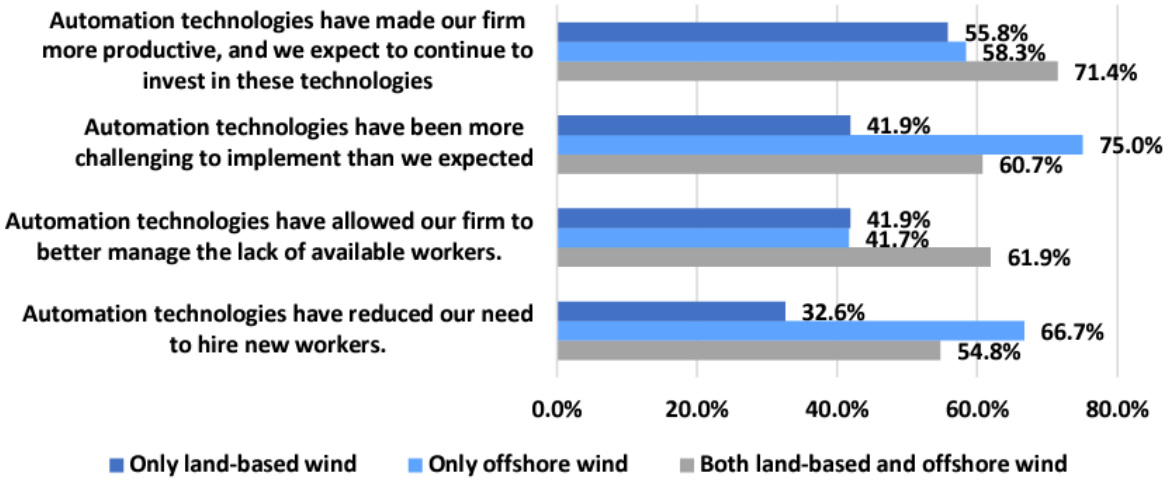
Graph courtesy of BW Research Partnership



Firms involved in land-based and offshore wind (71.4%) reported that automation technologies made their firm more productive and expected to continue investing in these technologies. While only 14.5% of respondents reported that the reason they implemented automation was because there are not enough applicants for positions needed to keep up with demand, wind industry employers reported automation technologies have allowed their firms to better manage the lack of available workers (61.9%) and reduced the need to hire new workers (54.8%).

Agreement with Statements About Automation Technologies at Wind Energy Firms by Wind Industry Segment (n=182)

Graph courtesy of BW Research Partnership



Top four occupational categories believed to be impacted from automation within wind energy firms:

1) Operations and maintenance (63.3%)
2) Accounting and administrative (59.9%)
3) Manufacturing and assembly (51.1%)
4) Research and development (50.7%).

While automation was a limiting factor in the SD model, it is integrated into the model as an assumption related to the speed of deployment for wind energy. While more research is needed on its effect on the wind supply chain, it has been a factor in the development of the SD model and projected outcomes related to workforce demands.

For the U.S., it is estimated that one robot unit lowers the demand for workers by 3.3 (Acemoglu & Restrepo 2020). From the survey effort, it was reported that automation is expected to grow significantly across industries.

Wind energy firms are following other industries in the the U.S. for the implementation of automation, with 68.1% of firms having implemented automation in some form in recent years, for reasons such as quality control, safety of workers, and reduction of operational costs.

With the overall expected growth of automation reducing worker demand across the nation, current survey efforts report that automation has already made firms more productive, with a continued need to invest more in such technologies.

Potential actions for industry and education/training programs to better connect with qualified students

More information can be found in the *Connective Actions for Educator & Wind Industry* presentation.

Actionable Steps to Address the Workforce Gap

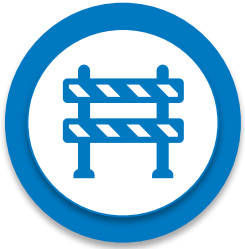
Lack of Experience

Collaborate with Educational Institutions to Build Awareness of Wind Industry Opportunities.

Establish Effective Internship and Apprenticeship Programs and Pipelines.

Lack of Applicants

Connect with Students Through Outreach and Programs such as CWC.



Reduce Barriers to Entrance for Historically Underrepresented Populations.

More information can be found in the *Connective Actions for Educator & Wind Industry* presentation.

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