Global Wind Workforce Outlook

2025-2030

GWEC
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Ben Backwell, CEO, Global Wind Energy Council

The momentum behind wind energy is continuing to build and it is critical that this decade sees an acceleration in deployment, with the development of the global wind workforce key to turning global ambition into the realisation of wind energy's potential on every continent.

Ambition was set at COP28, where almost 200 nations agreed on a global goal to triple renewable energy capacity by 2030, while wind power was recognised as a key technology to mitigate climate change. In 2024, GWEC's Market Intelligence team recorded yet another record year for new wind energy capacity, with 117 GW of installations worldwide. That record growth is not enough however, and global wind capacity remains off-track for the tripling target.

The latest report tracking progress, Delivering on the UAE Consensus: Tracking Progress Toward Tripling Renewable Energy Capacity and Doubling Energy Efficiency by 2030, co-released by IRENA, the COP30 Presidency, and the GWEC-supported Global Renewables Alliance, highlights a significant gap in progress to meet the COP28 objective and keep 1.5°C within reach. The gap has closed on the year before, but still requires a growth rate of 16.6%. This can be achieved by targeting the key challenges to accelerating the scaling up of wind deployment: streamlining permitting, strengthening supply chains, mobilising finance, and investing in grids and storage.

Wind deployment is still set for record years through the rest of the decade, with GWEC's latest Global Wind Energy Outlook showing that current policies set the world on course to deliver 1TW of wind energy between 2025-2030. That will take total installed wind capacity past 2.1 TW globally. To build and maintain this expanding fleet, the wind industry will require more than 628,000 skilled wind technicians by 2030.

Onshore wind will continue to be the backbone of deployment, but offshore wind is growing rapidly and requires a specialised workforce with advanced technical skills and enhanced safety competencies.

The Global Wind Organisation (GWO) and the Global Wind Energy Council (GWEC) are calling for urgent action to address the workforce shortage and scale up installation capability. This sixth edition of the Global Workforce Outlook provides a framework for workforce growth, which can support the expected demand for skilled technicians across the global wind sector by 2030.

Workforce demand is expected to surge, particularly in O&M. In this area growth is driven by the longevity of existing assets and the complexity of next-generation turbines. This evolving landscape calls for more diverse and advanced skill sets. The challenge is compounded by a lack of new entrants and natural labour attrition, widening the gap between available workers and accelerating demand.

The report also highlights how national institutions such as NIWE in India, SENAI/CTGAS-ER in Brazil, Germany's Fachhochschulen and BZEE, as well as state-level programmes in the USA and Australia, are becoming critical partners in building the wind workforce. For GWEC and GWO, standardisation and international cooperation are essential to scaling up at pace.

The next five years brings huge opportunity for the wind sector across the world. Meeting that potential will mean rising to the challenge and ensuring that as countries intensify their efforts to meet 2030 wind targets the sector is there to deliver.

Jakob Lau Holst,
CEO, Global Wind Organisation

GLOBAL WIND ORGANISATION

The global wind industry is entering a period of remarkable opportunity. Wind power has established itself as one of the most competitive and scalable sources of electricity, and countries are turning to it to strengthen energy security, reduce emissions, and support economic growth. Yet, as this report makes clear, turning ambition into reality depends on more than the availability of turbines, infrastructure, or finance. It depends on people.

The technicians who construct and maintain wind turbines are the foundation of this industry. Their expertise, professionalism, and commitment to safety enable wind projects to be delivered reliably and operated effectively. This year's Global Wind Workforce Outlook highlights just how essential this workforce is to the next phase of global wind expansion.

Between now and 2030, wind deployment is expected to increase significantly across many regions. Meeting this demand will require strong, capable technician workforces in the two value-chain elements that rely most heavily on onsite skills: Construction & Installation (C&I) and Operations & Maintenance (O&M). These roles are central to project delivery, asset performance, and long-term sector growth.

The Outlook shows that as the global installed fleet expands, O&M will account for an increasing share of total labour requirements. Every new turbine added to the world's wind capacity contributes to long-term maintenance needs. At the same time, C&I remains crucial. Periods of intense build-out will continue to place pressure on labour availability, especially where multiple large projects compete for similar skills. Ensuring adequate staffing for C&I and O&M will be essential to meeting project timelines and maintaining asset performance.

What is especially clear from this year's analysis is that workforce development has become a strategic industrial imperative. Many countries face shortages of experienced technicians, limited training capacity, and growing competition for skilled labour. These workforce pressures can impact project schedules, increase costs, or compromise operational resilience.

However, these challenges also present significant opportunities. Investment in workforce readiness strengthens local communities, builds technical capacity, and supports long-term economic development. Nations that invest in training infrastructure, expand access to certification, and prioritise safety will be better positioned to deliver wind energy at scale. For companies, the benefits are equally clear: improving reliability, reducing operational risk, and enhancing their ability to attract and retain skilled people.

Workforce development is also central to a just and inclusive energy transition. Wind energy offers high-quality jobs and long-term career paths in both rural and urban regions. Ensuring equitable access to training and supporting workers transitioning from fossil-intensive sectors are essential to building public support and delivering a socially resilient transition.

I would like to thank all contributors to this year's Outlook. Their work underscores a simple truth: the energy transition will be delivered by people – people whose skills, experience, and commitment make wind energy possible.

As we look ahead to 2030, we must match our ambition with a sustained commitment to workforce readiness. By investing in the skills and safety of the wind workforce, we can ensure that global wind deployment continues to grow – and that the people powering that growth are supported every step of the way.

Matt Riding
Chief Commercial Officer
Atlas Nextwave

Lead sponsor

ATLAS NEXTWAVE

The global wind industry is moving into a decisive decade. Ambition is rising in every major region and governments are turning commitments into auctions, targets and long-term policy frameworks. Technology is advancing, capital is available and project pipelines are growing at a scale the sector has never experienced before. Yet as this report shows, there is a fundamental constraint that will determine how much of this ambition can be delivered in practice. That constraint is the availability of skilled people.

The labour challenge facing the wind sector is not only about technician numbers. It is a structural issue that spans the entire workforce system. Every country entering a major build-out phase is now experiencing pressure on construction crews, turbine technicians, commissioning specialists, cable and foundation teams, marine personnel and the many operational roles that ensure long-term availability. The speed and volume of global expansion are outpacing the systems that prepare, deploy and support these workers.

What makes this moment different is that workforce constraints are no longer local market problems. They are global coordination problems. The United States is navigating the dynamics between union and non-union labour and the availability of experienced offshore crews. Europe is competing with oil and gas for many of the same technical skill sets and is seeing experienced workers pulled across sectors. APAC markets are encountering visa and mobility bottlenecks that slow the deployment of specialised roles. In Latin America and markets such as South Africa and Vietnam, talent potential is high but structured entry pathways and large-scale training capacity remain limited. Each of these regions faces different pressures, but they all point to the same underlying issue. The current labour ecosystem of the global wind industry is not designed for the speed and intensity of the growth ahead.

Traditional recruitment and local training models cannot meet the next decade of demand. Wind is becoming a true global industry with interdependent talent flows. Large projects operate on international schedules and depend on workers who move from one region to another as demand peaks and dips. Developers, OEMs, vessel operators and service companies need workforce systems that can react quickly and safely to shifting project requirements. They need a stable base of new entrants arriving through structured, high quality pathways. They need internationally recognised competence standards that reduce retraining and accelerate time to deployment. They need mobility frameworks that allow skilled workers to move across borders without adding legislative or compliance risk. And they need all of this to happen at scale.

The wind industry has made strong progress over the past decade, especially in the development of technician training frameworks and safety standards. Yet the next phase of global growth will require a far broader and more coordinated approach. Competence standards need to evolve across a wider range of roles. Entry programs need to be faster and more accessible, particularly in regions with high talent potential and limited training infrastructure. Workforce mobility requires deeper alignment between regulators, industry bodies, vessel operators and crew managers. And workforce planning must be integrated into project development in the same way that supply chain and infrastructure planning already are.

At Atlas NextWave, we see these dynamics every day. Our work supporting offshore wind projects across established and emerging markets shows how quickly workforce shortages can slow down project delivery or increase operational risk. It also shows how powerful coordinated workforce systems can be when they are implemented well. Structured entry programs, harmonised competence development and compliant cross-border deployment are not theoretical concepts. They are practical solutions that allow developers to build and operate assets more predictably and more safely.

Our focus is to operate as a long term knowledge partner to developers, OEMs and vessel operators, providing the workforce architecture and global deployment capabilities that enable projects to be delivered predictably and safely.

The Greenhands Offshore program is one example of how fast new talent can be developed when industry, training partners and local authorities work together. By preparing new entrants for offshore work within weeks, it creates a consistent flow of job ready personnel in regions where demand is rising rapidly. On the other end of the experience spectrum, compliant international mobility allows projects to access critical expertise at the moments it is needed most. Together, these elements support a more resilient and more flexible workforce ecosystem.

The findings of this report highlight the urgency of building that ecosystem at global scale. Workforce strategy can no longer sit behind supply chain strategy or project engineering. It must be treated as core infrastructure for the energy transition. If the world is to meet its 2030 wind targets, the industry must widen the pool of new entrants, accelerate training capacity, expand international competence standards and strengthen the systems that allow skilled people to move safely between markets.

Atlas NextWave is proud to support this report as lead sponsor. We share the belief that the next era of global wind growth will be shaped by the ability to build and sustain the workforce that delivers it. The turbines, vessels and infrastructure of the future will only reach their potential if the people behind them are supported by a workforce ecosystem that is robust, coordinated and ready to grow.

We are committed to playing our part in building that foundation and to working with partners across the world to ensure that talent is never the reason a project cannot move forward.

Chapter 1:
Executive Summary

The global wind industry is entering a decisive period of expansion as countries accelerate their energy-transition strategies and electricity systems adapt to growing demand. Wind power's competitiveness and scalability continue to strengthen its position as a cornerstone of the global clean-energy mix. Against this backdrop, the capabilities, availability, and resilience of the wind workforce have become central determinants of the industry's ability to deliver on its ambitions. Around the world, the energy transition has proven to be a powerful job creation engine – and the wind energy sector stands as one of its most dynamic examples.

This year's Global Wind Workforce Outlook analyses the workforce requirements associated with wind deployment between 2025 and 2030, with a particular focus on the two value-chain segments that rely most heavily on onsite technicians: Construction & Installation (C&I) and Operations & Maintenance (O&M).

Integrating energy deployment forecasts, workforce modelling, and industry expertise, this edition emphasises that meeting global wind targets depends fundamentally on the strength and preparedness of these technician workforces.

Wind Expansion Drives Increasing Labour Needs Across C&I and O&M

Both onshore and offshore wind markets are projected to expand over the 2025–2030 period, though the pace of growth varies across regions. As the global installed fleet expands, technician requirements rise across the value chain, particularly in C&I – where turbine assembly, mechanical and electrical completion, and commissioning take place – and in O&M, where the long-term performance and reliability of the global fleet are maintained.

Labour demand is shaped by both annual build-out cycles and underlying structural factors. Turbines continue to grow in size and sophistication; project logistics require higher coordination; and expanding installed capacity necessitates sustained maintenance activities. These trends reinforce the importance of a well-trained workforce capable of safely executing high-risk technical tasks throughout the project lifecycle.

O&M Represents an Increasing Share of Total Technician Demand

One of the clearest findings of this year's Outlook is that O&M forms a growing share of total onsite workforce requirements as global installed capacity expands and the turbine fleet ages. Although C&I continues to drive significant and often peak labour demand during construction years, O&M needs increase steadily and predictably over time.

The growth in O&M is driven by:

- the expanding size of the global operating fleet,
- the rising complexity of turbine systems,
- the need for routine inspections, repairs, and troubleshooting, and
- the importance of maintaining safety and performance standards.

This does not mean that O&M will become an increasingly substantial component. Rather, it becomes an increasingly substantial component of total workforce demand, while C&I remains essential for delivering new capacity.

C&I Remains a Cornerstone of the Wind Workforce

C&I continues to represent a major driver of technician demand, especially in markets with large project pipelines or concentrated build-out phases. Activities across this segment – supported by pre-assembly and staging – require mechanical, electrical, and commissioning capabilities, strong project coordination, and rigorous safety practices. Labour availability in this phase has a direct influence on project timelines, quality assurance, and cost control.

Workforce Development is now a Core Industrial Challenge

Across global markets, workforce constraints are becoming more visible and more consequential. Many countries face shortages of experienced technicians, competition for skilled labour across industrial sectors, limited training capacity, challenges associated with workforce ageing, and inconsistent application of internationally recognised training standards.

These pressures highlight why workforce development is increasingly recognised as a strategic industrial issue rather than a peripheral concern.

Project-level Workforce Planning Must Be Strengthened

Chapter 3 of the report highlights a growing recognition of the importance of workforce planning in project management, people-competence management, and companies' strategic planning. At the same time, we identify a gap: proactive workforce planning for installation work – both in terms of competence management and strategic planning – is relatively missing compared to maintenance sector.

Developers currently only consider workforce preparedness at a minimal viable level. This leaves substantial untapped value, including improved risk mitigation and more efficient resource allocation, that could be unlocked through more robust workforce planning. As project volumes continue to grow, the potential benefits of enhanced workforce planning will become even more impactful.

Workforce Readiness Underpins a Just and Socially Resilient Transition

Chapter 4 highlights the macro context of the energy transition, in which wind energy is positioned as both a driver of decarbonisation and a source of high-quality employment. Workforce preparedness contributes to economic resilience, supports regional development, and offers new technical career pathways – including for workers transitioning from fossil-based sectors. Ensuring equitable access to training, strengthening safety cultures, and offering durable employment opportunities will remain essential components of a just transition.

Country Insights Show Common Workforce Themes Across Diverse Markets

The six countries examined in this edition – United States, India, Brazil, Germany, France, and Australia – represent a wide range of market conditions. Each faces distinct workforce challenges:

- **USA:** rapid onshore growth and the emergence (albeit uncertain) of offshore wind increase demand across both C&I and O&M.
- **India:** deployment growth requires major scaling of training infrastructure.
- **Brazil:** strong O&M demand and a need for upskilling in line with turbine modernisation.
- **Germany and France:** mature markets with ageing workforces and growing O&M loads.
- **Australia:** fast-growing onshore markets with significant shortages in electrical and mechanical skills, plus a long term offshore pipeline with considerable planning demands.

Despite their differences, common themes emerge: technician availability, training capacity, and retention are core challenges across all focus markets.

Although many of these countries have outlined offshore wind development plans, substantial progress is not expected until after 2030. To provide a more comprehensive and objective perspective, this chapter extends workforce forecasts through 2030-2035, delivering a long-term outlook on demand across both onshore and offshore sectors. Detailed projections are presented in the dedicated section for each country.

A Clear Call to Action

The findings of this Outlook reaffirm that workforce readiness must be elevated to the same priority level as supply-chain investment, permitting reform, and grid development. Achieving 2030 wind deployment goals will require coordinated, strategic investment in technician training, certification, and long-term retention.

Chapter 2:

Wind Workforce Forecast: from Energy Outlook to People Outlook

Workforce demand in onshore and offshore wind is projected to increase significantly. By 2030, approximately 628,000 professionals will be required to meet industry needs. This growth is particularly pronounced in the operation and maintenance portion of the wind energy value chain, where the surge in workforce demand reflects an evolving need for higher and more diverse skill sets to service and maintain the world's 2.1 TW wind fleet. Consequently, this trend raises critical questions for the industry regarding talent availability, skill development, and workforce readiness.

Around the world, the energy transition has proven to be a powerful job creation engine – and the wind energy sector stands as one of its most dynamic examples.

On the production side, renewables have spurred growth in industries that supply equipment, components, and technology. Manufacturers are hiring engineers, technicians, and factory workers to meet rising demand.

Then, on the implementation side, there's a boom in construction, installation, and maintenance – the boots-on-the-ground work that brings wind energy projects to life.

This report specifically addresses the implementation side in C&I and O&M processes (the teal boxes highlight the scope of research in the figure below).

Job creation is often cited as one of the strongest arguments supporting the clean energy transition – both as a key benefit and as a justification for it. Compared with nuclear power, renewable energy sources such as wind distribute their economic and social value more broadly across communities and industries; they are, quite simply, more inclusive and widely beneficial.[1]

From a business perspective, employment in the wind sector – the wind workforce – should not merely be viewed as a byproduct of the transition, but as an essential means of achieving it. Building and empowering this workforce is fundamental to realising our collective clean energy goals.

The updated GWEC Global Wind Energy Outlook, shows that between 2025 and 2030, new wind capacity additions are projected to reach 982 GW, bringing total cumulative installed capacity to approximately 2117 GW by 2030. This continued expansion of the wind sector will significantly increase labour demand across the value chain. On the implementation side, beginning at construction to commissioning and operation, the number of wind technicians required worldwide is expected to reach 493,000 in 2026, and exceed 628,000 by 2030, reflecting both the scale of new installations and the growing need for ongoing operations and maintenance.

Figure 1: Value Chain of Wind Capacity Development

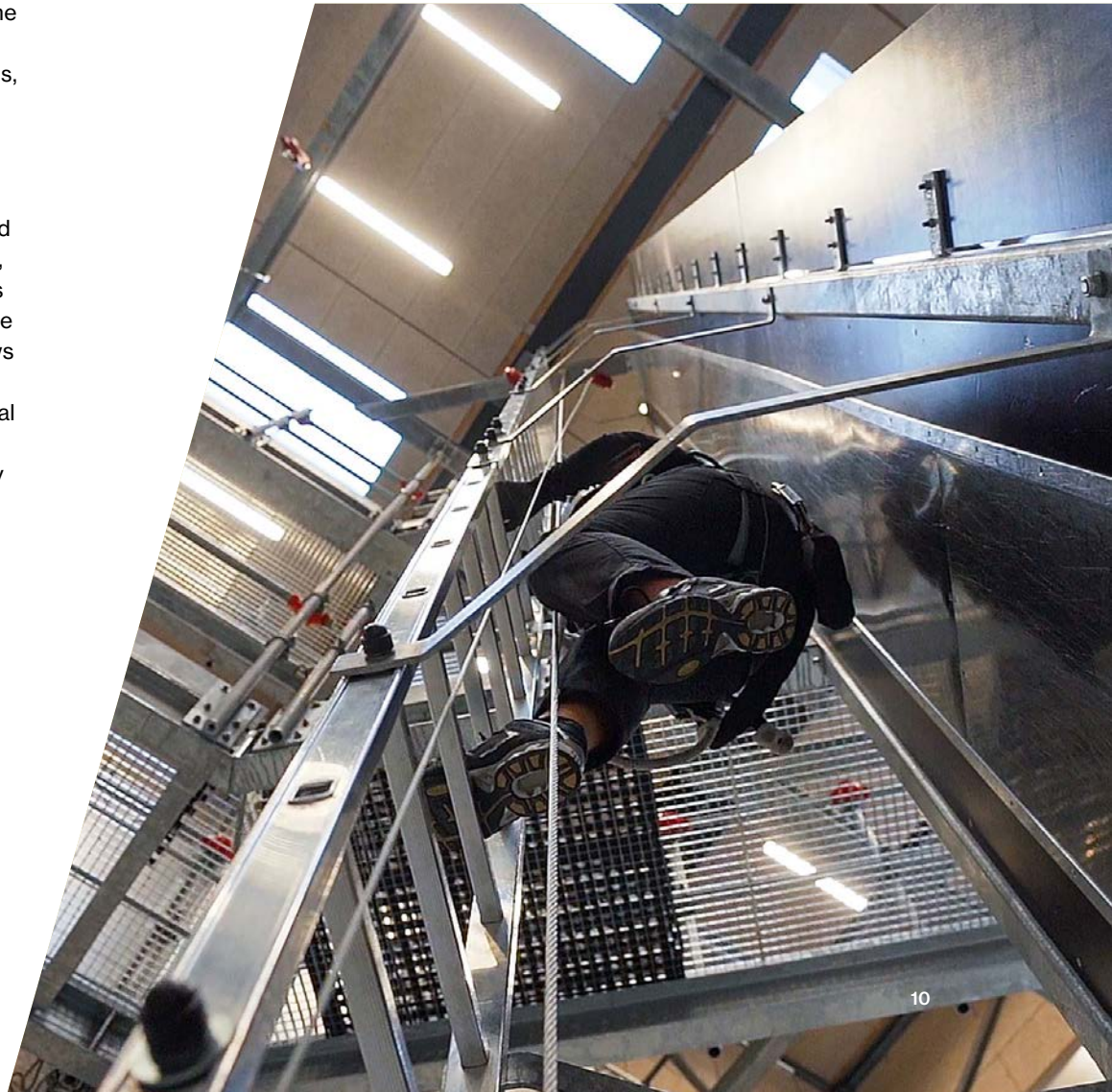
[1] Submission 69. (n.d.). Inquiry into nuclear power generation in Australia: Evaluating Australia's energy future – Renewable energy vs. nuclear power. Submission to the House Select Committee on Nuclear Energy, Parliament of Australia.

The outlook for global energy is shaped by a combination of interconnected factors. Policy ambition, regulatory frameworks, and government incentives set the direction for energy development, while market dynamics – such as investment flows, technology costs, and supply chain maturity – shape economic viability.

At the same time, technological innovation, including advances in turbine efficiency, digitalisation and offshore capabilities, drives the pace and scale of deployment. Environmental and social priorities, from decarbonisation goals to community engagement, further influence the speed and distribution of energy growth.

Ultimately, the same forces that shape the global energy outlook – policy ambition, technological innovation, market dynamics, and societal priorities – also define the outlook for people.

As expectations for wind energy deployment rise, so too does the demand for skilled professionals who can design, build, and maintain these systems. In this sense, the energy outlook determines the people outlook: workforce growth follows the trajectory of the energy transition itself. Anticipating these shifts is essential for ensuring that the supply of talent keeps pace with the scale of opportunity in wind energy.

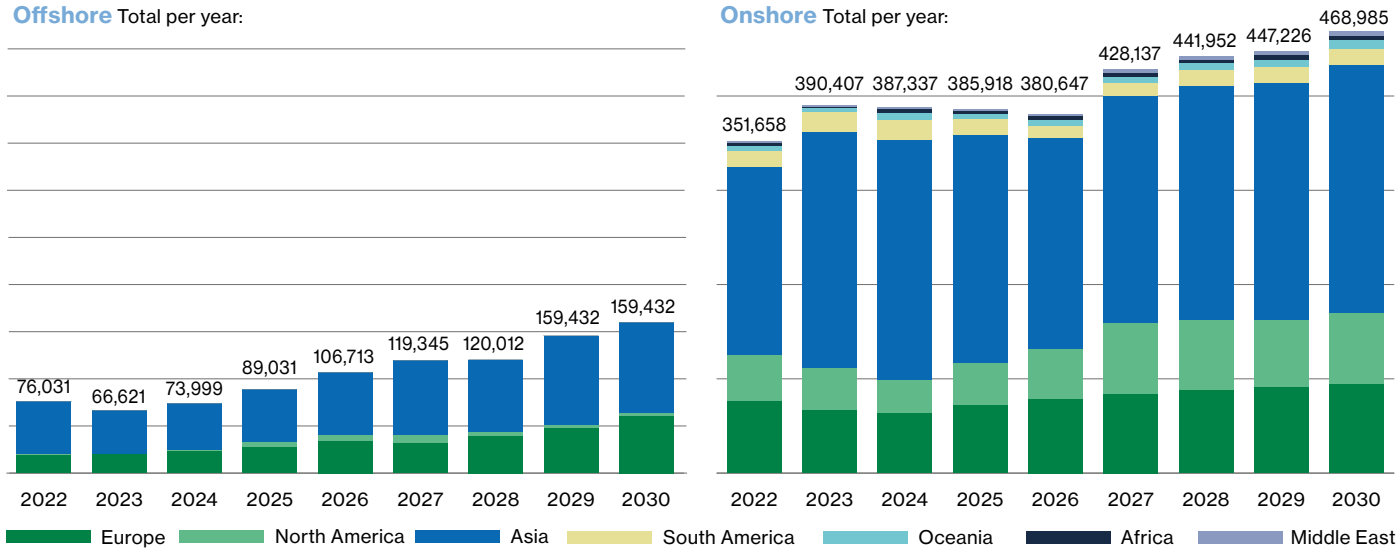


Workforce Structure

We are in an era where the structure of the workforce evolves alongside energy deployment, creating new demands across the entire industry. The trend, in short, points to increased maintenance needs, with a gradually growing emphasis on offshore wind – an area that requires experience, exposure, and specialised skills.

Historically, the development of wind energy has evolved along two main segments: onshore and offshore. Reflecting this structure, the workforce forecast continues to maintain a clear separation between onshore and offshore, as each requires substantially different skill sets and technical expertise.

Figure 2: Technician Demand 2022-2030



Source: Brinckman, GWEC, GWO Intelligence

Workforce Structure: Onshore vs Offshore

Offshore wind is expected to grow beyond 212 GW by 2030, representing approximately 10% of cumulative global wind capacity (out of an estimated 2,117 GW worldwide). In the long term, onshore wind will remain the backbone of global wind energy, accounting for most of the installed capacity.

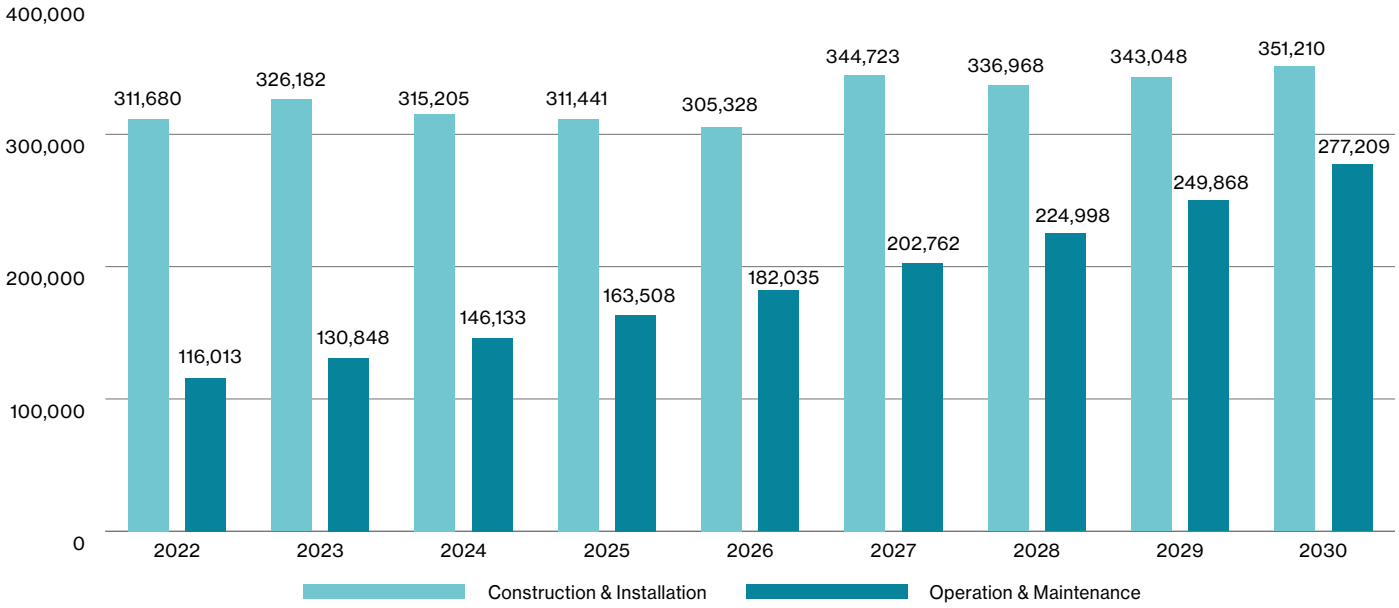
Workforce demand does not scale in the same way as capacity growth. While offshore wind may account for only about 10% of total installed capacity, it can represent as much as 25% of workforce demand by 2030.

Workforce Structure: Maintenance and Construction

Technician demand in the maintenance sector is catching up with the installation sector.

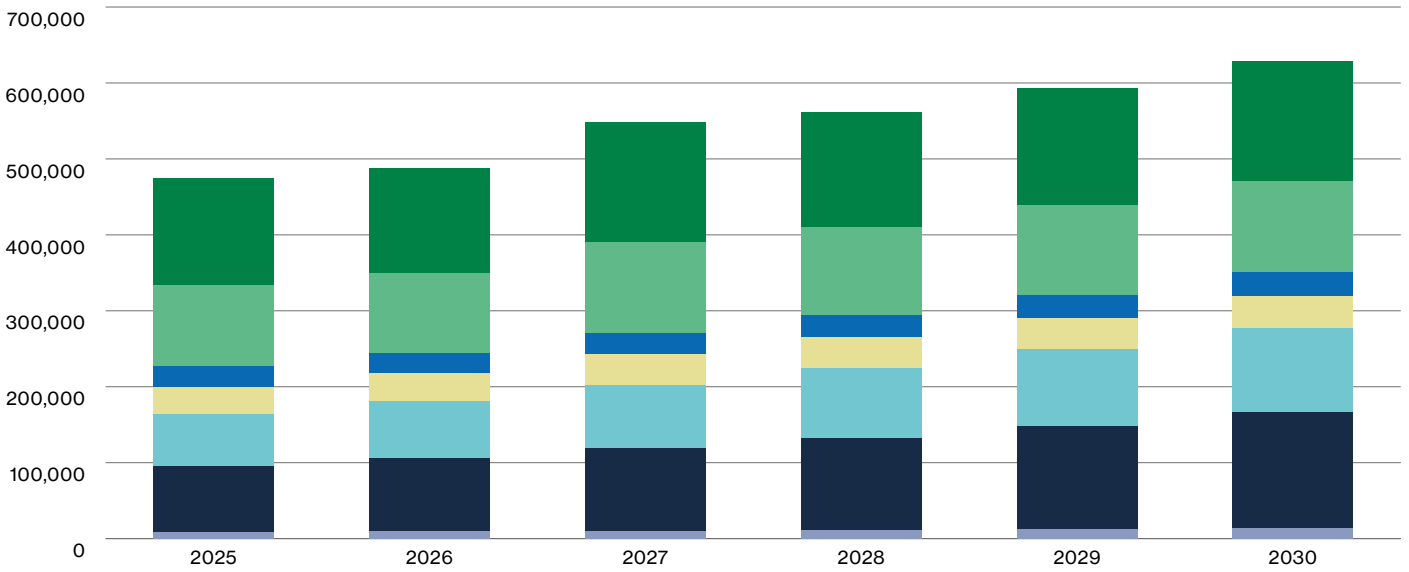
As new capacity is added and the energy transition accelerates, the structure of the workforce is evolving. The construction and installation segment is directly impacted by new capacity additions, taking on the responsibility of deploying the new fleet. In contrast, the operations and maintenance segment must manage the entire cumulative installed capacity, which continues to grow over time. These dynamic drives increasing demand for technicians in O&M as cumulative capacity expands. It also introduces new skill requirements, as these two parts of the value chain – while related – are not identical and require distinct competencies.

Figure 3: Technician Demand by Portion of the Value Chain 2023-2030



Source: Brinckman, GWEC, GWO Intelligence

Figure 4: Technician Demand by Roles and Responsibilities (2025-2030)



Wind Workforce Demand by Responsibility – C&I – O&M	2025	2026	2027	2028	2029	2030
Assembly (Pre-Assembly Support Technician and Assembly Technician)	140,250	137,340	156,870	150,900	153,830	157,130
Electrical Work (Commissioning Technician)	106,940	104,750	118,810	117,170	117,820	119,940
EHS/QHSE (Lead Technician/Supervisor, Site Manager, Construction Manager)	27,410	26,840	27,990	28,570	29,970	31,410
Technical Advisory (Field Engineer/Technical Support, Troubleshooting Technician)	36,810	36,380	41,030	40,310	41,420	42,710
Component Repair (Blade Repair Technician, Advanced Blade Repair Technician, Blade Repair Supervisor	68,120	75,560	83,340	919,30	101,120	110,300
Regular Inspection (Service Support Technician, Service Technician, Electrical Repair Technician, Mechanical Repair Technician)	86,520	96,640	108,580	121,100	135,600	152,560
Corrective Maintenance (Troubleshooting Technician, Field Engineer/Technical Support)	8,850	9,820	10,830	11,950	13,140	14,330

Workforce Structure: Technician Responsibility and Job Roles

Wind energy is setting a precedent with its rapid technological evolution and fast deployment. This has been achieved without formal agreements between companies, but it is possible to align definitions of technician roles at a high level[2].

This steady alignment between employers on job roles provides a good foundation to forecast workforce needs at a more granular level, considering technician roles and responsibilities. While companies may use different naming conventions, the purpose of this forecast is not to enforce terminology but to understand the skills and experience levels that will be needed.

[2] Global Wind Organisation Job Roles in Wind (2025, May 23): Mapping career pathways for wind turbine technicians. Global Wind Organisation.

‘Global Wind Organisation’s Job Roles in Wind’ outlines the structure of technician roles and their corresponding experience levels within the wind industry. The research identifies four primary career pathways – Pre-Assembly, Installation, Service, and Blade Repair – which represent the core areas of work for wind turbine technicians. Progression within these pathways is achieved through a combination of education, technical certification, and hands-on field experience[3].

Among the four groups, Service Support Technician and Blade Repair Technician are closely associated with the maintenance sector. Currently, the largest share of the workforce holds technician roles in Assembly (2025–2029). However, this distribution is expected to evolve over time as maintenance demand continues to grow. By 2030, the demand for technicians in Regular Inspection is expected to exceed that for Assembly.

In terms of experience levels, which are considered as a separate layer rather than a secondary attribute of job roles, we foresee growing demand for intermediate to advanced-level technicians, reflecting the sector’s increasing technological complexity and the operational requirements of both onshore and offshore installation.

[3] Global Wind Organisation Job Roles in Wind (2025, May 23): Mapping Career Pathways for Wind Turbine Technicians. Global Wind Organisation.

Chapter 3:
Wind Workforce Development as an Industrial Challenge

Early wind development was led by fully integrated companies handling the entire value chain. They knew the whole value chain and took ownership of the roles and responsibilities that defined a framework for workforce planning. That is no longer the case. The wind energy sector has undergone rapid evolution, both technologically and commercially.

Over the last twenty years, the industry has moved away from a model in which a single company could handle the entire value chain – covering construction, maintenance, and power generation – toward one in which firms increasingly focus on specialised services, supplies, or solutions. Technicians are an essential component in delivering energy transition targets, yet in this context, no single company can take full ownership of addressing the shortage as companies are increasingly focusing on specific segments of the value chain.

Technicians play a vital role in delivering renewable energy projects, which collectively drive progress toward global renewables development and energy transition targets. In public discussions about these targets, much attention is often given to policy frameworks and supply chain challenges. However, one critical aspect is frequently overlooked: the workforce. The availability of skilled workers is, in fact, a fundamental part of the supply chain. Yet, it has not received the same level of recognition or systematic planning.

Through interviews with industry experts, this report identifies how workforce planning and competence management are increasingly acknowledged as key enablers of the energy transition – but the practice is still underdeveloped at any meaningful level.

As wind energy continues to expand rapidly, a clear trend has emerged: companies are becoming increasingly specialised within specific segments of the value chain. For example, in the past, an Original Equipment Manufacturer (OEM) might have acted simultaneously as a power producer, turbine supplier, and constructor.

Today, only a handful of OEMs retain a wind farm development and operation business. The degree of OEM involvement, however, varies by market. In North America and parts of Asia, Engineering, Procurement and Construction(EPC) contractors typically handle installation and project commissioning. In China, asset owners often carry out installation work for their own wind farms and may even procure towers directly from third-party suppliers, leaving OEMs with a limited role in construction.

By contrast, in Western markets, turbine OEM contracts commonly include installation and commissioning services, contributing to higher turbine costs compared to Chinese models. Overall, there is no universal ('one-for-all') approach, but a clear movement toward specialisation and redistribution of project responsibilities across the value chain.

No single entity now holds full responsibility or influence over workforce development and long-term capability building across the entire value chain

This evolution has undoubtedly improved efficiency, as the industry has discovered that specialisation streamlines operations and drives performance. However, it has also created a new challenge: no single entity now holds full responsibility or influence over workforce development and long-term capability building across the entire value chain. This fragmentation raises important questions about how the industry can collectively ensure the availability of a skilled and competent workforce to meet the demands of the accelerating energy transition.

Chapter 4:
Wind Projects Duty Holders and Workforce Planning

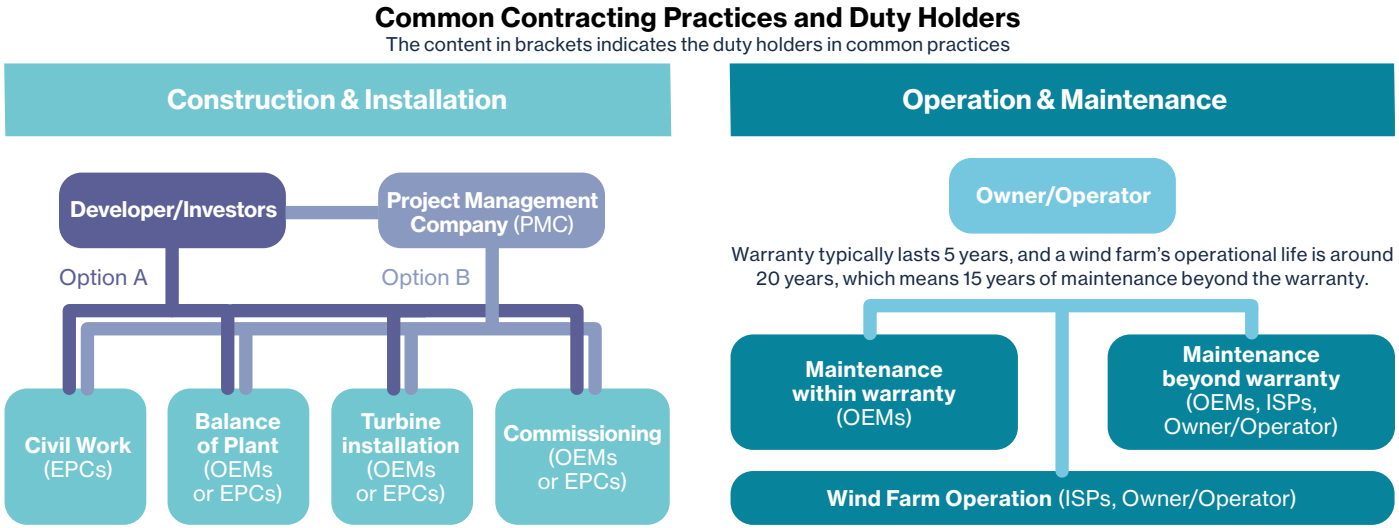
Workforce planning in the wind industry typically reflects where an organisation sits in the project value chain – a pattern that is well understood but often underestimated.

Upstream developers tend to defer workforce planning to partners, especially in onshore wind, and most companies still manage talent needs within discrete functions rather than enterprise-wide.

In contrast, O&M has developed more sophisticated and broadly adopted workforce planning practices, driven by its strategic importance and long-term labour demands.

This uneven maturity underscores the central challenge: organisations are expanding faster than their workforce strategies, creating operational, financial, and competitive risks that can no longer be treated as routine.

Figure 5: Wind Project- Project Lifecycle, Major Tasks and Contracting Practices



In the Construction & Installation phase, it is common for Developer/Investors to use multi-contract approach. A contract for turbine supply, and its installation, depends on region, and is either handled by OEMs or EPCs.

Developer/Investors may also choose to contract with a project management consultancy, which creates a single point of responsibility.

Separate contracts will be signed for civil works (foundations, roads) and electrical balance of plant (eBoP).

In some cases, EPCs may take on project design responsibilities, extending their value chain by stepping into Project Management Company (PMC) roles and contracting directly with OEMs as turbine suppliers. These are exceptional scenarios, not the standard practice.

After commissioning, the developer hands over the completed project to the Owner/Operator.

The operation of a wind farm is typically carried out by the party responsible for running the asset, typically the operator or owner, and is independent of warranty.

Wind farm maintenance depends on its warranty status during the warranty period. The OEM usually performance maintenance, while after the warranty expires, maintenance can be handled by any contracted party- OEM in-house teams, Independent Service Providers (ISPs), or the operator's own maintenance team, depending on winning the bid.

SCADA systems often give OEMs significant influence over operations and maintenance, even beyond the warranty period.

In a wind energy project, the developer (often the investor) is the driving force behind the project, responsible for securing land rights, obtaining government permits, conducting feasibility studies, and arranging financing. Developers also negotiate the Power Purchase Agreement (PPA) and, after construction, may either operate the wind farm themselves or sell it to another owner.

Sometimes, developers manage all contracts directly – including those with turbine suppliers and construction contractors – but they may also appoint a PMC to oversee the project and act as a single point of responsibility.

The civil works company begins the physical construction phase, carrying out activities such as building access roads, laying turbine foundations, and preparing logistics and accommodation facilities. After this, the turbine supplier delivers and installs the wind turbines; their engineers often supervise installation and commissioning to ensure technical compliance. The Electrical Balance of Plant (eBoP) contractor connects the turbines to the substation, handling internal cabling, switchgear, and grid connection works. Some Engineering, Procurement, and Construction (EPC) contractors have the capacity to perform both civil and eBoP scopes. Once construction is complete, the wind farm Owner/Operator becomes the power producer, selling the generated electricity to the grid. To maintain high availability and minimise downtime, O&M are handled either by the owner's in-house team or by ISPs.

When reading the chart, it can be understood as a workflow showing how responsibility flows from project development through construction to operation – starting with the developer (project initiation and contracting), moving through PMC, civil works, turbine supplier, and eBoP during the construction phase, and finally ending with the Owner/Operator responsible for long-term operation and maintenance.

Workforce Planning and Competence Management

Workforce planning is the process of understanding prospective workload requirements and applying this knowledge to inform staffing needs. Throughout the process, workload estimation is essential. In the wind energy sector, workforce planning for wind technician[3] roles involves estimating installation and maintenance workloads specific to wind turbines, while considering critical factors such as technician availability, skills and competence assessments and their alignment with future business goals or technology advancements.

This report finds that investors and developers, who operate in the upstream segment, often delegate workforce planning to their partners, a pattern that is particularly pronounced in onshore wind. Onshore projects are typically smaller and dispersed across multiple sites, making direct management of technical staff challenging. Developers focus on securing approvals and financing, defining workforce eligibility requirements while relying on specialised contractors and service providers for implementation and execution. This approach is reinforced by the established contracting tradition in onshore wind, where a well-developed network of ISPs handle installation, maintenance, and operations, providing flexible, site-specific workforce solutions. This allows developers to concentrate on their core strategic activities.

A similar pattern exists in the offshore segment, where it is rare for a single company to manage the entire value chain, from approvals to operating the asset. Projects can still run smoothly even when developers are not directly involved in technical execution. However, in offshore wind, there is often a closer connection – or overlap – between the roles of OEMs and turbine installers.

Input for this chapter has been collected from a range of companies, including turbine manufacturers, service providers,

[3] A wind turbine technician is a broad term for professionals who are responsible for assembling, installing, inspecting, servicing, maintaining, operating and repairing wind turbines. Global Wind Organisation. (2025, May 23). Job roles in wind: Mapping career pathways for wind turbine technicians. Global Wind Organisation.

Figure 6: Presence of Workforce Planning and Competence Management

The color coding has three levels, from lightest to darkest: Ad hoc ■ , Medium ■ and Integrated ■ . Users can find the detailed definitions in Chapter 7, Methodology.

	Construction & Installation			Operation & Maintenance			
	Investor/Developer	**EPC** (civil work, logistics)	**EPC** (installation and balance of plant & commissioning)	**OEM** (installation and balance of plant & commissioning)	**OEM** owner/operator service function	**ISPs**	**Third-Party Recruiting**
as a **strategic planning process**			The contracted work and projected income for the next 1–2 years are used to guide technician training and recruitment planning.	is strongly embedded at the strategic level. OEMs benefit from robust internal resource pools, which allows them to align their workforce and competencies with the turbine technology roadmap, upcoming project pipelines, and the needs of the maintenance and service function.		ISPs demonstrate a high level of workforce planning. They expect their technicians to have well-rounded skills and experience with as many different turbine models as possible, to be able to solve issues effectively. Technicians from ISPs are often required for major maintenance and troubleshooting tasks, which often require senior expertise. ISPs that sign long-term service contracts will have a strong understanding of capacity management as well.	The transactional recruiting service company actively maintains and manages technician competence, invests in programmes to attract new entrants to the industry, and innovatively integrates their data – CRM and competence management systems – to predict regional technician shortages.
as a **competence management process**		Workforce planning is conducted on an ad hoc basis to support project scheduling and resource allocation. The process also supports the training and retention of experienced technicians, ensuring that skilled personnel are available for complex lifting, transport, and assembly operations across multiple projects.	With the expansion of construction demand, some EPCs have established task–skill–technician competence management systems and have begun investing in in-house training capacity.	OEMs have established task–skill–technician competence management systems and have long histories investing in in-house training capacity.	OEM's in-house maintenance function has a long history of skill development and strong technician competence. Also, when it comes to developing the workforce for the industry, we observe many technical and commercial leaders at EPC companies who have earlier careers in OEMs and asset owners' service teams.		
as a **project management process**	Aside from a small number of offshore developers who have an established process, most implement it to meet compliance requirements, verifying contractor eligibility. Local workforce readiness is rarely considered during the Final Investment Decision (FID) stage, which occurs before contracts with construction partners are signed.		Regular workforce planning is carried out to maintain alignment between staffing levels and project timelines.	At the project management level, workforce planning in OEM installation and commissioning tends to be ad hoc and reactive. This is due to the high degree of subcontracting in project execution (onshore), where the OEM often provides key specialists rather than full installation teams. As a result, OEMs frequently operate in a Technical Advisor (TA) role, working closely with EPC contractors who supply the majority of on-site labour.	Close collaboration between the OEM and the Operator's in-house maintenance function in the area of maintenance is observed. The maintenance function also has a solid understanding of the turbine's technical requirements and often takes an advisory role in manpower planning for maintenance projects.		

and project developers, to understand how workforce planning is positioned across different segments of the wind project development value chain.

See the detailed definitions in Chapter 6, Methodology

The findings indicate that workforce planning practices tend to be function-dependent rather than organisation-wide. Moreover, the process is most developed within the maintenance sector, both in terms of its breadth of application and its level of **priority** within organisations. This is due to the critical nature of maintenance activities, which require a higher level of technical skill – such as troubleshooting and system diagnostics – and are typically carried out by full-time employees under long-term contracts. As a result, maintenance workforce planning tends to be more structured and strategically integrated compared to other functions.

Case study

Building the global workforce pipelines needed for 2030

Around the world, wind developers, OEMs and service providers face a shared challenge. Projects cannot move at the speed required because there are not enough skilled people to deliver construction and installation peaks or to maintain the global turbine fleet. Markets differ, but the impact is the same. Delays increase, costs rise and assets struggle to reach availability levels expected by governments and investors. Talent has become a structural constraint on global wind growth, and solving it requires coordinated solutions that place workforce development at the centre of the energy transition.

Global Workforce Pressures Across Key Regions

Workforce pressures appear differently across global regions. The United States faces union and non-union dynamics that influence access to experienced crews. Europe competes with oil and gas for technical talent. APAC markets face visa and mobility bottlenecks that restrict deployment. Latin America shows strong potential but limited readiness in places such as Brazil. South Africa and Vietnam highlight the gap between talent availability and structured entry pathways.

A Global Workforce Partner Across the Full Project Lifecycle

Atlas NextWave supports workforce needs from early development through construction, operations, maintenance and decommissioning. Our approach combines structured entry pathways, competency development, harmonised standards and compliant international mobility. This creates transportable talent pipelines across multiple regions, securing essential skills, stabilising schedules and reducing workforce related risk across the lifecycle.

Greenhands Offshore as a Proven Entry Pathway

Many regions have strong talent potential but limited access to structured entry routes. Greenhands Offshore fills this gap. It is an accelerated program that prepares new talent for offshore work within weeks. The initiative is active in Europe, Latin America and Africa and consistently delivers job ready personnel for construction and maintenance activities. Greenhands Offshore shows that effective pipelines can be created quickly when industry, training centres and local authorities collaborate, particularly in emerging markets where demand is rising rapidly.

Solving the Mobility Challenge Through Compliance and Coordination

Many markets still require experienced personnel from abroad during installation peaks or for advanced roles. Cross border deployment remains one of the most complex challenges in wind. It requires deep understanding of immigration, labour legislation, maritime rules and insurance. Atlas NextWave manages these elements in a fully compliant manner, enabling safe and timely deployment and reducing project risk throughout the lifecycle.

A Coordinated Global Ecosystem for the Energy Transition

Atlas NextWave works with governments, regulators, training organisations and industry partners to expand workforce capacity in emerging regions and to support consistent competency standards. The wind sector can meet its 2030 goals, but only if high volume global talent pipelines are developed at pace. We are dedicated to helping build these pipelines and ensuring that the workforce is never the reason a project cannot proceed.

Chapter 5:
Energy Transition and Workforce Readiness

Workforce development to support the energy transition is increasingly a priority at the macro level. However, to establish clear targets and actionable plans, the public sector needs stronger signals from investors to inform its actions. This analysis indicates that workforce planning within the private sector will provide a crucial foundation for public-sector efforts to prepare the workforce for the energy transition. Development of large-scale energy assets requires support not only in terms of physical infrastructure, but also in terms of human capital.

While effective workforce development depends on collaboration between public sector agencies and investors, the qualitative analysis from subject matter expert interviews in this report suggest that the primary responsibilities for workforce assessment, capacity building, and monitoring lie with public sector bodies. At the same time, defining workforce requirements and leading stakeholder engagement are roles best driven by investors and asset owners.

The energy transition is part of a wider industrial shift towards electrification. Policymakers are attempting to bridge massive demand increases with competing societal challenges of job creation, sustainable energy development, and the protection of people's livelihoods.

Over the years, it has become clear that the workforce supporting this growth is in short supply. Talent migrating from adjacent sectors such as oil and gas – particularly younger professionals – represents a crucial source for bridging the wind sector's workforce gap. When we talk about workforce development in wind, a key question arises: to what extent is workforce readiness considered in public policy, or industrial strategy, and how much is it factored into investors' decisions? According to IRENA, fewer than 12% of Nationally Determined Contributions (NDCs) explicitly mention education and skills related to energy or low-carbon development. Although many countries may be pursuing skills initiatives outside their NDC frameworks, the small proportion that set explicit targets indicates that human capital needs are still not being fully integrated into national energy transition strategies[5].

In terms of the industrial agenda, major conferences and exhibitions tend to concentrate on the earlier stages of the value chain – such as technology development, component design, and manufacturing. However, meaningful discussion of workforce development and skills preparedness is conspicuous by its absence. Findings from this report show that local workforce readiness is generally not considered during a project's Final Investment Decision (FID) stage, which happens before contracts with construction partners are signed.

In some high-profile projects, however, workforce readiness is increasingly being integrated into early planning, sometimes through feasibility studies or Corporate Social Responsibility (CSR) initiatives – demonstrating growing recognition of its value in project success.

Projects such as Vineyard Wind 1 (USA), Dogger Bank Wind Farm (UK), Empire Wind and Beacon Wind (USA), Star of the South (Australia), and Horns Rev 3 (Denmark) have incorporated workforce planning during feasibility studies or prior to final investment decisions. These initiatives often involve partnerships with local training institutions, vocational programs, and community organisations, reflecting a recognition that skilled local labour is critical to project success.

[5] IRENA, COP28, COP29, GRA, MoEA and Government of Brazil (2024), Delivering on the UAE Consensus: Tracking progress toward tripling renewable energy capacity and doubling energy efficiency by 2030, International Renewable Energy Agency, COP28 Presidency, COP29 Presidency, Ministry of Energy of the Republic of Azerbaijan, and Government of Brazil, Abu Dhabi.

This trend is particularly evident in the offshore segment, where authorities and national wind industry associations play an influential role in project approvals and emphasise local economic benefits and community retention. When attracting investment in the energy transition, factors such as job creation and public infrastructure development are carefully considered.

This report finds that collaboration between public agencies and investors in assessing local workforce readiness is an effective approach to project planning. This process involves examining the region's industrial background and identifying transferable skills within the local workforce. In many contemporary governance models, the public sector tends to be less interventive for economic efficiency and lacks detailed, up-to-date knowledge of industry trends, technologies, and workforce needs. In this context, such collaboration offers several benefits: it enhances public communication and provides a deeper understanding of workforce characteristics, including age and gender distribution.

These insights bring greater clarity to project planning and help investors make informed decisions, such as whether alternative solutions are needed when certain technical roles are not available locally. They also guide strategies for knowledge transfer between technicians relocated from abroad and local workers – ensuring that long-term project maintenance and social benefits are sustained within the community.

Key Actions to Improve Workforce Preparedness

Local authorities and investors in many regions have begun jointly analysing workforce preparedness as part of project and investment planning. For example, CanREA's National Workforce Development Strategy[6] in Canada, Ireland's Building Our Potential: Offshore Wind Skills and Talent Needs[7], and the workforce transition research in Victoria, Australia[8] all illustrate how closer partnerships between developers and local communities can enable more systematic evaluations of regional industry capacity and transferable skills.

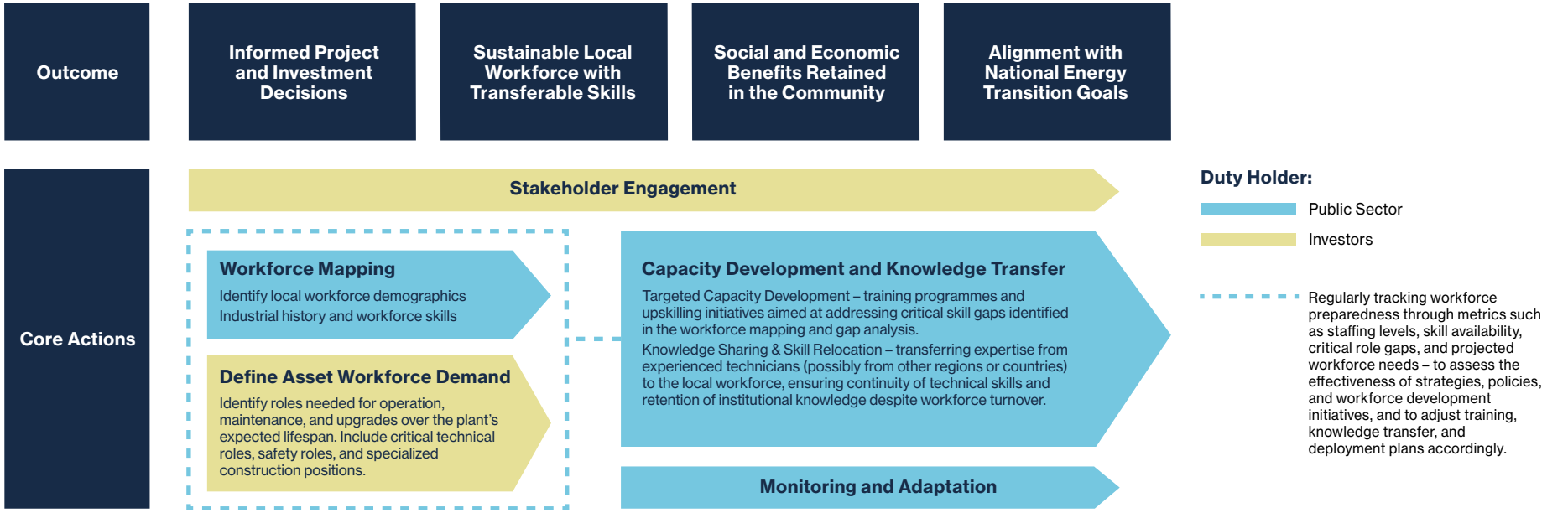
In these examples, closer partnerships between developers and local communities have supported more systematic assessments of regional industry capacity and transferable skills.

Following these examples, the Global Wind Workforce Outlook has identified five core actions that are essential for ensuring local workforce readiness to support project development and long-term asset management: **Stakeholder Engagement; Workforce Mapping; Define Asset Workforce Demand; Capacity Development and Knowledge Transfer;** and **Monitoring and Adaptation**. For each action, while recognising that all tasks require collaboration between the public sector[9] and investors, the Outlook also identifies the most responsible party. The role of the duty holder is assigned by considering long-term operational needs, knowledge ownership, and sustainable community benefits. Tasks such as workforce assessment, capacity development, and monitoring are better led by the public sector, while defining workforce requirements and stakeholder engagement are best driven by investors or asset owners.

This report presents this collaboration model (on the following page) as a useful example of how workforce-related considerations are embedded throughout the project lifecycle – from feasibility to operation and maintenance.

[6] Canadian Renewable Energy Association. (2023, April). CanREA's National Workforce Strategy for the wind, solar and energy storage industries (April 2023 Edition). Canadian Renewable Energy Association.
[7] BVG Associates, Green Tech Skillnet & Wind Energy Ireland. (2024, January). Building Our Potential: Ireland's Offshore Wind Skills and Talent Needs. Wind Energy Ireland.
[8] EnergyAustralia. (2023, December). Transition Opportunities: Coal to Offshore Wind. Energy Australia.
[9] Public Sector: The segment of the economy and governance that is controlled, funded, or regulated by government entities at the local, regional, or national level. This includes agencies, departments, and organizations responsible for policy-making, planning, regulation, and public services.

Figure 7: Local Workforce Readiness Assessment and Development



This approach can inform the design of national energy transition roadmaps, enabling countries to set clear workforce development targets as part of their renewable energy and industrial strategies, develop detailed national programmes and action plans to upgrade education and transition support systems to channel and train enough professionals for industry needs.

Public Sector Considerations

Local government branches will play an important role in understanding workforce readiness to support both project development and long-term asset management. An effective assessment could examine the availability, skills, and capacity of the local workforce, particularly for critical roles in maintenance sector.

As wind energy develops rapidly, the public sector may experience challenges to respond in time to workforce demands during project development, which can lead investors to source labour externally.

Workforce Assessment

By proactively assessing and developing the local workforce, however, communities can capture long-term benefits, including job creation and sustained value through ongoing maintenance and operations.

Typically, a combination of sources can be used to gain a comprehensive view of the local workforce. National or regional labour statistics, industry reports, and data from vocational and training institutions can provide insights into workforce demographics, skill levels, and emerging talent. Information from employers, unions, and industry associations can further highlight workforce availability, existing gaps, and potential training needs.

Capacity Development

Once workforce readiness has been assessed, capacity development becomes a critical focus to ensure the long-term sustainability of skills and job creation. While governments often prioritise investment in transferable skills – those that can be applied across industries – there is also a strong case for committing to wind-specific training.

Investing in wind-specific skills reduces reliance on external labour and ensures that the local workforce is prepared for the unique technical requirements of the asset. This is not intended to suggest that immigration is unwelcome – labour mobility and international recruitment have long contributed to energy development worldwide. For example, Indian workers are active in the Middle East, Brazilians across the Americas, and Filipino and Japanese technicians across the APEC region, often sharing training facilities with skilled professionals in Italy, the Netherlands, and France. Such movements help fill immediate workforce needs and enable knowledge exchange across regions.

However, while this mobility is valuable in the short term, it cannot fully meet the long-term operational and maintenance needs of local assets, also, it may conflict with the goal of maximising local economic benefits from the energy transition. Wind farms typically have a lifespan of around 20 years, during which ongoing maintenance requires a stable, locally available workforce.

Relying on technicians from abroad is often economically inefficient and may be constrained by immigration policies, while also limiting the potential for local economic benefits and community engagement from the energy transition.

Based on interviews with industry experts, The Global Wind Workforce Outlook finds that transactional recruiting services have historically served to fill immediate gaps. Transactional recruiting can help fill positions for senior technicians or technical advisors that are otherwise difficult to hire locally. However, the study finds that they are limited in the number of personnel they can recruit. Continuity and retaining critical knowledge within regional projects is a remaining issue for the local community.

Chapter 6:
Country Commentaries

This chapter provides an analysis of energy policy and workforce development initiatives across six key markets – United States, India, Brazil, Germany, France, and Australia – each characterized by distinct workforce demand conditions.

In the United States, rapid onshore expansion is driving strong demand across construction, installation, and operations and maintenance. Even when offshore wind development is uncertain – the anticipation of future projects creates preparatory demand. India's accelerating deployment requires a significant scale-up of training infrastructure to meet workforce needs, while Brazil faces growing O&M demand alongside the need for upskilling to support turbine modernization. Germany and France, as mature markets, are contending with aging workforces and increasing O&M requirements. Australia, meanwhile, is experiencing fast onshore growth coupled with acute shortages in electrical and mechanical skills, as well as a long-term offshore pipeline that demands extensive planning.

Although many of these countries have outlined offshore wind development plans, substantial progress is not expected until after 2030. To provide a more comprehensive and objective perspective, this chapter extends workforce forecasts through 2030-2035, delivering a long-term outlook on demand across both onshore and offshore sectors. Detailed projections are presented in the dedicated section for each country.

USA

Windy Flats Wind Farm, Goldendale, WA, USA

As the world's second largest wind market, the USA exceeded 154 GW of total onshore wind installations by the end of 2024. Despite a robust project pipeline, new onshore wind installations in the US dropped sharply in 2024, with less than 4 GW commissioned – the lowest level since 2014. The low levels were due to market saturation in certain areas and delays caused by siting, permitting, supply chain constraints, inflation, and political instability.

According to the American Clean Power Association (ACP), nearly 16 GW of onshore wind was under construction and 9.3 GW in advanced development across 79 projects as of Q4 2024. However, policy changes made under the new Administration have hit the industry very hard. The rollback of the Inflation Reduction Act (IRA) through the One Big Beautiful Bill Act (OBBB) has reshaped America's energy landscape by accelerating the phase-out of tax credits for wind and other clean technologies.

Although the final guidance on the safe harbor window is positive and provides the runway for project execution through nearly the end of 2030, the continued ambiguity surrounding permits and tariffs as well as the upcoming guidance on Foreign Entity of Concern (FEOC) rules to wind projects have resulted in a 30% downgrade for US onshore wind projection in 2025-2030 compared with GWEC Market Intelligence's Q1 2025 Outlook.

In offshore wind, the country is facing a combination of a vulnerable local supply chain and macroeconomic challenges, which has already created a 'perfect storm' for offshore wind before the new government re-entered power in January 2025.

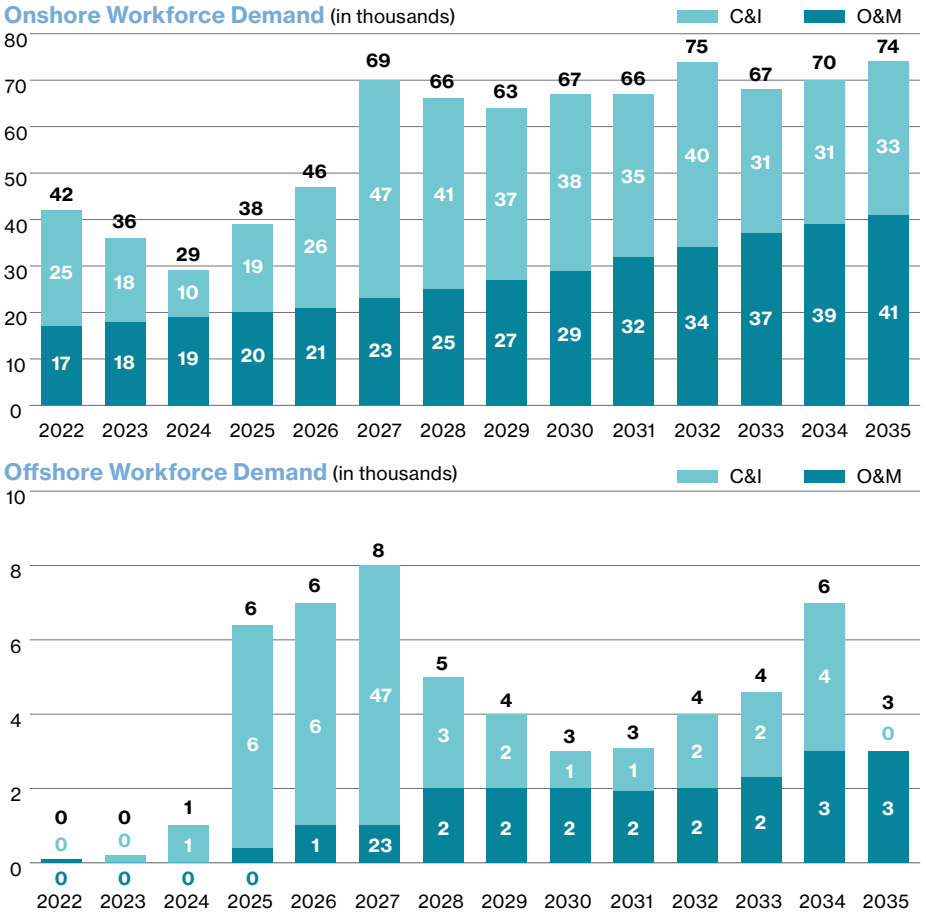
By January 2024, 13 fixed-bottom offshore wind projects off the East Coast totalling nearly 12 GW were affected, with nine projects, totalling 7.7 GW, having their offtake agreements terminated or being cancelled entirely. The current government's Executive Order to temporarily withdraw all offshore wind energy leasing within the Outer Continental Shelf (OCS) will stop new offshore wind project development off the US coast.

To compound matters, the threat of revocation hangs over project permits already awarded under the previous administration, as in the case of the Atlantic Shores South offshore wind project, the Empire 1 offshore wind project (for which the stop-work order was lifted in May), the Revolution Wind (for which the stop-work order was lifted in September) and recently Maryland offshore wind project and New England Wind 1 and 2 wind projects.

The industry is also suffering from the effects of the tariffs that the current presidential regime has been imposing on imports of goods from both allies and adversaries. Following the current policy situation, GWEC Market Intelligence believes that only five projects, totalling 5,784 MW, are likely to be commissioned in the next five years. Those five projects are Vineyard 1, Revolution Wind, Coastal Virginia Offshore Wind, Empire 1 and Sunrise.

The turmoil in the offshore wind sector has already had significant labour implications. According to analysis by the Center for American Progress, more than 17,000 jobs in US offshore wind development are linked to projects that have been cancelled, paused, or placed under serious risk. These include more than 12,000 direct jobs and some 5,000 indirect jobs across construction, port infrastructure, manufacturing, and supply chain activities[10].

Figure 8: USA C&I and O&M Workforce Demand



Source: GWEC

[10] Center for American Progress. (2025, July 24). The Trump administration and Congress' attacks on wind power are killing thousands of jobs and risk thousands more.

For instance, the cancellation of federal funding and the freezing of project approvals have jeopardised thousands of construction- and operations-stage roles at domestic port and vessel facilities, as detailed by unions which reported hundreds of positions lost when offshore wind projects were terminated.

Workforce Expansion

Nevertheless, the wind workforce in the United States will continue expanding. The US Bureau of Labor Statistics projects job growth of more than 50% through 2034[11]. To support workforce development and training, key initiatives include New Jersey's Wind Institute for Innovation and Training, New York's Offshore Wind Training Institute (led by SUNY and Stony Brook University), and the Massachusetts Clean Energy Center's Offshore Wind Works programme, as well as the Offshore Wind Workforce Education and Training Database to broaden training access.

These efforts are complemented by initiatives from the National Renewable Energy Laboratory (NREL), which focus on skills of pathway development and strengthening collaboration between industry and academic institutions. While such programmes enhance long-term labour availability, short-term policy uncertainty still poses risks to job continuity and workforce retention, particularly in offshore wind where project delays may reduce near-term workforce demand.

Based on our latest growth projection for the US wind market, we believe that annual workforce demand for onshore wind is expected to stay within the range of 63,000-75,000 in the next ten years. For offshore wind, demand will scale gradually, averaging around 4,000 technicians per year over the next decade as commercial projects advance.

[11] Bureau of Labor Statistics. (2025). Occupational employment projections data. (Data analysis and processing by USAFacts). U.S. Department of Labor. https://www.bls.gov/emp/data/occupational-data.htm.

Brazil

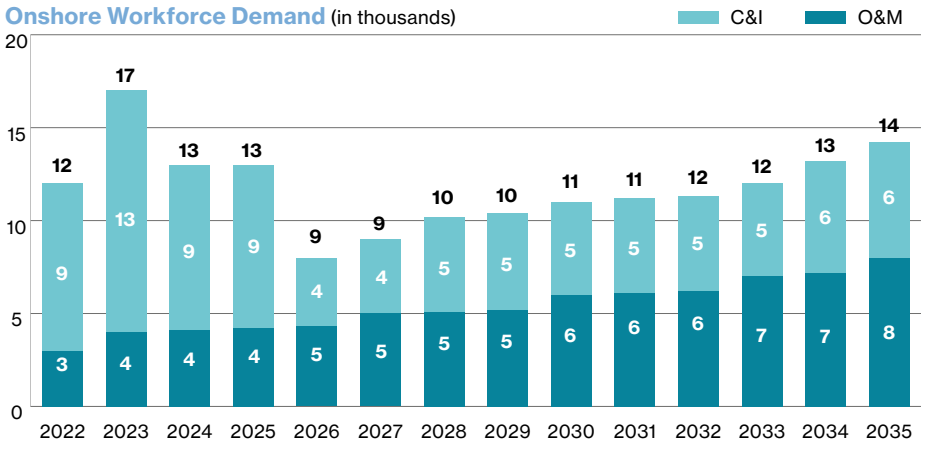
Rosa Dos Ventos, Aracati, Ceará, Brazil

Thanks to the strong growth momentum driven by private PPAs, Brazil accounted for two-thirds of the capacity added in this region over the past four years, making it the largest wind market in this region. However, growth slowed down in 2024 with annual installations expected to drop continuously in the next 2-3 years. In addition to lower-than-expected electricity demand and missing demand from regulated new energy auctions, curtailment remains a critical local challenge.

Despite challenges remaining for the wind industry in the short term, recent government projections present a more optimistic outlook in the medium and long-term. By the end of 2024, the country had 33.7 GW of wind capacity installed across 1,103 wind farms comprising 11,720 turbines. GWEC Market Intelligence believes that Brazil will continue to strengthen its leadership in the LAC region with its total onshore wind expected to be doubled by 2035, making wind energy as a pillar of national decarbonisation and industrial strategy.

While there are no offshore wind projects in this country, the recent passage of the Offshore Wind Law (Law 15.097/2025) has laid the legal framework for offshore wind development in the country. Based on the latest status of offshore wind development as well as our stakeholder consultation, GWEC Market Intelligence believes that offshore wind development in Brazil will gain traction from the beginning of 2030s although a small-scale demonstration project is likely to be built before the end of this decade. Leveraging decades of leadership in offshore oil and gas, Brazil enters the offshore wind era with pre-existing advantages in specialized vessels, advanced subsea and engineering expertise, robust environmental-assessment capabilities, and strategically located port infrastructure across the South, Southeast, and Northeast regions. Free-trade-zone incentives and export-financing frameworks further enhance the competitiveness of domestic manufacturing, enabling supply-chain integration and future participation in international offshore wind markets.

Figure 9: Brazil C&I and O&M Workforce Demand



Source: GWEC

This market shift directly intersects with Brazil's workforce priorities. As the wind sector evolves from primarily onshore deployment to offshore-enabled industrialization, targeted skills development is accelerating to ensure national readiness. SENAI and CTGAS-ER are leading dedicated offshore training programs – including technician education and GWO aligned safety qualifications – to prepare thousands of workers for construction, installation, and O&M activities across coastal regions[12].

Regional innovation ecosystems are strengthening this momentum. Research institutions such as COPPE/UFRJ and the Offshore Technology Innovation Centre (OTIC/USP), along with innovation hubs like Verde Hub and InnovaPower, are advancing technology in floating foundations, transmission infrastructure, advanced materials, and digital monitoring systems, contributing to a more competitive industry and supporting the creation of high-value technical roles.

[12] Buljan, A. (2025, August 14). Brazil launches offshore wind training to power future workforce. OffshoreWIND.biz.

The workforce dimension remains critical to delivering Brazil's socioeconomic ambitions. Upskilling and reskilling programs are essential for workers transitioning from fossil-fuel industries, creating an inclusive shift that protects livelihoods while building a future-ready clean-energy labour market. Strengthened coordination between federal and state governments, industry stakeholders, universities and regional training centres will be central to ensuring accessible pathways into wind careers while aligning technical education with sector needs.

Workforce trends reflect new installations and emerging opportunities. Total wind workforce employment increased from 12,013 workers in 2022 to 16,686 in 2023 before moderating to 12,857 in 2024 as the market adjusted to the wind commissioning projects. Workforce demand is projected to remain stable at 12,827 in 2025, followed by a decline to 8,582 in 2026 and 9,208 in 2027 due to weaker onshore wind construction activity. Gradual recovery is expected from 2028 onward, with demand growing to 9,767 workers in 2028, 10,169 in 2029 and 10,622 in 2030 as onshore projects increase. Stronger expansion resumes in preparation for Brazil's first commercial offshore wind projects in the early 2030s, driving projected workforce demand to 11,139 in 2031, 11,590 in 2032, 12,041 in 2033, 12,782 in 2034 and 13,552 workers by 2035. These projections highlight the growing importance of timely skills planning, logistics, readiness and talent diversification as offshore wind accelerates. Also, there are 31 GWO certified training centres active at the end of 2024, up from two in 2018.

Brazil's wind trajectory also aligns with global climate and sustainability ambition. COP30 – taking place in Belém in 2025 is focusing on nature conservation, ecosystem restoration and the effective implementation of mitigation commitments, placing country at the centre of global climate conversations. This international spotlight reinforces the urgency of rapid renewable expansion and a just transition in regions long tied to fossil fuel activities. By proactively advancing workforce development, Brazil can capture the socioeconomic benefits of wind deployment while supporting national sustainability outcomes.

Australia

Albany Wind Farm, Western Australia

Australia is the largest wind market in Pacific region with more than 12 GW of installed wind power capacity by the end of 2024. Wind power – all of it onshore – provided 13.4% of Australia's total electricity generation in 2024, making it the single-largest renewable technology in this country.

2024 saw seven onshore wind farms, totalling 836 MW, commissioned. After a particularly poor 2023 for Australia, with no new financial commitments to utility-scale wind projects, onshore wind bounced back in 2024 with a total of 2,218 MW reached financial commitment. According to the Clean Energy Council's quarterly investment report, 19 onshore wind projects worth 5.8 GW were either under construction or committed at the end of 2024. To meet the federal government's target of 82% renewables by 2030, Federal and state governments have worked to streamline assessment processes and reduce commercial risks for clean energy investment through the expanded Capacity Investment Scheme. This competitive tendering programme will provide revenue underwriting for 23 GW of new large-scale generation and 9 GW of dispatchable capacity by 2027, supporting investor confidence.

Despite the strong policy support, no onshore wind projects were financed in the first half of 2025 due to permitting, grid and social licensing issues.

In 2024, the Australian offshore wind industry saw significant developments in Victoria. Following 12 GW of feasibility licences awarded in 2023 for six projects in Gippsland, a further six licences were granted in July 2024, bringing total licensed capacity in the area to 25 GW. Additionally, Victoria legislated its 2GW by 2032, 4GW by 2035 and 9 GW by 2040 offshore wind target under the Climate Change and Energy Legislation Amendment (Renewable Energy and Storage Targets) Act 2024 in March, making it the only government in Australia with an offshore wind target.

Although Australia's state of Victoria has delayed its inaugural offshore wind auction which was set to commence in September, VicGrid, an agency of the Victorian government, has recently narrowed down preferred rout and shortlisted three consortia for the development of the transmission infrastructure that will connect the first 2 GW of offshore wind generation to the grid.

The Clean Energy Council highlights that Australia's offshore wind industry could create significant employment opportunities, especially in regions affected by the coal transition. An estimated 4,000 construction jobs, 500 long-term O&M roles, and 3,500 indirect jobs could be generated through manufacturing[14].

Building the required domestic supply chain will demand rapid workforce development. Industry feedback indicates that 3-10 years are needed to upscale a workforce. By 2030, Australia will require around 85,000 additional workers to build and operate renewable energy infrastructure, underscoring the urgency for action.

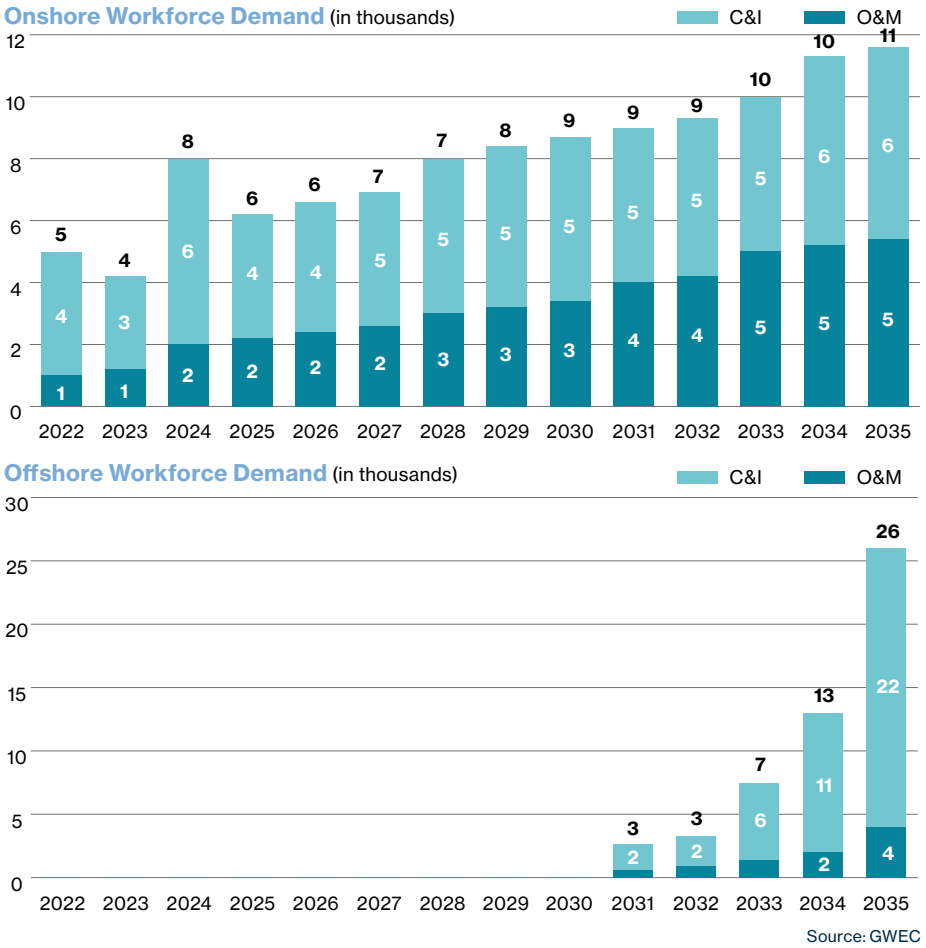
A coordinated national workforce strategy – aligned with federal initiatives such as the National Energy Workforce Strategy and state programs like Victoria's Clean Economy Workforce Development Strategy and the Local Jobs First Act 2003 – will be key. Industry can also leverage investment and training support through Future Made in Australia, the Australian Renewable Energy Agency, and the National Reconstruction Facility.

However, there are skills shortage challenges in Australia. If unaddressed, the industry's growing project pipeline will exacerbate these pressures. The Powering Skills Organisation, a government-established jobs and skills commission, highlighted that the country is facing a projected shortfall of about 42,000 clean-energy workers by 2030[15]. Despite workforce improvements in 2024, large gaps persist in technician roles critical for wind and transmission projects. The shortfall threatens timely delivery of major projects and may raise costs or lead to commissioning delays.

[14] Clean Energy Council. (2025, March). Winds of opportunity: Powering Australia's clean energy future with offshore wind (Short report).

[15] Powering Skills Organisation. (2025). Workforce plan 2025: High load, short supply, bridging the gap to 2030.

Figure 10: Australia C&I and O&M Workforce Demand



Source: GWEC

Recognition of this challenge is also occurring at the state scale. Queensland's Energy and Jobs Plan will legislate renewable energy targets and define a pathway to deliver 22 GW of new wind projects by 2035. According to the Queensland authorities, this will support 64,000 direct and indirect jobs in construction and operations and maintenance, and 36,000 jobs in the supply chain[16].

To support workforce development in the country, Ocean Winds (OW) & Federation University have also formed a partnership to develop the offshore wind workforce in the Gippsland region. The partnership will focus on skills, training, and professional development for the emerging offshore wind sector. RIGCOM Training Facilities (part of GEV group) providing courses on Provides specialized blade maintenance and repair. fully accredited by the Global Wind Organisation (GWO). Focus on blade inspection/repair technicians in Australia.

The number of active GWO certified training centres in Australia also grew significantly from two in 2018 to 15 in 2024, successfully addressing the training needs of a rapidly growing wind workforce.

The scale and pace of workforce change required for 2030 is urgent for Australia's clean energy growth and requires coordinated reforms. Without this, onshore wind-specific workforce requirements in the next ten years will be relatively low. This forecast, which focuses solely on the annual direct technician demand for C&I and O&M projects, estimates a need for 7,000 to 9,000 full-time equivalents (FTE) per year. This steady demand comes primarily from onshore wind projects, as no offshore project is likely to be online until the early 2030s.

[16] Clean Energy Council. (2023, June 22). Queensland Energy and Jobs Plan – The update.

India

Kanyakumari, Tamil Nadu, India

India is one of the world's leading and fastest-growing wind energy markets, supported by a strong domestic manufacturing base and the country's broader ambition to pursue a clean, secure, and affordable energy transition. With 3.4 GW of new wind capacity added in 2024, the highest since 2017, India's operational wind capacity has now reached around 53 GW, reinforcing its position as the fourth-largest wind market globally. Looking ahead to 2030, India aims to significantly scale its non-fossil fuel capacity to 500 GW, and wind will remain central to achieving that goal.

GWEC Market Intelligence expects that more than 40 GW of wind capacity is expected to be added over the next five years depending on policy implementation, investment flow, and grid readiness. This expansion is directly linked to continued growth in wind workforce demand across a wide spectrum of engineering, manufacturing, construction, and long-term service roles. India's wind workforce spans activities including wind resource assessment, land acquisition and permits, wind turbine and component manufacturing, logistics, EPC, commissioning, and operations and maintenance (O&M).

Workforce projections highlight a steady rise in jobs driven by increased onshore deployment and cumulative O&M requirements. Based on the latest workforce demand, total employment in the wind sector rose from 15,643 workers in 2023 to 16,997 in 2024, and is estimated to reach 19,060 in 2025, reflecting increased site activity associated with new installations. Demand is forecast to grow further to 20,988 workers in 2026, 21,392 in 2027, and 22,694 in 2028, before climbing to 24,231 in 2029. In the early 2030s, workforce needs expand more rapidly as both operational capacity and repowering activities accelerate, with projections of 32,439 workers in 2030, 35,471 in 2031, 36,847 in 2032, 38,525 in 2033, 41,017 in 2034, and more than 41,000 workers by 2035 depending on the volume of construction and commissioning activity.

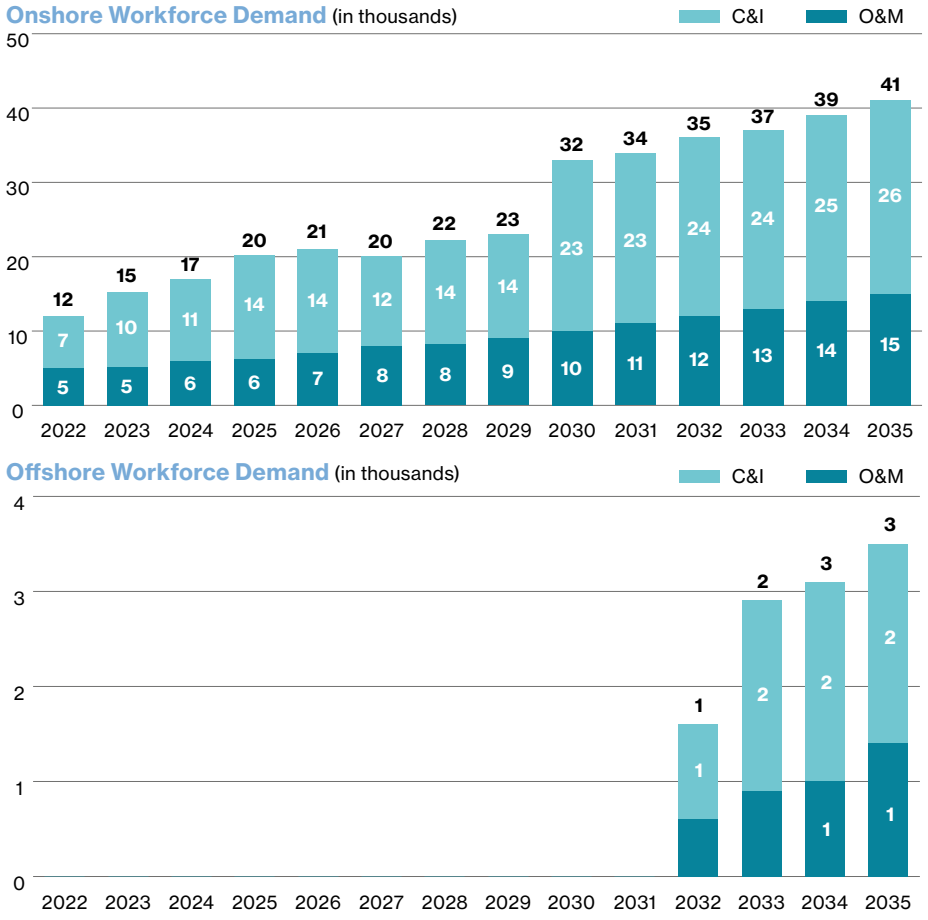
This reflects over 2.5 times workforce growth between 2023 and 2035. The successful allocation of offshore wind tenders by the government in the coming years will unlock a new offshore wind market in India. However, challenges need to be solved including the need to establish a domestic offshore wind supply chain, tackle ground-level market barriers, and implement cost-reduction strategies. With an estimated offshore wind potential of 70 GW, India's offshore sector will create demand for higher-value technical skills across marine operations, port logistics, offshore safety, heavy engineering equipment, subsea cable installation, and specialized maintenance services.

This remarkable progress in the wind sector highlights the growing need for a qualified workforce, particularly for offshore wind, towards the end of this decade in India. The National Institute of Wind Energy, a training facilitator and agency of the national government, has implemented the Vayumitra Skill Development Programme in nine onshore wind states in India.

Since its establishment in 1998, NIWE has trained thousands of professionals and supported various programmes, such as the Skills Council for Green Jobs and the National Skills Development Mission. These efforts, in collaboration with industry, education, and civil society.

Deloitte Touche Tohmatsu India LLP notes that the Ministry of Labour & Employment will implement four Labour Codes – on Wages, Industrial Relations, Social Security, and Occupational Safety, Health and Working Conditions – effective 21 November 2025. These reforms aim to enhance social security, workforce protections, and ease of doing business. For the wind energy sector, they may impact workforce management, compliance requirements, and operational planning.

Figure 11: India C&I and O&M Workforce Demand



Source: GWEC

[17] Ministry of New and Renewable Energy, Government of India. (n.d.). Skill development programme: Vayumitra (Wind Energy Technician) Programme. https://vsdp.niwe.res.in/

Meanwhile, safety and technical training aligned with Global Wind Organisation (GWO) standards continues to scale rapidly: India has increased the number of GWO-trained personnel from approximately 2,000 in 2018 to around 20,000 in 2024, while certified GWO training providers have expanded from just one in 2018 to 27 nationwide as of 2024, reflecting strong industry alignment with global best practices. This capacity growth is timely given forecasted O&M expansion and emerging offshore requirements.

Leading wind OEMs in India are revisiting and strategising to scale up their involvement in Engineering, Procurement and Construction (EPC) activities to improve market presence, enable them to strengthen project delivery control, and optimise supply chain efficiency. In parallel, strategic partnerships between developers, OEMs, and utilities to jointly develop large-scale projects – including multi-gigawatt wind and wind–solar hybrid pipelines (e.g., 2 GW and 2.5 GW partnerships) – are emerging as a key approach to accelerate execution and support the energy transition.

These collaborative partnerships expand the scope of EPC responsibilities and require stronger project management and integrated technical capabilities. As India expands onshore wind and prepares for its first offshore wind projects, increased OEM participation in Engineering, Procurement and Construction (EPC) and partnership-led project development will heighten workforce demand across civil and electrical works, logistics, commissioning, hybrid system integration, quality assurance, and health, safety and environment.

Stronger coordination between policymakers, industry, and training institutions will be essential to ensure that recruitment, retraining, and upskilling efforts keep pace with installation trajectories. If India successfully scales annual installations to 8 GW per year by 2030, this could support around 116,000 direct and indirect jobs, reduce technology costs by increasing local manufacturing efficiency, and push domestic content above 80%.

A more ambitious 15 GW per year installation scenario could generate ~154,000 jobs and position India as a global wind supply chain hub. With its strong industrial capabilities and expanding skill training ecosystem, India is well positioned to build a future-ready, skilled, and inclusive wind workforce that supports accelerated deployment, economic resilience, and long-term national development goals.

Germany

Nordergrund, Near Bremerhaven, Germany

Germany is the largest wind market in Europe with total installed wind energy capacity surpassed 70 GW by the end of 2024. The country has entered a decisive phase in its energy transition, with wind power at the center of efforts to strengthen industrial competitiveness, reduce reliance on fossil fuels, and ensure long-term energy security. As the country accelerates its decarbonisation and energy security goals toward 2030, both onshore and offshore projects are expanding rapidly, driving strong labour demand across construction, installation, and operations and maintenance.

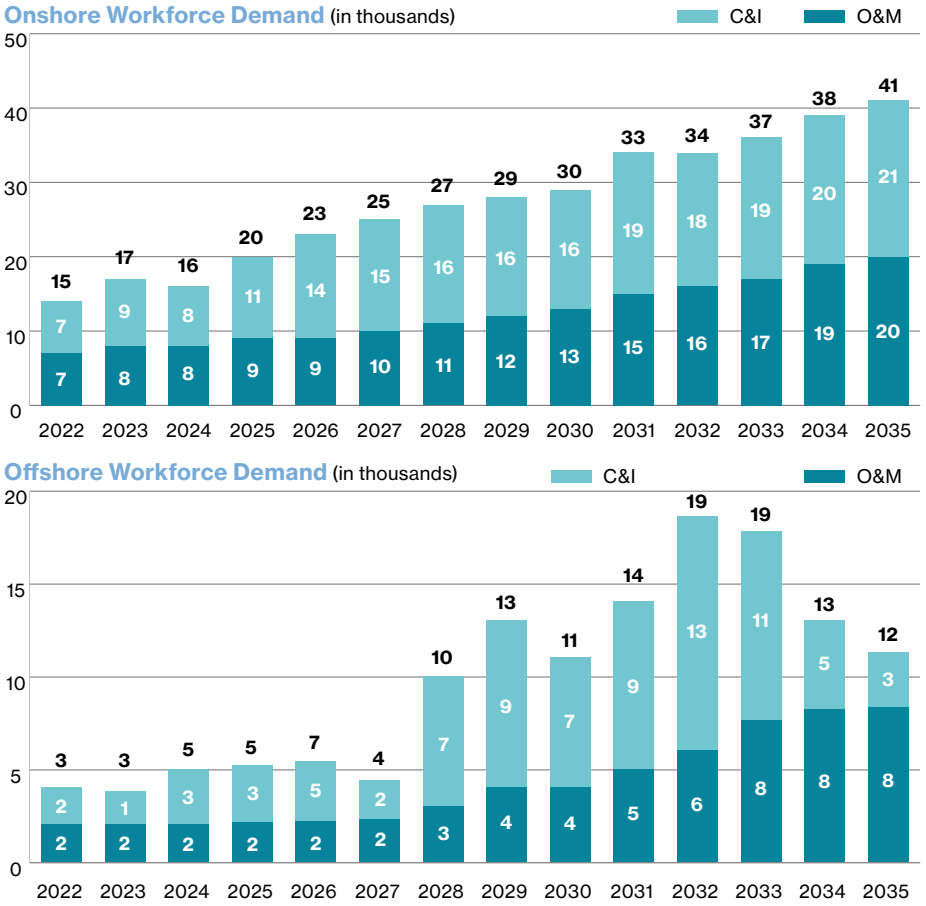
Its wind energy market is experiencing unprecedented momentum: legislative improvements under the former government, including the designation of wind energy as being of 'overriding public interest', have enabled faster permitting decisions, reduced administrative obstacles and prioritised renewable projects in land-use planning. Record-breaking results in 2024 underline the effectiveness of these measures. Nearly 11 GW of new onshore wind capacity was awarded in tenders during the year, representing a 70 percent year-on-year increase, through two oversubscribed onshore wind bids.

North Rhine-Westphalia captured 28 percent of this volume, followed by Lower Saxony with 14 percent and Brandenburg with 10 percent, jointly exceeding the capacity awarded across all other federal states combined. Permitting performance has also surged, with around 2,400 new turbines totalling 14,000 MW approved in 2024, again led by North Rhine-Westphalia with close to one-third of national permitting volume. Additionally, 8 GW of offshore wind capacity was awarded in 2024, the highest in Europe.

Project deployment is advancing steadily: by early 2025, VDMA and BWE reported that 635 new onshore turbines with a combined capacity of 3,251 MW were commissioned in 2024, while gross additions in 2025 are projected to reach between 4.8 and 5.3 GW, supported by an accelerating rate of repowering, which already contributed 37 percent of new capacity in 2024. GWEC Market Intelligence expects Germany will continue to lead regional market growth with more than 35 GW of new onshore wind and 10 GW of new offshore wind installations in the next five years, driven by a robust auction schedule, PPA uptake and the WindLandG land-use mandate requiring federal states to allocate 2 percent of their territory to wind energy by 2032.

These dynamics will translate into a significant rise in workforce demand. According to GWO, onshore wind will require roughly 19,834 technicians in 2025, increasing to between 23,162 and 27,347 technicians per year from 2026 to 2028 as installation volumes increase, and continuing to rise to 36,583 technicians by 2033 and around 40,783 by 2035, reflecting high levels of repowering and maintenance activity. Workforce demand in offshore wind expands even more sharply, increasing from 4,754 technicians in 2023 to around 5,057 in 2024, then to approximately 7,644 in 2025, and peaking at close to 19,204 in 2032–2033 before gradually easing to 11,591 by 2035 as the market shifts toward the operations and maintenance stage following new wind installation phases. Strong policy drivers showcase a greater number of wind workforce requirements for both onshore and offshore wind growth in the next ten years.

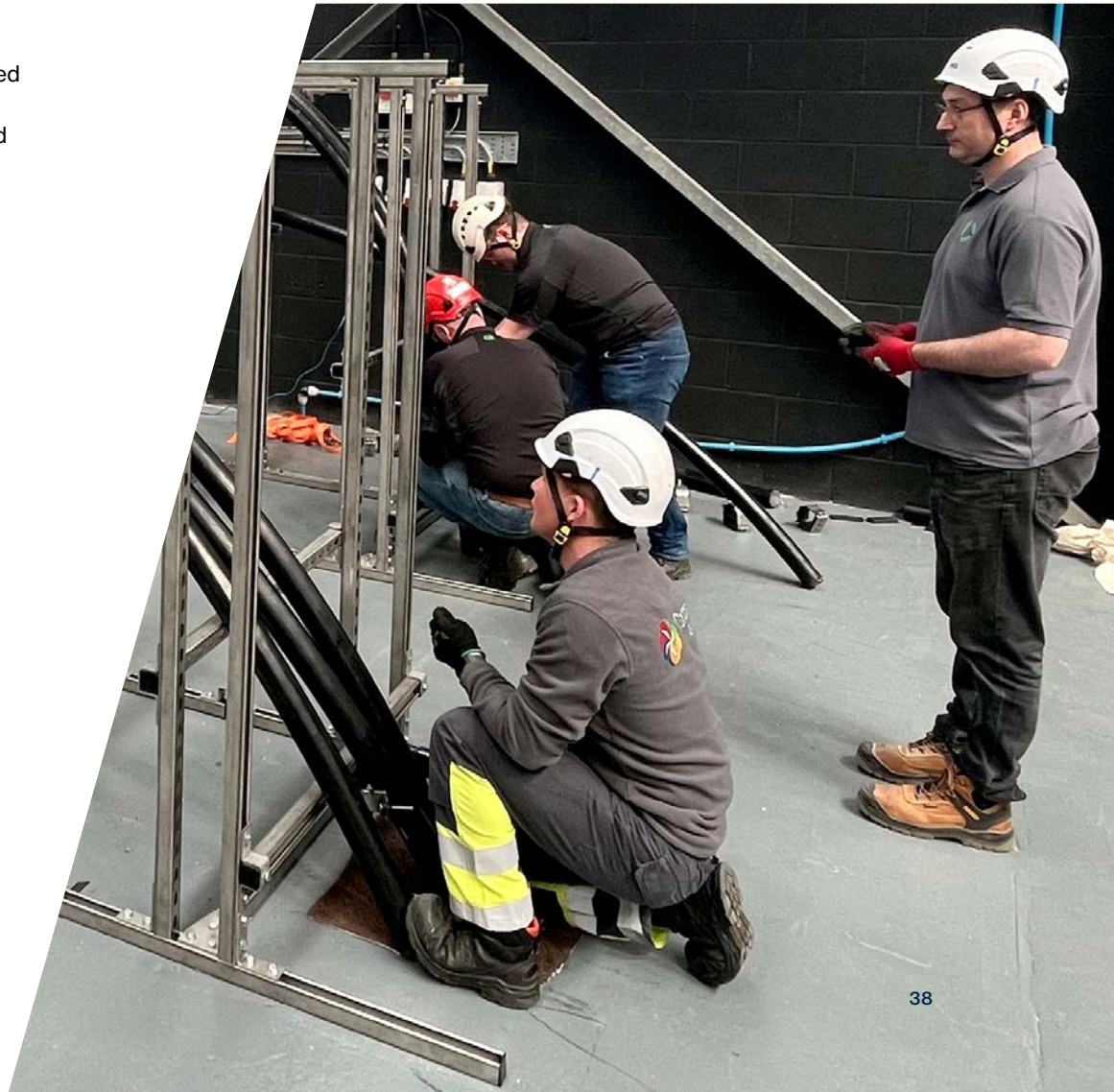
Figure 12: Germany C&I and O&M Workforce Demand



Source: GWEC

Responding to these workforce trends requires a strong and adaptable skills ecosystem. Germany already benefits from a dense network of universities, technical universities and Fachhochschulen that anchor high-level engineering education, complemented by a robust system of vocational institutes and dual apprenticeships that develop skilled technicians. Specialist training providers such as BZEE (Bildungszentrum für Erneuerbare Energien) support the practical upskilling needed for field and maintenance roles, while advanced programmes at Hochschule Flensburg and Hochschule Bremerhaven strengthen competencies in turbine diagnostics, high-voltage electrical systems, digital condition monitoring and structural analysis to enable repowering and lifetime extension projects.

As offshore wind scales up, training in marine engineering, naval architecture and offshore operations is delivered through training centres such as OffTEC and Deutsche Wind Guard, which provide certifications in working at heights, offshore safety and sea survival – essential for heavy-lift operations, subsea cable installation and managing offshore logistics chains. By the end of 2024, 27,249 people had already received training to BST through the 36 GWO training providers in Germany, compared with only 7,500 in 2018. Sustaining this momentum will require continued policy stability and rapid workforce and skills development. With these elements in place, Germany is well positioned to consolidate its leadership in the European wind market.



France

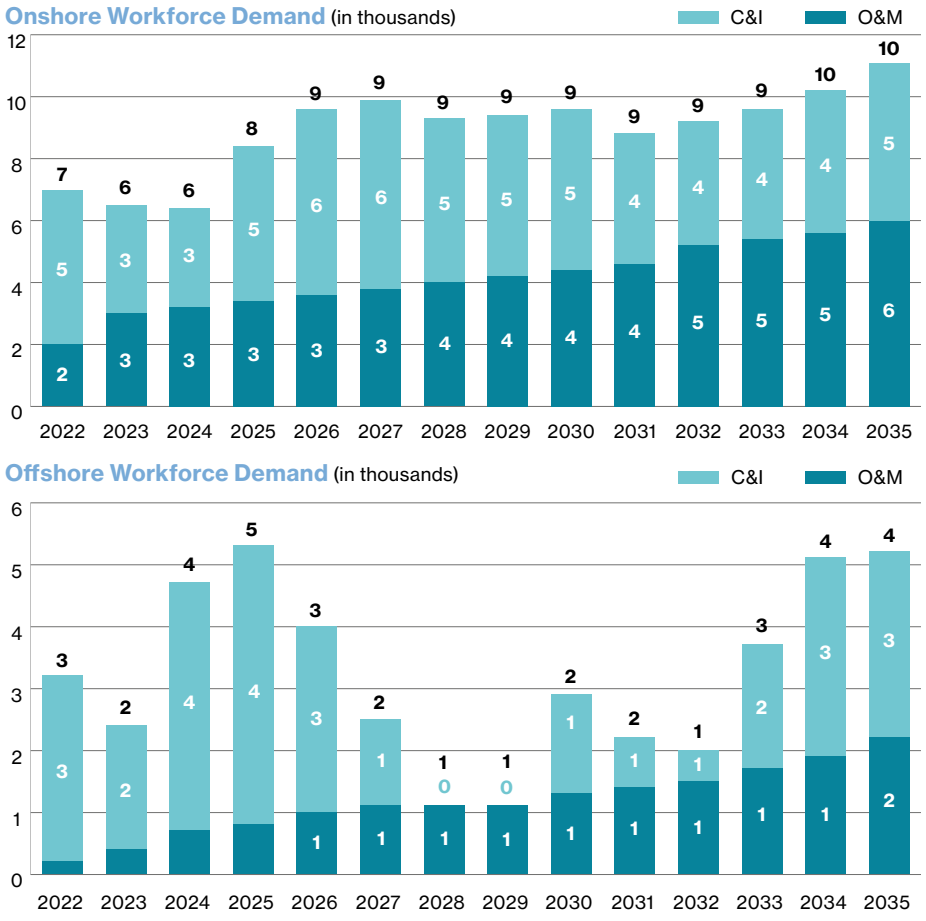
Cap Fréhel, France

France is the fourth-largest wind market in Europe, with total installed wind energy capacity of 24.5 GW by the end of 2024. Wind power made up 11% of France's electricity mix in 2024, making it a strategic pillar to support the country to achieve its energy transition while strengthening the country's energy sovereignty. As the country advances its offshore wind ambitions and seeks to stabilise onshore deployment, workforce needs across construction, installation, and operations and maintenance (O&M) are expected to rise. However, project development continues to face delays due to lengthy permitting processes, supply-chain challenges, and competition for skilled labour. Ensuring the timely scale-up of training capacity will be critical to avoiding bottlenecks during peak installation years.

In 2024, France connected 658 MW of offshore wind, including its first commercial-scale floating project, bringing total offshore capacity to 1.5 GW, while a further 1.5 GW is under construction across five projects. Onshore wind added 1.1 GW of new capacity in 2024, which is 22% less than the capacity added in the previous year. Development remains constrained by stringent turbine height restrictions linked to aviation and military requirements, as well as permitting and legal challenges, despite political instability and regional resistance in grid-constrained areas.

France has made progress in auctions in 2024. France's offshore wind auction programme awarded three fixed-bottom and three floating projects totalling 4.5 GW before 2023, followed by awards for the 250 MW AO5 in May 2024 and the two 250 MW AO6 floating projects in December 2024. Results for the 1.0 GW AO7 and 1.5 GW AO8 fixed-bottom projects were announced this year, while the 2.5 GW AO9 tender launched recently includes one floating project in South Brittany, two in the Mediterranean, and one fixed-bottom project in the South Atlantic, with commissioning scheduled for 2032-2034.

Figure 13: France C&I and O&M Workforce Demand



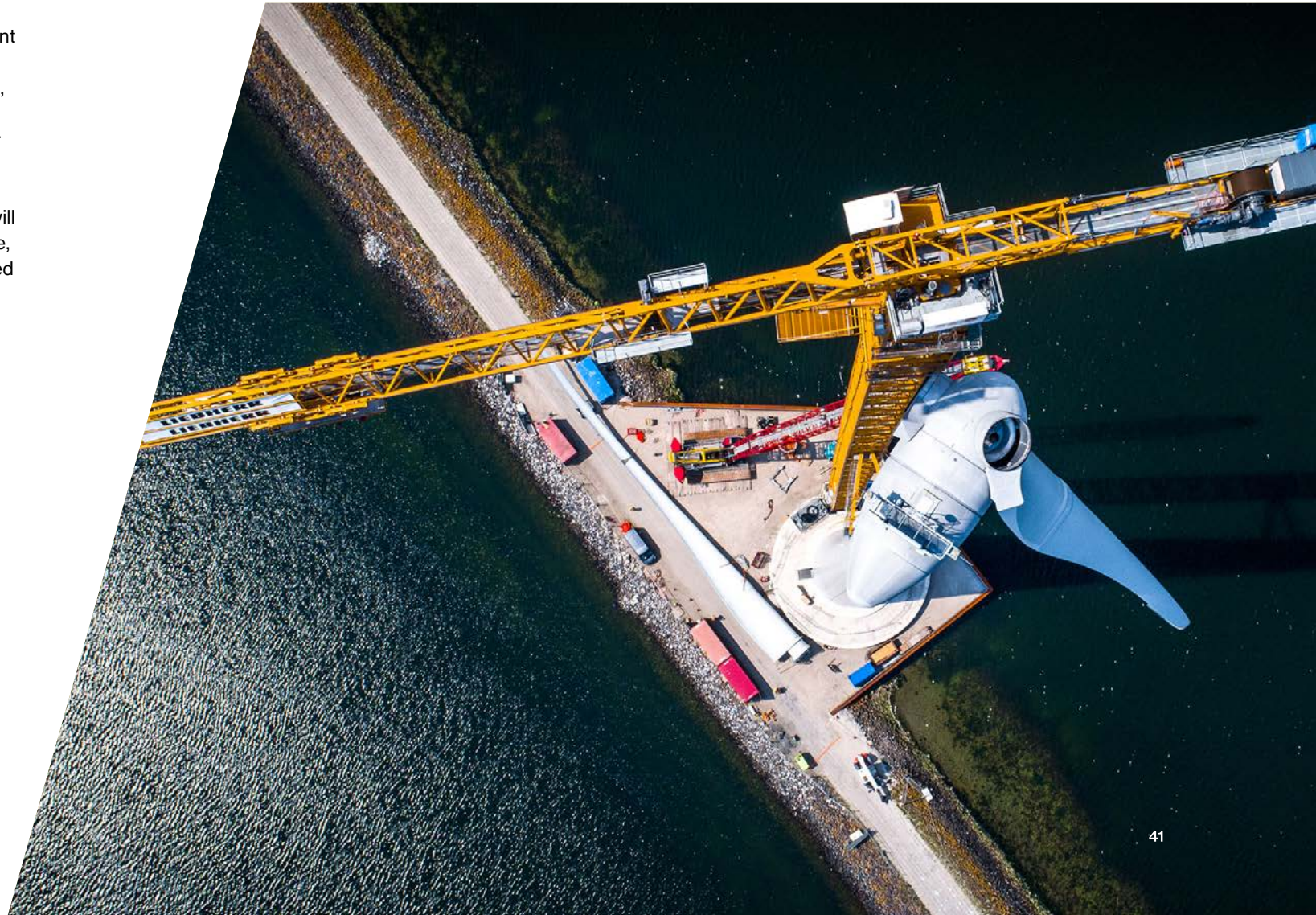
Source: GWEC

In addition, the government has announced the 9 GW AO10 tender across five sites, due to launch this year with commissioning expected by 2035. In parallel, 1.8 GW of onshore wind capacity was awarded through the 7th and 8th wind tenders under the 2021–2026 plan. The awarded volume in 2024 is significantly lower than that awarded in 2023 (3,097 MW) because one fewer round was offered. Furthermore, there is also political instability affecting future onshore wind legislation. France's technology-specific auction scheme will end in 2025, while the technology-neutral auction scheme (where onshore wind competes with solar PV) will end in 2026. These challenges are impacting workforce planning, limiting the ability to scale workforce and training in line with future wind projects.

At present, more than 31,000 people work directly and indirectly in the wind sector, a number which is expected to increase by 2030. HTC Techniques Verticales is providing GWO-certified training in France, including modules such as First Aid, Manual Handling, Fire Safety, Working at Heights, and Sea Survival. SGS has partnered with APQP4Wind to deliver expert-led training for the wind industry in France, focusing on quality assurance, standardised processes, and supply-chain risk reduction. École des Ponts et Chaussées, in partnership with EDF Renouvelables, is developing new courses aligned with energy-transition and wind-industry skills needs. Alpic (part of the Delta Plus Group) is a dedicated centre training wind-industry technicians in height safety and rescue on wind turbines. FMTC Safety & TotalEnergies – a training facility in Marseille – has set up a partnership to deliver GWO Basic Safety Training modules such as Working at Heights, Sea Survival, and Fire Awareness, aimed at meeting offshore wind safety requirements.

Despite the challenges, there is optimism about wind energy development in France. With continued government support, favourable technical resources, technological advancements, and strengthening market conditions, sector growth is expected. GWEC Market Intelligence believes that more than 11.3 GW of new onshore wind capacity will be added in France by 2030. On average, around 9,000 technicians will be required to support onshore wind development during the forecast period.

For offshore wind, workforce demand will scale up significantly this decade as project construction accelerates. Peak offshore workforce needs are expected in 2025, requiring over 4,500 workers, before declining temporarily in 2026-2029 and then rising again above 4,000 workers by 2034–2035. GWO has 34 active BST training centres in France at the end of 2024.



Chapter 7:
Methodology

This study adopts a qualitatively led research design, supported by quantitative modelling to examine the structure of technician demand in the wind industry. Qualitative inquiry forms the primary evidentiary base, particularly in relation to workforce planning and workforce preparedness. These insights establish the conceptual framework for the analysis and inform the assumptions embedded in the quantitative model.

The research design integrates three components:

1. quantitative modelling, using GWO's workforce forecast model to test and refine assumptions about Full-Time Equivalent (FTE) labour demand
2. Qualitative mapping of wind project development structures.
3. Semi-structured stakeholder interviews, guided by hypotheses concerning organisational workforce planning and competence management practices

Workforce Modelling

GWO maintains a workforce forecast model that estimates the FTE requirements for wind turbine installation and maintenance.

To enhance the accuracy and reliability of this model, we have identified a set of key drivers and variables that most strongly influence FTE demand. Below is acategorised overview of the variables we consider most significant. Not all relevant variables are included, due to practical constraints such as the unavailability of structured data.

Among the drivers we identified, those related to schedule and work-breakdown-structure elements (e.g., task sequencing, task overlaps, and the use of parallel crews) are the most difficult to quantify due to limited availability of structured data. For this publication and for our modelling approach, we therefore rely primarily on the turbines-and-capacity outlook, complemented by insights on major project tasks, labour-hour estimates, job roles, and crew configurations gathered through interviews with subject-matter experts.

Table 2: Variables Influencing Technician Demand

Project Characteristics	Project Scope & Work Breakdown	Team Composition	Schedule Parameters
• Number of turbines	• Task list by phase	• Job roles involved	• Timeline (start–end)
• Turbine rating (MW)	• Standard labour hours per task (by role)	• Crew configuration (how many people per role per task)	• Valid workdays (accounting for weather, access)
• OEM type / design (affects task breakdown)		• Standard productivity rates (turbines/year)	• Number of parallel crews or teams
• Site location (can influence logistics/productivity)			• Sequencing or overlapping of tasks

Note: Grey-shaded text denotes factors hypothesised to have potential influence. These factors were not included in the current model due to incomplete data.

As installation and maintenance practices and project management processes have matured across the sector, this report also provides forecast by technician role at global level. This modelling is supported by interviews with project managers and project engineers to understand how different technician roles are involved in major tasks, their core responsibilities, and typical team compositions.

The forecast results presented in this publication are triangulated with GWO's actual training statistics. We continuously monitor the number of course participants to understand training demand and industry trends.

Wind Project Structure

Desk research was conducted to gain a structured understanding of how wind projects are planned, developed, governed, and executed. This included mapping the end-to-end project development process, the types of organisations involved, and the contractual and governance arrangements that define their interactions.

This mapping enabled the identification of key duty holders across the value chain and clarified their respective responsibilities within typical project structures. These insights also informed the sampling framework for stakeholder interviews.

For this study, the construction phase of a wind project is defined as the period beginning after logistics providers have delivered the turbines to site and ending once the wind farm is fully commissioned and begins producing electricity.

The maintenance phase is defined as the period beginning once the wind farm has been fully commissioned and is operational and continuing throughout the project's operational lifetime. It encompasses all scheduled, preventive, and corrective activities required to ensure the turbines and associated infrastructure operate safely, reliably, and at their intended performance levels. Decommissioning and repowering activities are not considered part of the maintenance phase.

The following organisations are identified in the wind project structure, and their terms are used consistently throughout the study.

Developers/Investors
(used interchangeably in this study): Organisations that originate and finance wind energy projects, assuming commercial risk during development and construction, and overseeing delivery to ensure financial close and operational readiness.

Owner/Operator
(used interchangeably in this study): The entity that holds ownership of the wind farm assets and is responsible for managing O&M activities once the project is operational. In many cases, this may be the same organisation as the developer, or a separate entity following asset transfer.

OEMs (Original Equipment Manufacturers): Companies that design, manufacture, and supply major wind turbine components (e.g., nacelles, blades, towers) and often provide long-term service agreements.

EPCs (Engineering, Procurement and Construction contractors): Contractors responsible for the detailed engineering, procurement of materials, and construction of project components, including civil works, electrical systems, and turbine installation.

PMC (Project Management Consultant): A firm appointed to oversee the project on behalf of the owner or developer, providing project management, technical oversight, schedule and cost control, and coordination across contractors.

ISPs (Independent Service Providers): Third-party companies that typically deliver O&M services independent of the OEM, including inspections, repairs, component replacement, and specialist technical services.

Definitions

Terms	Definition
ABEEólica	Associação Brasileira de Energia Eólica e Novas Tecnologias – Brazilian Association of Wind Energy and New Technologies
BST	Basic Safety Training Standard (GWO Standard)
CoHE	Control of Hazardous Energies Training Standard (GWO Standard)
C&I	Construction and Installation
COP 28 etc	Conference of the Parties (Numbered in Series)
DOE	Department of Energy (USA)
DISCOMS	Electricity Distribution Companies
Firm Power	Mean power output during a certain critical period
FTE	Full-Time Equivalent (a full-time employee)
GW	Gigawatts
GWEC	Global Wind Energy Council
GWO	Global Wind Organisation
HSE	Health, Safety and Environment
IEA	International Energy Agency
IRA	Inflation Reduction Act (USA)
NEA	National Energy Administration (China)
NREL	National Renewable Energy Laboratory (USA)
MW	Megawatts
OEM	Original Equipment Manufacturer
O&M	Operations & Maintenance
PPA	Power Purchase Agreement
REC	Renewable Energy Certificate
WINDA	GWO's online database of wind training records

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