

Tamil Nadu coastal communities skills roadmap for Indian offshore wind

June 2026



Abbreviations

BVGA	BVG Associates
CAD	Computer aided design
CBSE	Central Board of Secondary Education
CII	Confederation of Indian Industries
CLCSS	Credit Linked Capacity Subsidy Scheme
CRZ	Coastal Regulation Zone
CS	Company secretary
CSO	Central Statistical Office
CTV	Crew transfer vessel
FTE	Full-time equivalent
GVA	Gross value added
GWEC	Global Wind Energy Council
GWO	Global Wind Organisation
HRA	Habitat Regulation Assessment
HSE	Health, safety, and environmental
HV	High-Voltage
HVAP	High Voltage Authorised Persons
IB	International Baccalaureate
ICSE	Indian Certificate of Secondary Education
IMS	Integrated management systems
LLB	Bachelor's degree in Law
LOTO	Lockout/tagout
MBA	Master's degree
MNRE	Ministry of New and Renewable Energy
NAPS	National Apprenticeship Promotion Scheme
NDA	Non-disclosure agreement
NFF	National Fishworkers Forum

NIC	National Industrial Classification
NSDC	National Skill Development Corporation
NSQF	National Skills Qualification Framework
OEP	Ocean Energy Pathway
OGD	Open Government Data
OSW	Offshore wind
OWGP	Offshore Wind Growth Partnership
PMKVY	Pradhan Mantri Kaushal Vikas Yojana
RPL	Recognition of Prior Learning
SAP	Senior Authorised Person
SCADA	Supervisory Control and Data Acquisition
SCGJ	Skill Council for Green Jobs
SIFFS	South Indian Federation of Fishermen Societies
SIPCOT	State Industrial Promotion Corporation of Tamil Nadu
STEM	Science, technology, engineering and mathematics
TANSIDCO	Tamil Nadu Small Industrial Development Corporation
TIDCO	Tamil Nadu Industrial Development Corporation
TIIC	Tamil Nadu Industrial Investment Corporation
TNSB	Tamil Nadu State Board
TNSDC	Tamil Nadu Skill Development Corporation
TPSDI	Tata Power Skill Development Institute
WEST	Wind Expert Support Toolkit
WFD	Water Framework Directives
ZED	Zero Defect Zero Effect

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Executive summary

Tamil Nadu is poised to become the centre of India's offshore wind (OSW) industry, with the majority of the country's projected OSW capacity expected to be deployed off its coast. This is due to its superior wind resource when compared to the rest of India and demand for more energy. Tamil Nadu has an estimated 35 GW of technical potential, making it the state most capable of driving national progress. This opportunity is not only strategic for India's energy transition but also economically significant for Tamil Nadu: OSW deployment can generate long-term employment, stimulate local supply chains, and create new income pathways for coastal communities.

Realising this potential depends on whether the state can build the skills, training systems, and institutional readiness required for a sector of this scale. Without targeted investment in human capital and enterprise capability, many of the economic and social benefits of OSW risk being captured elsewhere. This roadmap therefore outlines how Tamil Nadu's coastal communities particularly school-age children, fishers, and micro, small, and medium enterprises (MSMEs) can be equipped to participate meaningfully in this emerging sector, ensuring that local economic benefits are broad-based, inclusive, and sustainable.

The analysis underpinning this report draws on socio-economic modelling, international OSW case studies, education system assessments and a review of the MSME landscape across Tamil Nadu's coastal districts. These inputs inform the key findings and recommendations presented in this executive summary, setting out a practical pathway for Tamil Nadu to unlock its OSW potential while maximising local socioeconomic impact.

Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines.



This roadmap therefore outlines how Tamil Nadu's coastal communities particularly school-age children, fishers, and micro, small, and medium enterprises (MSMEs) can be equipped to participate meaningfully in this emerging sector, ensuring that local economic benefits are broad-based, inclusive, and sustainable.





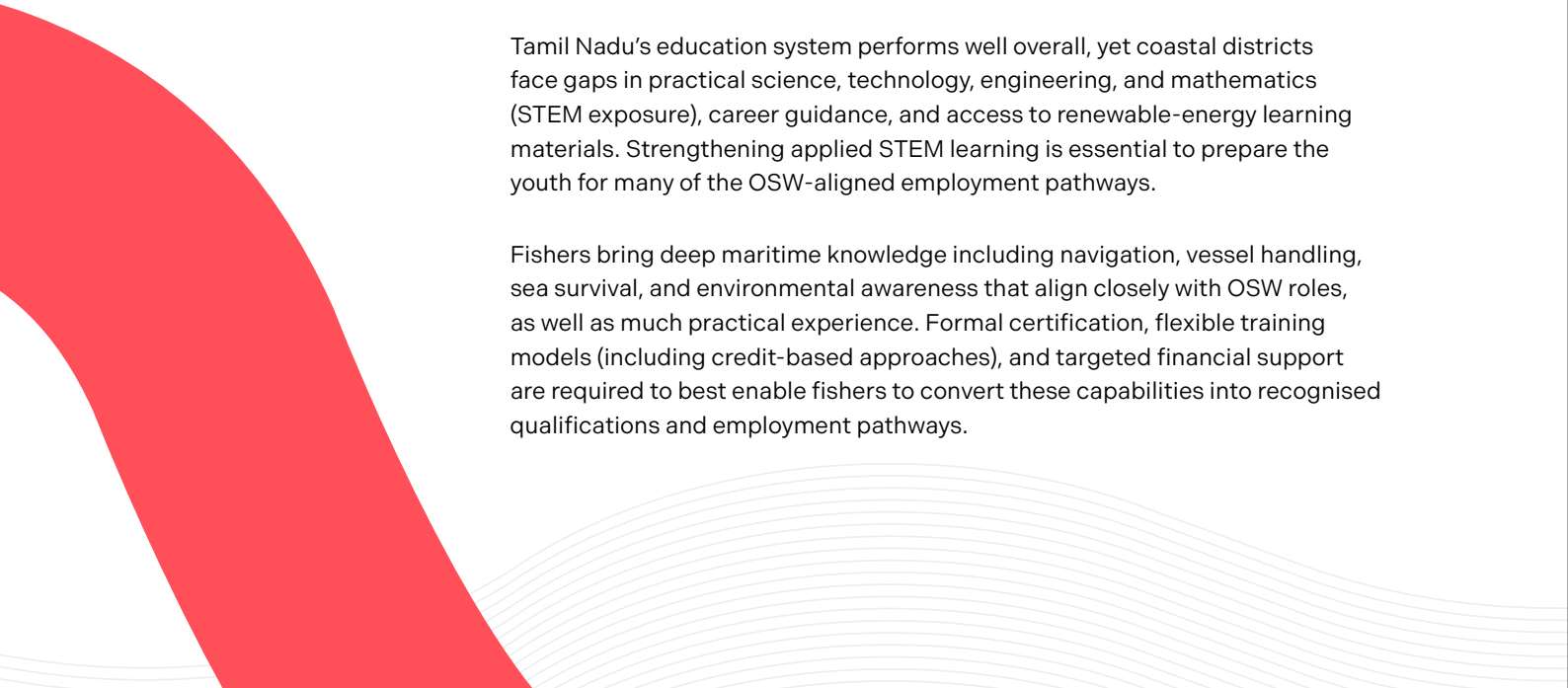
Key findings

Across India's OSW pipeline installed up to the end of 2043, modelled in this project as 25.5 GW, Tamil Nadu stands to gain approximately 535,000 full-time equivalent (FTE)-years of employment. This figure represents the total lifetime direct and indirect employment impacts of the pipeline, including development, manufacturing, installation, operations, and decommissioning phases (so extending beyond 2043). Additional employment would be generated by projects installed beyond this pipeline. The peak employment is expected to occur in 2040, at approximately 34,300 FTEs that year.

The greatest demand is in mechanical and electrical practical roles, especially in ports and logistics, maritime services, and long-term operations, but there will be opportunities in environmental, human resource and many other fields as well. These roles span all project phases, creating opportunities for both younger and more experienced workers, including via pathways through education and targeted reskilling programmes for workers from fishing and other maritime sectors. Tamil Nadu's coastal communities can also reap the social benefits that OSW has delivered in other countries, including improved access to stable employment, enhanced training provision, and wider local economic development.

Tamil Nadu's education system performs well overall, yet coastal districts face gaps in practical science, technology, engineering, and mathematics (STEM exposure), career guidance, and access to renewable-energy learning materials. Strengthening applied STEM learning is essential to prepare the youth for many of the OSW-aligned employment pathways.

Fishers bring deep maritime knowledge including navigation, vessel handling, sea survival, and environmental awareness that align closely with OSW roles, as well as much practical experience. Formal certification, flexible training models (including credit-based approaches), and targeted financial support are required to best enable fishers to convert these capabilities into recognised qualifications and employment pathways.



More than 5,500 MSMEs across the eight coastal districts operate in OSW-relevant sectors. MSMEs are expected to capture the largest share of GVA from development and project management phase activities, potentially receiving 61% of overall value in Tamil Nadu, followed by operations phase activities (potentially receiving 53% of overall value in Tamil Nadu in this phase). Yet challenges such as certification costs, limited access to capital, and uncertainty around OSW timelines are likely to constrain their ability to invest and scale. Clear market signals and structured supplier-development pathways will be important in enabling MSMEs to benefit from OSW.

Recommendations

A detailed roadmap of recommended actions is provided in the report, considering STEM pathways in schools, fisher participation and supporting MSMEs, with suggested action owners and timing of activities.

Below is a summary of recommendations:



Recommendation	Description	Recommended owner organisation
STEM education	1 Expand STEM programmes to include renewable-energy technologies and hands-on learning	TNSDC and TN SCERT
	2 Promote use of offshore-wind learning materials in schools through the Skill Council for Green Jobs	SCGJ
	3 Broaden climate-change education programmes to cover renewable-energy technologies and green-economy career awareness	Environment Education Programme (lead) and CEE Tamil Nadu
	4 Increase school-industry engagement through site visits, staff interactions, and vocational exposure	TN SCERT and SCGJ
	5 Enhance career guidance to include onshore and offshore wind pathways	Department of School Education
	6 Continue efforts to reduce dropouts linked to seasonal fishing	Department of School Education
Fishers	1 Establish realistic developer commitments for fisher involvement	MNRE
	2 Launch tailored training programmes aligned with fishers' seasonal availability and prior learning	Tamil Nadu State Skill Development Corporation
	3 Provide subsidies and dedicated funding streams to reduce certification barriers	Tamil Nadu Government (lead) and National Fisheries Development Board
	4 Expand opportunities for fisherwomen through targeted skill-development schemes	Tamil Nadu Fisheries & Fishermen Welfare Department and TNSDC
	5 Offer short-course retraining through ITIs to build on existing maritime and mechanical skillsets	Industrial Training Institutes (ITIs)
	6 Strengthen partnerships between OSW employers and accredited training providers to ensure relevance and quality	SCGJ
	7 Implement flexible, NSQF-aligned and RPL-based certifications to convert informal maritime experience into recognised qualifications	NSDC
	8 Increase community awareness of OSW opportunities through NGO- and industry-led engagement and monitoring of outcomes	NGOs and OSW industry stakeholders and donors
	9 Formalise local hiring commitments, including skilled and permanent roles, and create clear career pathways for coastal youth	OSW employers
	10 Support fisher-to-fisher learning exchanges drawing on international experience and peer-to-peer communication	NGOs and other international donors

Recommendation	Description	Recommended owner organisation
MSMEs		
1	Publish a clear, sequenced OSW development pathway for Tamil Nadu covering leasing, auctions, and project rollout	MNRE, through SECI and with technical inputs from NIWE
2	Align state port planning, land allocation, and industrial-infrastructure decisions with the OSW trajectory	Tamil Nadu Energy Department
3	Define transparent MSME-relevant procurement pathways coordinated across state industrial agencies, NIWE, OEMs, and EPC contractors	TIDCO, SIPCOT, TANSIDCO and Guidance Tamil Nadu, coordinate with NIWE, wind turbine suppliers, and EPC contractors and industry bodies like Confederation of Indian Industries (CII)
4	Integrate port-adjacent MSME manufacturing and service activity into port-planning processes through coordinated state and central action	Tamil Nadu Maritime Board and port authorities, with TIDCO and SIPCOT coordinating with the Ministry of Ports, Shipping and Waterways.
5	Extend state industrial-policy incentives and financial-support schemes to OSW-linked manufacturing, services, and technology upgradation	The State Industries Department, in coordination with MNRE and the State Energy Department
6	Notify internationally recognised OSW technical and safety standards and align training delivery with OEM and EPC requirements	MNRE, in coordination with NIWE
7	Establish a state-level OSW coordination body to align ports, industry, environment, fisheries, and central agencies	A state-level OSW body, anchored within the Energy Department
8	Develop online supplier-education materials and outreach events to support MSME awareness and onboarding	State-level OSW body
9	Create targeted supplier-development programmes for larger firms and innovators, drawing on international models such as the UK OWGP	State-level OSW body

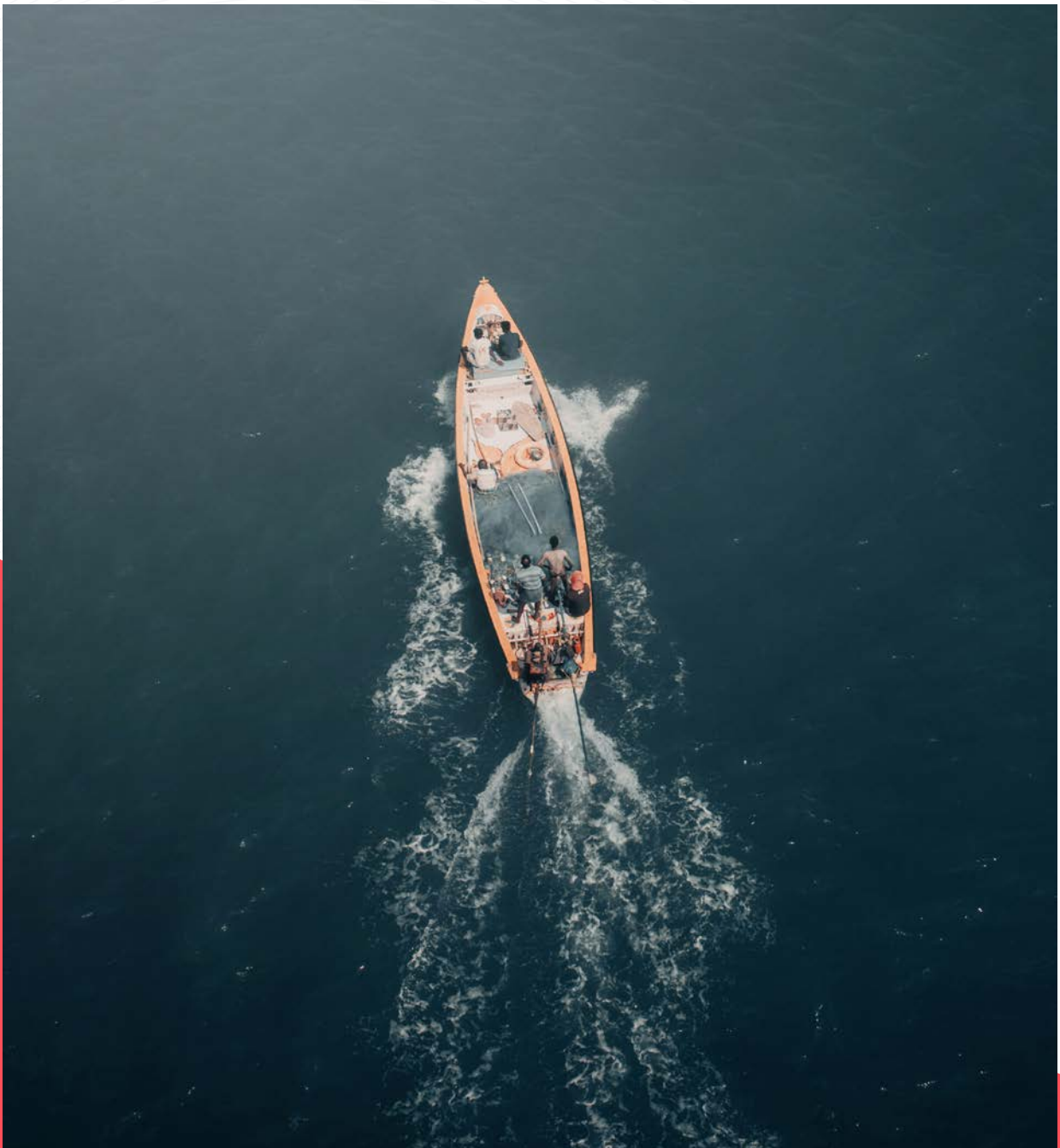
Tamil Nadu has a unique opportunity to lead India's offshore wind transition while delivering broad-based benefits to coastal communities. By strengthening STEM education, enabling fishers to participate in the OSW workforce, and supporting MSMEs to integrate into the supply chain, the state can build a resilient, inclusive, and future-ready ecosystem that supports OSW deployment for decades to come.



First project development													First construction		Early operation								
													2030	2031	2032	2033							
Tamil Nadu offshore wind													2026	2027	2028	2029	2030	2031	2032	2033			
													Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
STEM	1. Extend existing STEM programmes to renewable energy																						
	2. Encourage schools to access wind industry learning materials																						
	3. Expand existing climate change programmes to renewable energy																						
	4. Increase links between onshore wind projects and schools																						
	5. Increase focus on onshore and offshore wind career pathways																						
	6. Proactive approach to dropouts linked to seasonal fishing																						
FISHERS	1. Requirement for developers to make fisher commitments																						
	2. Develop tailored training programmes																						
	3. Leverage skills development programmes to train fisherwomen																						
	4. Facilitate access to funding and incentives for training																						
	5. Provide short course retaining for fishers in key areas																						
	6. Develop partnerships between OSW employers and training providers																						
	7. Implement flexible certification frameworks																						
	8. Raise awareness ad build community engagement																						
	9. OSW employers allocate a percentage of jobs to local residents																						
	10. Support fisher-to-fisher programmes to share global expertise																						
MSMEs	1. Clear OSW vision for Tamil Nadu, including leasing, auctions and project rollouts																						
	2. Align ports, land and industrial planning to the OSW pathway																						
	3. Define transparent MSME entry points and progression routes for OSW supply chains																						
	4. Port planning includes space and infrastructure for MSMEs supporting OSW manufacturing and services																						
	5. Extend existing subsidies and credit schemes to OSW manufacturing and services																						
	6. Notify international OSW technical and safety standards and support aligned training delivery																						
	7. Establish a state level OSW body to support OSW coordination																						
	8. Provide supplier education materials and event to support MSME participation																						
	9. Offer strategic support programmes for larger firms and investors entering OSW																						

Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines.

Introduction



1.1 India's offshore wind ambition

India is rapidly emerging as one of the world's fastest growing economies, with an ambitious commitment of achieving 50 GW of offshore renewable energy operating by 2047. [1] The nation's extensive coastline and favourable wind resources make offshore wind (OSW) a pivotal element of its future energy strategy. In 2023, the Ministry of New and Renewable Energy (MNRE) set a national target to auction 37 GW of OSW capacity by 2030, reflecting the sector's growing importance.

1.2 Tamil Nadu's strategic role

Tamil Nadu, with an estimated 35 GW of OSW technical potential, and identified offshore wind zones located off the coasts of the Gulf of Mannar and Kanyakumari, is uniquely positioned to lead the way in India's OSW development. The Government of India's announcement of a 4 GW tender off the coast of Tamil Nadu in 2024 exemplifies this leadership role and signals the region's significance in the country's renewable energy ambitions.

Although the process for the 4 GW tender was cancelled due to a lack of developer interest, surveys are now underway in Tamil Nadu with a new tender process likely to be announced in the first half of 2026.[2][3]The establishment of the national India-UK Offshore Wind (OFW) Taskforce further reinforces the Government's commitment to accelerating OSW deployment and strengthening coordination across central and state agencies.

Deploying OSW in Tamil Nadu is expected to deliver substantial economic benefits, including for local communities and micro, small, and medium enterprises (MSMEs). Realising these benefits will depend on a strategic approach to skills and workforce development.

1.3 Purpose of this report

This report explores how smart policy setting by government bodies and collaboration with OSW project developers and education providers can identify and address future skills demands across the OSW value chain.

Effective communication of employment and community benefits by government and developers is essential to building local support for OSW projects.

Additionally, coordinated training initiatives are vital to bridging skills gaps, integrating members of coastal communities into the workforce, and aligning national and regional skills programmes with industry and government needs.

By fostering a sustainable pipeline of qualified workers, Tamil Nadu can support both OSW deployment and broader regional development goals.

1.4 Geographical area of study

Tamil Nadu has a population of over 80 million people and 38 districts. To avoid skewing results and help focus on the needs of relevant communities, this study focuses on the eight districts within the State that:

- Are closest to the identified OSW potential zones, and¹
- Have port infrastructure that could potentially be used to provide OSW services (including manufacturing for some).

Figure 3 shows these, the locations of potential OSW zones, and the locations of ports:

- Kudankulam and V.O.Chidambaram ports relevant for OSW construction, and
- Udangudi port relevant for OSW operations

This classification narrows the study area and helps identify the fishing villages associated with each port type.

The districts, from south to north, are Kanniyakumari, Tirunelveli, Thoothukudi, Ramanathapuram, Pudukottai, Thanjavur, Nagapattinam and Mayiladuthurai.

These eight districts form the focus for developing the science, technology, engineering, and mathematics (STEM) education pathways and for understanding the MSME landscape. Towns and villages surrounding the ports classified as OSW-relevant are designated as the areas of interest for designing skill-development pathways for fishing communities (including fish landing villages and those near fish landing villages). Further, relevant communities were selected based on data availability from Tamil Nadu Government sources.

The coastal villages, Town Panchayats, and municipalities from south west to north east are:

- The cluster of Kallukuttam, Kolachal, Neiyyur, and Reethapuram
- The settlements of, Kottaram, Agasteeswaram, Kanniyakumari, Azhagappapuram, Levinjipuram at the southernmost tip on Tamil Nadu

¹ National Institute of Wind Energy (NIWE), Offshore Wind Development Department responsible for offshore wind resource assessment, surveys and demarcation of potential offshore wind zones along the Indian coastline, including Tamil Nadu. Available at: https://niwe.res.in/department/department_owd/

- Heading north, Chettikulam, Erukkandurai, Koondankulam, Vijayapathi, Kulasekaranpattinam, Manapad, Kulasekaranpattinam, Veerapandiyanpattinam, Udangudi, Tiruchendur, Palayakkayal and Mullakadu then Milavittan, Mappilaiurani and Muttayyapuram in Thoothukudi
- The Palk Strait region, including Sattakkonvalasai, Mandapam, Pamban and Rameswaram
- On the East coast, Vadakkupoigainallur, Nagapattinam, Manikkapangu, Pillaiperumalnallur, Kalamanaallur, Tharangambadi and Chinnakudi,

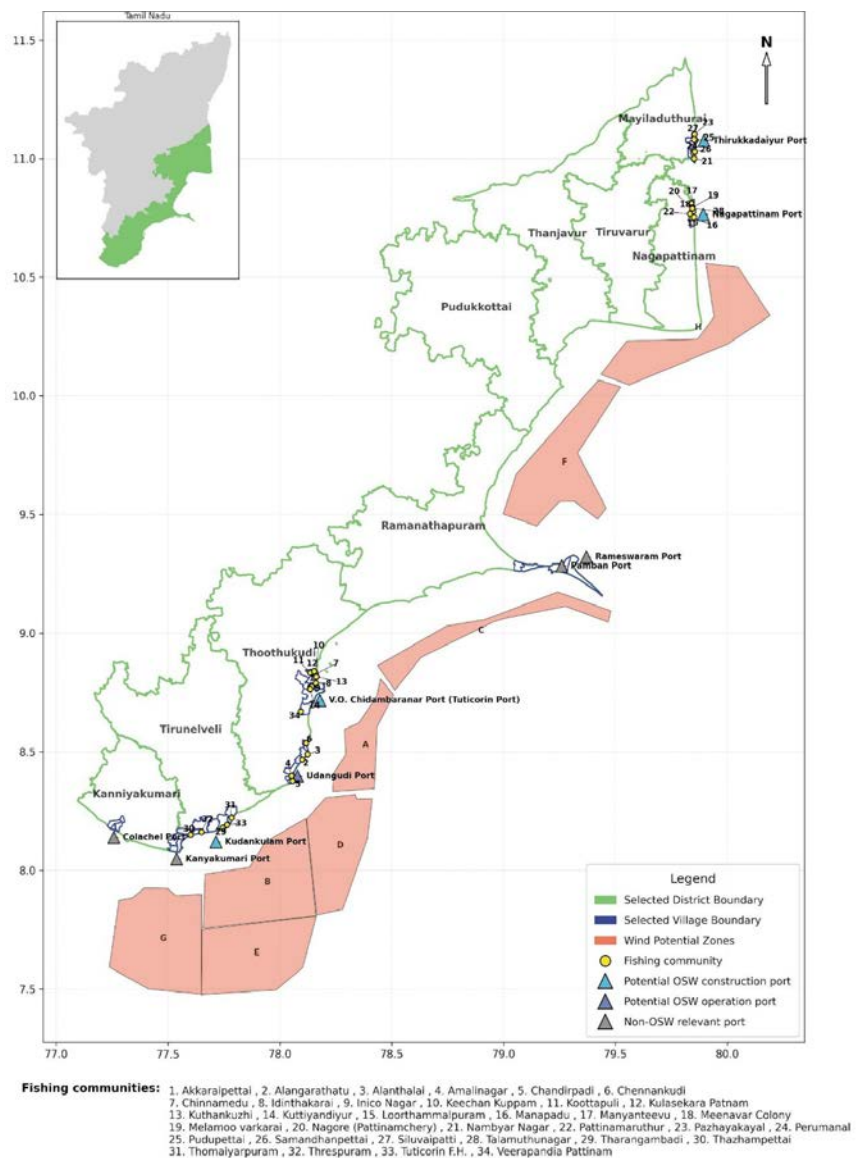
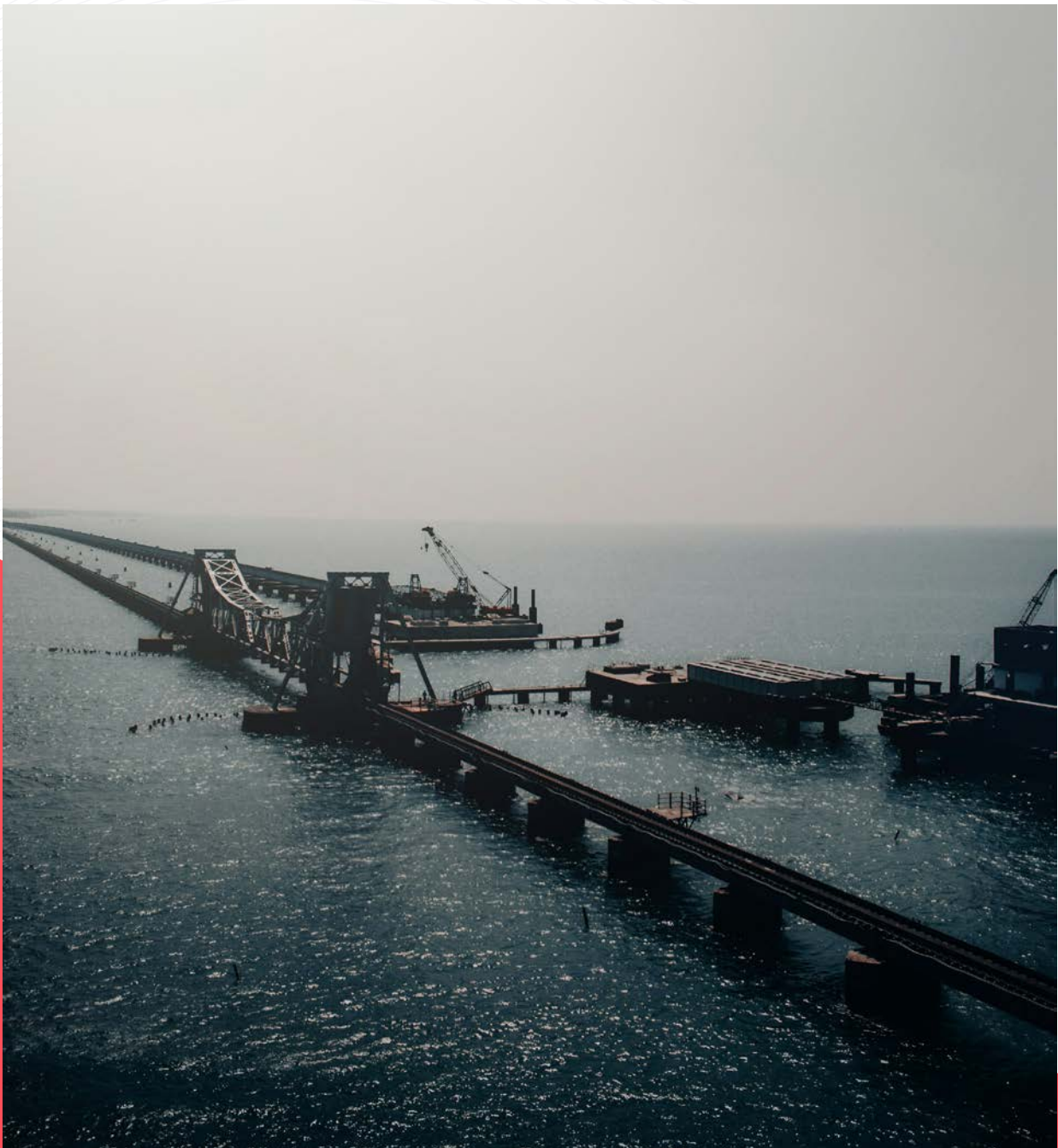


Figure 3: Geographical area of study and potential offshore wind zones in Tamil Nadu.

It is recognised that there many other settlements and employment will flow to other districts within the state. Numerical analysis and opportunity are not limited to just the geographical study area.

Projected skills demand for offshore wind



A wide range of skills are required through the lifecycle of an offshore wind project, from early-stage development to decommissioning after an operational life of about 30 years. The previous BVGA report Socioeconomic impacts and skills development for Indian offshore wind examines the gross value add and employment for Tamil Nadu state and the rest of India for a single 1 GW project and a wider pipeline of projects. [4]The pipeline considered aligns with MNRE intention to auction 37 GW of OSW leases in India by the end of 2030.

While MNRE's 37 GW OSW lease target by 2030 provides an important long-term signal of ambition, it was established under earlier market conditions and is now widely regarded as aspirational. The deployment projection used for this study is shown in Figure 4 and sees India reach a cumulative capacity deployment of 25.5 GW by 2043, of which 20.5 GW is in Tamil Nadu. This projection reflects the absence of participation in initial tenders and broader global headwinds affecting the development of early-stage markets.

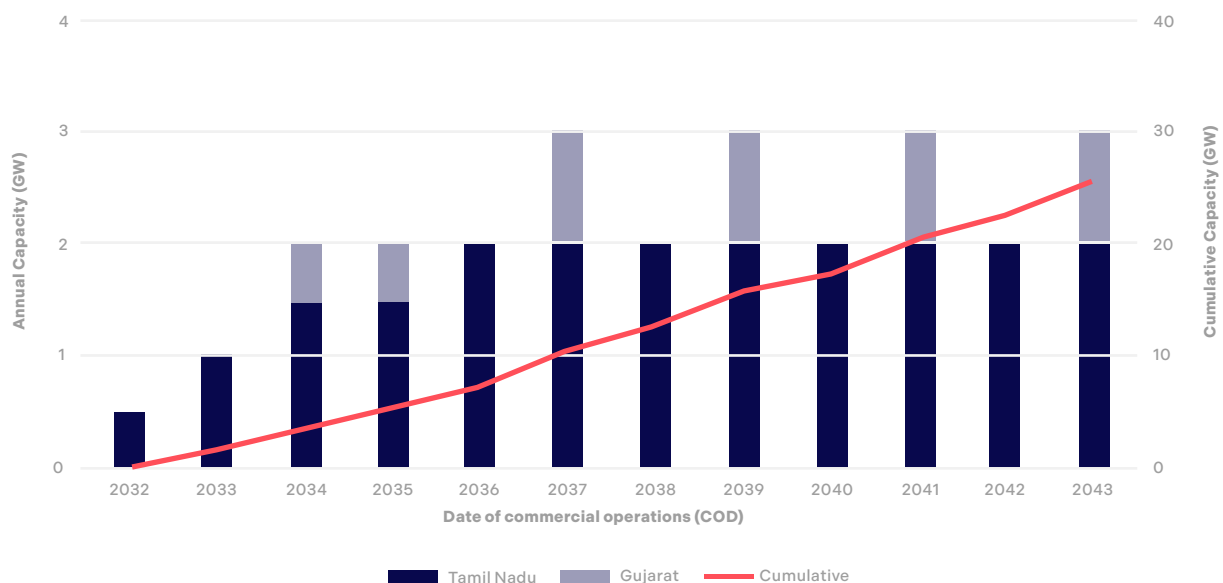


Figure 4: Annual and cumulative installed capacity forecast for India. Source: BVG Associates

To evaluate demand, it is helpful to break a project down into lifecycle phases, then jobs into broad categories.

2.1 Project lifecycle phases

2.1.1 Development and project management

Development and project management include activities required to secure planning consents, such as the environmental impact assessment, as well as the design, engineering and project management of the wind farm through to the start of operation. This phase of wind farm development is typically high in local content. Developers often rely on local lawyers and through to

biodiversity survey firms but may set up a local office as project development progresses as specific local knowledge is often required. Tamil Nadu has a relevant capabilities, so a similar locally driven development approach would be expected. It is assumed that for a 1 GW project, the development and project management phase will occur over seven years.

In this phase key roles include most of those in the environmental and mechanical design and management categories (see Section 2.2).

2.1.2 Manufacturing

This phase encompasses the supply of turbines and the balance of plant components. Turbine supply includes the fabrication of towers, nacelles, generators, and blades, while the balance of plant covers all other components necessary for the wind farm, including foundations, cabling, and substations. It is assumed that for a 1 GW project, the manufacturing phase will occur over three years,

For the pipeline shown in Figure 4, the political intent shown and reflecting the opportunities for export from competitive Indian facilities, it has been assumed that the following coastal manufacturing facilities will be established in Tamil Nadu:

- Towers, established in 2033
- Blades, established in 2033
- Nacelle assembly, established in 2035
- Monopile foundations, established in 2033, and
- Array cables, established in 2034.

Report Socioeconomic impacts and skills development for Indian offshore discusses the logic and prerequisites for establishing such facilities, including adequate port infrastructure and sustained industry appetite for investment. Where these conditions are met, there is potential for more OSW services to be offered. The commercial date of operations for these facilities has been updated in line with the forecast used in this report. It may be that a different combination of facilities are established that may include manufacture of export cables.

Each facility is assumed to have a maximum annual production capacity, which is first used to meet demand in Tamil Nadu, with any remaining capacity allocated to Gujarat, the other major state with a significant OSW interest and therefore a logical secondary market for component supply. Any remaining capacity after meeting domestic demand is assumed to be exported.

Table 2 outlines the annual facility production capacity assumptions for each facility. It is assumed that all facilities will be supplying components suitable for turbines with an 18 MW to 20 MW turbine rating. For towers, blades, nacelles, and turbine foundations, this equates to a production capacity of 1.8 GW to 2 GW per facility. In the case of array cables, it is assumed that the manufacturing facility will also serve other sectors, with 50% of its output allocated to OSW, which will still be enough to meet demand in the peak year of deployment.

In this phase mechanical practical and related management roles dominate.

Table 2: Manufacturing facility assumptions, annual production capacity.

Component	Annual production capacity
Towers	100 towers
Blade	300 blades
Nacelle assembly	100 nacelles
Monopile foundation	100 monopiles
Array cable	700 km of cable

2.1.3 Installation and commissioning

The installation and commissioning phase involves the transportation of wind farm components from the construction port to the project site, and the on-site works to install turbines and associated electrical equipment, making them ready for generation. It is assumed that for a 1 GW project, the installation and commissioning phase will occur over four years.

In this phase, again mechanical practical and related management roles dominate, along with a peak in port and logistics and maritime roles.

2.1.4 Operation

This includes the operation of the wind turbines, balance of plant, and associated transmission assets. It is assumed that for a 1 GW project, this phase will span over 30 years.

In this phase mechanical practical and related management roles continue to dominate.

2.1.5 Decommissioning

Decommissioning involves the removal or making safe of offshore infrastructure at the end of its useful life. Turbines, foundations, cables, and substations must be removed and shipped to shore. Decommissioning will involve similar skills and contractors to those used in the installation and commissioning phase of the OSW farm. Because decommissioning practices could evolve over the operating life of the wind farm, employment needs may reduce by the time projects are decommissioned, starting in about 40 years' time.

In this phase, key job roles match those in the installation and commissioning phase.

2.1.6 Typical distribution of employment across the project lifecycle

A typical distribution of direct and indirect Indian jobs across the project lifecycle for a 1 GW project installed in 2041 in Tamil Nadu is shown in Figure 5. It shows a project commissioned in 2041 to capture the economic benefits associated with well-developed supply chain capabilities, as expected in Tamil Nadu by then.

Total employment generated in India over the project lifetime is about 45,400 FTE years. 5% of this is in development and project management, 52% in manufacturing, 9% in installation, 27% in operations and 7% in decommissioning.

Over time, later projects tend to create more employment as localisation continues but somewhat less as a significant route to cost of energy reduction is reduced employment.



Figure 5: Indian direct and indirect employment impacts of a single 1 GW project in Tamil Nadu, split by year and project lifecycle. Source: BVG Associates

As shown in Figure 6, of the 45,400 FTE years of Indian employment generated by the project, Tamil Nadu captures 61%, Gujarat 5% and the rest of India 34%. For Tamil Nadu, this is equivalent to 27,700 FTE years employment.

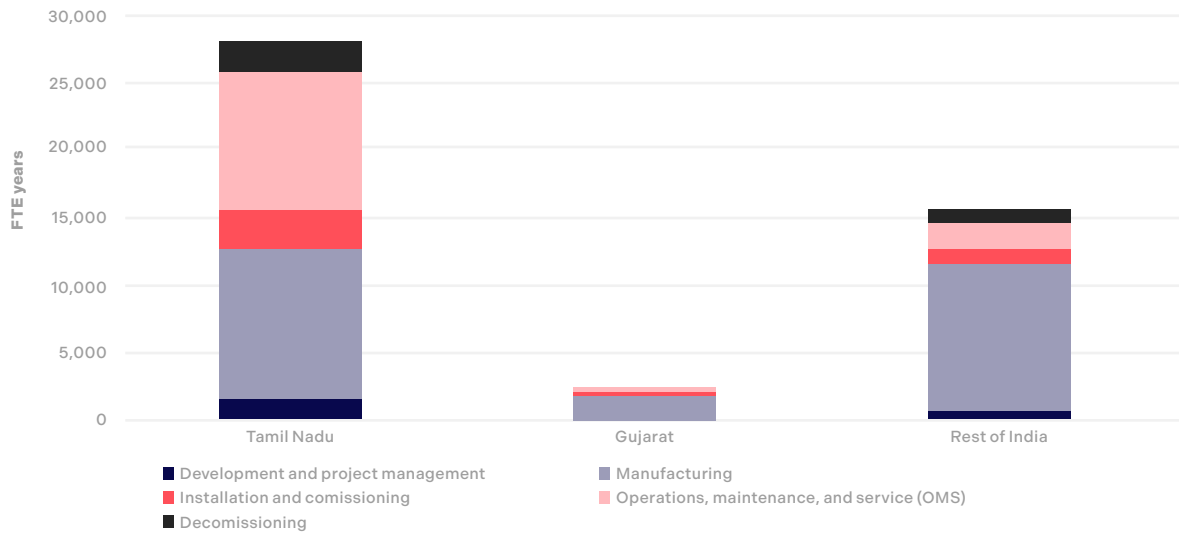


Figure 6: Direct and indirect employment impacts of a single 1 GW project in Tamil Nadu, split by region and project phase. Source: BVG Associates

2.1.7 Forecast employment for the Indian project pipeline

Figure 7 shows the employment created in Tamil Nadu across India's project pipeline shown in Figure 4. Total employment generated in Tamil Nadu for the project pipeline is about 535,000 FTE years over the lifetime of the projects. 6% of this is in development and project management, 35% in manufacturing, 12% in installation, 40% in operations, and 7% in decommissioning.

Of total employment created 45% are direct FTE years, associated with direct jobs created in development teams, tier 1 manufacturing facilities and in site and port activities, including ongoing operations. The remaining 55% are created in the supply chain to these activities.

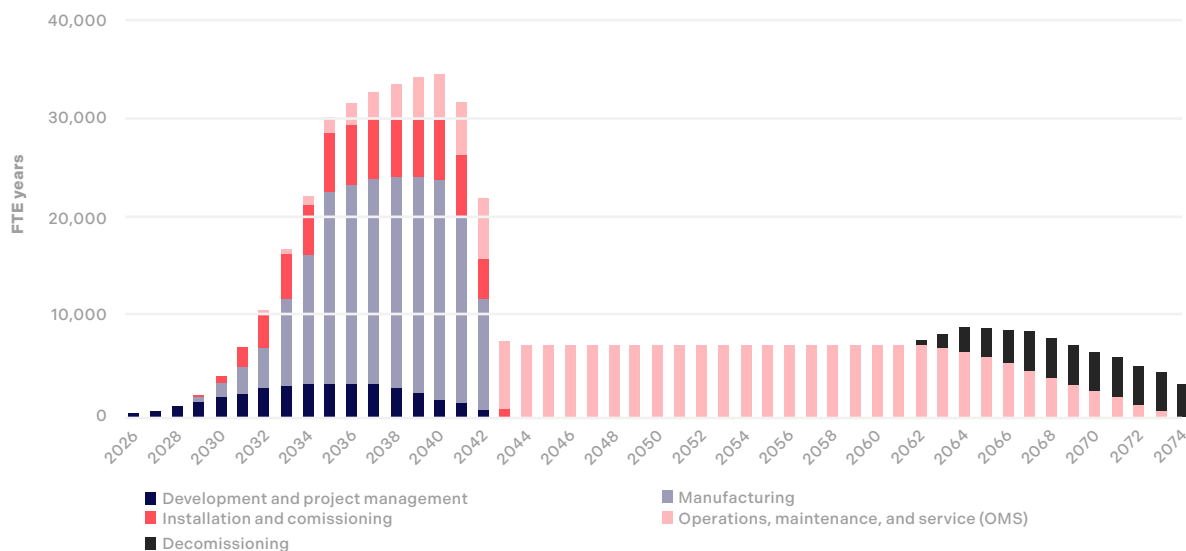


Figure 7: Tamil Nadu direct and indirect employment impacts of the pipeline of projects in Tamil Nadu, split by year and project phase. Source: BVG Associates

Employment impacts above are calculated assuming the first capacity becomes operational in 2032 and the final capacity becomes operational in 2043. If additional capacity comes online beyond this period, the impacts related to development, project management, and installation and commissioning are expected to continue past 2043, rather than drop off, as shown. The first capacity, operational in 2032, already creates employment in 2026.

Employment is broadly in line with a previous study published by OEP, though its basis does not enable a direct comparison.

2.1.8 Additional employment created

The focus of this analysis is the direct and indirect jobs created in the development, installation and commissioning and operation of installed capacity. It does not include other related activities that may also generate employment. These related activities include:

- Design, manufacturing, installation and operation of transmission network upgrades to transfer energy from the grid connection point to areas of demand.
- Design and manufacturing of tooling and vessels used on multiple projects
- Construction of port extensions and manufacturing facilities
- Design and delivery of the frameworks supporting offshore wind, covering especially the role of government and stakeholders relating to leasing, permitting, offtake contracts, grid connection and industry financing
- Induced activity, so jobs created indirectly as a result of increased economic activity and consumer spending generated by direct and indirect employment.

As such, the employment figures presented are conservative, and the actual number of jobs associated with OSW are expected to be higher.

2.2 Categories of jobs created

A wide range of different jobs are created, including:

- Data analysis: supports the collection and interpretation of data across the offshore wind lifecycle, including site assessment, environmental, geotechnical, and operational data to inform decision making and manage risk.

- Electrical design and management: designs and manages supply of electrical, supervisory control and data acquisition (SCADA) and control systems including within turbines, offshore substations, array cabling, and export system. This includes troubleshooting, technical oversight and support of operational reliability.
- Electrical practical: focuses on hands-on electrical work such as, assembly, installation testing, commissioning, inspection and maintenance of OSW electrical components like turbine power and auxiliary systems, cables and switchgear.
- Environmental: support environmental assessment, consenting, and monitoring activities including marine ecology, technical aspects of seabed and oceanography and impact mitigation.
- IT and communications: manages and carries out practical work on digital infrastructure, SCADA systems, and communication networks. This includes data platforms, control systems and cyber security supporting manufacturing and other offshore wind activities.
- Maritime: supports offshore and marine operations, including vessel operations, navigation, marine planning, lifting operations and offshore activities critical for transporting equipment and personnel to wind farm sites and installing/ maintaining assets.
- Management, administration and support: provides organisational management and business support functions, including procurement coordination, document control and general administrative support.
- Mechanical design and management: designs and oversees mechanical systems such as turbine components and balance of plant. This includes engineering design, troubleshooting and technical oversight. Supports operational reliability.
- Mechanical practical: performs hands-on mechanical activities including fabrication, assembly, installation, inspection, maintenance, and repair of OSW turbines and balance of plant components.
- Ports and logistics: coordinates and implements on-land value chain, including storage, handling and transport of OSW components through port facilities.
- Professional: provides specialist advisory services, includes legal, financial, quality and health and safety activities that support OSW.

- Project management: plans, integrates and controls project delivery activities, including timelines, budgets, risk, contracts, activities and stakeholder coordination from through the project lifecycle.
- Other support services: provides practical, non-technical services that support OSW activities, such as accommodation and catering, security, cleaning and facility management.

Table 3 summarises for each category of jobs:

- Pipeline employment demand to 2074
- Which project phases most of the employment is in

Of overall employment created by the Indian project pipeline in Tamil Nadu, demand is highest in electrical practical and mechanical practical related roles. The demand roles within this category occur across all project phases but are largely concentrated within the manufacturing and operational phases. Of the total pipeline demand for mechanical practical roles, 49% is expected to occur within the manufacturing phase. For electrical practical roles, employment is highest in the operational phase, accounting for 46% of total FTE year demand.

Ports and logistics, maritime, and management and support roles also show relatively high demand, with employment occurring in all phases, with a notable concentration in manufacturing and operations. High demand for support services roles reflects the wide range of non-technical supporting activities required for OSW.

Appendix A provides a breakdown of 76 job roles within these job categories, for each presenting:

- Lifecycle phases the role is relevant to
- Description
- Job category
- 2023 revised Indian National Skills Qualifications Framework (NSQF) level, and
- Skills and qualifications typically sought
- The jobs in Appendix A job roles, chosen as examples that include roles:

Table 3: Employment demand for each job category.

Job category	Pipeline employment demand to 2074 ²	Project phases ³
Data analysis	Q	D, M, I&C, O* DE
Electrical design and management	QQ	D, M*, I&C, O* DE
Electrical practical	QQQ	D, M*, I&C, O* DE
Environmental	Q	D, M, I&C, O* DE
IT and communications	Q	D, M, I&C, O* DE
Management, administration and support	QQ	D, M*, I&C, O* DE
Maritime	QQ	D, M, I&C, O* DE
Mechanical design and management	Q	D, M*, I&C, O DE
Mechanical practical	QQQ	D, M*, I&C, O DE
Ports and logistics	QQ	D, M*, I&C, O*, DE
Professional	Q	D, M*, I&C, O*, DE
Project management	Q	D, M*, I&C, O*, DE
Other support services	QQ	D, M*, I&C, O*, DE

2 D = development and project management, M = manufacturing, I&C = installation and commissioning, O=operations, DE = decommissioning. * indicate phases where a significant share of employment occurs, where * represents >30% of total FTE years created is in that category.

3 Key, Q = up to 30, 000 FTE-years of employment. QQ = 30, 000 to 60, 000 FTE-years of employment. QQQ = over 60, 000 FTE-years of employment.

- Relevant to fishers and other local communities
- That may be harder to fill, so are good examples in assessing the capability of the education system in Tamil Nadu.

There are many other job roles within the categories listed that will provide opportunities for employment. Ultimately, the roles that are made available locally will depend on the needs of the specific project developers and suppliers active in each project.

It should be recognised that these demand figures are indicative, apply over a long period of time and are for the whole of Tamil Nadu, assuming manufacturing facilities are established in line with report Socioeconomic impacts and skills development for Indian offshore wind.

Appendix A also provides a summary of Indian NSQF levels, for reference. The use of NSQF levels provides businesses, education and training establishments and administrations a standardised way of communicating about skill levels. It is recognised that it does not capture nuances of any job role.

STEM skills enhancement for school children



3.1 Introduction

Building strong STEM foundations in school-age children is essential for creating a future workforce capable of supporting India's emerging OSW industry. Early exposure to science, technology, engineering and mathematics not only strengthens cognitive and problem-solving abilities but also shapes long-term interest in technical careers. Establishing clear development pathways at the school level ensures that young learners, particularly those in coastal regions of Tamil Nadu, can progress into higher education and vocational routes that align with the needs of the OSW sector.

This section identifies the development pathways for the STEM skills required for developing a thriving OSW industry in India. It is divided as follows:

- Section 3.2 STEM knowledge and soft skills requirements for OSW: Provides an overview of the predicted job role demands in OSW in Tamil Nadu and identifies the skill requirements of these job roles.
- Section 3.3 Local education capacity: Provides an overview of the access to education in the main OSW regions within Tamil Nadu and opportunities and barriers relating to STEM.
- Section 3.4 Development pathways for STEM skills: Identifies the different development pathways for STEM skills in school children.
- Section 3.5 Recommendations for STEM skills enhancement: Provides recommendations for the advancement of an OSW local workforce.

3.2 STEM knowledge and soft skills requirements for offshore wind

3.2.1 STEM knowledge requirements for offshore wind

Table 3.1 highlights the wide spectrum of STEM competencies and soft skills that different OSW job roles require. Many of the listed knowledge areas such as physics, mathematics, coding, environmental science and design principles build directly on concepts introduced in primary (including middle school (class 1 to 8) and secondary (including higher secondary (class 9 to 12) education. Schools that teach these subjects with sufficient depth, practical, hands-on application and relevance to OSW enable students to progress into vocational, technical and higher education pathways aligned with OSW careers.

In parallel, many OSW job roles also depend on strong soft skills, including communication, teamwork, leadership, problem-solving, and stakeholder engagement, across all NSQF levels and job categories. Educators develop these competencies most effectively through approaches that mirror the same emphasis on applied learning such as experiential activities, project-based tasks, interdisciplinary problem-solving, and real-world exposure ensuring that both technical and soft-skill foundations are built consistently throughout schooling.

Table 4: STEM knowledge and soft skills required across job categories for an offshore wind project..

Job category	Example jobs	Key STEM knowledge areas	Core soft skills	NSGQ Level
Data analysis	Data analyst, financial analyst, GIS technician and resource analyst	Maths, statistics, data science, geospatial analysis and programming	Analytical thinking, attention to detail and communication skills	6 to 7
Electrical design and management	Electrical engineer and jointing and testing engineer	Maths, physics, electrical engineering, electrical systems and control systems	Project management, problem-solving and collaboration, innovation and attention to detail	7
Electrical practical	Electrical technician, offshore commissioning supervisor and Senior Authorised Person	Electrical systems	Teamwork and adaptability, attention to detail	4 to 6
Environmental	Environmental monitoring assistant, geophysicist, hydrographer, marine ecologist, oceanographer and ornithologist	Maths, biology and environmental science	Stakeholder engagement, critical thinking and reporting	7
IT and communications	Communications network technician, control room supervisor and IT manager	Networking, software engineering and control systems	Troubleshooting, communication and adaptability, attention to detail	4 to 6
Management, administration and support	Finance & cost control, fishing and community liaison officer, HR, training and workforce planning, marketing, sales and business development, support staff - catering / administration and support staff - security / waste management	Maths	Leadership, teamwork, decision-making and stakeholder coordination	3 to 7
Maritime	Carousel / tension operator, chief- and deck officers, crew transfer vessel / safety boat master, deck hand / vessel crew, harbour pilot, major vessel master / captain, marine warranty surveyor / client representative, medic, ROV technician and vessel master's mate	Navigation systems, mechanical and electrical systems	Situational awareness, resilience, and teamwork and adaptability	3 to 7
Mechanical design and management	Asset integrity manager, CAD technician, civil engineer, geotechnical engineer, manufacturing manager, mechanical engineer, production/team supervisor, stores/warehouse manager and structural engineer	Maths, physics, mechanics, computer aided design (CAD), materials science and fluid dynamics	Project management, problem-solving and collaboration, innovation and attention to detail	5 to 8

Job category	Example jobs	Key STEM knowledge areas	Core soft skills	NSQF Level
Mechanical practical	Blasting and coating technician, equipment service technician, machine operator, mechanical technician, process coordinator, production operative, rope access and blade repair technician stores/warehouse operative, vessel maintenance technician and welder	Physics, mechanical systems	Teamwork and adaptability, attention to detail	3 to 4
Ports and logistics	Crane and rigging inspector, crane operator, crew manager, heavy lift supervisor, logistics coordinator and manager, marine coordinator, operations risk manager, port / transport / lifting operative and vessel supervisor	Maths, physics, engineering	Organisation, time management and communication	3 to 6
Professional	Health and safety manager, legal counsel and quality manager	Maths, finance	Leadership, negotiation and strategic thinking	7 to 8
Project management	Administrative support manager, bid manager, commercial manager, communications and engagement coordinator, consents manager, offshore ESIA manager, procurement/supply chain manager, project director, project manager and site manager	Systems engineering, budgeting, scheduling and risk management	Leadership, teamwork, decision-making and stakeholder coordination	7 to 8

3.3 Local education capacity in Tamil Nadu

3.3.1 Educational profile in priority regions

The Tamil Nadu Skill Gap Report shows that the state outperforms the national average on literacy with an overall literacy rate of 80% compared to 74% across India.[5] Male literacy reaches 87%, while female literacy stands at 74% highlighting both strong attainment and ongoing gender gaps. Despite this progress, 25% of the working-age population has no formal education, and only 7% hold graduate or postgraduate qualifications, pointing to relatively weak progression beyond basic schooling or that higher education relies on vocational, technical and professional pathways not just universities.

Literacy outcomes vary widely across districts as shown in Table 5. Kanniyakumari stands out with high literacy among both women and men (90% and 94%), while districts such as Thoothukudi and Pudukottai record much lower female literacy, at below 70%. In every district, male literacy exceeds female literacy, mirroring the state-level pattern. These disparities underline uneven educational outcomes across Tamil Nadu and highlight the need for targeted action to improve girls' participation and progression in education.

Table 5: Literacy rates in selected districts in Tamil Nadu

District	Literacy rate – female (%)	Literacy rate – male (%)
Kanniyakumari	90	94
Tirunelveli	76	90
Thoothukudi	69	85
Ramanathapuram	75	88
Pudukottai	70	86
Thanjavur	77	89
Nagapattinam & Mayiladuthurai	78	90
Whole of Tamil Nadu	74	87

Table 6 shows consistently high primary enrolment across districts, with rates around or above 98%, indicating strong access to early schooling. Kanniyakumari and Ramanathapuram lead with near-universal enrolment. Most districts have low primary dropout rates, generally below 3% and often lower than the state average of 4%.

Dropout rates rise sharply at the upper-primary level. Districts such as Thoothukudi, Ramanathapuram, Thanjavur and Nagapattinam record upper-

primary dropout rates between 6% and 8%, with Thoothukudi at 7.7%, close to the state average of 7.6%. These trends show that while Tamil Nadu succeeds in enrolling students, it struggles to retain them beyond the primary stage.

Table 6: Dropout rate and primary school enrolment for selected districts in Tamil Nadu from 2011 census data.

District	Primary enrolment (%)	Primary dropout rate (%)	Upper primary dropout rate (%)
Kanniyakumari	99	2	2
Tirunelveli	99	1	4
Thoothukudi	98	3	8
Ramanathapuram	99	2	7
Pudukottai	99	3	5
Thanjavur	99	2	6
Nagapattinam	98	3	7
Whole of Tamil Nadu	98	4	8

Overall, Tamil Nadu has built a solid foundation in access and basic literacy, but retention and learning quality at the secondary level remain key challenges. Strengthening secondary education is therefore helpful in preparing students for vocational pathways, technical education and skill-intensive sectors like OSW.

3.3.2 Secondary school suitability

Schools in Tamil Nadu offer a variety of curricula, including the Tamil Nadu State Board (TNSB), Central Board of Secondary Education (CBSE), Indian Certificate of Secondary Education (ICSE), and International Baccalaureate (IB). At present, only three schools in the selected region follow the IB curriculum, while the other three curricula are widely distributed across districts, with TNSB being the most prevalent in each selected region. All curricula in Tamil Nadu from class 6 to 10 and in class 12 incorporate STEM subjects, though the depth and emphasis of these subjects vary by curriculum.

Schools following the TNSB curriculum constitute the vast majority in all of these districts, so this analysis of STEM focus in the existing curricula concentrates on TNSB schools.

The overall performance data for secondary schools in Tamil Nadu in Table 7 shows a high pass percentage across the state, with 95% of students successfully completing their examinations. The breakdown by school type reveals important differences in capability. Private schools achieve a pass rate of 99%, significantly higher than the 92% recorded in government schools. This gap indicates that while the state’s examination system enables most students to pass, government schools particularly those in rural districts face greater challenges in delivering consistent STEM learning quality. As a result, strengthening STEM capacity within government-run TNSB schools is essential for improving equitable access to high-quality STEM education and ensuring that students across all districts can progress into technical pathways relevant to the offshore wind sector.

Table 7: Pass rates for secondary schools in Tamil Nadu by type of school

Metric	Pass rate (%)
Government school	92
Private school	99
Aided school	96
All schools	95

Tamil Nadu’s STEM education system operates under the Samacheer Kalvi (Equitable Education) framework, designed to ensure curriculum uniformity across all districts.

The framework encompasses science subjects (Physics, Chemistry, and Biology), mathematics and technology subjects. This standardised curriculum applies to classes 9 to 12 in both government and government-aided schools. The state mandates uniform textbooks, clearly defined learning outcomes, and consistent examination standards across all districts to promote educational equity.

STEM education quality varies significantly across Tamil Nadu’s districts, primarily due to inadequate physical and instructional resources. Government schools in rural areas frequently lack functional laboratories and essential teaching materials. Consequently, a substantial quality gap exists between metropolitan and rural areas, with rural regions facing considerable capacity limitations in STEM education delivery.

Although pass rates are high, above 99% for all STEM subjects, these figures do not necessarily reflect the depth of students' conceptual understanding or their practical STEM readiness. The Samacheer Kalvi system's standardised examinations emphasise predictable, theory-based assessments that students can often complete through memorization. In rural districts, where schools frequently lack functional laboratories and adequate teaching resources, students may achieve high exam scores but still have limited exposure to hands-on scientific inquiry or applied problem-solving. As a result, significant disparities in STEM learning quality persist despite uniformly high pass percentages.

- Overall, the school system in Tamil Nadu is stronger than in many Indian states, but has room for improvement in STEM education, especially relating to facilities in more rural areas.
- The system can provide sufficient numbers of students to fill anticipated local OSW roles.
- Targeted improvements and the use of teaching materials relevant to the wind industry will, however, help increase the pool of students interested in careers in OSW and with relevant base skills to build on as they move to higher education or entry-level roles.

3.3.3 Higher education capability

The higher-education system in Tamil Nadu provides an essential bridge between school-level STEM learning and the specialised technical skills required in OSW job roles. The region has a wide range of institutions offering programmes relevant to OSW job categories, including engineering colleges, polytechnic institutes, maritime academies, IT and management schools, and universities with strong engineering, environmental science and geoscience departments. Table 8 gives an overview of the higher educational capacity within Tamil Nadu for each job category.

The distribution of these institutions is uneven, however. While metropolitan centres such as Chennai, Coimbatore and Tiruchirappalli offer extensive engineering and technical programmes, access to OSW-relevant courses becomes more limited in the coastal districts where OSW development will be concentrated. Programmes in areas such as marine engineering, geospatial analysis, renewable-energy engineering, offshore safety, and advanced manufacturing remain concentrated in a relatively small number of universities and specialised academies. This geographic imbalance creates a mismatch between where OSW projects will be located and where students can currently access advanced STEM and technical training. Students can migrate for training but relying on migration reduces the opportunities for coastal students and weakens the development of a stable local OSW workforce.

Despite these gaps, Tamil Nadu's higher-education system provides a strong foundation on which to build OSW-specific capability. Many existing engineering and science programmes already include core subjects such as fluid dynamics, materials science, power systems, environmental science, and data analytics that map directly to OSW job requirements. Strengthening industry partnerships, expanding practical training infrastructure, and introducing wind industry-focused modules or electives will enhance the role these institutions can play in preparing a skilled local workforce.

Much of the job-specific learning that will be required will be provided by wind industry employers. What they seek most is:

- Employment-ready staff with a strong base technical knowledge in relevant areas
- The aptitude to apply knowledge and learn fast in new environments
- The attitude needed to take responsibility and succeed in a busy team in a commercial environment.

Table 4: STEM knowledge and soft skills required across job categories for an offshore wind project...

Job category	Relevant institutions (examples only)	Available courses/ programmes (examples only)	Infrastructure and facilities	Existing industry partnerships relevant to OSW
Data Analysis	Anna University Tirunelveli, IIT Madras (online)	BSc data science, M.Tech AI, PG diploma in data analytics, AI/ML certificate courses (online)	Data labs, coding training, cloud computing access, computer labs with AI/ML software	Infosys, TCS iON, IBM SkillsBuild, NASSCOM members
Electrical Design and Management	University VOC College of Engineering (Thoothukudi), Dr. GU Pope College (Thoothukudi), Government College of Engineering (Tirunelveli), Mohamed Sathak Engineering College (Ramanathapuram)	BE electrical and electronics engineering, M.Tech power systems, electrical design	Advanced electrical laboratories, simulation software, power system testing equipment	TCS, Infosys, Siemens, ABB, Schneider Electric, Larsen & Toubro
Electrical Practical	Government Polytechnic College (Thoothukudi), Chandy Polytechnic (Thoothukudi), Sri Muthalman Polytechnic (Ramanathapuram), Government Polytechnic (Tirunelveli)	Diploma in electrical and electronics engineering (3 years), Electrical Technician	Workshop facilities, electrical testing equipment, hands-on training labs	Local manufacturing units, electrical contractors, power distribution companies
Environmental	Nadu Dr. J. Jayalalithaa Fisheries University - College of Energy and Environmental Engineering (Nagapattinam), Sir Isaac Newton College (Nagapattinam)	BE environmental engineering, B.F.Sc (fisheries), marine sciences, coastal zone management, environmental management	Environmental testing labs, water quality analysis facilities, coastal research centres, marine biology labs	Environmental consultancies, Thoothukudi Port Authority, Fisheries Department, NGOs
IT and Communications	Dr. Sivanthi Aditanar College of Engineering (Thoothukudi), Jayaraj Annapackiam CSI College (Thoothukudi), Sir Isaac Newton College (Nagapattinam), Anna University College of Engineering Thirukkuvilai (Nagapattinam), PET Engineering College (Tirunelveli)	BE information technology, BE computer science, B.Tech IT, MCA, network administration	Computer labs, networking labs, servers, cloud infrastructure, programming studios	TCS, Infosys, Wipro, HCL, IBM, Tech Mahindra, local IT startups
Management, administration and support	Xavier Institute of Business Administration (Tirunelveli), Government Arts College for Women, Ramanathapuram	B.B.A (finance/marketing)		

Job category	Relevant institutions (examples only)	Available courses/ programmes (examples only)	Infrastructure and facilities	Existing industry partnerships relevant to OSW
Maritime	Sunva Maritime Academy (Thoothukudi), Tamil Nadu Maritime Academy (Thoothukudi), Tamil Nadu Dr. J. Jayalalithaa Fisheries University (Nagapattinam)	BSc nautical science, maritime training courses, pre-sea training (general purpose ratings), ship security training, deck officer	Navigation simulators, ship handling simulators, maritime library, classroom facilities, hostel accommodations	Directorate General of Shipping (DG Shipping), Thoothukudi Port Authority, Shipping corporations, Indian Navy
Mechanical Design and Management	National Engineering College (Thoothukudi), Jayaraj Annapackiam CSI College (Thoothukudi), Mohamed Sathak Engineering College (Ramanathapuram), Government College of Engineering (Tirunelveli)	BE mechanical engineering, M.Tech mechanical engineering, mechanical design courses, CAD/CAM	CAD labs, CNC machines, machine shops, testing rigs, materials testing facilities, workshops	Larsen & Toubro, Bosch, Timken, Caterpillar, automotive industry partners
Mechanical Practical	Lakshmi Ammal Polytechnic (Kovilpatti), Jayaraj Annapackiam CSI Polytechnic (Tiruchendur), Government Polytechnic (Tirunelveli)	Diploma in mechanical engineering, mechanical technician courses, CNC/machining	Machine shops, CNC machines, lathe machines, welding shops, practical training labs	Manufacturing firms, automotive component suppliers, construction companies
Ports and Logistics	Tamil Nadu Maritime Academy (Thoothukudi), Tamil Nadu Dr. J. Jayalalithaa Fisheries University (Nagapattinam), Thoothukudi Port Trust	Maritime-port logistics, port operations management, supply chain management, shipping	Port operations simulation, cargo management systems, supply chain software, library facilities	Thoothukudi Port Authority, Nagapattinam Port, Shipping companies, Logistics providers
Professional/ Management	SCAD College of Engineering and Technology (Tirunelveli), Mohamed Sathak Engineering College (Ramanathapuram), Holy Cross College of Management (Ramanathapuram)	MBA (finance, HR, marketing, operations), BBA, management studies, hotel management	Management labs, case study centres, business simulation software, conference halls	TCS, Infosys, Finance sector companies, Hotel chains, Corporate management firms
Project Management	SCAD College of Engineering and Technology (Tirunelveli), PSN College of Engineering (Tirunelveli), Anna University affiliated colleges	MBA with project management specialization, PMP certification, project management diploma, business analytics	Project management tools access, case study labs, business software, training facilities	TCS, Infosys, Project Management firms, Consulting companies, Construction sector

3.4 STEM opportunities and development paths

3.4.1 Existing opportunities and barriers to expanding STEM education

Local education establishments as listed in Table 9 were engaged with and publicly available data was used including the Naan Muldhalven, the National Skill development mission, to capture the existing opportunities and barriers to expanding STEM education and analyse the typical education and career opportunities for local STEM students.

Table 9: Stakeholders engaged for feedback on existing opportunities and barriers, typical education opportunities and development pathways

Name of organisation	Type of organisation	Role/designation interviewed
Save the Children	NGO	Field Training officers
WASH Institute	NGO	Project manager
Indian Red Cross Society	NGO	Field training officers
Tamil Nadu Government school, Avadi	Government	Teachers

Feedback was that Tamil Nadu has a relatively strong foundation for STEM education, supported by a network of government schools, active NGOs, and state-level skill development initiatives. The availability, quality, and accessibility of STEM learning opportunities, however, vary significantly across districts and socio-economic groups. Insights from stakeholder consultations highlight a mix of promising initiatives such as experiential learning programmes, digital learning platforms, and targeted skill development schemes alongside persistent barriers including infrastructure gaps, limited teacher training, uneven exposure to practical science, and low awareness of emerging technical career pathways such as offshore wind.

The predominant pedagogical approach remains heavily theoretical and exam-oriented, focusing on securing marks rather than developing conceptual understanding. This proves particularly problematic for mathematics instruction, which multiple teachers identified as a critical barrier to STEM progression when taught theoretically without real-world applications.

Teachers acknowledged limited familiarity with emerging technologies (such as wind energy) and stressed that “proper expert training is essential before we teach students”. One Government teacher observed, “renewable energy is mentioned briefly in textbooks, it appears in one chapter of environmental science. There’s no comprehensive explanation.”

Another stakeholder advised “if we incorporate application-based practical knowledge with curriculum updates on emerging technologies, it could significantly change student interest and prepare Tamil Nadu’s youth for opportunities in the offshore wind sector.”

In addition, Tamil Nadu’s maritime universities offer no dedicated courses in offshore wind energy. Marine curricula demonstrate strong theoretical instruction but limited practical exposure, with many marine institutes located inland rather than in coastal areas. Historical comparison reveals that earlier, some marine institutes, such as the Central Marine Fisheries Research Institute, provided regular sea exposure, whereas current expansion to 10 to 15 institutes has reduced practical training opportunities. No certificate-level skill courses exist yet specifically for offshore wind operations.

3.4.2 Local opportunities and typical education and career opportunities for local STEM students

Tamil Nadu’s school system performs better than that of many other Indian states and provides a solid foundation for STEM learning. However, stakeholder consultations show that gaps persist particularly in rural and coastal districts where schools lack adequate laboratory facilities, digital tools, and opportunities for applied science. Stakeholder highlights that whilst the curriculum covers the fundamental concepts in physics, chemistry, and biology, renewable energy topics receive minimal attention, appearing briefly in passing, rather than as comprehensive dedicated units. Despite these challenges, the system is expected to produce enough students to meet the anticipated demand for local OSW roles. Strengthening practical STEM delivery and integrating wind-industry-relevant teaching materials will, however, expand the pool of students who show interest in OSW careers and who enter higher education or entry-level roles with stronger foundational skills.

After secondary school, STEM students typically pursue engineering degrees, polytechnic diplomas, or undergraduate science programmes. These pathways again deliver strong theoretical grounding, but practical exposure and industry alignment remain inconsistent. It is observed that, over time, students increasingly gravitate towards science and technology fields, such as data science and AI, as these sectors grow. It is also observed that many students struggle with mathematics because it is taught theoretically without demonstrating practical application, such that mathematical proficiency becomes a barrier.

Many students receive limited career guidance and have little awareness of emerging sectors such as renewable energy, leading them to favour traditional engineering fields. Female students often face additional mobility and socio-cultural constraints that shape their educational and career choices. Improving counselling, increasing visibility of OSW career options, and strengthening linkages between schools, colleges, and industry will help address these gaps and create clearer pathways into OSW-related fields.

Although the education system supplies the base talent pipeline, employers in the OSW sector provide most job-specific training. Industry representatives consistently state that they seek candidates with strong foundational technical knowledge, the ability to apply concepts quickly in new environments, and the capacity to learn rapidly as technologies evolve. They also emphasise the importance of attitude; students who take responsibility, work effectively in busy teams, and adapt to commercial pressures succeed more readily in OSW roles. Strengthening early STEM pathways therefore not only increases the number of potential OSW candidates but also improves their readiness for industry-led training and long-term career development. Examples of pathways for five OSW jobs are provided in Section.

3.4.3 Overview of five example development pathways

To illustrate how students in Tamil Nadu can progress from early STEM exposure to specialised OSW careers, this section presents a series of example development pathways for roles across the OSW value chain.

These pathways show how learners typically build foundational STEM skills, gain contextual understanding of renewable energy, and transition into further education, technical training, and early career roles. They also highlight the points at which industry engagement, practical experience, and targeted skilling can accelerate readiness for OSW employment.

Examples are provided in Table 10 to Table 14 for a Mechanical technician, Civil engineer, Offshore environmental and social impact assessment ESIA manager, Production or team supervisor, and Senior Authorised Person (SAP) – an electrical safety role. The pathways illustrate the principles of progressive skill development, increasing industry exposure, and structured upskilling that together form a coherent pipeline into OSW careers. Note that multiple routes to any job role (and on from that job role) exist and that few activities in any pathway are mandatory. Activities that would be expected in most cases are underlined.

3.5 Recommendations for STEM skills enhancement in schools

To maximise the opportunities for students to get involved in OSW, the following recommendations are made to be validated through follow-up engagement prior to implementation:

1. The Tamil Nadu Skill Development Corporation (TNSDC) and Tamil Nadu State Council of Educational Research and Training (TN SCERT) work with the Naan Mudhalvan scheme to extend existing STEM skill development programmes and NGO STEM laboratory programmes to incorporate renewable energy technology. This expansion through Naan Mudhalvan's curated course and partnership framework would facilitate more application-based learning, enabling students to gain more practical knowledge and clearer pathways into OSW-aligned vocational, technical, and higher-education options.

Table 10: Overview of an example development pathway: mechanical technician.

Development step	Age range	Example activities
Foundational STEM skills	6 to 14 (primary & lower secondary)	Hands-on science experiments (basic mechanics, energy concepts) and school projects on wind energy
Contextual learning	14 to 16 (middle secondary)	Renewable energy and mechanical topics in physics, other STEM and wider classes Field visit to local wind farm and manufacturing facility for onshore wind and guest visits from engineers or technicians
Career awareness and industry engagement	15 to 17 (middle to upper secondary)	Career talks Job shadowing / work experience
Advanced skills and specialisation (upper secondary)	16 to 18 (upper secondary)	Vocational technician electives Mentorship programmes with industry partners
Further education	18+ (post-secondary education)	Polytechnic diploma or ITI courses in mechanical trades Safety workshops Apprenticeship with turbine supplier or contractor
Early career	21+	Junior / trainee technician on an onshore wind farm or in a nacelle assembly facility On-the-job training with specific systems and continuous upskilling Certifications: Global Wind Organisation (GWO) ⁶ Basic Safety Training, Working at Heights
Job role	24+	Further certifications On-the-job training with specific systems and continuous upskilling

6 Global Wind Organisation (GWO) is a non-profit body established in 2012 by leading wind turbine manufacturers and operators to create standardised safety and technical training for the wind energy sector. Its mission is to reduce risks and improve safety across the wind industry by ensuring that technicians and support staff meet consistent training standards. GWO collaborates with over 6,500 certified training providers/centres in more than 55 countries, and its training records are maintained in the WINDA database, a global registry used by employers to verify qualifications. By aligning training across the value chain, GWO helps ensure that personnel can move between projects and regions with minimal retraining. This standardization supports workforce mobility in a rapidly expanding global offshore wind market.

Table 11: Overview of an example development pathway: civil engineer.

Development step	Age range	Example activities
Foundational STEM skills	6 to 14 (primary & lower secondary)	Hands-on maths and physics activities (forces, structures) Model-building projects (bridges, towers) Environmental awareness activities
Contextual learning	14 to 16 (middle secondary)	School projects on coastal infrastructure or renewable energy Renewable energy and engineering topics in physics, other STEM and wider classes such as geography Applied physics modules on materials, loads, and energy Visits to construction sites or ports
Career awareness and industry engagement	15 to 17 (middle to upper secondary)	Career talks from civil engineers Short work placements with local construction firms Participation in STEM competitions
Advanced skills and specialisation	16 to 18 (upper secondary)	Electives in advanced maths, design and technology Mentorship from engineering students or professionals Introductory CAD workshops
Further education	18+ (post-secondary)	Diploma or bachelor's degree in civil engineering Modules on geotechnics, structural engineering, coastal engineering Internships with infrastructure developers, EPC firms, or ports Safety and site readiness training
Early career	21+	Graduate engineer roles in construction, ports, or infrastructure projects Exposure to marine works, foundations, and heavy lift operations Training in QA/QC, site supervision, and HSE
Job role	24+	Civil engineer specialising in marine structures, foundations, or port upgrades for offshore wind Professional certification Continuous upskilling in offshore standards and digital tools

Table 12: Overview of an example development pathway: offshore environmental and social impact assessment manager.

Development step	Age range	Example activities
Foundational STEM skills	6 to 14 (primary & lower secondary)	Environmental science clubs Nature based learning (ecosystems, biodiversity) Basic data interpretation and mapping activities
Contextual learning	14 to 16 (middle secondary)	Environmental science, geography, and biology modules Projects on coastal ecosystems, climate change, or pollution Environmental topics in STEM and wider classes such as geography Field visits to wetlands, coastal zones, or conservation sites
Career awareness and industry engagement	15 to 17 (middle to upper secondary)	Talks from environmental scientists, ecologists, and planners Participation in citizen science projects Short internships with NGOs or local environmental departments
Advanced skills and specialisation	16 to 18 (upper secondary)	Electives in environmental management, geography, or biology GIS introduction workshops Mentoring from environmental professionals

Development step	Age range	Example activities
Further education	18+ (post-secondary)	Bachelor's degree in environmental science, marine biology, ecology, or geography Specialised modules in ESIA, marine ecology, environmental law Internships with consultancies, regulators, or research institutes Training in GIS, data analysis, and field survey techniques
Early career	21+	Environmental analyst or junior consultant Experience in baseline surveys, stakeholder engagement, and permitting Training in offshore survey methods and impact assessment frameworks
Job role	24+	Offshore ESIA Manager leading multi-disciplinary assessments Coordination with regulators, communities, and technical teams Advanced certifications in project management, GIS, or marine ecology

Table 13: Overview of an example development pathway: production/team supervisor.

Development step	Age range	Example activities
Foundational STEM	6 to 14	Handson problem solving activities Team based projects (model building, simple manufacturing tasks) Basic numeracy and communication skills
Contextual learning	14 to 16	Exposure to manufacturing processes in school workshops Manufacturing topics in STEM and wider classes Visits to manufacturing facilities for onshore wind Modules on safety, quality, and basic engineering principles
Career awareness and industry engagement	15 to 17	Talks from production managers and supervisors Short internships in local manufacturing MSMEs Participation in vocational skills competitions
Advanced skills and specialisation	16 to 18	Vocational electives in manufacturing, welding, machining, or electrical trades Leadership and communication workshops Mentorship from industry supervisors
Further education	18+	Diploma or ITI in manufacturing, mechanical, or electrical trades Training in quality control, lean manufacturing, and safety Apprenticeships in turbine assembly, tower fabrication, or component manufacturing
Early career	20+	Operator or technician roles in manufacturing or assembly lines Experience in shift operations, quality checks, and team coordination Training in digital tools, ERP systems, and HSE
Job role	24+	Production / team supervisor in tower, blade or other component manufacture or nacelle assembly Responsible for shift management, quality, safety, and productivity Continuous leadership development and technical upskilling

Table 14: Overview of an example development pathway: Senior Authorised Person.

Development step	Age range	Example activities
Foundational STEM & Practical Skills	6 to 14 (primary & lower secondary)	Hands-on problem-solving activities Team-based projects (electrical circuits) Basic numeracy and communication skills
Contextual learning	14 to 16 (middle secondary)	Renewable energy and electricity topics in physics, other STEM classes Exposure to electrical / electronic manufacturing, assembly and maintenance processes in school workshops Visits to factories or assembly units Modules on safety, quality, and practical electrical activities
Career awareness and industry engagement	15 to 17 (middle to upper secondary)	Talks from electrical technicians and supervisors Short internships in local electrical utilities through to manufacturing or service MSMEs Participation in vocational skills competitions
Advanced skills and specialisation	16 to 18 (upper secondary)	Vocational electives in electrical trades Leadership and communication workshops Mentorship from industry supervisors
Further education	18+ (post-secondary)	Diploma or ITI in electrical trades Training in quality control and safety Apprenticeships in turbine or switchgear electrical assembly or maintenance
Early career	21+	Electrical technician roles in manufacturing or maintenance, ideally in wind industry or switchgear Experience electrical quality control, small team coordination and site working High-voltage (HV) safety training
Job role	30+	Onshore or offshore practical electrical technician with responsibility for the safe operation and management of HV electrical systems This includes overseeing and authorising switching operations, isolations, and the safety of personnel working on high-voltage equipment such as substations, transformers, and turbine HV electrical circuits.

2. The Skill Council for Green Jobs (SCGJ) encourages schools to access available learning materials about the offshore wind industry, such as provided by Offshore Wind Learning and in time any other local providers.
3. The Environment Education Programme, potentially working with organisations such as CEE Tamil Nadu, expands existing climate change awareness programmes in schools to renewable energy technologies, enhancing environmental literacy and informing students about emerging career opportunities in the green economy.
4. The Directorate of School Education, Tamil Nadu State Council of Education Research and Training (TN SCERT) and Skill Council for Green Jobs (SCGJ) collaborate with wind industry employers to increase links between onshore wind projects and schools, via staff visits to schools, student visits to wind farms and increased work experience / vocational training opportunities.

5. The Department of School Education, through its Career Guidance and Counselling Cell, increases focus on onshore and offshore wind career pathways, ensuring that students receive comprehensive information about the diverse opportunities available within the renewable energy sector.
6. The Directorate of School Education continues its proactive approach to addressing the critical issue of student dropouts linked to seasonal fishing opportunities. This important initiative demonstrates commendable commitment to upholding the spirit of the Right of Children to Free and Compulsory Education.

The timing of implementation of these recommendations will depend on progress towards implementation of OSW projects. An indicative roadmap is provided below. Note that various recommended actions will continue indefinitely, beyond the initial implementation phase shown. Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines, to keep in step with industry workforce needs.



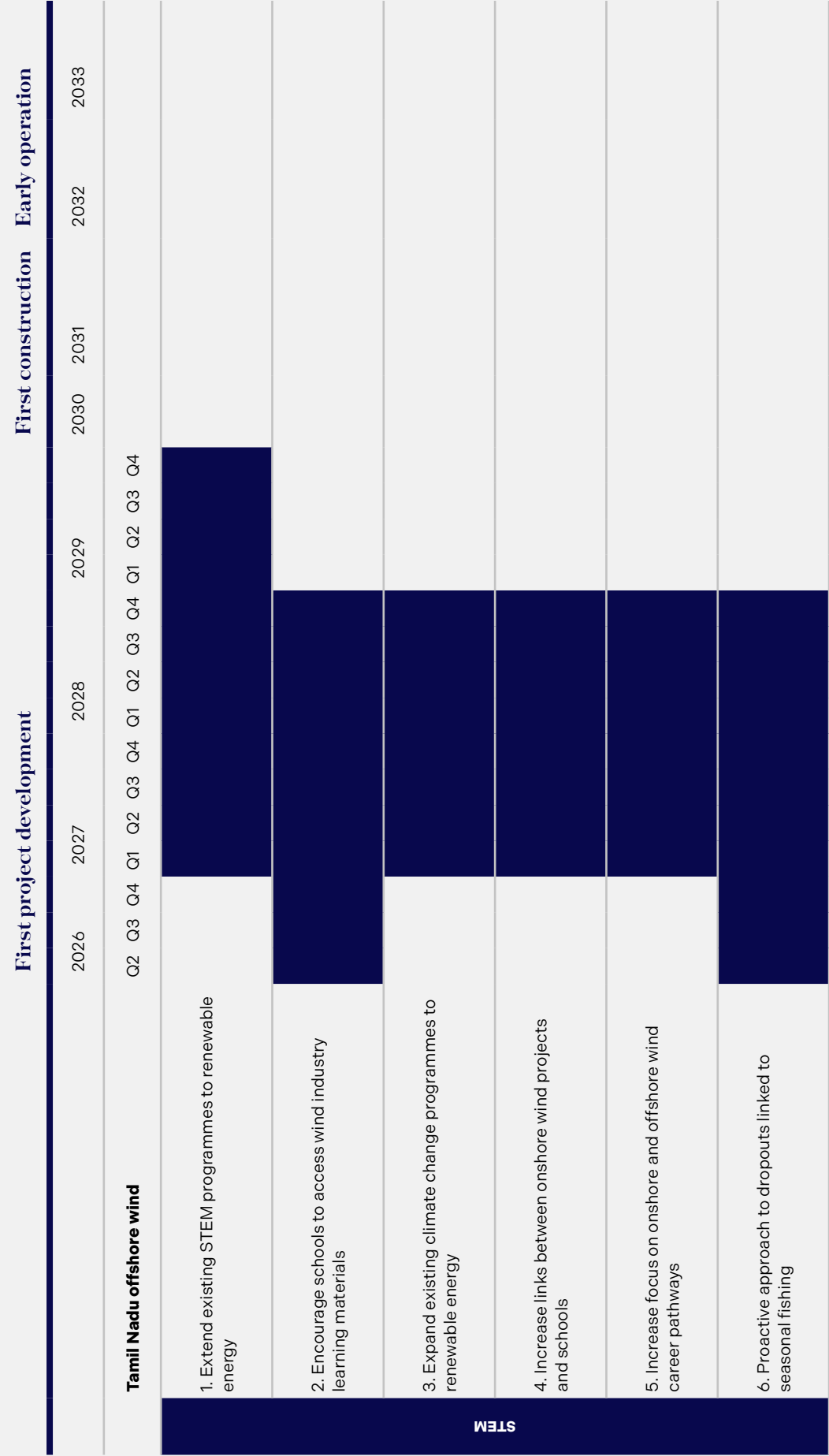


Figure 9: Indicative roadmap for STEM skills enhancement relevant to OSW

Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines.

Enhancing offshore wind skills amongst fishers



4.1 Introduction

Developing and enhancing OSW-relevant skills and interest among fishers is important in ensuring inclusive growth of the OSW sector and enabling meaningful participation from (and benefit to) coastal communities. Fishers possess a wealth of knowledge and practical capability relevant to the OSW industry. By recognising and building upon these existing strengths, this section presents a clear pathway for fishers to engage in OSW-related employment, particularly during periods when fishing activity is limited.

This section is divided as follows:

- Section 4.2 Adaptable skillsets and development of new skills required for OSW: Identifies capabilities held by fishers and maps them against OSW job role requirements, introducing new skills where necessary to support workforce transition.
- Section 4.3 Multi-sector working opportunities exploration: Examines seasonal fishing patterns and OSW activity cycles to identify windows of opportunity for supplementary employment and assesses enablers and barriers to fishers participation in OSW.
- Section 4.4 Fisher community engagement: summarises engagement regarding employment, awareness and future wishes relating to OSW.
- Section 4.5 Recommendations for fisher enablement: Synthesises findings from previous sections into a phased implementation plan, outlining priority skill areas, training interventions, and enabling mechanisms to support fishers integration into the OSW sector.

4.2 Adaptable skillsets and development of new skills required for offshore wind

4.2.1 Skillsets of fishers relevant to offshore wind

Overview of skillsets

Table 15 provides an overview of skillsets among fishers and other coastal workers that are relevant to the OSW sector. It highlights the transferability of these skills to various OSW roles, indicating their frequency in coastal communities and the corresponding NSQF levels. Of course, there will be many examples of fishers with skillsets beyond these.

Table 15: Overview of existing skillsets held by fishers within Tamil Nadu.

#	Fisher skillset	Relevance to offshore wind	Frequency of skillset availability	NSQF level
1	Sea-going experience, offshore working conditions (from fishing & aquaculture)	Highly relevant – strong base for deck crew, survey assistants, environmental monitoring with upskilling	High	3 to 4
2	Vessel maintenance (inc. engines)	Highly relevant – transferable to OSW vessel maintenance and other mechanical technician roles	Low	3 to 4
3	Vessel operations, navigation, marine safety	Highly relevant – essential for CTVs, supply vessels, offshore logistics, major vessels	Medium	3 to 7
4	Warehousing, storage, and equipment handling	Highly relevant – transferable to port logistics, component handling, inventory management	Medium	3 to 6
5	Knowledge of local marine ecosystems (from fishing & aquaculture)	Moderately relevant – useful for environmental monitoring and marine surveys	High	3 to 4
6	Fibreglass structure construction	Moderately relevant - aspects relevant to blade manufacturing	Low	3 to 4
7	Steel fabrication (from shipbuilding / boatbuilding)	Moderately relevant – applicable to turbine / balance of plant component / tooling manufacture and vessel maintenance	Low	3 to 4
8	Manual handling, teamwork, and physical endurance	Broadly relevant – foundational for many entry level OSW roles	High	2 to 3
9	Processing and preserving fish / seafood	Low relevance – transferable to port based logistics, catering, support services	Medium	2 to 3
10	Rope handling, rigging, knotting (from cordage/net making)	Low relevance – but some relevance to lifting, and deck operations with training	Medium	2 to 3

Relevant fisher skillsets required for offshore wind

Table 16 shows the OSW job roles with potentially most overlap to the fisher roles. These roles have significant marine or port-based content. Fishers with skills in other areas, for example IT, will have opportunities in those areas. Of course, there is the potential for fishers to retrain and, hence secure many other roles. The roles listed are in many cases entry-level, with development potential beyond them. Table A.1 in the Appendix provides a fuller list of job roles.

Table 16: Potential offshore wind job roles with most overlap with fisher roles in Tamil Nadu

Job role	Lifecycle phase	Description	Skills and qualifications typically sought	Fisher skillsets relevant	NSQF level
Electrical practical					
Electrical technician	I&C, O	Assembles, installs and maintains and repairs electrical components and systems across all OSW farm components including turbines and balance of plant equipment. Also needed for major installation vessel support (an offshore)	Diploma/ITI in electrical engineering, HV/LV certification, troubleshooting	Basic electrical familiarity, problem solving	4
Environmental					
Environmental monitoring assistant	D, I&C, O	Collect marine and coastal data to monitor environmental impacts	Data collection, sampling techniques, GIS basics, safety training	Knowledge of local marine ecosystems, observational skills	3
Biodiversity and conservation field assistant	D, I&C, O	Supports biodiversity surveys and conservation monitoring around OSW areas. Assists specialists in implementing mitigation measures and reporting ecological observations.	Field survey methods, species identification basics, ecological monitoring techniques, safety at sea, GIS familiarity.	Strong local ecological knowledge, species observation skills, understanding of seasonal patterns, ability to navigate and work safely at sea.	3 to 4
Management, administration and support					
Fishing and community liaison officer	D, I&C, O	Acts as the link between OSW developers and fishers/communities communication, addressing concerns, and promoting cooperation to find the best shared outcomes for all.	Stakeholder engagement with coastal communities; knowledge of MoES/MNRE offshore policies; exposure to Coastal Regulation Zone (CRZ) norms; proficiency in local languages; reporting & grievance redressal under state fisheries frameworks	Local fishing knowledge, trusted community relationships, negotiation, practical seamanship and safety awareness	4
Support staff - catering / administration	D, M, I&C, O	Supports technical and other activities. Can also be vessel-based role.	If vessel-based, relevant OSW competencies (HSE induction, role-specific certification, communication, record-keeping)	If vessel-based, transferable fishing skills (seamanship, deck safety, gear handling, local waters knowledge)	3

Job role	Lifecycle phase	Description	Skills and qualifications typically sought	Fisher skillsets relevant	NSQF level
Support staff - security / waste management	D, M, I&C, O	Supports technical and other activities	Basic security/guarding qualification, waste segregation & handling, incident reporting, HSE induction	Mechanical handling discipline, vigilance, teamwork, experience keeping quaysides/decks/holds orderly and safe	3
Maritime					
Carousel / tension operator	I&C	Manages and operates the cable carousel and tensioning system used to store and deploy subsea cables during installation	Cable handling training, mechanical systems knowledge, safety protocols	Rope/cable/net handling experience, coordination, mechanical systems	4
Chief- and deck officers	I&C, O	Support the vessel master by managing navigation, deck operations, and safety systems, ensuring smooth and compliant marine operations during OSW installation.	Directorate General of Shipping licences, Certificate of Competency appropriate for officer rank, substantial experience in navigation, cargo handling, and vessel operations, with qualifications in advanced safety, survival, and emergency response training.	Vessel handling and management, team leadership	5 to 6
Crew transfer vessel / safety boat master	I&C, O	Operates support vessels, taking responsibility for navigation and safe operation to guard other vessels or transport personnel and equipment to and from OSW installations, ensuring compliance with maritime safety standards and emergency procedures	Advanced seamanship, navigation, radar/GPS use, STCW, marine engine maintenance	Skilled boat operators, knowledge of tides/currents, safety awareness	5
Deck hand / vessel crew	I&C, O	Assists with practical activities when onboard vessel	Basic seamanship, safety protocols, small engine handling, Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) certification	Boat handling, navigation familiarity, sea survival	3
Harbour pilot	I&C, O	Guides vessels safely into and out of ports, ensuring manoeuvring complies with local marine conditions	Master mariner certification, pilotage licence, advanced navigation	Deep local sea knowledge, tide/current awareness	5

Job role	Lifecycle phase	Description	Skills and qualifications typically sought	Fisher skillsets relevant	NSQF level
Major vessel master / captain	I&C, O	Has overall command of the vessel, ensuring safe navigation and operation, compliance with maritime regulations, and coordination of all marine and operational activities.	Directorate General of Shipping licences, Unlimited Tonnage Certificate of Competency, advanced qualifications in navigation, seamanship, and marine safety, and knowledge of ISM, STCW, and international maritime regulations	Vessel handling and management, team leadership, critical decision making	6 to 7
Marine warranty surveyor / client representative	I&C, O	Monitors marine and heavy-lift operations on behalf of the project developer to ensure full compliance with approved procedures and international standards, thereby safeguarding safety and protecting client assets.	Advanced certificate, diploma, or graduate diploma in a relevant subject area such as marine engineering, naval architecture, or offshore operations. Knowledge of international standards such as IMO, SOLAS, and OCIMF guidelines.	Experience in marine good practice and offshore operations	6
Medic	M, I&C, O	Provides emergency medical care, occupational health support, and clinical oversight onboard vessels, ensuring crew fitness, incident response, and medical evacuation coordination; also relevant in the manufacturing environment.	Diploma or degree in paramedical/ medical sciences. STCW-compliant medical training, offshore safety training, awareness of ISM, STCW, and onboard clinical governance standards.	On-vessel emergency medical care	5 to 6
ROV technician	O	Operates ROV's to perform tasks like inspection, maintenance, and repair of OSW farm structures, cables, and equipment.	Higher national certificate or equivalent in a relevant subject area such as marine engineering, science or equivalent experience in marine maintenance. Maritime safety.	On-vessel mechanical equipment operation and maintenance	5
Vessel master's mate	I&C, O	Assists the vessel master in navigation, safety, and operations during OSW farm activities.	STCW, navigation certification, maritime operations training	Navigation familiarity, seamanship	4
Mechanical practical					

Job role	Lifecycle phase	Description	Skills and qualifications typically sought	Fisher skillsets relevant	NSQF level
Blasting and coating technician	M	Prepares the surfaces of wind turbine components using abrasive blasting and applies protective coatings (e.g., anti-corrosion paints) to offshore components to ensure durability in harsh marine environments	Coating/blasting certification, PPE/safety training, surface prep knowledge	Experience with marine corrosion, familiarity with protective gear	4
Equipment service technician	M, I&C, O	Conducts routine inspections and repairs on equipment (tooling) used for manufacturing, installation and operations.	Mechanical and electrical troubleshooting; torquing and tool calibration, basics of hydraulic and pneumatic systems, lockout/tagout (LOTO) as per OSHA-equivalent under OSH Code 2020, manufacturer service training	Hands-on repair of winches, engines and deck gear, fault finding	4
Machine operator	M	Operates and monitors machines used in the manufacturing facility, following detailed specifications and safety procedures.	Machine operation training, safety certification, quality awareness	Experience with mechanical equipment	3
Mechanical technician	I&C, O	Assembles, installs, maintains, and repairs mechanical components and systems across all OSW farm components including turbines and balance of plant equipment.	Mechanical diploma/ITI, hydraulic systems knowledge, maintenance experience, safety training	Mechanical aptitude, familiarity with engines/gear	4
Process coordinator	M	Coordinates and improves manufacturing processes to increase efficiency and ensure consistent product quality. Includes quality control / non-destructive testing under management of quality manager and scheduling under production supervisor / manufacturing manager.	Production planning; QC aligned to IS/ISO standards; basic NDT awareness; ERP usage; 5S/Lean; compliance with Indian labour & safety codes	Organising crews, teams and tasks, methodical approach, accurate record-keeping	4
Production operative	M	Performs hands-on manufacturing tasks such as material handling, component preparation and assembly. Role is similar to that of electrical and mechanical technician but based in manufacturing facilities.	Basic manufacturing training, safety certification, quality awareness	Experience with mechanical equipment	3
Rope access and blade repair technician	O	Inspects and repairs wind turbine blades for wear, cracks, and structural damage. Uses specialized tools and resin materials, often working via rope access.	IRATA Level 1-3, blade repair training, composites knowledge, marine safety certification, working at heights	Rope handling	4

Job role	Lifecycle phase	Description	Skills and qualifications typically sought	Fisher skillsets relevant	NSQF level
Stores / warehouse operative	M, I&C, O	Oversees storage and inventory of spare parts, tools, and equipment used in construction. Ensures timely dispatch and procurement aligned with maintenance needs.	Inventory systems, forklift licence, basic IT, safety training	Organised handling of gear/ equipment, teamwork	3
Vessel maintenance technician	I&C, O	Onshore role to maintain offshore transfer vessels and crew boats, including engines, navigation systems, and safety gear. Also, vessel-based roles do similar for major installation and service operation vessels.	Marine engineering diploma, engine maintenance, diagnostics, safety training	Experience maintaining vessels, mechanical repair	4
Welder	M	Joins metal components using various welding techniques to fabricate or repair OSW components such as towers, frames, and support structures.	Welding certifications to IS/ISO (e.g., IS/ISO 9606); WPS/PQR reading; plate/pipe positional welding; hot work permits as per port/yard rules	Metalwork and repair on hulls/frames, safe hot-work practices	4
Ports and logistics					
Crane and rigging inspector	I&C, O	Inspects cranes and rigging equipment used for installation to ensure safety and functionality. Also can be vessel-based.	Inspection to Indian Dock Regulations or LOLER equivalent; familiarity with BIS/IS lifting gear standards, lift plan verification, statutory registers	Practical rigging knowledge, recognising worn gear, safe slinging and lifting habits	5
Crane operator	I&C, O	Operate cranes for lifting turbine components, cargo, and equipment	Crane operator licence, load handling certification, safety protocols	Experience with lifting gear, port- and vessel-based crane operations	5
Crew manager	I&C, O	Manages offshore personnel schedules, certifications, and welfare. Ensures proper crew rotation and compliance with labour and safety regulations.	Rostering; tracking medicals (MLCaligned) & DG Shipping certificates (where applicable); labour compliance; vendor & travel coordination	Coordinating crews and shifts, strong people skills, maintaining logbooks	5 to 6
Heavy lift supervisor	I&C, O	Supervises all heavy lifting operations. Can also be a vessel-based role.	Appointed person/heavy lift planning; radio comms; dynamic risk assessment; compliance with port/ bylaw notifications and IS standards for lifting	Directing quay/deck lifts, signalling, understanding sea state and weather windows	5 to 6

Job role	Lifecycle phase	Description	Skills and qualifications typically sought	Fisher skillsets relevant	NSQF level
Logistics coordinator and manager	I&C, O	Organises the transportation of wind turbines, balance of plant, materials, and personnel to the offshore site, ensuring efficient and timely delivery.	Port & coastal shipping coordination; ICEGATE/customs documentation; GST e-waybills; inventory control; familiarity with OSW components; VHF procedures licensed by WPC/DoT	Route/weather planning experience, moving gear efficiently, contacts across ports and suppliers	6
Marine coordinator	I&C, O	Manages vessel scheduling, marine traffic, and offshore personnel logistics to ensure smooth operations. Coordinates between marine crews, technicians, and control rooms.	Vessel scheduling & marine traffic monitoring; VHF/GMDSS comms (WPC licensing); PTW interface; Metocean window planning; DG Shipping marine notices awareness	Seamanship, understanding tides and local grounds, clear radio comms	6
Operations risk manager	I&C, O	Plans operations and carries out risk assessment, safety planning, and coordination to assure safe working in ports and on installation vessels.	Risk assessments (JSA/RAMS); SIMOPS; HSE MS per OSH Code 2020 and port safety rules; emergency response plans; incident investigation	Hazard awareness at sea, stop-work authority culture, practical judgement in dynamic conditions	6
Port / transport / lifting operative	I&C	Responsible for providing day-to-day component and equipment logistics around the port - includes stevedoring, SPMT operation and heavy-lift rigging (also a vessel-based role).	Banksman/slinger; forklift & SPMT operation (if applicable); mooring & stevedoring skills under Dock Workers Regulations; PPE compliance; load securing to IS codes	Loading/unloading catch and gear, knotting/lashed load security, stamina for manual handling	3
Vessel supervisor	I&C, O	Oversees daily operations on offshore support vessels, ensuring safe transport of personnel and equipment. Coordinates with marine crews and offshore teams to maintain operational schedules	Deck operations leadership, crew briefings & toolbox talks, permit and work-at-sea coordination, DP/CTV familiarity, DG Shipping safety circulars; incident/hear miss reporting	Coordinating small crews, deck safety leadership, situational awareness offshore	5 to 6
Support staff - Security / Waste / Catering / Administration	I&C, O	Provide essential support services for offshore and onshore bases	Basic vocational training, safety induction, catering/administration skills, IT literacy	Community service skills, adaptability, teamwork	3 to 4
Equipment service technician	I&C, O	Maintain and repair mechanical/electrical equipment used in offshore operations	Diploma/ITI in mechanical/electrical trades, troubleshooting, preventive maintenance	Mechanical aptitude, practical repair experience	5 to 6

4.2.2 New skillsets required for fishers to work in offshore wind

The transition of fishers in Tamil Nadu to OSW roles often necessitates acquiring or demonstrating new skillsets that complement their existing expertise. Table 17 below outlines the new qualifications and skills required for various job roles within the OSW sector, highlighting the relevance of these skills to fishers and the indicative NSQF levels for training and certification

Table 17: Overview of existing skillsets held by fishers within Tamil Nadu.

New skillset or qualification	Job role required for	NSQF level
Basic offshore safety and survival	Crew for support vessels	4
Advanced vessel operation and navigation	Crew transfer vessel (CTV)/safety boat operator	5
Electrical and mechanical maintenance basics	Electrical technician (trainee), equipment service technician	5 to 6
Environmental monitoring and data collection	Environmental monitoring assistant	4
Logistics and inventory management	Logistics & stores assistant, stores / warehouse operative	3 to 4
Manufacturing and fabrication skills	Production operative, welder, blasting and coating technician	4 to 5
Rope access and working at heights	Rope access technician	5 to 6
Leadership and vessel supervision	Vessel supervisor	6

4.3 Multi-sector working opportunities exploration

4.3.1 Seasonal and livelihood context for fishers

Tamil Nadu's seasonal fishing patterns are shaped by monsoon cycles and coastal ecology. During January to May small-scale fishers venture further offshore for species like sardines, mackerel, and anchovies. These periods also coincide with peak demand in local markets, making them economically important for coastal communities that rely on daily catches. Activity is then reduced, including due to the Southwest Monsoon then subsequently rises, despite the arrival of the Northeast Monsoon.

For larger-scale mechanised fleets, seasonal patterns are less weather-related and more fish stock-related. The Southwest Monsoon (June–September) brings nutrient-rich upwelling, boosting tuna and seer fish stocks, which

industrial trawlers target in deeper waters, carrying on through into early summer. Government-imposed fishing bans (Mid-April to mid-June) for trawlers allow fish stocks to regenerate, so operations resume after the ban ends. Based on informal input, FAO and CMFRI reports on monsoon impacts on artisanal fisheries in South India and academic studies on mechanised vs small-scale fishing effort and seasonal catch trends, Figure 10 shows an indicative representation of these trends covering both artisanal and commercial fishing. [6][7][8][9][10][11][12][13][14][15][16]

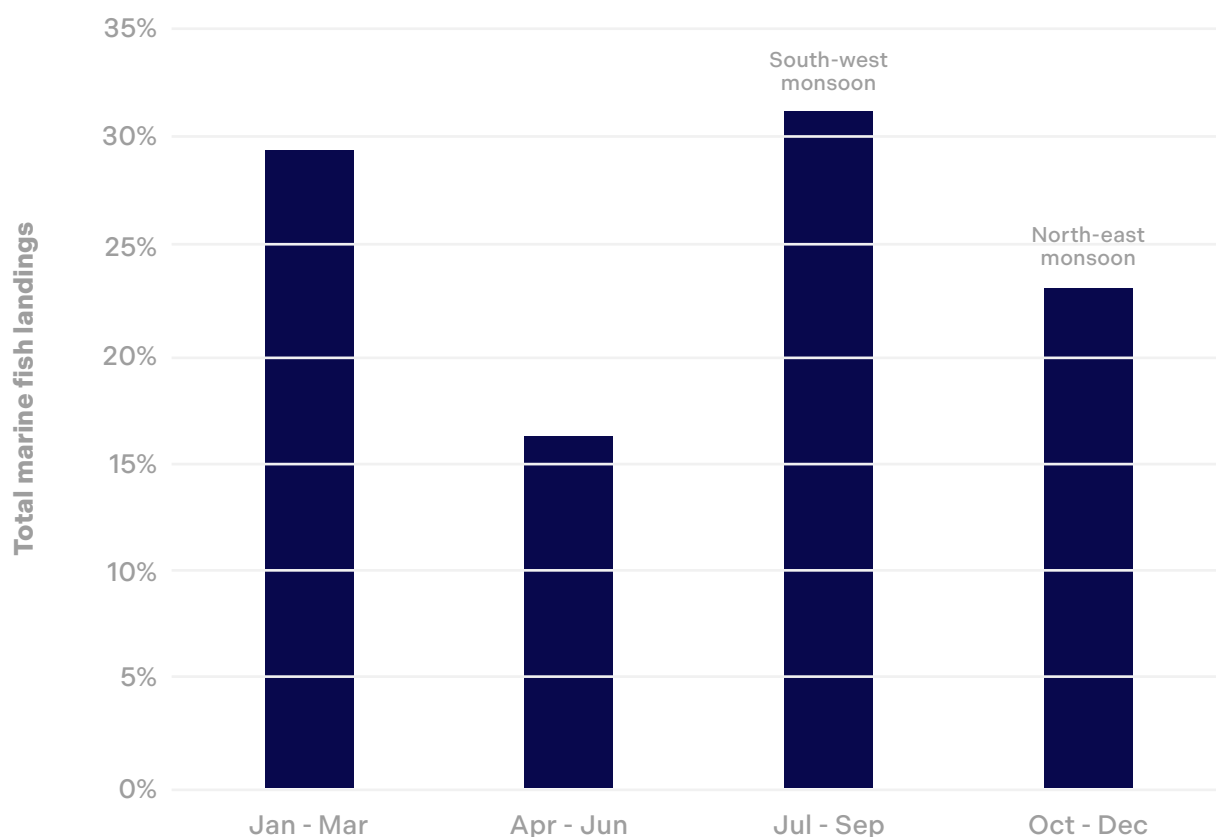


Figure 10: Indicative seasonal differences in fishing activity in Tamil Nadu. Source: BVG Associates.

This means that fisher demand is greatest in July to March, with a quieter period during the period from April to July.

4.3.2 OSW activity cycles and demand

Offshore activity is in three main phases, each with a different seasonal consideration.

- Surveys, where technical surveys are best completed in lower-wind seasons and environmental surveys need to be designed with the target species in mind and may be at any time.

- Installation, which is best conducted in lower-wind seasons to minimise downtime waiting for suitable weather. The most weather-critical lifts are of the turbine blades, which are limited by wind speeds. Raising and lowering a jack-up vessel has sea-state limits. This means there is increased need for staff in lower-wind seasons.
- Operations, where in higher-wind seasons there is greater frequency of unplanned service interventions to fix faults as turbines are more highly loaded, and lower-wind seasons when more planned maintenance work is programmed in. Typically, there is a slightly increased need for technicians in lower-wind seasons.

In Tamil Nadu, there is a seasonal difference in mean wind speed, as shown for representative Zones B (in the south, see Figure 3) Geographical area of study and potential offshore wind zones in Tamil Nadu.) and F (to most northern), based on data from the Global Wind Atlas. This shows a difference in variation between zones, with both having a higher-wind season from May to September (the Southwest Monsoon) although less marked in Zone F from July to September, and generally a lower wind season from October to April in Zone B while Zone F has an additional period of higher winds in December and January.

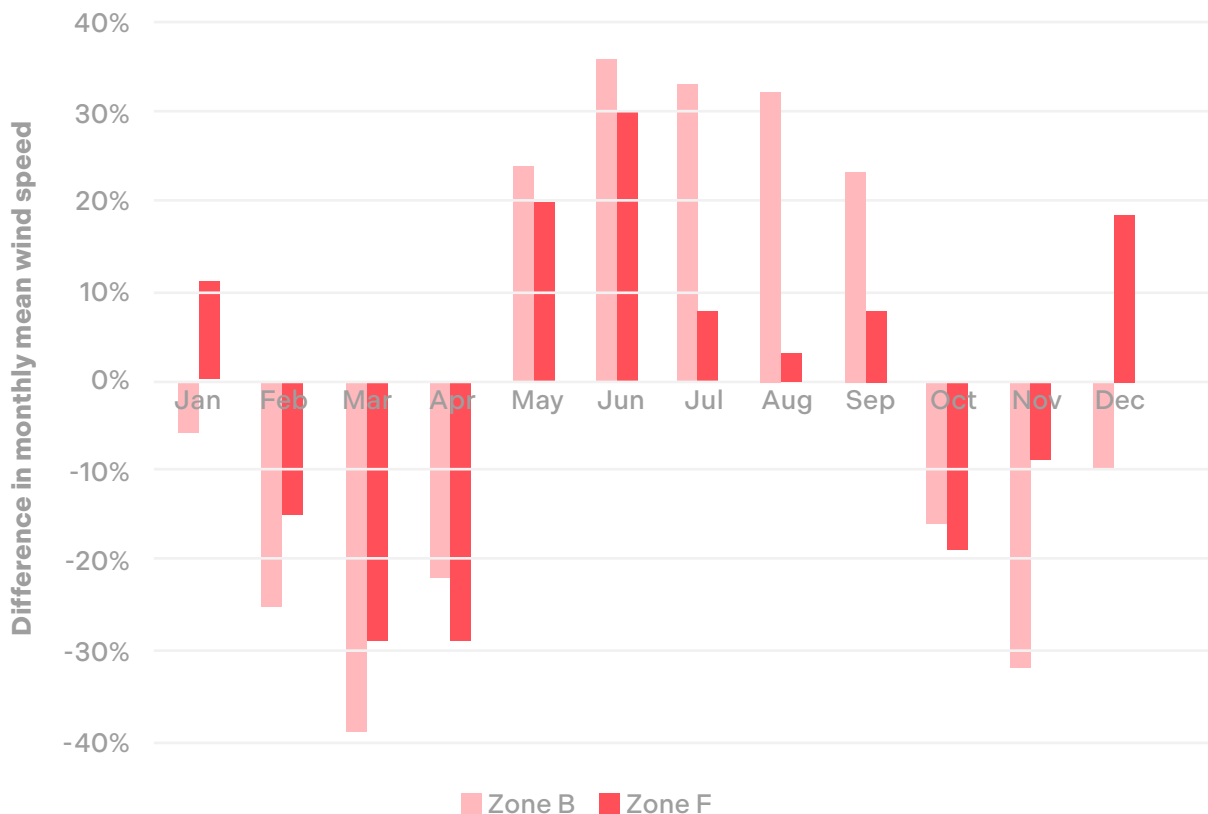


Figure 11: Seasonal difference in mean wind speed for two representative zones in Tamil Nadu.
Source: BVG Associates.

The combination of the seasonal wind climate and avoiding planned maintenance during the Northeast Monsoon (October to December) means that there is likely to be an increase in demand for seasonal labour in January to April (early summer), before the windy season.

4.3.3 Alignment between fishing and offshore wind workforce needs

Fishing activity is high from July to March, which overlaps with much of the period where OSW operational phase needs are likely to be highest; January to April. Fishing activity drops from October to December, aligning with the lower-wind period when OSW survey and installation work takes place. Routine maintenance can also be scheduled into the low-fishing, low-wind months such as April. It is important to note that the seasonality in OSW need is likely to be less significant than the seasonality in fishing activity. As both fishing and offshore wind have differences in (and changes to) seasonal demand, it is likely that some workers will work for both industries, in parallel.

4.3.4 Opportunities and barriers for fishers in offshore wind

Fishers in Tamil Nadu face both opportunities and barriers in accessing employment opportunities in the OSW sector alongside existing fishing livelihoods. Opportunities include leveraging their existing maritime skills, such as navigation knowledge, vessel handling, and sea survival, which align well with OSW operational roles. Seasonal alignment between fishing downtimes and OSW labour demand offers potential for supplementary income during quieter fishing periods.

There is a strong push from parents to steer the younger generation away from traditional fishing. Motivated by the lack of guaranteed income in the fishing sector, parents are actively seeking stable, salaried employment opportunities for their children to ensure financial security. The younger generation in coastal regions generally demonstrates a keen interest in the broader maritime industry, specifically in marine engineering, maritime crewing and international opportunities relating to fisheries. This aligns well with the technical requirements of the OSW sector. Currently, many qualified and educated youths are engaged in traditional fishing solely due to a lack of alternative job opportunities and opportunity knowledge. This creates a ready-made pool of candidates who possess sea experience and education, making them ideal to access new opportunities in the OSW sector, where appropriate.

The government is actively providing training programmes designed to introduce new technologies and develop activities related to fishing. These existing frameworks can be leveraged to introduce OSW-specific skills. Non-Governmental Organisations (NGOs) have launched integrated development programmes aimed at enhancing sustainable livelihoods for small-scale fishers. These programmes provide a trusted platform for introducing OSW as a complimentary livelihood opportunity.

Barriers, however, remain, including the need for formal certifications such as GWO and STCW safety modules, which require significant time and financial investment. Contractual flexibility is also critical, as fishers often rely on daily or seasonal work patterns that differ from standard OSW employment contracts.

Despite the government and NGOs providing formal training programmes, the community shows a strong preference for traditional learning methods specifically, learning from practical experiences with elders and peers while at sea.

There is a distinct difference between educated youth and those that dropped out of school involved in fishing. Educated youth possess the potential for technical roles but lack traditional fishing skills, making them vulnerable and inexperienced in rough sea conditions. Conversely, those that dropped out of school and are involved in fishing typically possess more experience and stronger traditional sea survival skills but lack the technical literacy required for OSW roles. This skill mismatch could create a shortage of skilled technicians capable of working in the sector.

A critical challenge is the overlap between school summer holidays and fishing ban-period activities. Since small boats are permitted to fish during the ban period, children often go to sea during these holidays and earn a significant amount of money. This immediate financial gratification encourages some to drop out of school to continue fishing, impacting their path to becoming well-educated technicians.

According to stakeholder interviews, adaptation to alternative livelihoods unrelated to the marine sector is low. Even though fishers recognise that marine fish landings are fluctuating and unreliable, they are typically unwilling to move to other sectors. They are, however, more open to allied activities as long as they remain within the marine environment. The OSW sector provides opportunities that align with this preference.

In addition however, communities are often deeply sceptical of developmental projects proposed within their traditional fishing grounds, fearing displacement or loss of territory. There is a significant lack of trust regarding assurances of job opportunities; fishers often view external promises of employment as unreliable or unlikely to materialise, based on past experiences. Building awareness will take engagement from project developers and others, but trust is likely only to grow as actual employment is provided. A challenge is that any significant volume of employment will only be provided well after permits for project delivery have been secured.

4.4 Fisher community engagement

Engagement was with fishing communities and research institutions working with fishing communities in Tamil Nadu, as listed in Table 18. The engagement sought to understand community perspectives on OSW development, assess existing skills and employment patterns within fishing communities, and identify pathways for meaningful participation in the emerging OSW opportunities shown in Table 16.

Table 18: Stakeholders engaged for feedback on priority skills areas, proposed interventions and enabling mechanisms.

Organisation	Role/designation interviewed
M S Swaminathan Research Foundation	Area director
M S Swaminathan Research Foundation	Executive director
Dakshin Foundation	Programme head
Fishing Community Keezhavaipar	Village Panchayat leader
Fishing Community Keezhavaipar	Fishermen cooperative society representative
Fishing Community Keezhavaipar	Panchayat-level federation head
Fisheries College and Research Institute FC&RI	Head of department
Fisheries College and Research Institute FC&RI	Fisheries researcher
Fishing Community Keezhavaipar	Fisher representatives ⁷
JRC Foods	Supervisor

7 These fisher representatives participated in the programme launch conducted by M S Swaminathan Research Foundation.

Tamil Nadu's fishing communities are represented by a mix of associations, federations, and cooperative societies. Their focus is on livelihood protection, marine access, conflict resolution, and welfare. Key organisations include:

- Tamil Nadu Fishermen Welfare Board – statutory body overseeing welfare schemes and compensation.
- Tamil Nadu Meenavar Peravai – state-level federation active in rights-based advocacy and coastal policy issues.
- South Indian Federation of Fishermen Societies (SIFFS) – regional body engaging on marine access, safety, and regulatory matters.

- National Fishworkers Forum (NFF) – national platform with active Tamil Nadu affiliates.
- Primary Fishermen Cooperative Societies – extensive network managing credit, welfare distribution, and collective decision-making at village level.
- Traditional Ur Panchayats – customary governance structures with strong authority over fishing zones and community mobilisation.

These organisations are important interlocutors for marine spatial planning, navigation safety, and community engagement and should be consulted early to avoid conflict and ensure equitable outcomes. They also provide potential channels for education and workforce development.

4.4.1 Current skills and employment patterns

Stakeholder discussions suggested that fishing communities combine traditional and technical skills. Fishers were reported to have practical competencies in basic engine operation, use of GPS and radio communication systems, net mending and diving, supported by knowledge of fishing grounds and local weather conditions.

One stakeholder, illustrative of a general pattern, advised the availability of specialised electrical and mechanical repair services at the village level was highly limited. In this instance, a single trained technician was reported to be servicing approximately 30 fishing vessels, resulting in delays in maintenance and repair and affecting the regularity of fishing operations, thus indicating these higher skills are likely to be difficult to source from the community.

Stakeholders advised employment patterns within fishing communities are changing. While fishing continues to be a primary livelihood along parts of the Nagapattinam–Thoothukudi coast, the sector was described as contracting. Stakeholders reported a decline in the number of fishing vessels from 51 to 29 over a period of seven years. Stakeholders also highlighted emerging challenges related to education and employment pathways, as discussed in Section 4.3.4.

4.4.2 Community awareness and attitudes towards offshore wind development

OSW development is not currently a major topic of discussion in fishing communities, as no significant development work has started. Stakeholders consistently report limited understanding of OSW technology, employment opportunities, job types, and skill requirements. This knowledge deficit extends also to educational institutions.

Despite little awareness of OSW technology, fishing communities articulate clear concerns based on historical experiences with industrial development. Primary issues include:

- Potential placement of offshore structures in fishing grounds
- Restrictions on freedom of movement and travel
- Creation of exclusion zones, making areas off-limits to fishers.

These concerns reflect documented vulnerabilities:

- Southern districts face international border waters
- Marine protected areas in the Gulf of Mannar Biosphere Reserve already have restricted access
- Communities operate in some of the world's richest marine biodiversity hotspots where additional restrictions could severely impact livelihoods.

Stakeholders advised that fishing communities are cautious about new projects that could overlap with traditional fishing grounds. For many households, altering long-standing livelihoods for a limited number of new jobs appears, at present, to offer an uncertain balance of risks and benefits.

4.4.3 Priority skills areas and opportunities

Based on the demand in the OSW industry, the readiness of fishers to transition, and the feasibility of training delivery, several priority skill areas and opportunities emerge. Key priority skills include:

- Offshore safety and survival certifications (such as STCW and GWO modules),
- Advanced vessel operation and navigation,
- Logistics, inventory, and port operations training,
- Manufacturing, fabrication, and coating skills training,
- Leadership and vessel supervision training,
- Electrical and mechanical maintenance basics, and
- Environmental monitoring.

Fishers' existing maritime skills provide a strong foundation, particularly in vessel handling, navigation, and sea survival, which can be upskilled with targeted training programmes.

Opportunities lie in both transitioning to working OSW (at least for a time) and in leveraging the seasonal alignment between fishing downtimes and OSW labour demand, enabling fishers to supplement their income during quieter fishing periods. This may involve dedicated training and re skilling pathways for fisherwomen, whose existing roles in processing, net making, trading, and community based marine activities position them well for OSW aligned opportunities in logistics, quality control, environmental monitoring, and shore based operations.

Training delivery feasibility is enhanced by the fishers' high motivation due to economic vulnerability and the presence of assets such as fishing craft that may be able to be repurposed for offshore support roles in some cases. Collaborative training partnerships and modular certification frameworks will be essential to address diverse skill levels and ensure accessibility.

4.5 Recommendations for fisher enablement

To maximise the mutual benefit to fishers and OSW, the following recommendations are made, including potential stakeholders, to be validated through follow-up engagement prior to implementation:

1. MNRE establishes realistic and clearly defined levels of developer commitments to enable fisher involvement in projects, and ensures that these commitments are incorporated into the requirements for project developers awarded development rights.
2. Tamil Nadu State Skill Development Corporation establishes tailored training programmes that recognise prior learning and accommodate fishers' seasonal availability. This should be started a year before job needs for the first project in Tamil Nadu, with delivery running for 3 years. Key programmes:
 - Mechanical and electrical technician training,
 - Basic working at height and mechanical handling training,
 - Offshore safety and survival certifications ,
 - Environmental monitoring,
 - Logistics, inventory, and port operations training,
 - Manufacturing, fabrication, and coating skills training, and
 - Leadership and vessel supervision training.
3. Tamil Nadu Government leverages National Fisheries Development Board skill development programmes to support the transition of fisherwomen into offshore wind.[17]
4. Tamil Nadu Fisheries & Fishermen Welfare Department and Tamil Nadu Skill Development Corporation (TNSDC) collaborate to establish dedicated funding streams and subsidy mechanisms to reduce financial barriers for

certification and training uptake among fishers. This could be achieved by utilising funding streams from diverse sectors, including:

- Government bodies: The Tamil Nadu State Department of Energy, Fisheries & Fishermen Welfare Department, and Tamil Nadu Skill Development Corporation.
 - Private partners: Schneider Electric Foundation, Tata Power Skill Development Institute (TPSDI), and Adani Saksham.
 - Skill initiative programmes: Pradhan Mantri Kaushal Vikas Yojana (PMKVY), National Apprenticeship Promotion Scheme (NAPS), and Vetri Nichayam.
5. Industrial Training Institutes (ITI's) provide short-course retraining opportunities for fishers in key areas, building on existing relevant skillsets. These could be funded through the recommendation above.
 6. SCGJ supports the development of partnerships between OSW employers and accredited training providers to ensure training relevance and quality.
 7. National Skill Development Corporation (NSDC) implements flexible NSQF-aligned and Recognition of Prior Learning (RPL)-based certifications to convert informal maritime experience into recognised qualifications, enabling incremental skill progression into OSW.
 8. NGOs and OSW industry stakeholders and donors raise awareness and build community engagement through education in OSW opportunities, career pathways and the benefits of training and certification, monitoring training outcomes, employment and socio-economic impacts to refine programme design over time.
 9. OSW employers formalise commitments to allocate a defined percentage of employment opportunities to local residents, extending beyond entry-level and casual labour to include skilled and permanent roles. This should include:
 - Working with local fisher associations to leverage existing fishing expertise, vessels and logistics networks for OSW roles.
 - Defining clear career pathways that allow educated coastal youth to access and advance into professional positions within the organisation.
 - Recognising the value of contractual flexibility to accommodate fishers' seasonal work patterns and preferences for flexible or part-time roles.
 10. NGOs and other international donors support fisher-to-fisher programmes sharing communication of what fishers elsewhere in the world have experienced and how to work with the OSW for best outcomes. This may include visits, videos and direct communication.

Again, the timing of implementation of these recommendations will depend on progress towards implementation of OSW projects. An indicative roadmap is provided in Figure 19. Note that various recommended actions will continue indefinitely, beyond the initial implementation phase shown. Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines, to keep in step with industry workforce needs.



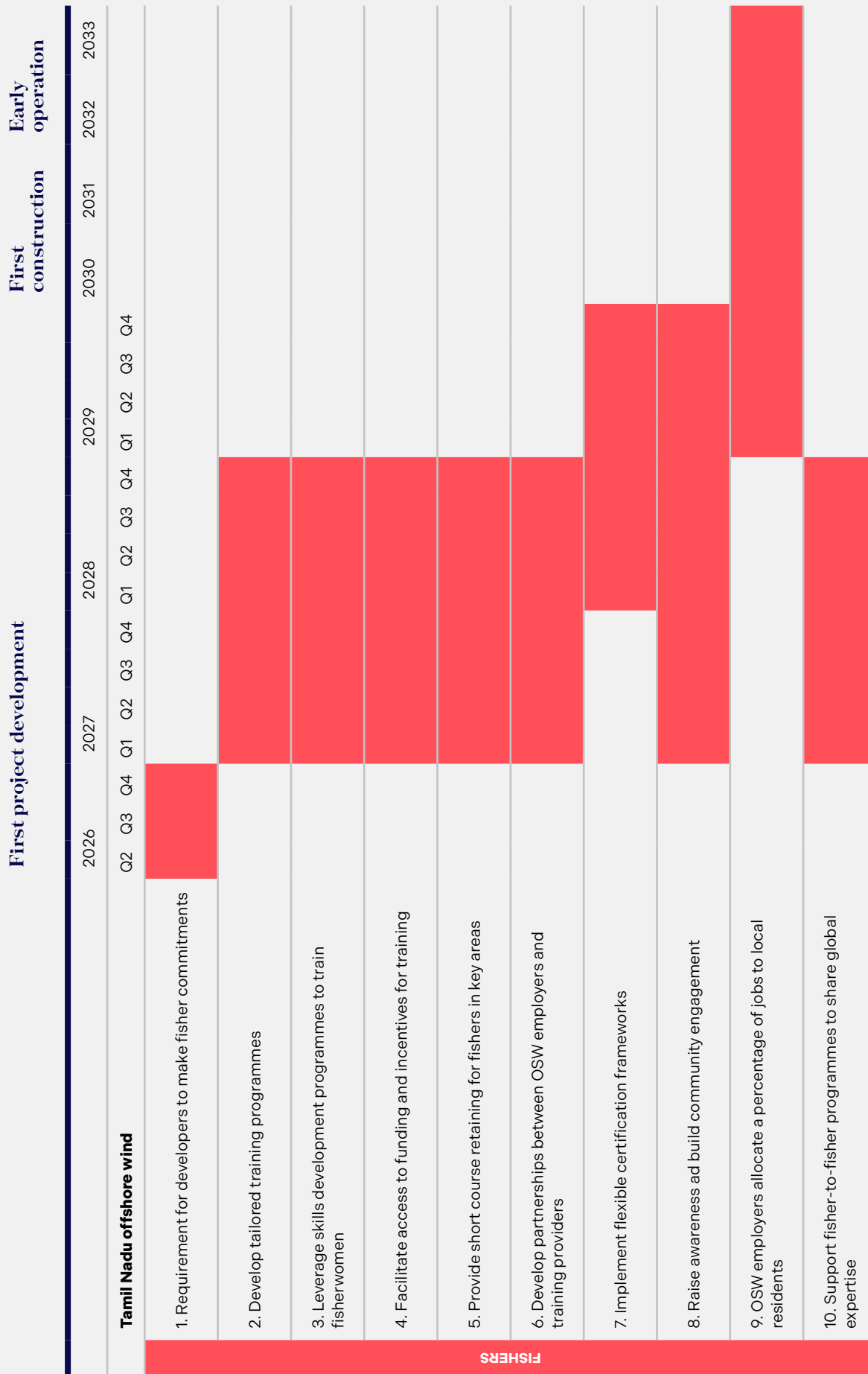
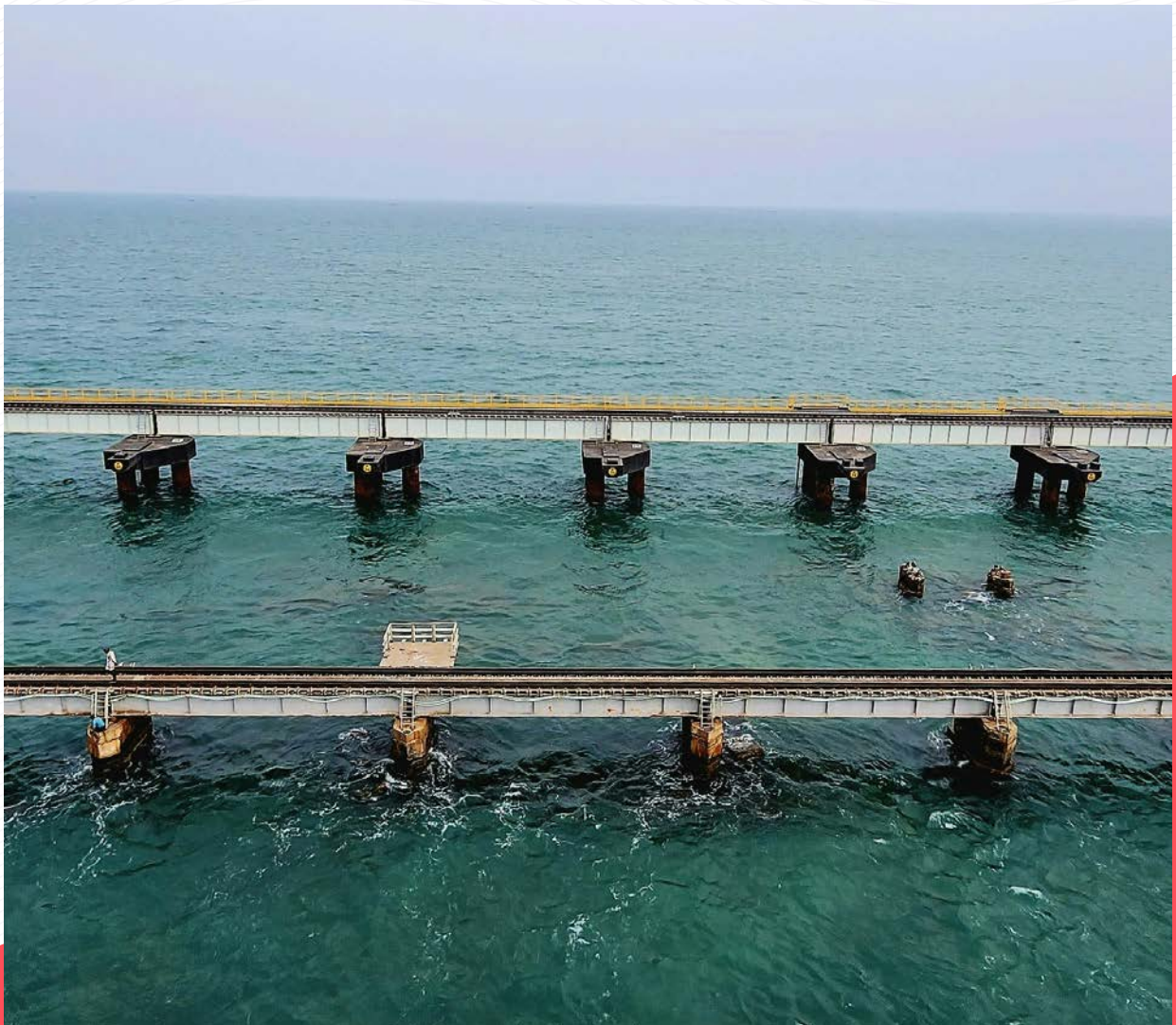


Figure 19: Indicative roadmap for fisher workforce development.

Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines.

MSMEs landscape, road map and action plan to benefit OSW and coastal communities



5.1 Introduction

Developing and strengthening the role of Micro, Small, and Medium Enterprises (MSMEs) within coastal communities is another critical contributor to ensuring that the OSW sector generates inclusive and sustainable local growth. MSMEs play a central role in coastal economic systems, anchoring local employment, services, and specialised capabilities that can align closely with the evolving needs of the OSW industry. For OSW specifically, MSMEs matter because many fabrication, marine services, logistics, electrical works, and operations-support activities rely on small, specialised firms that can supply components and services close to ports and project sites. By recognising their existing contributions and identifying pathways for integration, this section outlines how MSMEs can be empowered to participate meaningfully in the OSW value chain. In doing so, it highlights opportunities for balanced economic development that benefits both coastal communities and the wider renewable energy transition.

This section is divided as follows:

- Section 5.2 MSME landscape mapping: Provides an overview of the current MSME ecosystem in coastal regions, identifying sectoral strengths, existing capacities, and linkages with community livelihoods.
- Section 5.3 Opportunity and barrier analysis: Examines potential areas where MSMEs can contribute to OSW development, while assessing structural, financial, and institutional challenges that may limit their participation.
- Section 5.4 MSME engagement: summarises engagement regarding priority skills areas, proposed interventions and enabling mechanisms.
- Section 5.5 Recommendations for MSME support: Summarises findings into a phased strategy, outlining priority interventions, enabling mechanisms, and collaborative frameworks to support MSME growth alongside OSW sector expansion.

5.2 MSME landscape mapping

Tamil Nadu is India's most industrialised state, hosting about 16% of the country's factories and ranking third in national exports, with exports of about ₹ 2.7 lakh crore. As of 31 March 2025, Tamil Nadu had over 33 lakh MSMEs registered on the Udyam portal, of which the vast majority are micro-SMEs, as shown in Table 5.1. Assuming an indicative turnover for micro-, small- and

medium-sized enterprises of ₹10 crore, ₹100 crore and ₹500 crore respectively, this gives a relatively even split in turnover between the three categories, as shown in the right-hand column of Table 20.

Table 20: Tamil Nadu MSME overview

Type of enterprise	Definition (Investment in Plant & Machinery / Equipment)	Number of enterprises	Fraction of enterprises (%)	Indicative fraction of MSME turnover, by type of enterprise (%)
Micro	Not more than ₹2.5 crore	33,00,096	98.2	38
Small	Not more than ₹25 crore	56,853	1.7	32
Medium	Not more than ₹125 crore	5,108	0.1	30
Whole of Tamil Nadu		33,62,057	100	100

The MSME landscape assessment draws on the following data and methodological steps:

1. Secondary research on the MSME and industrial landscape in Tamil Nadu, including policy documents and sectoral reports.
2. MSME-level data extraction from the Open Government Data (OGD) platform, using the dataset “List of MSME Registered Units under UDYAM” (July 2020 to 12 December 2025).⁸
3. Geographic filtering to focus on districts identified as areas of interest for OSW-related coastal development.
4. Identification of OSW-relevant sectors based on secondary research, followed by mapping of corresponding NIC codes, this can be found in Appendix C.
5. Extraction of relevant MSME enterprises from the dataset using the identified NIC codes, without assessing feasibility or readiness at this stage.

The MSME landscape shows a strong OSW-relevant base of about 5,500 firms, with the largest concentrations in Kanniyakumari, Thanjavur, and Pudukkottai, indicating clear coastal hubs for supply-chain development. Marine transport/

⁸ MSME-level data extracted from the Open Government Data platform using the dataset “List of MSME Registered Units under UDYAM” accessed via the UDYAM Registration search portal: <https://udyamregistration.gov.in/SearchRegistration.aspx>.

logistics and electrical equipment & power system components dominate across districts, together accounting for more than half of all MSMEs, which suggests immediate local capacity for port, installation, and grid-integration activities. A summary of the number of relevant MSMEs in each district is shown in Table 21.

Table 21: MSMEs in each district of interest.

District	Total number of enterprises	Number of OSW-relevant MSMEs	Fraction of TN OSW-relevant MSMEs that are in the district(%)
Kanniyakumari	87,661	1,036	19
Tirunelveli	30,000	269	5
Thoothukudi	72,765	791	14
Ramanathapuram	45,706	648	12
Pudukkottai	59,587	825	15
Thanjavur	91,872	1,002	18
Nagapattinam	31,102	486	9
Whole of Tamil Nadu	4,62,330	5,529	100

MSMEs active in marine transport/logistics and electrical equipment and power system components dominate across districts, together accounting for more than half of all OSW-relevant MSMEs, which suggests immediate local capacity for port, installation support, and grid-integration activities. In particular, Kanniyakumari and Thanjavur, each host over 1,000 OSW-relevant MSMEs, positioning them as leading coastal hubs, while Pudukkottai, Thanjavur and Ramanathapuram provide mid-level clusters that can support fabrication and operations support. Shipbuilding, floating structures & marine asset-related activity forms a significant secondary pillar of the MSME base, with notable clusters in Kanniyakumari, Nagapattinam, and Tuticorin that can support fabrication of secondary steel structures for foundations, offshore platforms, vessels and tooling.

Building on experience from existing wind farms in Tamil Nadu, many of these MSMEs are already embedded in onshore wind supply chains, for example, fabricating tower and other structural components, providing transport and crane services for turbine logistics, and supplying transformers, switchgear, and cabling, which can be leveraged and upgraded to serve future OSW projects as the market matures. The geographical spread of OSW-relevant MSMEs is shown in Table 22, with darker green signifying more offshore wind-relevant MSMEs.

Table 22: Geographical spread offshore wind-relevant MSMEs.

Sector	Kanniyakumari	Nagapattinam	Pudukkottai	Ramanathapuram	Thanjavur	Thiruvarur	Tirunelveli	Tuticorin	Total
Marine transport, logistics & port services	220	140	356	312	302	172	64	307	1,873
Electrical equipment & power system components	317	126	207	128	317	148	86	157	1,486
Shipbuilding, floating structures & marine assets	237	154	33	57	29	35	15	128	688
Structural steel & fabricated metal products	93	22	119	41	188	44	38	73	618
Mechanical equipment, turbines & industrial O&M	79	21	46	19	54	24	31	58	332
Power generation, transmission & utility construction	65	14	31	16	62	27	30	63	308
Offshore oil and gas extraction & support services	25	9	33	75	50	22	5	5	224
Total	1,036	486	825	648	1,002	472	269	791	5,529

The MSME base in the eight selected coastal districts of Tamil Nadu's is tightly interlinked with everyday coastal livelihoods:

- Fishing depends on MSMEs that build, repair, and service fishing boats, ice/fish-processing vessels, and the small barges that move catch to ports.
- Tourism draws on local operators running ferries, water taxis, cruise services, and maintaining related marine infrastructure such as pontoons and jetties.
- Logistics and trade rely on MSMEs providing coastal freight services, warehousing, dredging, and structural steel work that keep harbours, cold chains, and cargo terminals functional, which in turn sustain jobs for transport workers, handlers, and small traders.
- Energy-related MSMEs maintain engines, turbines, power lines, and substations that supply electricity to landing centres, cold storage, hotels, and coastal industries, enabling reliable power to underpin incomes from fishing, tourism, and services.

Typical activities in these sectors, their links with key local activities and their relevance to OSW are shown in Table 23.

Table 23: Overview of typical activities and relevance to offshore wind

MSME sector	Typical activities (based on NIC description)	Links with fishing, tourism, logistics, energy-related activities & coastal livelihoods	Relevance to offshore wind
Marine transport, logistics & port services	Sea and coastal freight transport; sea/coastal ferry services; water cruises/water taxis; services incidental to water transportation; construction of waterways/harbours and dredging	Coastal freight, ferry, and port services enabling movement of goods, passengers, and fish catch	Logistics and marine transport for OSW mobilisation, port infrastructure, and marine movement support
Electrical equipment & power system components	Manufacture of distribution transformers and regulators; manufacture of switchgear/control apparatus; manufacture of insulated wires and cables; manufacture of generators and motors	Manufacturing base for electrical equipment and power-system components	Power systems (electrical components and equipment) relevant to grid/interface and electrical supply chains
Shipbuilding, floating structures & marine assets	Building of fishing boats and fish-processing vessels; construction of floating structures (pontoons, barges, floating docks); construction of floating/submersible platforms; building of commercial vessels	Construction and repair of fishing vessels, passenger craft, barges, and floating assets used in fishing operations, coastal passenger services, and port logistics	Marine/offshore asset activities; OSW marine support ecosystem (vessels, floating structures)
Structural steel & fabricated metal products	Manufacture of steel structures and fasteners	Structural steel fabrication supporting port and marine infrastructure	Fabrication (structural steel) relevant to OSW
Mechanical equipment & industrial O&M	Repair and maintenance of engines and machines; manufacture and repair of gears/bearings	Mechanical repair and maintenance services for engines and equipment used in coastal logistics and energy operations	Service ecosystems that can support OSW operations over time
Power generation, transmission & utility construction	Construction and maintenance of power plants and substations; erection/maintenance of transmission and telecommunication lines; construction of utility projects	Construction and maintenance of power generation, transmission, and utility infrastructure supplying coastal areas	Grid and utility interface relevant to onshore enabling infrastructure associated with OSW integration
Offshore oil and gas extraction & support services	Services for offshore petroleum product extraction	Offshore extraction and associated marine support services directly linked to offshore energy operations	Offshore operations; offshore service industrial base

5.3 Opportunity and barrier analysis

OSW development in Tamil Nadu has the potential to create demand across a wide range of industrial and service activities across multiple stages of OSW-project lifecycles, including component fabrication, port and yard operations, transport and logistics, marine support, electrical and mechanical works, and operations support. Studies highlight that OSW projects are likely to be delivered through large organisations acting as project developers and EPC contractors. In the near term, MSME opportunities are expected to arise primarily through subcontracting and service provision to tier 1 and 2 suppliers to these project developers and EPC contractors. Realising these opportunities will require addressing several constraints that currently limit MSME participation in the offshore wind supply chain.

Key Barriers include:

- High certification and qualification costs, particularly for marine-grade applications and wind turbine supplier-specific vendor approval processes.
- Scale requirements related to fabrication space, lifting capacity, specialised machinery, and proximity to port infrastructure, which many MSMEs do not currently possess. Offshore wind projects and components are typically significantly larger than in onshore wind or solar.
- Working capital constraints: Long payment cycles, milestone-based contracting, and the need to finance materials and labour upfront pose significant risks, particularly in the absence of dedicated financial instruments for MSMEs.
- Contracting practices: reduce entry points for smaller firms and limit the scope for modular or task-based participation.
- Limited transition pathways for MSMEs in adjacent sectors to move into offshore wind through phased qualification or supplier development programmes.

5.3.1 Analysis of supply chain areas where MSMEs can contribute

Offshore wind development in Tamil Nadu presents a varied set of market entry points for MSMEs. While large developers and EPC contractors will anchor project delivery, MSMEs can play meaningful roles through subcontracting, providing specialised services and through phased capability development over time. Their participation is most feasible in supply chain areas where existing industrial strengths such as marine services, fabrication, electrical equipment, mechanical repair and utility construction align with OSW requirements.

MSME participation potential varies across supply chain segments. In some areas such as marine logistics or structural fabrication, MSMEs already operate in adjacent sectors such as fishing, coastal transport, port services, metalworking and can transition with targeted support. In others, such as turbine components or high-voltage electrical systems, opportunities are more limited and would require structured supplier development, certification pathways and partnerships with tier-1 suppliers, which may potentially exist (or may be best initiated) via onshore wind.

Across all segments, barriers such as certification costs, scale requirements, working capital constraints and restrictive contracting practices shape the degree to which MSMEs can enter and sustain participation. Table 24 identifies where MSMEs can contribute, the nature of the opportunity, and the barriers that must be addressed.



Table 23: Opportunities and barriers for MSMEs in OSW.

OSW supply chain area	Potential MSME role	Description of opportunity	Barriers identified
Marine transport, logistics & port services	Crew transfer services; small-vessel operations; port-side logistics; warehousing; local transport; minor dredging and harbour works	Strong alignment with existing coastal freight, ferry and port-linked MSMEs. OSW mobilisation requires movement of components, personnel, and equipment; opportunities in auxiliary marine services, bunkering, vessel provisioning, and port-side handling.	High certification costs for marine-grade operations; safety and compliance requirements; limited access to finance for vessel upgrades; port access constraints; contracting structures favouring larger marine operators.
Electrical equipment & power system components	Manufacture of cables, switchgear, control panels, small transformers; assembly of electrical sub-components; testing and quality services	Tamil Nadu has a strong MSME base in electrical equipment manufacturing. OSW creates demand for cables, switchgear, auxiliary electrical systems, and onshore substation components. Opportunities exist in low- and medium-voltage equipment, balance-of-plant electrical works, and testing services, mainly onshore.	Supplier qualification requirements from turbine suppliers; need for specialised testing and certification; scale and precision requirements for offshore-grade components; long payment cycles for EPC-linked contracts.
Shipbuilding, floating structures & marine assets	Fabrication of pontoons, barges, small workboats; repair and maintenance of vessels; fabrication of structures for port operations	Existing MSMEs in fishing vessel construction and repair can diversify into OSW-related marine assets. Opportunities include small craft fabrication, barge modification, floating storage units, and port-side floating structures.	Need for marine-grade materials and certification; limited fabrication space and lifting capacity; capital-intensive upgrades; stringent quality assurance processes.
Structural steel & fabricated metal products	Fabrication of secondary steel, ladders, platforms, railings, transition-piece accessories; port infrastructure steelworks	Strong overlap with MSMEs producing structural metal products. OSW requires extensive secondary steel fabrication for balance-of-plant structures and manufacturing / port assets. MSMEs can supply modular components and undertake subcontracted fabrication tasks.	Scale requirements for large components; welding and NDT certification; need for precision fabrication; competition with larger fabricators; working capital constraints for steel procurement and payment terms.
Mechanical equipment, turbines & industrial O&M	Repair and maintenance of mechanical systems, hydraulic units; machining services; workshop-based component refurbishment	MSMEs already active in mechanical repair for coastal logistics, industrial machinery and onshore wind can support OSW operations over time. Opportunities include workshop-based machining and auxiliary equipment refurbishment and repair.	Need for specialised tools and diagnostic equipment; wind turbine supplier-specific training and qualification; limited visibility of long-term O&M contracts; milestone-based payments.
Power generation, transmission & utility construction	Civil works, cable trenching, substation construction support, installation of utility infrastructure, auxiliary electrical works	OSW integration requires onshore substations, transmission lines, and utility upgrades. MSMEs can contribute to civil works, cable laying, and auxiliary electrical installations.	High entry barriers for EPC-led utility projects; safety and quality compliance; bonding and guarantee requirements; limited pathways for smaller contractors.
Offshore oil and gas extraction & support services	Marine support services; offshore logistics; safety and inspection services; supply of consumables	MSMEs with experience in offshore oil and gas can transition into OSW, leveraging knowledge of offshore operations, safety protocols, and marine logistics.	Certification and requalification for OSW; competition with established offshore service firms; need for investment in OSW-specific equipment and training.

5.3.2 Quantifying MSME Participation in Tamil Nadu's Offshore Wind Supply Chain

The scale of MSME participation in Tamil Nadu's offshore wind sector can be assessed by estimating the expected gross value added (GVA) generated through MSME activity. The economic benefit to Tamil Nadu from the Indian project pipeline was calculated in Section 2, using a methodology developed in-house by BVGA for the offshore wind sector and used for many assessments. This methodology accounts for the capabilities of the Tamil Nadu supply chain, typical project costs, and the expected level of MSME contribution. For a full description of the methodology, inputs, and GVA calculations, see Appendix C. These results form the basis for understanding the scale of MSME opportunities in the state.

The largest opportunities for MSMEs are expected at tier 3 and tier 4 levels of the supply chain. To capture the potential share of MSME activity, both direct MSME allocations and the share of non-MSME activity attributable to Tamil Nadu MSMEs were considered. These assumptions build on previous BVGA work for offshore wind projects in established European markets, adjusted to reflect expected supply chain activity in Tamil Nadu and the capacity of local MSMEs relevant to offshore wind development.

Table 5.6 presents the total GVA in Tamil Nadu generated by a 1 GW project in Tamil Nadu waters, broken down by supply chain category, along with the share of the GVA directly allocated to MSMEs and the additional share subcontracted to MSMEs through the supply chain. In total, over ₹2,800 crore GVA is anticipated to be generated by MSMEs in Tamil Nadu.

MSMEs are expected to capture the largest share of GVA from development and project management phase activities, potentially receiving 61% of overall value in Tamil Nadu, and 53% of overall value during operations phase activities (53%). In the manufacturing and installation phase, the share of work undertaken by MSMEs is expected to be lower, due to the high capital requirements and dominance of tier 1 suppliers within these phases. The MSME share can be expected to grow over time, as the market develops. This growth will depend on market conditions and deployment.

As discussed in Section 5.2, Coastal regions host a high proportion of the MSMEs with experience relevant to offshore wind, suggesting a significant economic opportunity in these coastal regions.

Table 25: VA in Tamil Nadu generated by a 1 GW in Tamil Nadu waters with potential MSME direct and subcontracted share.

	Total Tamil Nadu GVA (₹ crore)	Tamil Nadu MSME GVA (₹ crore)	MSME share of Tamil Nadu GVA (%)
Development and project management	346	211	61
Manufacturing	3,655	970	27
Installation and commissioning	837	222	27
Operations	2,547	1,357	53
Decommissioning	198	52	26
Total	7,583	2,813	37

5.3.3 International examples

Case study 1 MSME integration at the port of Blyth, UK

Over the past decade, the Port of Blyth in Northeast England has developed into an OSW operations and supply-chain hub. Growth has been driven by a combination of anchor-tenant investment, strong subsea cable-sector capabilities and consistent regional support. The port's deep-water access, proximity to North Sea OSW projects and available industrial land made it an attractive base for larger OSW companies to set up regional bases, which in turn created opportunities for SMEs and specialist suppliers.

Networks such as NOF Energy and Energi Coast helped SMEs understand procurement expectations and connect with contractors. Local Enterprise Partnership grants supported equipment upgrades, certification and digital QA systems, enabling firms to meet OSW standards more quickly. Institutions played a role with ORE Catapult's National Renewable Energy Centre provided testing, validation and R&D facilities, but companies still needed to demonstrate commercial readiness and invest in their own upgrades.

National supplier chain development programmes provided by Offshore Wind Growth Partnership (OWGP), including Wind Expert Support Toolkit (WEST) and Fit4OR programmes provided strategic industry support and practical advice for SMEs.

Co-location around the port helped communication (rather than forcing collaboration). The Blyth Innovation Zone and nearby industrial spaces placed SMEs close to Tier-1 suppliers, but engagement typically occurred only when it helped to solve real operational problems such as cable-handling, inspection, or vessel-turnaround challenges.

Anchor companies were central to creating steady demand. Relevant decisions included:

- Project developer EDF Renewables established its UK Offshore Wind Control Centre at Blyth, generating ongoing operations and monitoring activity for its local OSW close-to-shore demonstration project.
- Project developer RWE located its Marine Coordination Centre for local OSW projects at the port, increasing vessel movements and logistics needs.
- EPC contractor Van Oord used Blyth as a base for array-cable logistics and near-shore operations.
- ORE Catapult attracted engineering and technology suppliers through its national testing and validation facilities on site.
- JDR Cable Systems invested in a new subsea cable manufacturing facility, significantly expanding the region's cable-sector footprint.

Tier-1 suppliers involved SMEs when it improved delivery performance, but proximity increased the logic for involving them and the effectiveness of that involvement. Many chose to source locally where it is commercially viable, creating demand for fabrication, cable-services, logistics and inspection technologies, recognising the long-term value to them of helping new suppliers to establish locally.

Blyth's strongest competitive advantage has been its cable-sector concentration, but OSW suppliers also provide wider services. The presence of JDR Cables, Van Oord's cable-logistics operations and ORE Catapult's testing facilities created a cluster of activity around cable manufacturing, logistics, installation, inspection, monitoring and repair. This specialisation provided clearer entry points for SMEs with relevant offerings than other parts of the OSW value chain.

Timeline of development

- 2010–2014: Early investments in port infrastructure and ORE Catapult's National Renewable Energy Centre establish Blyth as a testing and R&D location. First SMEs choose to locate activities nearby.
- 2018–2022: EDF and RWE set up control and coordination centres; SMEs begin entering OSW supply chains through logistics, fabrication and engineering services.

- 2018–2021: Van Oord and other contractors use Blyth for array-cable logistics; demand for cable-handling and inspection services increases.
- 2021–2024: JDR Cables announces and develops its new subsea cable manufacturing facility, strengthening the region's cable-sector identity.
- 2019–present: Growth in SMEs and specialist suppliers accelerates, with firms expanding into export markets and supporting North Sea OSW projects.

More than 200 SMEs and specialist suppliers in the Northeast (not all based in Blyth) now contribute to the OSW supply chain. Many are medium-sized engineering firms or satellite offices of larger companies that expanded because OSW offered stable, long-term work. Blyth has emerged as a recognised OSW cluster built on a realistic mix of commercial opportunity, anchor-tenant presence and sectoral specialisation.

The Blyth experience shows that SME integration succeeds when anchor companies create operational demand, SMEs and medium-sized firms scale into OSW when the commercial case is strong and co-location enables faster problem-solving and technology development.

For Tamil Nadu, the key message is that OSW is a large-scale industry with space for SMEs, medium-sized firms and larger players, provided anchor tenants and sectoral strengths are established early and support is provided to enable their entry to, and growth in, the OSW sector.

Case study 2 MSME integration in the onshore wind sector in Tamil Nadu

Tamil Nadu has built one of India's strongest onshore wind ecosystems and MSMEs are an important aspect of this. The state's early adoption of wind power, combined with an industrial base in Chennai, Coimbatore, Kanchipuram, and Tiruchirappalli created a foundation for MSMEs to enter the supply chain. Over time, these MSMEs have contributed to machining of minor parts, basic fabrication, production of electrical sub-assemblies, transport, storage, waste handling, refurbishment of spares and field-level construction (inc. civil engineering) and installation and O&M support.

Wind turbine suppliers such as Regen Powertech, Siemens Gamesa, Suzlon and Vestas established major manufacturing and assembly facilities in Tamil Nadu. These facilities relied primarily on large and medium-sized suppliers for towers, castings, forgings, steel fabrications, gearboxes, electrical systems and other large components, as these components require high-capital equipment and multi-crore turnover operations.

Procurement teams at wind turbine suppliers identified capable small firms for niche, low-value, or labour-intensive tasks, such as:

- Machining of small brackets and fixtures,
- Welding and fabrication of non-critical components,
- Cable routing accessories and minor electrical items,
- Packaging, storage and material-handling services,
- Refurbishment of used components and,
- Waste-management and recycling services.

In this context, wind turbine suppliers provided technical specifications and conducted supplier audits. MSMEs upgraded quality systems mainly to meet minimum requirements for ISO certification or documentation compliance enabling them to supply small batches or service-oriented work.

Cluster effects emerged not because MSMEs collaborated extensively with wind turbine suppliers and project developers, but because Tamil Nadu's engineering ecosystem already contained:

- Foundries and machining shops,
- Gearbox and motor specialists
- Electrical equipment manufacturers, and
- Logistics, civil engineering and crane service providers.

These firms served as intermediaries. MSMEs often supplied to these larger Tier-2 and Tier-3 companies, rather than directly to turbine suppliers or project developers. Proximity reduced transport costs and allowed small firms to respond quickly to urgent machining, repair or service needs. Specialist service providers such as transporters, crane operators, storage yards, and O&M contractors also grew around these industrial clusters of engineering and manufacturing firms in Chennai, Coimbatore, Kanchipuram, and Tiruchirappalli supporting wind project deployment across Tamil Nadu and other states.

Tamil Nadu's manufacturing incentives, MSME capital-subsidy schemes and renewable-energy policies encouraged firms to modernise equipment and expand capacity. Technical institutes and engineering colleges introduced

training aligned with wind-sector needs, helping MSMEs recruit workers with skills in electrical systems, composites and wind turbine maintenance. Most MSMEs remained in lower-value segments due to capital constraints and the high technical requirements relating to major components.

Hundreds of MSMEs now contribute to India's wind industry, primarily through supporting services, minor components and refurbishment work rather than core turbine manufacturing. Many have expanded into national markets, supplying spares, repair services and logistics support to wind farms across India. Their participation has strengthened Tamil Nadu's broader renewable-energy ecosystem.

5.4 Stakeholder discussion

Discussions were held with MSME representatives active in identified sectors, senior industry professionals, and sector experts with experience across the onshore and offshore wind value chain. The engagement focused on assessing opportunities and barriers of MSME participation in the emerging OSW value chain.

Table 26: Stakeholders engaged for feedback on priority skills areas, proposed interventions and enabling mechanisms.

Organisation	Role/designation interviewed
Global Wind Energy Council (GWEC)	Director-level representative
Aban Power (Aban Group)	Senior management-level representative
Space Tech	Director-level representative
(Wind energy sector company)	Senior management-level representative
(FRP manufacturer)	Director-level representative
Velmurugan Heavy Engineering Industries	Senior leadership-level representative

Stakeholders indicated that offshore wind in Tamil Nadu is not yet seen as a bankable area of activity, still being so many years away from OSW construction and with no projects yet in development. While interest in the sector exists, the lack of clarity on project timelines, the expected scale of work and contracting structures was identified as key reasons for limited activity. This uncertainty affects both MSMEs and larger supply-chain firms, including those with prior experience in onshore wind, fabrication, and marine services.

Industry stakeholders pointed out that OSW requirements differ substantially from those of onshore wind. These differences relate to component scale, safety practices, certification standards, and operational risk. Further, stakeholders pointed out transportation of OSW components may be challenging with existing road and bridge infrastructure, necessitating either port-based manufacturing or modular component designs with final assembly at ports. This is true of OSW in all markets but does not apply to the scale of many components that MSMEs are likely to be involved with.

Stakeholders noted that the most realistic areas for MSME involvement are in component manufacturing, fabrication, and selected support services. Examples included steel fabrication, mechanical and electrical sub-components, corrosion-protection systems, port-related logistics, customs and export facilitation, and quality-assurance services. Entry into these areas was considered feasible, primarily in sub-supplier roles and dependent on technical specifications, defined certification requirements, and steady demand. Steady demand is always attractive to the supply chain, but potentially less needed for MSMEs with low sector-specific investment than for tier 1 suppliers that invest in supply to local OSW projects.

Participants pointed to the absence of OSW-specific training and certification infrastructure in India, which is not unexpected at this early stage. While Tamil Nadu has a strong technical workforce, offshore work requires safety and technical training including GWO-aligned programmes and offshore-grade welding and inspection certifications. This was seen as a workforce and ecosystem gap rather than a lack of technical capability. Additionally, absence of OSW sector specific MSME support in MSME policy and access to affordable finance were also highlighted as constraints.

Taken together, stakeholder feedback suggests that MSME participation in OSW will grow as the market scales, supported by coordination with larger developers on skills and knowledge transfer, improved access to training, certification and finance and a reliable project pipeline. Stakeholders also highlighted potential spillover demand linked to regional offshore wind and marine infrastructure activity in the Indian Ocean region, especially in neighbouring countries like Sri Lanka.

5.4.1 Priority OSW sectors for MSMEs

Stakeholder consultations and supply-chain analysis indicated that MSME participation in Tamil Nadu's OSW sector will emerge gradually, with early opportunities concentrated in project-development support and in areas aligned with existing industrial strengths, coastal capabilities and transferable experience from onshore wind, marine services and fabrication.

Although stakeholders expressed strong interest in OSW, they noted that confidence in the sector remains limited due to the absence of a confirmed project pipeline, uncertainty around timelines and limited visibility on contracting structures. These conditions restrict proactive investment by MSMEs and larger supply-chain firms and are reinforced by several systemic barriers:

- Lack of OSW-specific training and certification infrastructure, including GWO-aligned safety programmes and offshore-grade welding and inspection certifications
- Absence of OSW-focused MSME support within existing MSME policy frameworks, limiting access to targeted incentives
- Limited access to affordable finance, particularly for vessel upgrades, fabrication equipment and certification costs
- Uncertainty around project timelines and scale, which discourages early investment

Despite these constraints, several OSW supply-chain segments still present realistic near- to medium-term entry points for MSMEs. These segments typically:

- Overlap strongly with existing MSME capabilities
- Involve delivery mainly to Tier-1 or Tier-2 suppliers rather than directly to developers or OEMs
- Offer potential to scale as project activity increases and regional spillover demand emerges

The priority sectors are outlined below.

Marine transport, logistics and port-related services

MSMEs already active in coastal logistics, ferry operations, warehousing and port-side services are well positioned to support OSW mobilisation activities. Opportunities include crew transfer services, small-vessel operations, vessel provisioning and port-side handling of components and equipment. These roles align closely with existing capabilities and can scale as OSW construction ramps up.

Stakeholders emphasised, however, that marine-grade certification, safety compliance and vessel upgrade financing are barriers. Contracting structures in marine logistics also tend to favour larger operators, limiting MSME entry unless targeted support mechanisms are introduced.

Electrical equipment and power system components

Tamil Nadu's strong MSME base in electrical equipment manufacturing creates a natural pathway into OSW-related production of cables, switchgear, control panels, auxiliary electrical systems, and testing services. These opportunities are most viable in low and medium-voltage components, balance-of-plant electrical works and onshore substation equipment.

Stakeholders noted that entry into some aspects of this segment depends heavily on supplier qualification by wind turbine suppliers, specialised testing and certification and the ability to meet offshore-grade precision and reliability standards. Onshore supply for substations, however, is the same as for other onshore power generation sectors.

Fabricated steel products

Secondary steel fabrication such as ladders, platforms, railings, transition-piece accessories and port-infrastructure steelworks represents one of the most accessible OSW segments for MSMEs. Tamil Nadu has a large base of structural metal fabricators capable of supplying modular components or undertaking subcontracted fabrication tasks.

Key barriers include welding and NDT certification requirements, precision fabrication standards, and working-capital constraints for steel procurement. Stakeholders also highlighted that OSW component scale may exceed the capacity of many MSME workshops, reinforcing the need for modularised designs or in-port final assembly.

Mechanical equipment and industrial O&M services

Workshop-based machining and auxiliary equipment repair are areas where MSMEs with industrial O&M experience can support OSW operations over time. These opportunities are expected to materialise primarily during the operations phase and may flow through long-term service contracts signed between project owners and wind turbine suppliers and may involve wind turbine supplier-specific training.

Barriers include the need for specialised diagnostic tools, quality requirements and wind turbine supplier qualification.

Power generation, transmission and utility construction

Civil works, cable trenching, substation construction support and auxiliary electrical installations offer opportunities for MSMEs already active in utility and infrastructure projects. These roles will be essential for OSW grid integration and have no OSW-specific requirements.

Stakeholders noted, however, that EPC-led utility projects have high entry barriers, including bonding requirements, safety compliance and stringent quality standards, which may limit MSME participation without targeted facilitation.

5.5 Recommendations for MSME support

To maximise the mutual benefit to MSMEs and OSW, the following recommendations are made to be validated through follow-up engagement prior to implementation it is recommended that:

1. MNRE, through SECI and with technical inputs from NIWE, should further clarify and communicate the offshore wind (OSW) development roadmap for Tamil Nadu, building on the existing national offshore wind policy and strategy, including the sequencing of seabed leasing, auctions, and project implementation milestones.
2. The Tamil Nadu Energy Department aligns port planning, land allocation, and industrial infrastructure decisions to this trajectory.
3. Procurement frameworks: The state and industrial bodies facilitate and make transparent the industry to industry pathway and progression routes aligned with wind turbine suppliers and EPC supplier requirements. The State Industries Department, through Tamil Nadu Industrial Development Corporation (TIDCO), State Industrial Promotion Corporation of Tamil Nadu (SIPCOT), Tamil Nadu Small Industrial Development Corporation (TANSIDCO), and Guidance Tamil Nadu, may coordinate with NIWE, wind turbine suppliers, and EPC contractors to operationalise these pathways. Industry bodies like Confederation of Indian Industries (CII) could support outreach, capability mapping, and supplier onboarding.
4. Port planning processes incorporate provisions for port-adjacent MSME activity linked to offshore wind manufacturing and services. This will require coordination between the Tamil Nadu Maritime Board and port authorities, with TIDCO and SIPCOT aligning land use and industrial infrastructure planning. Where central port assets are involved, coordination with the Ministry of Ports, Shipping and Waterways will be required to ensure consistency with national port-led development initiatives.
5. The State Industries Department, in coordination with MNRE and the State Energy Department extends capital subsidy and incentives available under the Tamil Nadu Industrial Policy 2021. This includes access to the term loan and working capital schemes of the Tamil Nadu Industrial Investment Corporation (TIIC), which offers project finance and MSME credit support, and MSME technology upgradation schemes, including the Credit Linked Capacity Subsidy Scheme (CLCSS), capital subsidy for plant and machinery modernisation and the Zero Defect Zero Effect (ZED) certificate scheme. These financial assistance measures could cover OSW-linked manufacturing and services, including capital support for technology upgradation, and working capital requirements.
6. MNRE, in coordination with NIWE, should guide internationally accepted offshore wind technical and safety standards, such as IEC 61400-3 (offshore wind turbines) and DNV offshore certificate guidelines, as a

reference standard for all Indian OSW projects, along with OSW work certificate pathway aligned to Global Wind Organisation (GWO) basic offshore safety Induction and safety Training. Training programme delivery on safety standards can be supported through the State Skill Development Mission and technical training institutions, with OEMs and EPC contractors involved to ensure alignment with project requirements.

7. A state-level OSW coordination mechanism, anchored within the Energy Department and operating through either an existing or dedicated institutional structure, should be established or designated to support OSW coordination across ports, environment, fisheries, industries, and central agencies. The focus should remain on alignment and sequencing, without creating additional approval layers.
8. State-level OSW coordination mechanism should facilitate the development of online supplier education materials and face-to-face events, supported by wind industry purchasers, to encourage, support, and inform interested MSMEs about OSW opportunities.
9. State-level OSW coordination mechanism should facilitate the establishment of a supplier strategy support programme for larger companies within the state, including innovators with potential to participate in OSW, drawing on principles from the UK OWGP's WEST programme.

Again, the timing of implementation of these recommendations will depend on progress towards implementation of OSW projects. An indicative roadmap is provided in Figure 20. Note that various recommended actions will continue indefinitely, beyond the initial implementation phase shown. Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines, to keep in step with industry workforce needs.

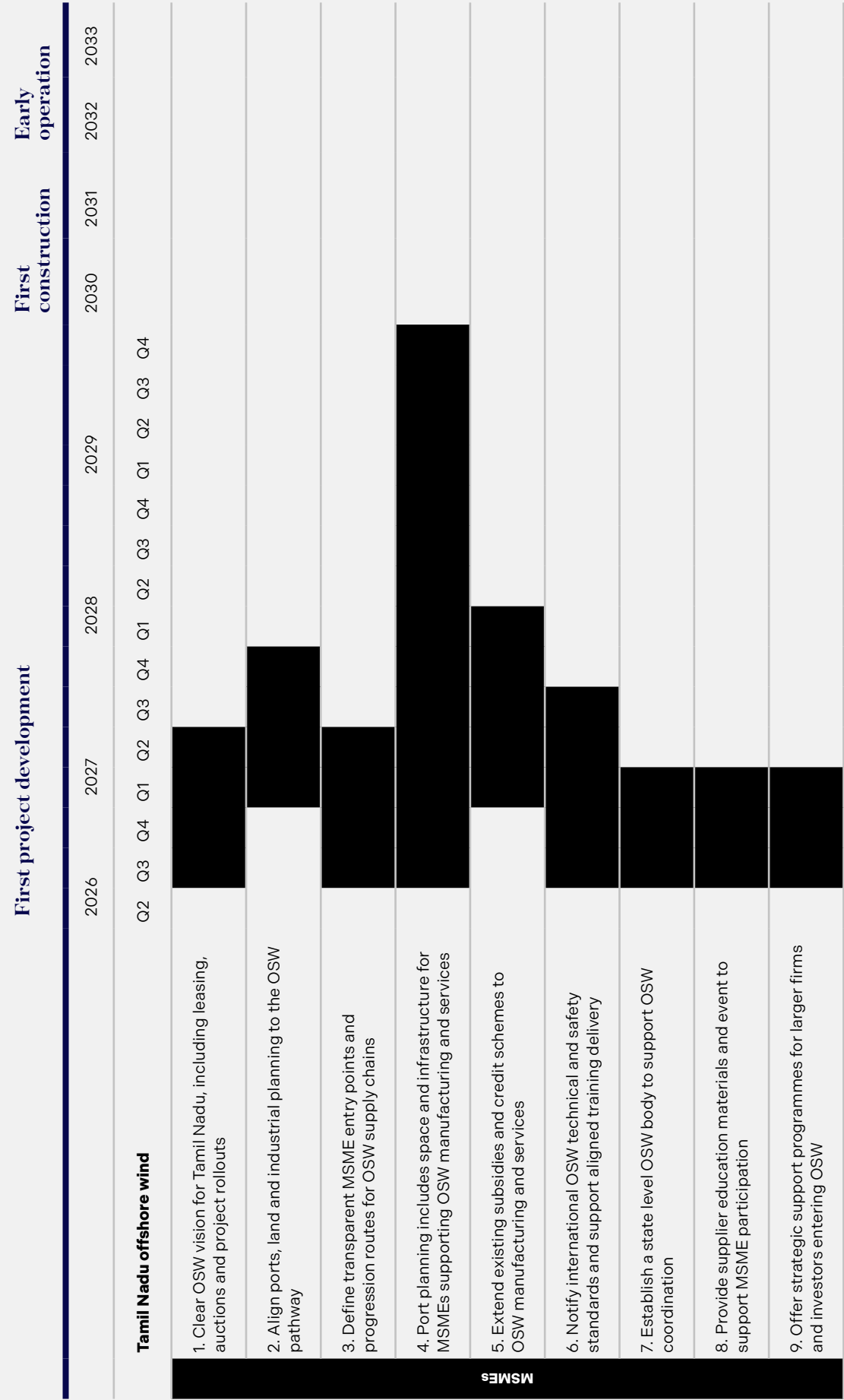
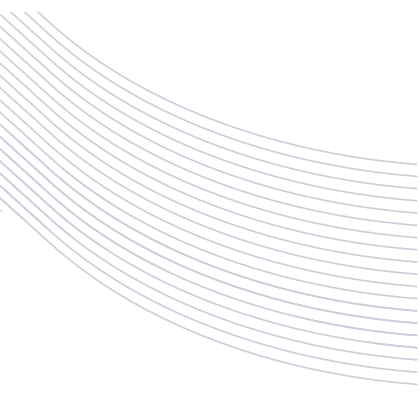


Figure 20: Indicative roadmap for MSME development

Timings are indicative and should be adjusted based on tender progress, project award, and implementation timelines.



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Appendix A Job roles

Table A.1 provides a detailed description of OSW jobs and associated skills and qualifications for 76 job roles, chosen as examples that include roles:

- Relevant to fishers and other local communities
- That may be harder to fill, so are good examples in assessing the capability of the education system in Tamil Nadu to provide relevant training.

Note that there are many other job roles within the categories listed that will provide opportunities for employment. Ultimately, the roles available locally will depend on the needs of the specific project developers and suppliers active in each project.

Table A.2 supports by providing detailed descriptors related to the NSQF roles. Note that in addition to the qualifications listed, many roles will benefit (or in some cases companies will require) relevant GWO certifications.



Table 27: Detailed description of OSW jobs and associated skills and qualifications

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Data analyst	O	Analyses turbine performance, weather, and maintenance data to optimize wind farm operations	Data analysis	6 to 7	NSQF Level 6-7 competencies and higher national diploma, bachelor's degree or equivalent in meteorology, statistics, or engineering - or a closely aligned discipline. Experience in relevant latest industry tools, depending on discipline.
Financial analyst	D	Assesses the financial viability of projects, monitors costs, and creates financial models to ensure profitability.	Data analysis	7	NSQF Level 7 competencies and a bachelor's degree in finance or related subject is required. 2 years' experience required.
GIS technician	D	Provides spatial data analysis and mapping support using GIS tools to assist in site selection, environmental assessments, and infrastructure planning.	Data analysis	6	NSQF Level 6 competencies and higher national diploma or bachelors qualification in related subject areas. Minimum of 2 years' experience across a broad range of GIS tools, remote sensing techniques, and spatial data management.
Resource analyst	D	Analyses wind data and models energy production potential to support site selection, financial forecasting, and project optimisation.	Data analysis	7	NSQF Level 7 competencies and bachelor's degree from an accredited university or college in meteorology, atmospheric science, or a closely related field.
Electrical engineer	D, M, I&C, O	Designs and manages supply of electrical, SCADA and control systems including within turbines, offshore substations, array cabling, and export system. Supports operational reliability. In a manufacturing environment this includes input on facility design and process improvement.	Electrical design and management	7	NSQF Level 7 competencies and bachelor's degree in electrical engineering (B.Tech/B.E) from an AITCET or UGC recognised university for senior roles. For junior level roles, a diploma in electrical engineering is required. A high level of experience in Electrical Engineering design environment with a lead role in project execution.
Joining and testing engineer	I&C	Responsible for managing electrical jointing and testing of cables during installation.	Electrical design and management	7	NSQF Level 7 competencies and bachelor's degree in engineering field (B.Tech/B.E) from an AITCET or UGC recognised university. 5 years' of experience from testing environment and/or power engineering.
Electrical technician	I&C, O	Assembles, installs and maintains and repairs electrical components and systems across all offshore wind farm components including turbines and balance of plant equipment. Also needed for major installation vessel support (an offshore	Electrical practical	4	NSQF Level 4 competencies and ITI or polytechnic diploma or equivalent in a relevant subject area such as electrical engineering or science. Experience with onshore wind is preferable if role is offshore.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Offshore commissioning supervisor	I&C	Leads testing and start-up of wind farm components and electrical systems to verify performance before commissioning. Works with OEMs and contractors to resolve issues.	Electrical practical	6	NSQF Level 6 competencies and higher national diploma or equivalent in an engineering discipline. Minimum 8 years' experience in the onshore wind or offshore oil or marine industry.
Senior Authorised Person (SAP)	I&C, O	Responsible for ensuring the safe operation and management of high-voltage (HV) electrical systems. This includes overseeing and authorising switching operations, isolations, and the safety of personnel working on high-voltage equipment such as substations, transformers, and electrical circuits.	Electrical practical	6	NSQF Level 6 competencies and higher national diploma or equivalent in a relevant electrical subject area. HV authorised persons (HVAP) course. Minimum 5 years of experience working with HV switchgear.
Environmental monitoring assistant	D, I&C, O	Collect marine and coastal data to monitor environmental impacts	Environmental	3	NSQF Level 3 competencies and basic certification or training in environmental monitoring or marine operations. Familiarity with offshore environments and fishing practices. Ability to assist in collecting environmental data, observing marine wildlife, and reporting on potential impacts of offshore wind activities. Experience in supporting compliance with environmental regulations, conducting visual surveys, and following safety protocols at sea.
Geophysicist	D	Assesses sub-seabed surveys to identify geological risks and inform foundation design and cable routing in offshore zones.	Environmental	7	NSQF Level 7 competencies and bachelor's degree in a STEM field from a deemed/recognised (AICTE) university or equivalent is required. At least 5 years industry related experience
Hydrographer	D	Assesses oceanographic data, including seabed topography and tidal patterns, to support safe and efficient offshore development.	Environmental	7	NSQF Level 7 competencies and bachelor's degree in marine sciences hydrographic surveying. Minimum 5 years' experience in nearshore and offshore survey covering pre-engineering, pre-construction, post-construction.
Marine ecologist	D	Assesses potential impacts of offshore wind development on marine biodiversity and ecosystems, providing guidance on appropriate mitigation measures.	Environmental	7	NSQF Level 7 competencies and bachelor's degree in ecology, oceanography, marine science or a relevant field. At least 5 years of experience in the relevant field. Experience in supporting technical assessments for ESIA, Habitat Regulation Assessment (HRA) and Water Framework Directives (WFD), planning processes, and ecological assessments.
Oceanographer	D	Assesses ocean currents, wave patterns, and environmental factors to assess the impact of the offshore wind farm on marine environments and its performance.	Environmental	7	NSQF Level 7 competencies and bachelor's degree in oceanography, marine science or a relevant field. 2 years' experience on field surveys or in a research lab is desirable.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Ornithologist	D	Assesses risks to bird populations, particularly migratory species along India's coast, and supports the design of mitigation practices.	Environmental	7	NSQF Level 7 competencies and bachelor's degree in ecology, zoology or related subjects. Work experience on field surveys or in a research lab is desirable.
Communications network technician	I&C, O	Installs and maintains communication systems that link turbines, substations, and control centres, including SCADA systems. Ensures reliable data and voice connectivity across offshore and onshore assets.	IT and communications	4	NSQF Level 4 competencies and ITI or polytechnic diploma or equivalent in a relevant field such as network infrastructure, systems engineering, computer science is required. 2 years' experience as a communications network technician in a relevant environment preferable.
Control room supervisor	O	Manages monitoring of turbine performance and grid connection from the onshore or offshore control room. Responds to faults and coordinates remote troubleshooting and dispatch.	IT and communications	6	NSQF Level 6 competencies and higher national diploma or equivalent in relevant engineering discipline (electronics & communication/ Electrical & electronics. Preferable to have certifications in the field of information security / TSCM. At least 5 years of experience in a leadership role in a similar position for a large-sized organization. Onshore wind experiences are valuable.
IT manager	D, I&C, O	Manages the IT infrastructure for onshore and offshore wind farm operations.	IT and communications	6	NSQF Level 6 competencies and higher national diploma or equivalent in IT or computer related discipline. Minimum 3 years' experience in IT Service Desk role, providing in situ technical support as well as remote support using remote desktop tools. Certifications on Microsoft and Cisco products desired.
Finance & cost control	M, I&C, O	Oversees budgeting, financial reporting, and cost control to maintain profitability and compliance with financial standards.	Management, administration and support	4 to 6	For more senior role, NSQF Level 6 competencies and a graduate diploma or degree in finance, accounting, or business management. Minimum of 5 years of experience in financial planning and cost control, preferably in construction or energy sectors, with proficiency in ERP systems and regulatory compliance.
Fishing and community liaison officer	D, I&C, O	Acts as the link between offshore wind developers and fishers/communities communication, addressing concerns, and promoting cooperation to find the best shared outcomes for all.	Management, administration and support	4	NSQF Level 4 competencies and experience in fisheries, maritime studies, or community development and engagement, with ability to communicate effectively with diverse stakeholders.
HR, training and workforce planning	M, I&C, O	Manages and administers recruitment, training, and workforce planning to ensure the right skills and personnel are available.	Management, administration and support	4 to 7	For more senior role, NSQF Level 6 competencies and a graduate diploma or degree in human resources, business administration, or a related field. Minimum of 5 years of experience in HR management, ideally in large-scale infrastructure or energy projects, with knowledge of labour laws, workforce planning, and training programme development.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Marketing, sales and business development	M	Develops strategies to promote offshore wind services, secure new business opportunities, and maintain client relationships.	Management, administration and support	4 to 6	For more senior role, NSQF Level 6 competencies and a graduate diploma or degree in marketing, business development, or a related field. Minimum of 5 years of experience in marketing and sales within the energy or infrastructure sector, with expertise in market analysis, client engagement, and proposal development.
Support staff - catering / administration	D, M, I&C, O	Supports technical and other activities. Can also be a vessel-based role.	Management, administration and support	3	NSQF Level 3 competencies and minimum of 1 year of experience in relevant area, with additional maritime safety qualifications if vessel-based.
Support staff - security / waste management	D, M, I&C, O	Supports technical and other activities	Management, administration and support	3	NSQF Level 3 competencies and minimum of 1 year of experience in relevant area.
Carousel / tension operator	I&C	Manages and operates the cable carousel and tensioning system used to store and deploy subsea cables during installation	Maritime	4	NSQF Level 4 competencies, and 3 years' experience working with associated equipment in a marine industry.
Chief- and deck officers	I&C, O	Support the vessel master by managing navigation, deck operations, and safety systems, ensuring smooth and compliant marine operations during offshore wind installation.	Maritime	5 to 6	NSQF Level 5–6 competencies and a higher national certificate or diploma in nautical science or a related maritime discipline. Licensed by the Directorate General of Shipping (or other recognized regulatory body) and hold a valid Certificate of Competency appropriate for officer rank. Should have substantial experience in navigation, cargo handling, and vessel operations, with qualifications in advanced safety, survival, and emergency response training, and maintain compliance with ISM and STCW standards.
Crew transfer vessel / safety boat master	I&C, O	Operates support vessels, taking responsibility for navigation and safe operation to guard other vessels or transport personnel and equipment to and from offshore wind installations, ensuring compliance with maritime safety standards and emergency procedures	Maritime	5	NSQF Level 5 competencies and higher national certificate or equivalent in a relevant maritime subject area. Licensed by the Directorate General of Shipping (or other recognized regulatory body) and hold a valid Certificate of Competency appropriate for vessel size and type or have substantial experience in the local fishing industry with proven skills in navigation, seamanship, and vessel handling and qualifications in advanced safety, survival, and emergency response training, and maintain compliance with ISM and STCW standards.
Deck hand / vessel crew	I&C, O	Assists with practical activities when onboard vessel	Maritime	3	NSQF Level 3 competencies and minimum of 1 year of experience working offshore and maritime safety qualifications.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Harbour pilot	O	Guides vessels safely into and out of ports, ensuring manoeuvring complies with local marine conditions	Maritime	5	NSQF Level 5 competencies and higher national certificate or equivalent in a relevant maritime subject area. Licensed by the Directorate General of Shipping (or other recognized regulatory body) and qualified for handling large vessels or have substantial experience in coastal navigation and vessel operations such as those gained in the fishing industry, supplemented by advanced training in pilotage. Candidates should demonstrate an exemplary record of maritime service and complete required security clearances and background checks as per regulatory standards.
Major vessel master / captain	I&C, O	Has overall command of the vessel, ensuring safe navigation and operation, compliance with maritime regulations, and coordination of all marine and operational activities.	Maritime	6 to 7	NSQF Level 6–7 competencies and a higher national certificate, diploma, or degree in a relevant maritime subject area such as nautical science or marine engineering. Licensed by the Directorate General of Shipping (or other recognized regulatory body) and hold an Unlimited Tonnage Certificate of Competency. Must demonstrate extensive experience in command of large offshore or commercial vessels, advanced knowledge of navigation, seamanship, and marine safety, and maintain compliance with ISM, STCW, and international maritime regulations.
Marine warranty surveyor / client representative	I&C, O	Monitors marine and heavy-lift operations on behalf of the project developer to ensure full compliance with approved procedures and international standards, thereby safeguarding safety and protecting client assets.	Maritime	6	NSQF Level 6 competencies and an advanced certificate, diploma, or graduate diploma in a relevant subject area such as marine engineering, naval architecture, or offshore operations. Minimum of 5 years of experience in marine assurance, heavy-lift operations, or offshore construction projects, ideally within renewable energy or oil & gas sectors. Should demonstrate expertise in reviewing and approving marine operations plans, risk assessments, and compliance with international standards such as IMO, SOLAS, and OCIMF guidelines.
Medic	M, I&C, O	Provides emergency medical care, occupational health support, and clinical oversight onboard vessels, ensuring crew fitness, incident response, and medical evacuation coordination; also relevant in the manufacturing environment.	Maritime	5 to 6	NSQF Level 5–6 competencies and a diploma or degree in paramedical/medical sciences (e.g., EMT/Paramedic, Nursing, MBBS or equivalent). Must hold STCW-compliant medical training (e.g., Medical First Aid and Medical Care Onboard Ship approved by the Directorate General of Shipping), current BLS/ACLS certification, HUET/BOSIET or equivalent offshore safety training, and at least 3–5 years' experience in pre-hospital/remote or maritime medicine; maintain compliance with ISM, STCW, and onboard clinical governance standards.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
ROV technician	O	Operates ROV's to perform tasks like inspection, maintenance, and repair of offshore wind farm structures, cables, and equipment.	Maritime	5	NSQF Level 5 competencies and higher national certificate or equivalent in a relevant subject area such as marine engineering, science or equivalent experience in marine maintenance. Minimum of 6 to 12 months of formal mechanical and hydraulic training, or combination of education and experience.
Vessel master's mate	O	Assists the vessel master in navigation, safety, and operations during offshore wind farm activities.	Maritime	4	NSQF Level 3 competencies and minimum of 5 years of experience working offshore, in oil & gas or fisheries.
Asset integrity manager	O	Monitors the structural and operational health and reliability of wind farm assets, including turbines, foundations, and cables. Leads inspection programmes and long-term maintenance planning.	Mechanical design and management	7	NSQF Level 7 competencies and bachelor's degree in engineering or mathematics field. Experience in the onshore wind is valuable.
CAD technician	D, M	Prepares detailed technical drawings and CAD models of turbine and balance of plant components and manufacturing layouts for use by engineering and production teams	Mechanical design and management	6 to 7	NSQF Level 6-7 competencies and graduate diploma or bachelor's degree in drafting or design engineering, marine engineering, or related field. Software proficiency in AutoCAD, SolidWorks, or similar 3D modelling platforms.
Civil engineer	D, I&C, O	Manages the design and construction of infrastructure for offshore wind farms, including cable landfall and ports.	Mechanical design and management	7	NSQF Level 7 competencies and bachelor's degree in civil engineering (B.Tech/B.E) from an AITCE or UGC recognised university for senior roles. For junior level roles, diploma in civil engineering is required. Minimum 5 years of experience.
Geotechnical engineer	D	Assesses seabed conditions to determine suitable foundation types, designs and installation methods.	Mechanical design and management	7	NSQF Level 7 competencies and bachelor's degree (B.Tech/B.E) in geotechnical engineering or related field from an AITCE or UGC recognised university for senior roles. A strong foundation in civil engineering and soil mechanics is required and a minimum 5 years of experience.
Manufacturing manager	M	Leads overall manufacturing operations, overseeing planning of production, resource allocation, and component delivery.	Mechanical design and management	8	NSQF Level 8 competencies and master's degree in a relevant field for example industrial engineering, manufacturing engineering or business management. Minimum of 10 years of experience in a manufacturing environment with staff management responsibilities.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Mechanical engineer	D, M, I&C, O	Responsible for designing and optimising the mechanical systems of an offshore wind farm. They ensure the performance of the wind turbine and foundations are optimised and comply with relevant trade standards. In a manufacturing environment this includes input on facility design and process improvement.	Mechanical design and management	7	NSQF Level 7 competencies and bachelor's degree in mechanical engineering (B.Tech/B.E) from an AITCET or UGC recognised university for senior roles. For junior level roles, diploma in mechanical engineering is required. Minimum 5 years of experience.
Production / team supervisor	M, I&C, O	Supervises day-to-day manufacturing and site operations, ensuring welfare and production targets and quality standards are met.	Mechanical design and management	5 to 6	NSQF Level 5-6 competencies and an advanced certificate, diploma or graduate diploma in relevant subject area. Minimum 2 years' experience in a manufacturing environment.
Stores / warehouse manager	M, O	Oversees storage and inventory of manufacturing / spare parts, tools, and equipment. Ensures timely provision aligned with needs.	Mechanical design and management	5 to 6	NSQF Level 5-6 competencies and an advanced certificate, diploma or graduate diploma and minimum of 5 years of experience working warehousing and storage of high-value items..
Structural engineer	D, M	Designs turbine towers, foundations, and substation topsides to withstand wind, wave, and operational loads, working with other engineers to ensure structural integrity	Mechanical design and management	7	NSQF Level 7 competencies and bachelor's degree in civil engineering (B.Tech/B.E) from an AITCET or UGC recognised university for senior roles. Along with a master's degree (MTech/ M.E) in structural engineering or related field. Minimum 5 years of experience.
Blasting and coating technician	M	Prepares the surfaces of wind turbine components using abrasive blasting and applies protective coatings (e.g., anti-corrosion paints) to offshore components to ensure durability in harsh marine environments.	Mechanical practical	4	NSQF Level 4 competencies and experience working with wind turbine components within the manufacturing environment and/ or offshore marine structures from the energy sector.
Equipment service technician	M, I&C, O	Conducts routine inspections and repairs on equipment (tooling) used for manufacturing, installation and operation.	Mechanical practical	4	NSQF Level 4 competencies and ITI or polytechnic diploma or equivalent in a relevant subject area such as electrical or mechanical engineering or science.
Machine operator	M	Operates and monitors machines used in the manufacturing facility, following detailed specifications and safety procedures.	Mechanical practical	3	NSQF Level 3 competencies and 2 years' experience in machine operating activities in a high-quality manufacturing environment.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Mechanical technician	I&C, O	Assembles, installs, maintains, and repairs mechanical components and systems across all offshore wind farm components including turbines and balance of plant equipment.	Mechanical practical	4	NSQF Level 4 competencies and ITI or polytechnic diploma or equivalent in a relevant subject area such as mechanical engineering or science. Experience with onshore wind preferable if role is offshore.
Process coordinator	M	Coordinates and improves manufacturing processes to increase efficiency and ensure consistent product quality. Includes quality control / non-destructive testing under management of quality manager and scheduling under production supervisor / manufacturing manager.	Mechanical practical	4	NSQF Level 4 competencies, and 2 years' experience working in the manufacturing environment is desired and in some cases required.
Production operative	M	Performs hands-on manufacturing tasks such as material handling, component preparation and assembly. Role is similar to that of electrical and mechanical technician but based in manufacturing facilities.	Mechanical practical	3	NSQF Level 3 competencies, and 2 years' experience working in the manufacturing environment is desired and in some cases required.
Rope access and blade repair technician	O	Inspects and repairs wind turbine blades for wear, cracks, and structural damage. Uses specialized tools and resin materials, often working via rope access.	Mechanical practical	4	NSQF Level 4 competencies ITI or polytechnic diploma in a relevant subject area such as mechanical engineering, science. More than 5 years' of hands-on experience in composites and epoxy blade repairs. GWO and rope access certification. Onshore wind experiences an advantage.
Stores / warehouse operative	M, I&C, O	Oversees storage and inventory of spare parts, tools, and equipment used in construction. Ensures timely dispatch and procurement aligned with maintenance needs.	Mechanical practical	3	NSQF Level 3 competencies and 2 years' experience of materials, inventory control and logistics. Computer literate especially in EXCEL desired.
Vessel maintenance technician	I&C, O	Onshore role to maintain offshore transfer vessels and crew boats, including engines, navigation systems, and safety gear. Also, vessel-based roles do similar for major installation and service operation vessels.	Mechanical practical	4	NSQF Level 4 competencies and ITI or polytechnic diploma or equivalent in a relevant subject area such as mechanical engineering, marine engineering, science or equivalent experience in marine maintenance.
Welder	M	Joins metal components using various welding techniques to fabricate or repair offshore wind components such as towers, frames, and support structures.	Mechanical practical	4	NSQF Level 4 competencies and experience working with large structures within a high-quality manufacturing environment.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Crane and rigging inspector	I&C, O	Inspects cranes and rigging equipment used for installation to ensure safety and functionality. Also can be vessel-based.	Ports and logistics	5	NSQF Level 5 competencies, and 5 years' experience working with associated equipment in a marine industry, with additional maritime safety qualifications if vessel-based.
Crane operator	I&C, O	Operates cranes to move wind turbine and balance of plant components. Also, vessel-based roles to install components.	Ports and logistics	5	NSQF Level 5 competencies, stage 3 offshore crane operator certification and 5 years' experience in marine heavy lift crane operations, with additional maritime safety qualifications if vessel-based.
Crew manager	I&C, O	Manages offshore personnel schedules, certifications, and welfare. Ensures proper crew rotation and compliance with labour and safety regulations.	Ports and logistics	5 to 6	NSQF Level 5-6 competencies and an advanced certificate, diploma or graduate diploma and 5 years maritime or shipping industry experience.
Heavy lift supervisor	I&C, O	Supervises all heavy lifting operations. Can also be a vessel-based role.	Ports and logistics	5 to 6	NSQF Level 5-6 competencies and an advanced certificate, diploma or graduate diploma in related subjects area such as engineering, business management, logistics or similar field. Minimum of 5 years of experience, ideally in onshore wind, with additional maritime safety qualifications if vessel-based.
Logistics coordinator and manager	I&C, O	Organises the transportation of wind turbines, balance of plant, materials, and personnel to the offshore site, ensuring efficient and timely delivery.	Ports and logistics	6	NSQF Level 6 competencies and higher national diploma or bachelor's degree in related subject area such as engineering, business management, logistics or similar field. Minimum of 5 years of experience.
Marine coordinator	I&C, O	Manages vessel scheduling, marine traffic, and offshore personnel logistics to ensure smooth operations. Coordinates between marine crews, technicians, and control rooms.	Ports and logistics	6	NSQF Level 6 competencies and qualification in marine engineering, mechanical engineering, or a related field. 5 years' experience in marine service operations, with leadership experience preferred. Expertise in marine engines, PLC systems, hydraulics, and electrical systems. Certifications: STCW, Marine Engineering licenses, or relevant industry certifications are a plus.
Operations risk manager	I&C, O	Plans operations and carries out risk assessment, safety planning, and coordination to assure safe working in ports and on installation vessels.	Ports and logistics	6	NSQF Level 7 competencies and an advanced certificate, diploma, or graduate diploma in a related subject area such as construction safety management, engineering, or project management. Minimum of 5 years of experience in health and safety coordination or design risk management, ideally within large infrastructure or renewable energy projects.
Port / transport / lifting operative	I&C	Responsible for providing day-to-day component and equipment logistics around the port - includes stevedoring, SPMT operation and heavy-lift rigging (also a vessel-based role).	Ports and logistics	3	NSQF Level 3 competencies and 2 years' experience in heavy goods / port logistics, with additional maritime safety qualifications if vessel-based.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Vessel supervisor	I&C, O	Oversees daily operations on offshore support vessels, ensuring safe transport of personnel and equipment. Coordinates with marine crews and offshore teams to maintain operational schedules	Ports and logistics	5 to 6	NSQF Level 5-6 competencies and an advanced certificate, diploma or graduate diploma in relevant discipline. 5 years' experience within ports / vessel logistics.
Health and safety manager	D, M, I&C, O	Implements and monitors health, safety, and environmental (HSE) protocols, ensuring legal compliance and worker safety.	Professional	7	NSQF Level 7 competencies and bachelor's degree in related subject. Post-graduate degree in Industrial Safety or related subject is desirable. A minimum of 5 years' experience in health, safety, and environmental roles is also required.
Legal counsel	D, O	Provides legal advisory services across all project phases, ensuring compliance with applicable laws and international regulations related to, for example, permitting, contracting and project financing.	Professional	7 to 8	NSQF Level 7 competencies and a bachelor's degree in Law (LLB) from a reputed institution recognised by the Bar Council of India. At least 10 years of experience.
Quality manager	M	Develops and enforces quality assurance protocols throughout the manufacturing process. Includes lead and other supervisory quality staff.	Professional	7	NSQF Level 7 competencies and bachelor's degree in related subject area. Knowledge of Integrated Management Systems (IMS), including standards such as ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health and Safety Management). Level II certification in Non-Destructive Testing, with specialization in Ultrasonic Testing, Magnetic Particle Inspection, Liquid Penetrant Testing, and Visual Testing. More than 10 years of experience in a relevant field such as engineering, safety, wind energy, or manufacturing.
Administrative support manager	D, M, I&C, O	Handles office operations, document control, and administrative coordination across project teams and stakeholders	Project management	7	NSQF Level 7 competencies and bachelor's degree in Law (LLB) and Company Secretary (CS) is desired.. Completion of Company Secretaryship course (or equivalent qualification). 3+ years of experience in corporate secretarial work.
Bid manager	D	Leads the preparation and submission of developer bids for contracts in development phase.	Project management	7	NSQF Level 7 competencies and a bachelor's degree in related subject is required. Minimum 5 years of experience in bid preparation / financial modelling, preferably in the power sector.
Commercial manager	D, M, I&C, O	Manages commercial and financial aspects of projects and facilities.	Project management	7	NSQF Level 7 competencies and bachelor's degree in relevant field related field is required. Experience: at least 10 years for more senior roles.

Job role	Lifecycle stages	Description	Job category	NSQF level	Skills and qualifications typically sought
Communications and engagement coordinator	D, I&C, O	Manages public relations and stakeholder engagement, ensuring positive relations with local communities, government agencies, and other stakeholders.	Project management	7	NSQF Level 7 competencies and bachelor's degree in PR/ Communications/Journalism or similar relevant field from a reputed institute is required. Should possess a minimum of 5 years' experience handling stakeholder projects independently.
Consents manager	D, O	Leads the planning and execution of all permitting and environmental consent processes, coordinating with regulatory bodies to secure the necessary permits and licences, then ensure these are retained.	Project management	8	NSQF Level 8 competencies and master's degree (MA, MSc) in environmental science, planning or related field. Extensive experience in either onshore consenting of complex infrastructure projects.
Offshore ESIA Manager	D	Responsible for managing the ESIA process for an offshore wind farm. This includes leading teams to complete the ESIA report, taking responsibility for the deliverables produced and managing the survey schedule.	Project management	8	NSQF Level 8 competencies and master's degree (MA, MSc) in environmental sciences, earth sciences, environmental Engineering or a related environmental discipline. 5 to 10 years of experience on projects experience in the energy sector preferred.
Procurement / supply chain manager	D, M, I&C, O	Manages sourcing and purchasing of equipment and services, ensuring cost efficiency and supplier compliance with project standards.	Project management	4 to 7	For more senior role, NSQF Level 7 competencies and a bachelor's degree in relevant subject area. A successful record of 10 to 12 years in Procurement / Sourcing / Materials Management with minimum 5 years of experience in handling procurement of wind turbines or other wind industry equipment or services.
Project director	D, O	Provides strategic leadership, overseeing all aspects of the project from development to decommissioning, ensuring alignment with corporate and national energy objectives.	Project management	8	NSQF Level 8 competencies and bachelor's degree in engineering (B.Tech/B.E) or related field is required. Level 9 competencies and master's degree (MBA) with PMP certification is strongly desired. Minimum 15 years of project management experience in the energy sector.
Project manager	D, M, I&C, O	Manages the day-to-day running of the project, including reporting, staff management and financial management. In a manufacturing environment, this includes managing continuous improvement or other process development projects.	Project management	7	NSQF Level 7 competencies and bachelor's degree in engineering (B.Tech/B.E) or related field is required. Experience: at least 10 years for more senior roles. Preference: Renewable energy.
Site manager	I&C, O	Manages on-site activities, ensuring that installation and construction work is completed safely, on time, and according to the project plan.	Project management	7	NSQF Level 7 competencies and bachelor's degree in related subject. Minimum 10 years' experience in project and team management in a relevant industry.

Appendix B National skills qualification framework

Table 28: Detail of generic descriptors for National Skills Qualifications Framework levels.

NSQF level	Generic role	Process	Professional knowledge	Professional skill	Core skills	Responsibility
1	Helper / assistant labourer	Routine and repetitive tasks	Basic awareness; no formal theory	Limited; basic manual tasks	Basic communication and counting	Works under close supervision
2	Semi-skilled worker / junior operator	Simple tasks with some variety	Limited factual knowledge	Uses tools with guidance	Basic literacy and numeracy	Works under supervision with some autonomy
3	Skilled technician / operator	Predictable tasks requiring some judgment	Basic theoretical knowledge	Applies known procedures	Communicates clearly; uses basic IT	Responsible for own work
4	Senior technician / supervisor	Tasks requiring interpretation and choice	Broad factual and theoretical knowledge	Selects and applies procedures	Communicates with clarity; uses IT tools	Works independently with some responsibility for others
5	Foreman / team leader / junior engineer	Tasks requiring problem-solving and planning	Detailed theoretical and practical knowledge	Applies judgment in varied contexts	Presents information; uses digital tools	Supervises others; accountable for outcomes
6	Engineer / senior supervisor	Complex tasks requiring analysis and decision-making	Specialized knowledge in a field	Develops solutions; adapts procedures	Analytical communication; advanced IT use	Manages teams; responsible for quality and safety

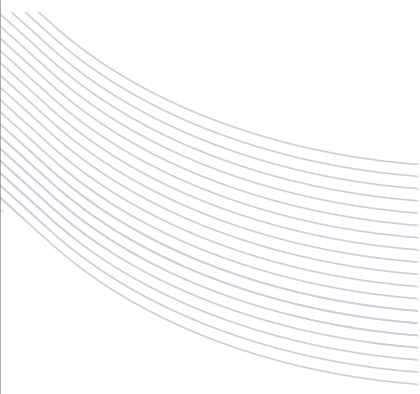
NSQF level	Generic role	Process	Professional knowledge	Professional skill	Core skills	Responsibility
7	Senior engineer / technical specialist / manager	Broad range of complex tasks; strategic planning	Advanced theoretical and practical knowledge	Innovates and evaluates solutions	Synthesizes information; professional communication	Full responsibility for projects and teams
8	Principal engineer / senior manager	Highly specialized tasks; research and innovation	Expert knowledge; integrates theory and practice	Designs new approaches; critical evaluation	Research-level communication and analysis	Leads innovation; responsible for strategic outcomes
9	Research scientist / technical director	Original research; highest-level project leadership	High level of theoretical and applied knowledge	Creates new knowledge; sets direction and culture of large teams	Scholarly communication; advanced synthesis; large team motivation and leadership	Leads research; full accountability for project delivery
10	Chief scientist / Industry expert	Groundbreaking research and leadership	Highest level of theoretical and applied knowledge	Develops new paradigms, initiates new markets	Thought leadership; policy-level communication	Leads national/ international initiatives; full accountability for market delivery

Appendix C NSQF Framework for secondary school and higher education capability

The National Skills Qualifications Framework (NSQF) for the Indian education system, including its alignment with Tamil Nadu Education Standards, was notified by the Ministry of Education, Government of India in 2013, establishing a 10-level competency-based framework with level descriptors for knowledge, skills, and aptitudes. [18] The framework was revised to an 8-level structure in 2023 and integrated with the National Credit Framework (NCrF). [19]

Table 29: Detail of National Skills Qualifications Framework levels for secondary school and higher education capability

Academic brand	Indian Standard Academic level	Assessment stage	NSQF level
Doctoral Degree	PhD		8
PG degree 1/2 years	PG- 2nd (Eng)	M.Tech. 2nd Yr./ Eng PG Degree	7
	PG 1st yr (Eng)	PG Degree/ M.Voc / M.Sc (eng)	6.5
4-year UG with honours/ Honours with	4-year UG with honours/ Honours with Research /PG – 1st yr	UG- Degree (Hons)/ PG Diploma/ B.Tech/B.E	6
	UG- 3rd Year	UG- Degree/ B.Voc/ B.Sc Eng	5.5
	UG- 2nd Year	UG- Diploma/ DiplomaEng	5
	UG- 1st Year/equivalent	UG- Certificate	4.5
2 year Senior Secondary	Class XII	CBSC / TNSB	4
	Class XI	CBSC / TNSB	3.5
2 Year Secondary	Class X	CBSC / TNSB	3
	Class IX	CBSC / TNSB	2.5
Middle school	Class VI - VIII	CBSC / TNSB	2



Appendix D Economic impact methodology

Conventional modelling of economic impacts for most industrial sectors relies on government statistics, for example, those based on the Ministry of Statistics and Programme Implementation's Central Statistical Office (CSO) and use input-output tables and other production and employment ratios.

National Industrial Classification (NIC) code data can be appropriate for traditional industries at a national level. The development of new codes for a maturing sector, however, takes time. This means that conventional NIC analyses of OSW need to map existing NIC data onto OSW activities, which is not easy and a source of error. Analyses using NIC codes also rely on generalised data.

OSW is ideally suited to a more robust approach that considers the current and future capability of local value chains because:

- Projects tend to be large and have distinct procurement processes from one another, and
- Projects tend to use comparable technologies and share value chains.

This approach enables a realistic analysis of the local and national content of projects even where there are gaps in the data.

In conventional analysis, multipliers are used that are based on statistics of expenditure flows in different sectors. Once the analysis has established what contracts have been awarded to companies in the territory under consideration, the contractors are associated with one of the more sectors used in the NIC. Input-output tables created, for example, by the CSO are used to develop multipliers. These multipliers are used to calculate how demand in each of the NIC sectors leads to direct, indirect, and induced impacts.



The multipliers used in the conventional analysis in effect ignore the value chain in detail, assuming that sector statistics are valid. The BVGA method is based on the principles of Methodology for measuring UK content for UK offshore wind farms that seeks to understand the value chain in the lower tiers and produces a figure that is equivalent to direct and indirect GVA. [20]

Calculating a local and national content figure, and understanding profit margins, costs of employment and salaries enable direct and indirect FTEs to be calculated. Induced impacts are calculated using conventional multipliers. The same methodology is followed for local content.

The remaining expenditure is analogous to the direct and indirect gross value added (GVA) created. GVA is the aggregate of labour costs and operational profits.

Full-time equivalent (FTE) employment can therefore be modelled from GVA, provided some key variables are understood. In the economic impact methodology, employment impacts are calculated using the following equation:

$$FTE_a = \frac{(GVA - M)}{Y_a + W_a}$$

Where:

FTE_a = Annual FTE employment

GVA = Gross value added

M = Total operating margin

Y_a = Average annual wage, and

W_a = Non-wage average annual cost of employment.

Appendix E NIC code mapping for OSW related sectors

Table 30: NIC code mapping for OSW related sectors.

OSW relevant sector	NIC code	Relevance
Tower and structural components manufacture	25112	Appropriate for turbine towers and structural steel
Electrical (array & export) cable manufacture	27320	Correctly covers power transmission cables used in OSW
Generator manufacture	27101	Applicable to wind turbine generator components
Vessel building (installation & O&M vessels)	30111,20112,30113	Commercial vessel construction
Installation services	33200	Industrial machinery and equipment installation
Power infrastructure construction	42201	Onshore substations and grid connections for OSW
Steel and iron production	24101,24102,24103	Upstream material supply



About Ocean Energy Pathway

Ocean Energy Pathway accelerates global offshore wind growth through programmes which support the energy transition, enhance marine ecosystems and empower local communities. We provide expert, independent support to governments and key decision makers to fast-track offshore wind worldwide. Through collaboration with leaders in policy, industry, and conservation, we help shape sustainable solutions for the long-term growth of offshore wind. Ocean Energy Pathway owns the offshore wind POWER Library, in collaboration with Climate Policy Radar, to help policymakers easily find curated reports and policies related to offshore wind. Headquartered in the UK, we work in Australia, Brazil, Colombia, India, Japan, Mexico, the Philippines, South Korea, and Vietnam with ongoing projects in several other countries.

<https://oceanenergypathway.org/>



About BVG Associates

BVGA provides strategy consulting in renewable energy. We help our clients to do new things, think in new ways and solve tough problems. Our practical thinking integrates the business, economics and technology of renewable energy generation systems. We combine deep wind industry knowledge with skills gained in the world of business consulting.

Specifically, BVGA acts globally to help national and local governments to establish offshore wind as a fairly and justly implemented, cost effective part a future energy mix. We help get projects located in the right places, designed, constructed and operated in the right way and providing benefits to local communities and workers, as well as the climate.

<https://www.bvgassociates.com/>



About Auroville Consulting

AVC is a sustainability advisory and solutions provider based in coastal Tamil Nadu specializing in renewable energy, climate action, and ecological development. AVC is a unit of the non-profit Auroville Foundation, established by the Government of India to promote sustainable development and human unity through innovative, community-oriented initiatives..



Ocean Energy
~ **Pathway**