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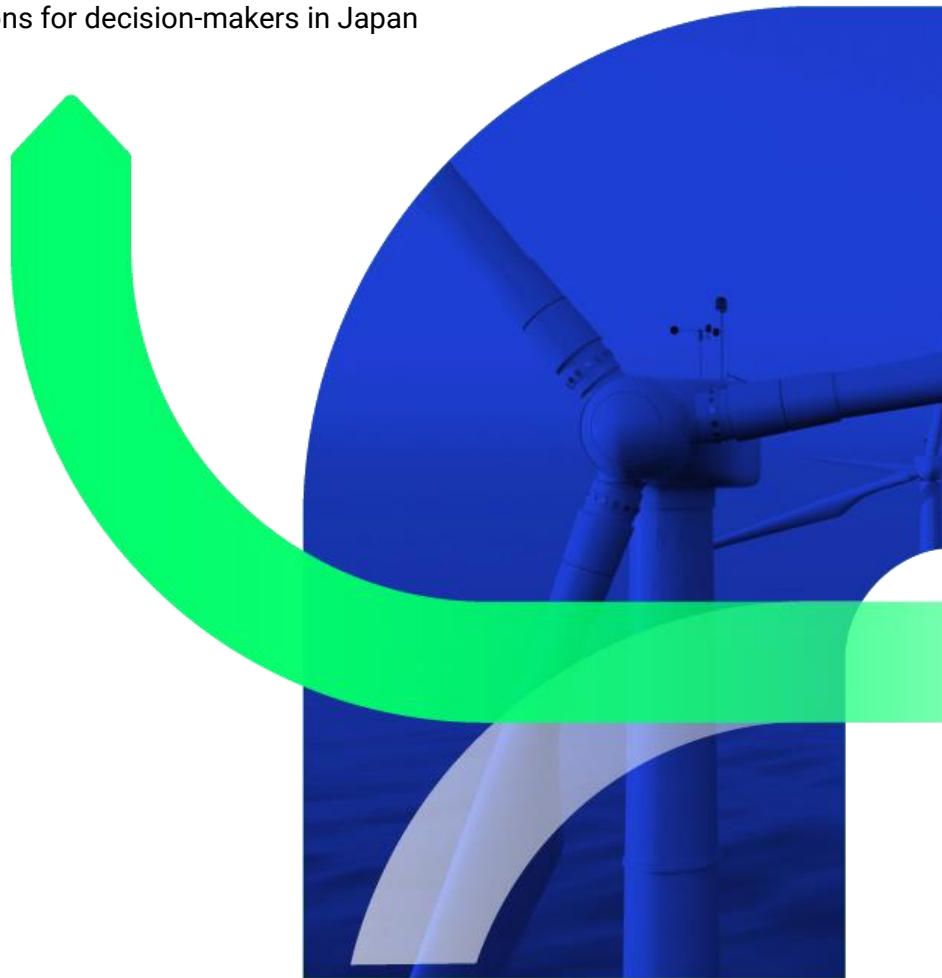
CARBON TRUST

REPORT

Recommendations to support skills development for Offshore Wind in Japan

Report assessing the skills need for the planned large-scale Offshore Wind deployment with case studies and recommendations for decision-makers in Japan

March 2023



Acknowledgments

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For the avoidance of doubt, this report expresses the independent views of the authors.

Who we are

Our mission is to accelerate the move to a decarbonised future. Climate pioneers for more than 20 years, we partner with leading businesses, governments and financial institutions to accelerate their route to Net Zero. We are the expert guide to turn your climate ambition into impact.

To date, our global network of 400 experts has helped set over 200 science-based targets and guided more than 3,000 organisations and cities across five continents on their route to Net Zero.

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About Renewable Energy Institute

Renewable Energy Institute is a non-profit think tank which aims to build a sustainable, rich society based on renewable energy. It was established in August 2011, in the aftermath of the Fukushima Daiichi Nuclear Power Plant accident, by its founder Mr. Masayoshi Son, Chairman & CEO of SoftBank Group, with his own resources.

The Carbon Trust's mission is to accelerate the move to a decarbonised future.

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Abbreviations

4 Rs	The four Rs refer to: Retain, Retrain, Renew, and Recruit
DEA	Danish Energy Agency
DWIA	Danish Wind Industry Association
EQF	European Qualifications Framework
EPRSC	Engineering and Physical Sciences Research Council
FIT	Feed-in Tariff
FOM	Fukushima O&M Association
GDP	Gross Domestic Product
GW	Gigawatt
GWEC	Global Wind Energy Council
GWO	Global Wind Organisation
HRD	Human Resource Development
IEA	International Energy Agency
JWEA	Japan Wind Energy Association
JWPA	Japan Wind Power Association
LCOE	Levelised Cost of Energy
METI	Ministry of Economy, Trade, and Industry
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MHLW	Ministry of Health, Labour and Welfare
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MoU	Memorandum of Understanding
MRI	Mitsubishi Research Institute
MTIC	Maritime Technology Innovation Center
MW	Megawatt
NaMICPA	Nagasaki Marine Industry Cluster Promotion Association
NEDO	New Energy and Industrial Technology Development Organization
NGO	Non-Government Organisation
NREL	National Renewable Energy Laboratory
NSAR	National Skills Academy for Rail
NSTC	Nippon Survival Training Center
OECD	Organisation for Economic Co-operation and Development
OPITO	Offshore Petroleum Industry Training Organization
OSW	Offshore Wind
OWGP	Offshore Wind Growth Partnership
OWIC	Offshore Wind Industry Council
R&D	Research and Development
RD&D	Research, Development and Demonstration
REI	Renewable Energy Institute (Japan)
RVO	Netherlands Enterprise Agency
SDG	Sustainable Development Goals
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
VET	Vocational education and training
WFO	World Forum Offshore Wind

Executive summary

Offshore wind is an important industry that will contribute to Japan achieving carbon neutrality by 2050. The transition to a carbon neutral society requires rapid action by decision-makers to support the upskilling of the workforce in Japan. Japan has ambitious plans to develop its offshore marine industry to reach carbon neutrality, create green jobs, and increase the domestic production of energy sourced from renewables. The offshore wind market is rapidly growing through attractive policies and a competitive auction scheme. As of February 2023, Japan has over 50GW of offshore wind capacity in the 'concept' and 'early planning' stages, with almost 10GW in 'development zone' status.[1]

The pipeline of offshore wind projects is expected to create a significant demand for skilled offshore wind workers. The challenge ahead for decision-makers is to implement adequate skills development initiatives for the workforce, to enable a carbon neutral economy.

Key messages

Good collaboration underpins successful skills markets

While skills remain a bottleneck for all offshore wind markets, **strong collaboration** and **communication** between government, industry, and education/research facilities to drive **education and research**, has led to many effective skills-related measures and actions (Section 4).

In Japan, collaboration, communication, and education and research activities are starting to be introduced (Section 3.1, Table 4), however, there is a need to further develop this in a holistic, cross-cutting way to support a skills transition to a carbon neutral society. Based on the available public resources and stakeholder interviews conducted for this report, a comprehensive baseline of Japan's offshore wind skills capacity has not yet been undertaken. In addition, national and local skills plans have not been published at the time of writing.

Skills plans must be underpinned by a just transition and a whole-systems approach

As offshore wind skills development is a complex topic, it is necessary to take a whole systems approach by engaging stakeholders from across different areas to design skills solutions. **A whole systems approach must be taken based on a just transition that understands the regional and demographic trends to facilitate a workforce transition for Japan.** A 'just transition' framework can be used to improve communication around: baselining, planning, implementing and evaluating skills development.

Understanding decision-making spheres of influence supports impactful implementation

Since there is a need for rapid action and the development of a strong local workforce in a short time, close collaboration between international, regional, domestic, and local entities is crucial**. Decision-makers must be aware of their sphere of influence to ensure skills development activities can build up from local spaces across the whole of Japan**.

Skills solutions must understand what problem they are solving

Overcoming barriers related to skills development will enable decision-makers to tackle not only the challenges for skills within the offshore wind industry, but also tackle deeper barriers in relation to Japan's

[1] The OSW pipeline data and corresponding stages are as per the classifications used by 4COffshore and we note that different databases may have different ways of classifying the project stages. We encourage readers to refer to the 4COffshore database for further details.

labour market. The key barriers identified through stakeholder engagement and a review of public resources (Section 5.2) are:

- **Barrier 1: Japan is facing a labour shortage** across many sectors which is primarily driven by an ageing population.
- **Barrier 2: Lack of understanding of offshore wind** and the skills required to develop the industry at a commercial level.
- **Barrier 3: Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory,** which limits the extent to which companies and relevant institutions can invest in developing new skills.
- **Barrier 4: Work-based cultural barriers** to developing the skills necessary for offshore wind include conservative company cultures and some companies struggling to adopt modern skills development practices.

Skills development in offshore wind should draw on other industry's strategic approaches

Decision-makers in Japan can adopt the lens of the **4Rs** – **Retain, Retrain, Renew and Recruit**, which have been applied to offshore oil and gas workers in other markets. The 4Rs from OPITO demonstrate that lessons on skills development can be transferred across industries and that the fundamental strategies underpinning skills development are similar.

Summary of recommendations

Decision-makers in Japan should adopt the below recommendations to quickly address the skills need for offshore wind in Japan in line with the steps to a just transition

Table 1: Summary of recommendations and steps to a just transition.

Recommendations and steps to a just transition	Timeframe
Take steps to clarify the current situation on skills development for the offshore wind industry within Japan ➢ There is a need to have stronger 'signalling' from the government of Japan that the economy is looking for a broader transition to renewables and that skills development is a core part of this. The government, with input from key stakeholders such as industry representatives and local authorities, must give the offshore wind industry and its supporters clarity on the skills development situation through a baseline survey to understand the current situation on skills development. Baselining	**Short-term, 1-2 years**
Communicate plans by decisions makers on the direction of skills development for offshore wind in Japan ➢ There is an urgent need to set direction by communicating strategic plans in parallel to the baselining activities. Government, local prefectural authorities, and industry should input on planning-related steps that clarify the direction of skills development. Plans should be underpinned by a whole systems approach that considers impacted communities and plans for inclusive diversity, such as	**Short-term, 1-2 years**

further encouraging women to enter traditionally male-dominated roles in the industry. Planning	
Take steps to align with the international offshore wind market on skills ➢ Standardising offshore wind-related education and training must be addressed immediately to overcome the lack of clarity on what skills are required for the offshore wind industry within Japan. Japan can draw on experiences from developed offshore wind markets, some of which are standardising training through digital 'skills passports'. Implementing	**Short-term, 1-2 years**
Take steps to modernise and futureproof skills for the offshore wind industry in Japan ➢ Japan must prepare for the offshore wind skills market of tomorrow, futureproofing the sector from economy-shifting events. To prepare, government, industry, and academia should map out how digitalisation and automation processes will influence the current and future offshore wind workforce in Japan within the context of a green economy. Planning	**Medium-term, 3-4 years**
Evaluate skills development measures in Japan and scale up ➢ There is a need to monitor and evaluate measures as they are planned and implemented. Doing so ensures measures are meeting their intended goals. With good feedback systems in place, measures can be rolled out at a larger scale. Evaluating	**Long-term, >5 years**

1. Background and scope of the report

1.1. Introduction

The Carbon Trust has partnered with the Renewable Energy Institute (REI) to support the Japanese offshore wind industry in achieving the human resourcing development plans introduced in the 'Vision for Offshore Wind Power Industry' (hereafter 'Vision').[2]

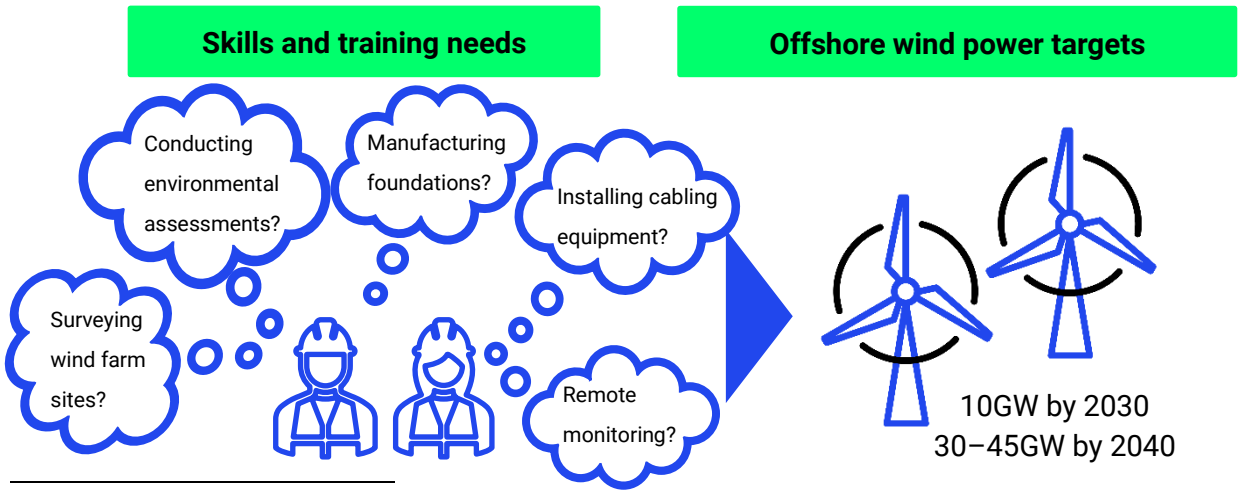
The report assesses the skills need for the offshore wind industry in Japan and proposes measures that should be taken to achieve the 'Vision', as well as the 2022 Skills Guide published by the Japan Wind Power Association (JWPA).[3] The Japanese government has ambitious plans to develop its offshore marine industry to enable the growth of a local supply chain, create green jobs[4] and economic opportunities as well as provide a new domestic renewable energy source from offshore wind energy.

In 2020, the Ministry of Economy, Trade, and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) established a public-private council to strengthen the competitiveness of the offshore wind industry. This was followed by the announcement of the aforementioned 'Vision', detailing plans by the government to designate areas with an average annual installation capacity of around 1 gigawatt (GW) for 10 years, which will contribute to the country's carbon neutral by 2050 goal.

The 'Vision' outlined a target of 10GW by 2030 and 30-45GW by 2040, underpinned by three key strategies:

1. Create an attractive domestic offshore wind power market.
2. Promote investment and build up the domestic supply chain.
3. Develop the next generation of technology and enhance international cooperation with a focus on the Asian market.

As ambitions for offshore wind deployment rapidly increase, the technical challenges of constructing and maintaining offshore wind farms must be addressed by policymakers and industry. However, socioeconomic issues also need to be properly investigated and planned for. This includes assessing the need for skills across the offshore wind project life cycle and the impact this will have on the demand for certain skills in the labour force (Figure 1).



[2] Vision for Offshore Wind Power Industry (1st)

[3] 洋上風力スキルガイド（第１版）, only available in Japanese.

[4] Green jobs are defined by the International Labour Organization (ILO) as jobs that '…reduce the consumption of energy and raw materials, limit greenhouse gas emissions, minimize waste and pollution, protect and restore ecosystems and enable enterprises and communities to adapt to climate change' (see World Employment and Social Outlook 2018: Greening with jobs).

Figure 1: Illustration showing that offshore wind encompasses a range of skills across the project life cycle, from early stage work in surveying sites and conducting environmental assessments to later stage work in construction, installation, and monitoring. These skills need to be cultivated to achieve the 'Vision for Offshore Wind Power Industry' in Japan.

This report presents an overview of the skills requirements discussed by the offshore wind industry in Japan and proposes a methodology that reviews the current skills situation in the country. It lays out how demand for offshore wind-related skills will rise significantly in order to meet the pipeline of offshore wind projects. Based on the current situation in the Japanese offshore wind market, this report proposes that decision-makers view the skills need as a key element that will support the transition into a carbon neutral society, which will lead to a significant increase in the number of green jobs.

To this end, the skills need in offshore wind cannot be met through isolated strategies or plans, as skills are closely dependent on broader economic, political, and educational policies. As such, skills development measures should not only target skills, training, and education. Instead, skills for the offshore wind industry must be addressed holistically, recognising the need to transition segments of the labour force. The need for offshore wind skills must be addressed through a whole systems approach that considers how skills connect to a range of systems (the education system, the political system, the workforce, the global offshore wind pipeline). Based on a whole systems approach (see Section 4.1), decision-makers can more effectively map pathways to the 'Vision', implement impactful steps, and evaluate the transition, as per the recommendations in Section 6.

> This report targets decision-makers in Japan who have the authority and responsibility to shape offshore wind skills-related plans, processes or outcomes. Decision-makers in this context refer to people working in a role that can influence how that person or the person's organisation acts with regard to meeting the skills need for offshore wind projects in Japan. This encompasses various leaders across organisations. For example, it can include an individual in an educational institution who has the authority to shape the curriculum to address offshore wind industry skills shortages, but also a company director who can set out a strategy to articulate the company's role in offshore wind and how this connects with retaining, retraining, renewing, and recruiting employees at that company to meet the skills need for the company's strategy.

The objectives of this report are to:

- **Build on the key information provided in the JWPA skills guide**, investigating the need for steps to improve skills development for Japan's offshore wind industry and proposing recommendations to decision-makers to meet the country's offshore wind targets.
- **Assess the current situation on skills development for offshore wind in Japan** through a landscape review of the literature and stakeholder interviews. The report consolidates its findings by providing an overview of 'the need for offshore wind-related skills in Japan' in Section 3.
- **Provide in-depth case studies on skills development in select international offshore wind markets**, namely, the UK, Denmark, the Netherlands, the US, and Taiwan, to demonstrate the importance of implementing skills-related measures as part of a whole systems approach. The report also focuses on the key actors that have a role to play in skills development, such as the government, industry, local authorities, and the education sector, as well as the drivers for change such as effective communication, education and research, and collaboration.

- **Propose a just transition framework** that builds on a whole systems approach and recognises the skills need as a holistic problem. The report also provides key steps for a just transition pathway to develop an effective offshore wind-related skills system.
- **Present analysis from the literature review and stakeholder engagement** on the barriers to developing the workforce required for offshore wind industry development in Japan.
- **Provide recommendations on the steps that should be taken over the short-, medium-, and long-term** to enable Japanese decision-makers to overcome key barriers and take a whole systems approach to meet the skills need through a just transition framework.
- **Serve as a strategic document to facilitate conversations among decision-makers in Japan**, who have the authority and responsibility to shape offshore wind skills-related plans, processes or outcomes. The Carbon Trust and the Renewable Energy Institute will also use this report to directly engage with local organisations and stakeholders for long-term change.

1.2. Skills and training scope

With the rapid growth of offshore wind markets internationally, Japan is not alone in grappling with a multitude of new and complex information surrounding all aspects of offshore wind. Skills are a key topic and challenge area for the global pipeline of offshore wind projects.

The Global Wind Energy Council report on the Global Wind Workforce for 2022-2026 states that there is a need to '…put workforce competence, availability and safety to the forefront of the energy transition agenda.'[5]

However, there remains some uncertainty as to how exactly the industry should quantify, define, categorise, and address the human resources needed. Securing a skilled workforce to deliver offshore wind projects is a growing bottleneck, which is why the industry, together with other key actors such as the government, financial institutions, and the education sector, must do more to collectively overcome the barriers that prevent the development and movement of skills into the industry. There also remains confusion on the types of job roles, the skills required and the pathways to securing these jobs. In response to this increased scrutiny of the scope of skills needed in offshore wind, there is an increasing number of resources to categorise, break down and typify the skills dimensions across the offshore wind industry. Hence, each market may have a slightly different approach to defining and scoping skills for offshore wind. Over time, it is the objective of international and national industry associations to standardise and align on skills needs.

For consistency with the skills development approach being taken by the offshore wind industry in Japan, this report aims to complement the ongoing activities and efforts of key stakeholders such as the Japan Wind Power Association (JWPA). In the 2022 JWPA 'Offshore Wind Skills Guide', the multi-dimensional aspects of skills within the offshore wind sector were emphasised, where industry, educational institutions, and young talent, to mention a few of the target audience, need to be taken on the journey of preparing for the emerging green energy industry.[6]

Figure 2 is an adapted graphic from the Offshore Wind Skills Guide,[7] demonstrating the skills need from the perspective of:

- **The operation area:** the offshore wind project life cycle requires skills across a range of operation areas from survey and site development work to decommissioning work.
- **Personnel requirements and job description:** the different areas of operation across the offshore wind farm life cycle create a range of personnel requirements and job descriptions that need to be clearly understood and communicated.
- **Qualifications and skills:** the job descriptions and personnel requirements need to be clearly connected to qualifications and skills (and vice versa) so that employees and employers can understand how to retain, retrain, recruit, or renew talent in the industry.
- **Related industries and occupations**: skills are a limited pool of labour resource, so there must be a consideration for how the skills need for offshore wind can be met through related industries and occupations in Japan.

[5] GWEC-GWO-Global-Wind-Workforce-Outlook-2022-2026-1.pdf

[6] 洋上風力スキルガイド（第１版）

[7] 洋上風力スキルガイド（第１版）

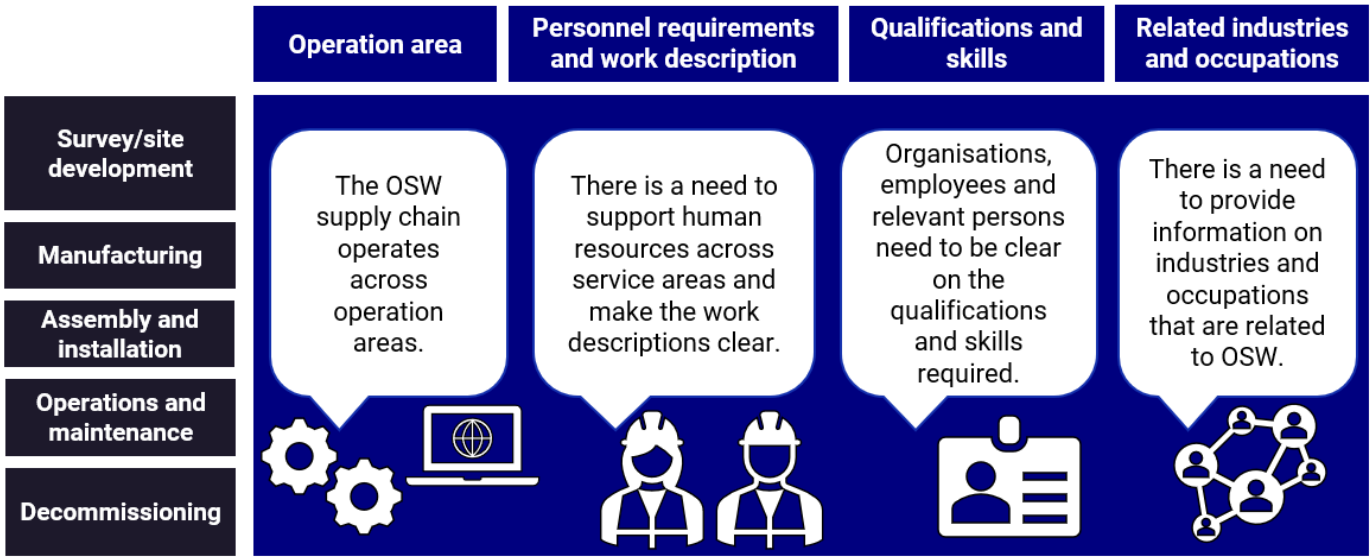


Figure 2: Graphic adapted from JWPA report on 'The Offshore Wind Skills Guide' to illustrate the multifaced considerations for decision-makers with regard to meeting the skills need.

The JWPA skills guide is an important first step for readers to understand the fundamentals of offshore wind and the skills needed within the industry. The guide covers factual information on offshore wind technology, how a project is created, a list of job roles and their common responsibilities, a list of high affinity industries and occupations that relate to offshore wind in Japan, a list of key qualifications required for working in the offshore wind industry, and a list of references.

The scope of skills discussed in this report refers to the lists published by JWPA (summarised under Table 2), where skills are those required across the project life cycle. The offshore wind project life cycle is often categorised into key stages. This report refers to the six-stage breakdown suggested by JWPA:[8]

- Cross-cutting
- Survey/design (referring to site development);
- Manufacturing
- Assembly and installation
- Operations and maintenance
- Decommissioning

This report considers skills as those related to the operation areas and main activities outlined in Table 2 while recognising the multifaced considerations highlighted in Figure 2.

[8] It should be noted that these stages are a stylised summary of activities involved in an offshore wind project that may not sufficiently cover all the skills involved from a human resourcing perspective. Similarly, there are semantic differences in the way different organisations and markets have categorised the wind project lifecycle.

Table 2: Adapted table from the JWPA report on 'The Offshore Wind Skills Guide', which this report uses as its basis for the scope of skills that are necessary for the industry.

Operation area	Main activities
Cross-cutting	• Project planning and development (overall supervision, project design and planning, procurement, financial management etc) • Finance related work • Insurance related work
Survey/Design	• Wind surveys: installation of wind measuring equipment, meteorological surveys • Seabed surveys: geotechnical and oceanographic surveys • Environmental surveys: bird, fish, marine mammal, onshore environments etc. • Design and engineering work • Environmental impact assessments; regional consensus building; securing appropriate permits and approvals
Manufacturing	• Wind turbine manufacturing • Foundation manufacturing • Submarine cable manufacturing • Substation equipment manufacturing • Other equipment manufacturing
Assembly and installation	• Offshore construction work management • Wind turbine and foundation installation • Submarine cable laying • Offshore substation installation • Onshore cable laying, onshore substation installation etc.
Operations and maintenance	• Operation and management work • Wind turbine maintenance (inspection, maintenance and replacement of parts in nacelles, blades etc.) • Maintenance of auxillary equipment (e.g. inspecting foundations, cables and substation equipment) • Logistical arrangements of personnel and vessels
Decommissioning	• Removal of wind turbines and foundations • Removal of submarine cables, substation equipment, etc.

Decision-makers who influence skills in offshore wind should also be conscious of the difference between a skills gap, skills shortage, and labour shortage as these words are often used interchangeably. The Offshore Wind Industry Council (OWIC) addresses this confusion in their '2022 Offshore Wind Skills Intelligence Report.'[9]

- **Skills gap**: this refers to a gap in skills that can be filled by **retraining** or **renewing** **the skills of the existing workforce**.
- **Skills shortage**: a skills shortage means that the **existing workforce supply is not sufficient** in meeting the skills demand. Instead, more people with the required skills must be **recruited**. Skills shortages are 'occurring' when there are insufficient applicants with the skills, experience, and qualifications required to fill vacancies.
- **Labour shortage:** a labour shortage refers more broadly to the **number of people required** and not their skills specifically.

To avoid the above, it is essential to **retain** people and support them with their skills development. The four Rs of **retain**, **retrain**, **renew**, and **recruit** are introduced fully in Section 5.2.1. In Japan, economists have long discussed challenges with the labour shortage in the country due to technological progress and

[9] OWIC Offshore Wind Skills Intelligence Report - March 2022

an ageing population.[10] Additionally, human resourcing challenges brought about through increased activities in offshore wind further expose a skills gap and a skills shortage.[11] In other words, the offshore wind industry in Japan suffers from all three; a skills gap, a skills shortage, and a labour shortage. For this report, the meaning of a 'skills need' refers to these three challenges of a skills gap, a skills shortage, and a labour shortage, where it is the responsibility of the decision-maker to consider how to appropriately tackle their skills need for their particular context.

This report aims to build on the key information provided in the JWPA skills guide, investigating the need for skills in the offshore wind industry for Japan to meet its offshore wind targets. This report intends to serve as a strategic document to facilitate conversations among decision-makers, the workforce and key stakeholders so that they have a clearer idea of the next steps they can take to meet the skills, job roles and qualifications outlined in the JWPA skills guide. The following section presents this report's methodology and its approach to forming recommendations on the next steps Japan can take to meet its need for offshore wind-related skills.

[10] Changing skill needs in the Japanese labour market | Creating Responsive Adult Learning Opportunities in Japan | OECD iLibrary (oecd-ilibrary.org)

[11] The local offshore wind stakeholders interviewed in this study have also expressed the same concerns.

1.3. Report methodology

The methodology of this report has been designed to answer the question:

To what extent is there a need for action on skills development for Japan to meet its large-scale offshore wind deployment ambitions?

The methodology is based on an 'input-analysis-output' logic model (Figure 3). The Carbon Trust first conducted a landscape review of the Japanese and key international offshore wind markets (input), followed by a comparative baseline understanding and barriers assessment (analysis), and lastly, provided recommendations on suitable measures for Japan with international case studies as examples (output). Our methodology is fully explained in Appendix 1:.

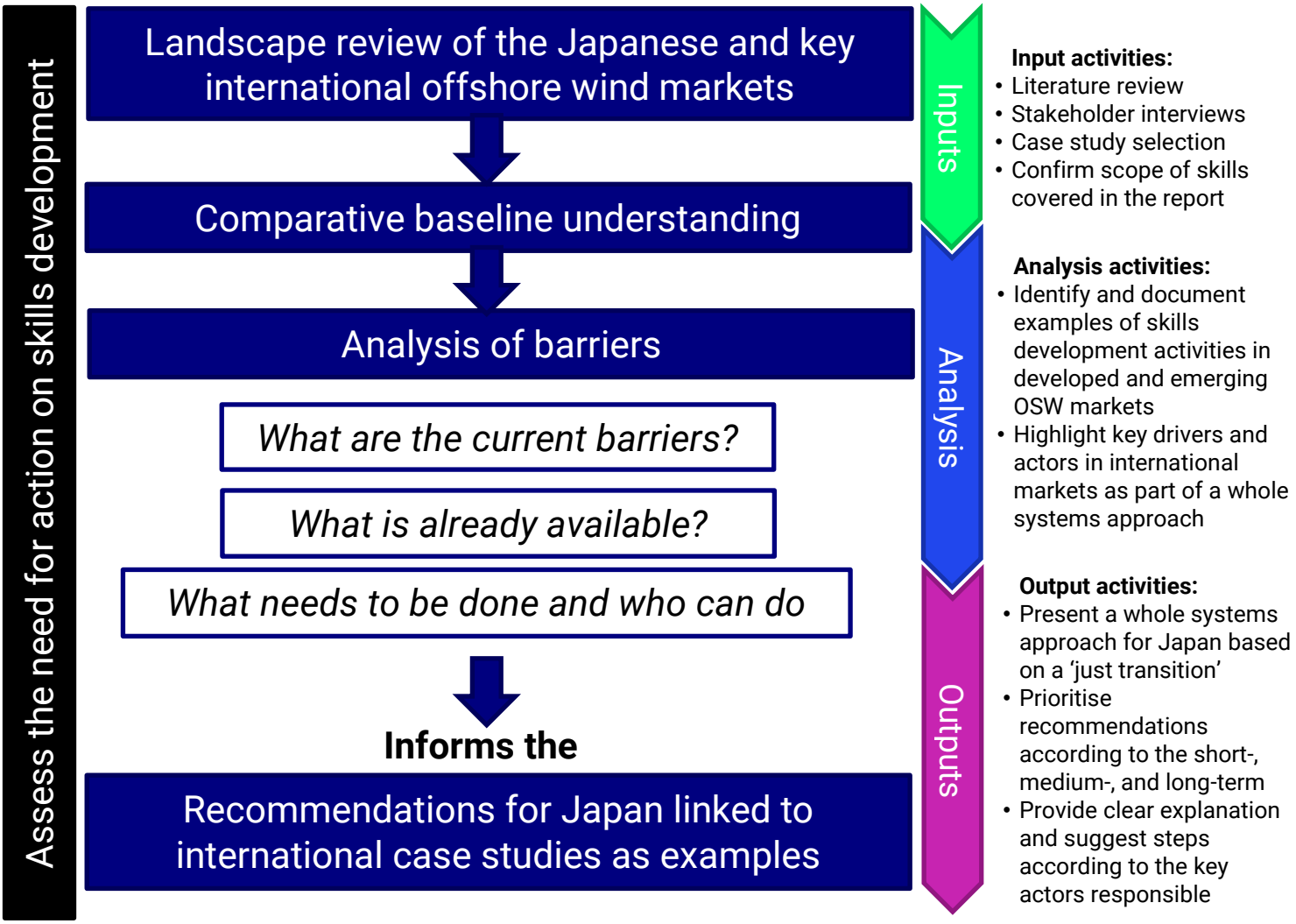


Figure 3: Visualised methodology to assess the need for action on skills development in Japan.

2. Contextualising offshore wind in Japan

2.1. Significance of offshore wind to energy and economic policies

Japan's energy policy is guided by the pillars of energy security, economic efficiency, environmental sustainability, and safety.[12] With an ageing population, steady electricity demand, and relatively low annual gross domestic product (GDP) growth rates, Japan is experiencing a decrease in energy demand.[13] This is significant because a decrease in energy demand suggests minimal energy security risks for fossil fuel imports—provided that the local generation capacity is maintained. Energy security has, therefore, increasingly been promoted through investment in renewables to reduce the country's reliance on coal and natural gas imports. Reducing reliance on fossil fuels is linked to the increase in renewable energy ambition, where 2021 renewable energy targets have nearly doubled the previous ambitions. The '2021 Sixth Strategic Energy Plan' outlines that 36-38% of the power generation mix will come from renewables of which 5% is targeted to be sourced from wind power.[14] This is up from the previous ambition of 22-24% renewable energy, with a target of only 1.7% wind energy.[15]

The increase in the role of renewables is also made feasible through the decreasing electricity demand. The International Energy Agency (IEA) data explorer shows that Japan's electricity generation peaked in 2010 and has been on a decline since the Great East Japan earthquake, reaching its lowest for the past 20 years in 2021 to around 1,000TWh (Figure 4)[16]. Wind energy generation (mostly attributed to onshore wind) nearly doubled from 4.7TWh to 8.7TWh from 2011 to 2021. Since 2020, there has been an increasing focus on offshore wind, which has proven to be cost effective, space saving on land, and able to produce a high quality of 'baseload energy'.[17] Offshore wind provides a strategic avenue for the government to gradually diversify its energy mix as per Japan's energy policies and economic strategies (Figure 5).

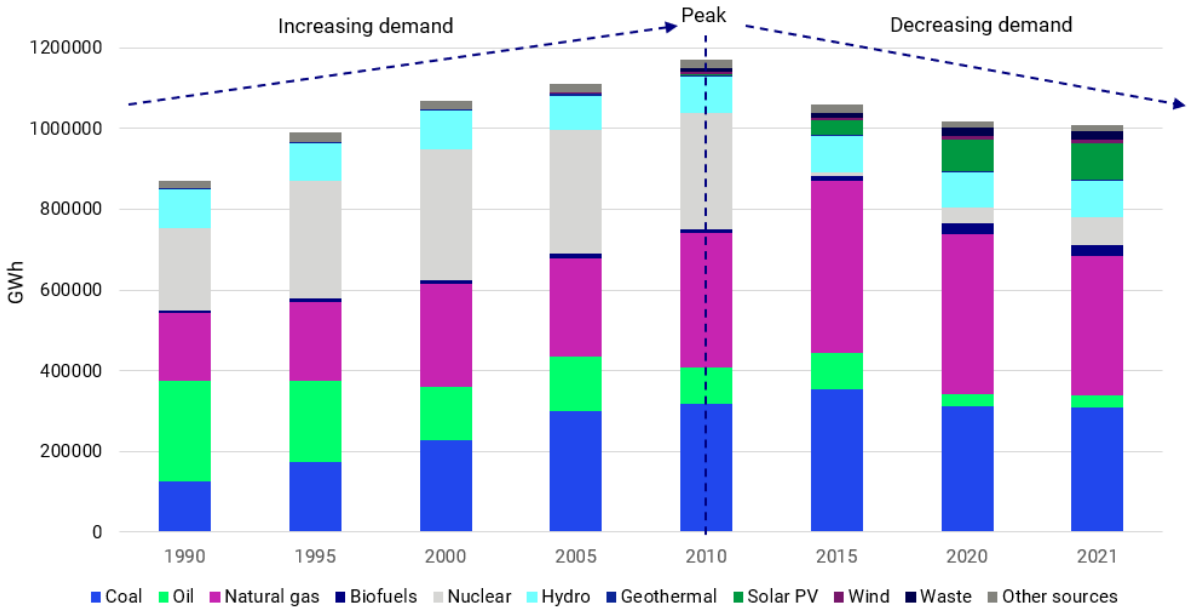


Figure 4: Japan's electricity generation by source, 2000-2021.

[12] Japan 2021 – Analysis - IEA
[13] Country Analysis Executive Summary: (eia.gov)
[14] Outline of Strategic Energy Plan (meti.go.jp)
[15] エネルギー市場動 2021 (nri.com)
[16] Japan - Countries & Regions - IEA
[17] Offshore Wind Outlook 2019: World Energy Outlook Special Report (windows.net)

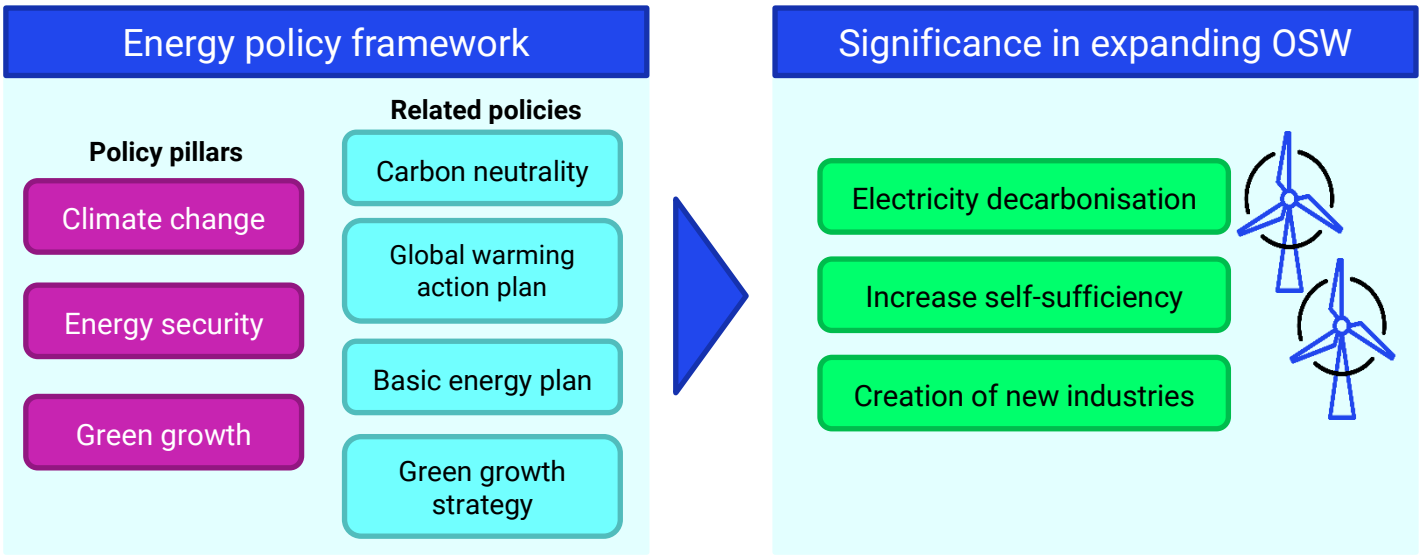


Figure 5: Illustration of Japan's Energy Policy Framework, which is significant for electricity decarbonisation, increasing self-sufficiency, and creating new industries in the economy.

In terms of the economic benefits expected from the transition to renewables it is estimated that, by 2050, 63GW of offshore wind capacity in Japan will create a cumulative 940.9 billion yen-worth economic ripple effect and create more than 30,000 jobs.[18] The 2022 Renewable Energy Institute report also estimates that a 10% substitution of fossil fuel production to 10% offshore wind production will produce a net surplus of 200 billion yen in domestic production.[19] 10% of thermal power capacity replaced with 10% offshore wind capacity will also lead to a net increase of 19,000 jobs while reducing CO_2 emissions in Japan by 16.08 million tonnes.[20] Next to meeting energy security and economic efficiency goals, offshore wind technology is recognised as pivotal to Japan's carbon neutral 2050 goal and Global Warming Action Plan as part of the country's environmental sustainability goals (Table 3). With the sources for Japan's electricity generation expected to increasingly come from renewables, this transition has a significant ripple effect on the composition of the skills and workforce in the country. The skills need as well as the plans to achieve this skills transition has not yet been comprehensively investigated.

Table 3: Summary adapted from JWPA on Japan's energy policy framework, related policies, and laws, indicating the significance of offshore wind to national energy and economic strategies.

Related policies and laws that enable the offshore wind market	Summary
Declaration of Carbon Neutrality 2050	• In October 2020, Japan announced its ambition to reach neutral greenhouse gas emissions by 2050 through the 'Declaration of Carbon Neutrality 2050'. • A policy is proposed to transform Japan's industrial structure and economic society and create a virtuous cycle between the

[18] Socioeconomic Analysis of Offshore Wind Power Development in Japan (renewable-ei.org)

[19] Socioeconomic Analysis of Offshore Wind Power Development in Japan (renewable-ei.org)

[20] Socioeconomic Analysis of Offshore Wind Power Development in Japan (renewable-ei.org)

	economy and the environment by proactively addressing global warming.
Global Warming Action Plan	• The government's comprehensive plan based on the 'Law on the Promotion of the Measures to Cope with Global Warming' was revised in October 2021. • The medium-term target for carbon neutrality is a 46% reduction in greenhouse gas emissions by 2030 (compared to 2013), with a further 50% target to be achieved by 2050.
Basic Energy Plan	• The Cabinet approved the 'Sixth Basic Energy Plan' in October 2021. • The plan calls for an increase in the share of renewable energy in the power supply mix to 36-38% by 2030. Additionally, 17.9GW of onshore wind power and 5.7GW of offshore wind power are expected to be installed.
Green Growth Strategy	• In December 2020, the 'Green Growth Strategy' associated with carbon neutrality in 2050 was developed. • It presents 14 key areas for Japan's future efforts and identifies the offshore wind industry as one of them.
The Act for the Promotion of Use of Marine Areas for the Development of Marine Renewable Energy Facilities	• In 2018, The Japanese parliament approved 'the Act for the Promotion of Use of Marine Areas for Development of Marine Renewable Energy Facilities' (the Act) also known as the 2018 Offshore Wind Promotion Bill.[21] A key outcome of this Act was that offshore sites can be leased for 30 years through an occupancy permit as part of the Renewable Energy Act accreditation. • This Act announced that renewable energy projects such as offshore wind sites can be auctioned through the country's legal framework, giving confidence to the industry and outlining how they can bid for 'Promotion Zones'.

[21] 洋上風力発電関連制度｜なっとく！再生可能エネルギー (meti.go.jp)

2.2. Market status and offshore wind project pipeline

Through the 2050 carbon neutral target and recent offshore wind market-enabling policies, the market has become progressively more visible since 2018 with a promising project pipeline. Price mechanisms and investments into offshore wind (and renewables more broadly) had been strategised since after the 2011 Fukushima Nuclear Incident. However, Japan's offshore wind potential continued to be largely underutilised and the market remained undeveloped. In the early period, Japan established a Feed-in Tariff (FIT) to support the offshore wind market. The FIT rate for fixed-bottom offshore wind was attractively high and unchanging between 2014-2019 at 36 yen/kWh ($0.34/kWh), while the global weighted levelised cost of energy (LCOE) was $0.115/kWh.[22] Even though the industry recognised the high technical potential (128GW of fixed-bottom; 424GW of floating wind) and lucrative FIT rate in Japan, there were unaddressed administrative challenges concerning the permitting stages, as well as the uncertainty of the overall development model. As a result, the market was not able to take off.[23,24]

A turning point came in 2018, with the approval of the 'Act for the Promotion of Use of Marine Areas for the Development of Marine Renewable Energy Facilities', enabling a competitive auction scheme and securing rights to a seabed lease for 30 years.[25] With the introduction of the auction scheme, the market became more visible to the industry and developers were more motivated to enter the market. The increase in confidence by developers can partly be seen by the increase in environmental impact assessments, which reached a total pipeline of 12.6GW in August 2019 after the introduction of the Act. It was estimated that an aggregated scale of 12.6GW projects could potentially reach up to 3 trillion yen (US $29 billion) of financing into the sector and the wider economy as a cascading effect.[26] Therefore, offshore wind is considered a promising 'sunrise industry' for Japan's future green economy. Following the auction scheme, the FIT rate for fixed-bottom offshore wind was revised downwards to 32 yen/kWh in 2021 and was revised downward further to 29 yen/kWh in 2022. From 2023, developers may not be eligible for the FIT for any new fixed-bottom offshore wind projects that have not already been approved to receive the FIT.[27] However, the FIT rate of floating offshore wind remains unchanged at 36 yen/kWh due to the immaturity of the technology.[28]

As of January 2023, Japan has over 50GW of offshore wind capacity currently in concept and early planning stages, with over 10GW in development zone status (Figure 6). By the end of 2021, the Government of Japan had awarded a total of 1.7GW in Round 1. By the end of 2022, the government had finalised its Round 2 auction scheme, offering a total of four sites which are projected to provide up to 1.8GW generation capacity. For Round 1, the ceiling price was set at 29 yen/kWh.[29] For Round 2, the price caps are set at 19 yen/kWh for the Akita and Niigata areas, and at 29 yen/kWh for the Nagasaki area.[30]

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[22] Offshore wind projects in Japan attract FDI - Investment Monitor

[23] GWEC-Global-Offshore-Wind-Report-2022.pdf

[24] Japan 2021 - Energy Policy Review (windows.net)

[25] Japan 2021 - Energy Policy Review (windows.net)

[26] Japanese wind fans bank interest | Reuters

[27] Renewable Energy Purchase Prices, Surcharge Rate, and Other Details related to FIT and FIP Schemes from FY2022 Onward to Be Determined (meti.go.jp)

[28] Renewable Energy Purchase Prices, Surcharge Rate, and Other Details related to FIT and FIP Schemes from FY2022 Onward to Be Determined (meti.go.jp)

[29] akita_noshiro_kouboshishin.pdf (meti.go.jp), akita_yuri_kouboshishin.pdf (meti.go.jp), chiba_choshi_kouboshishin.pdf (meti.go.jp)

[30] kouboshishin_20221228.pdf (meti.go.jp)

METI has indicated that the adjusted rate is due to different technologies applied, such as monopile or jacket foundations.

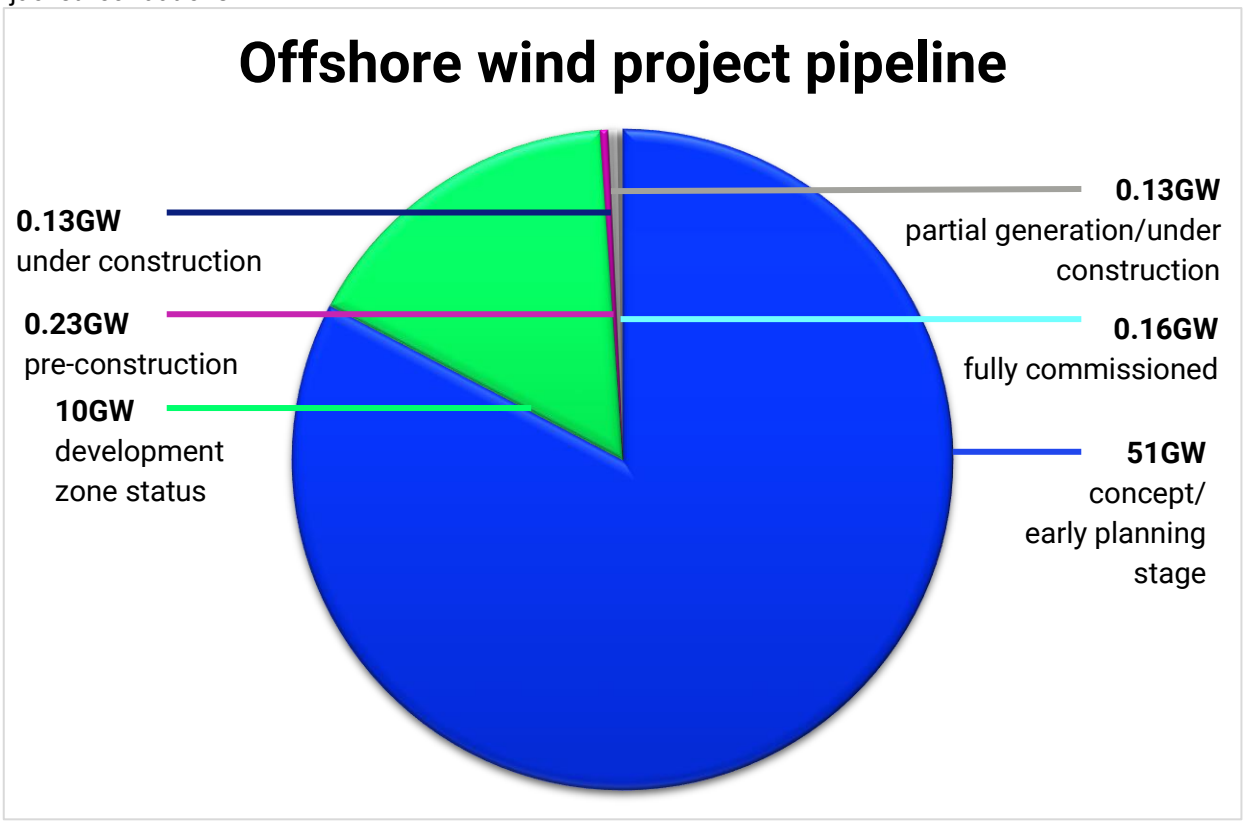

Figure 6: Offshore wind project pipeline in Japan.[31]

As the offshore construction for commercial scale projects is expected to begin 6-8 years after the auction award date, approximately 6.6GW of expected tender projects are expected to begin offshore construction by 2030. With a higher target set for 2040, offshore wind (including floating) measures are expected to accelerate in the 2030s. Market researcher, 4C Offshore, forecasts that Japan will realise 6.6GW by 2030 and 14.3GW by 2035.[32] The first large-scale offshore wind farm is the Akita-Noshiro wind farm, which encompasses two wind farm sites. The Akita Port has 54.6MW generation capacity and the Noshiro port has 84MW generation capacity.[33] Both wind farms have started commercial operation, signalling a strong start for the Japanese commercial offshore wind market.

The vast majority of the pipeline project capacity is in the early concept and planning stages, indicating that there is likely to be a significant increase in the need for skills as these projects' life cycles move into construction, operations and maintenance. Comparison with international upscaling of the offshore wind industry can provide insight into the likely increase in demand for skills. For example, in the UK, offshore wind capacity is expected to increase from 6.4GW in 2017 to 35GW in 2032, with an associated expected increase in employees from 10,000 to 36,000.[34] As Japan looks to deploy potentially up to 50GW within the next decades, the associated skills need should be investigated according to the GW projections to better prepare the industry and wider labour force. Hence, the necessary preparations should be put into place, which this report will explore in Section 6: Conclusion and recommendations for Japan.

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[31] This excludes dormant, cancelled and failed proposal projects. Source: 4COffshore database, February 2023.

[32] 4C Offshore (2022) Global Market Overview, Q3 2022 Slide Deck.

[33] Japan's First Commercial-Scale Offshore Wind Farm Starts Delivering | Offshore Wind

[34] Aura-EU-Skills-Study-Summary-Report-October-2018.pdf (aura-innovation.co.uk)

3. The need for offshore wind-related skills in Japan

The skills shortage of the workforce is currently a significant bottleneck to the growth of the offshore wind industry globally, and this is recognised as a challenge in Japan. However, there is not yet a clear path to meet the skills need to support the offshore wind pipeline within the country. The Japanese government has set out an intention to implement an 'Offshore Wind Power Talent Development Programme', which prioritises local content production and local job employment.[35] For local content production and local content goals to be achieved, in addition to the deployment targets, the upcoming skills-related programme must be rooted in an understanding of the existing baseline of skills across the project operation areas. This baseline should be used to model the expected skills need, to then consider how suitable measures can be implemented to address retaining, retraining, renewing, or recruiting requirements.[36]

Addressing the skills need will not only be essential to meeting offshore wind targets, but to realising the role of the offshore wind industry as an integral part of Japan's economic strategy. Furthermore, the key drivers that can enable the shift towards a carbon neutral economy can also be approached through skills strategies that enable an economy-wide transformation, which generates positive social impacts for workers and communities. In sum, key stakeholders will need to work closely together to facilitate a structural shift to secure the skilled workforce needed for the deployment of large-scale offshore wind. At present, the skills need in Japan is addressed only in relation to an increase in offshore wind deployment, however, moving workers into the necessary offshore wind-related roles requires a whole systems approach.

3.1. Existing measures on skills for offshore wind in Japan

Based on the available policy documents and stakeholder interviews conducted for this report, a comprehensive baseline of Japan's offshore wind skills capacity does not appear to have been undertaken. This section will therefore present an overview of the current activities that are addressing the skills need for offshore wind within Japan. Table 4 covers examples of plans, policies, and programmes (overall labelled as 'activities') that have been implemented or are in the process of being implemented to address the skills need in Japan.

Some noteworthy examples entail the significant subsidy scheme that METI is offering to the offshore wind industry for skills and training, up to 650 million yen, while various institutions, training centres and industry collaboration initiatives have been established to help grow the human resource pipeline.[37] In addition, the newly planned training facilities aim to train at least 1,000 professionals per year starting in 2024.[38]

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[35] Overview of the Vision for Offshore Wind Power Industry (mlit.go.jp)

[36] Overview of the Vision for Offshore Wind Power Industry (mlit.go.jp)

[37] Subsidy Details | jGrants Easy with the Net! Grant Application | jGrants (jgrants-portal.go.jp)

[38] NYK to Establish Comprehensive Training Center for Offshore Wind Power Generation in Akita Prefecture | NYK Line

Table 4: Overview of activities in Japan that address the skills need for the offshore wind industry.[39]

Key government policies/actions	Education/research activities	Industry/private sector facilities/actions	Collaboration examples
Green Innovation Fund • New Energy and Industrial Technology Development Organization (NEDO) provided 2 trillion yen to support green R&D projects including offshore wind. **METI Human Talent Programme** • METI provided 650 million yen to support talent growth under the '2022 Subsidy for Offshore Wind Power Human Resource Development (HRD) Project'. **Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation** • Japan's offshore wind public-private council was formed between METI, MLIT, and industry players.	**Fukushima O&M Association (FOM) Academy** • A training facility responsible for the maintenance of wind power generation facilities, located in Fukushima City. **Kyushu University, Research and Education Centre for Offshore Wind** • The research centre aims to contribute to the formation of a world-class research and education base for offshore wind power in Japan. Kyushu University is one of the awardees of METI's 2022 offshore wind HRD subsidy. **Nagasaki Ocean Academy** • The Nagasaki Ocean Academy introduced various courses aimed at professionals. The academy aims to train 1,600 people over the next five years. Nagasaki University is one of the awardees of METI's 2022 offshore wind HRD subsidy.	**Certification services for training providers by ClassNK** • ClassNK provides certification services for training providers based on the international Global Wind Organisation (GWO) training standards. **Japan Wind Power Association (JWPA)** • JWPA introduced various training and industry guides aimed at professionals. **Nagasaki Marine Industry Cluster Promotion Association (NaMICPA)** • NaMICPA introduced various training aimed at professionals. **Nippon Survival Training Center (NSTC)** • NSTC is a GWO-certified offshore survival training centre providing safety training to professionals. **O&M training by Hokutaku Corporation** • As METI's 2022 offshore wind HRD subsidy awardee, Hokutaku Corporation is due to provide O&M training services. **Respective ship crews training by MOL Marine & Engineering Co., Ltd and Japan Yusen Line Corporation** • Automatic positioning systems and small workboat training are to be provided by MOL Marine & Engineering Co., Ltd and Japan Yusen Line Corporation, under METI's 2022 offshore wind HRD subsidy. **Wind power generator maintenance and emergency first aid training by Eos Engineering & Service Co., Ltd** • Located in Akita, Eos Engineering & Service Co., Ltd. is GWO-certified and provides wind power generator maintenance and emergency first aid training. **Other international bodies' certifications** • GWO Basic safety training, Offshore Petroleum Industry Training Organization (OPITO) certification training, and International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Convention Basic Training are also individually available in Japan.	**Consortium between the offshore wind Industry-Academia-Government, through Kyushu University** • Brings together the experience of Japanese industry, academia, and government, in realising offshore wind energy in Japan. **Industry collaboration across international markets by Wind Power Group Co., Ltd. and Taiwan Wind Power Training Co., Ltd.** • METI's 2022 offshore wind HRD subsidy awardee, Wind Power Group Co., Ltd. is partnering with Taiwan Wind Power Training Co., Ltd. to develop a training facility, with a target to train 1,000 people starting in 2024. **Education for wind farm operators and fuel ship crews by ClassNK and Maersk** • A Memorandum of Understanding (MoU) regarding training for offshore wind farm operators and education for alternative fuel ship crews was signed between ClassNK and Maersk. **The Nippon Foundation Ocean Innovation Consortium** • The Nippon Foundation Ocean Innovation Consortium is dedicated to training future generations of ocean engineers and to expanding awareness about marine energy resources. **Public-private partnership: Formation of a training centre by NYK, Nippon Marine Enterprises, and local governments of Akita Prefecture and Oga City** • METI's 2022 offshore wind HRD subsidy awardee, with a target of training 1,000 people in the industry per year starting in 2024.

[39] Carbon Trust research - compilation from various resources, including interviews, of which public resources are listed in the references section.

3.2. Expected demand for offshore wind related skills in Japan

Based on the overview of existing skills development activities for offshore wind in Japan (Section 3.1), it is clear that **more can be done to fully address the skills, training and labour demand**, which is expected to persist until plans for a skills transition are implemented.

Japan's labour market has persistently faced skills gap, [40] skills shortage, [41] and labour shortage[42] issues in general. As of 2022, surveys show that over half of the companies in Japan are suffering from a labour shortage,[43] on top of that 74% of employers report that they have difficulty finding the talent they need (skills shortage). Within the manufacturing industry—an important offshore wind supply chain area—this was even higher, as 82% of employers expressed that they are facing a skills shortage.[44] The Organisation for Economic Co-operation and Development (OECD) has studied the labour market extensively and found that even when the labour market is performing above the OECD average, many skills risk becoming irrelevant (skills gap) unless a skills transition is implemented:

> *'The Japanese labour market is characterised by low unemployment and high employment rates, resulting in a labour market performance above the OECD average. However, structural changes – such as technological progress and population ageing – are transforming the supply of and demand for skills. This is likely to make it increasingly difficult for employers to find workers with the right skills and for adults to find jobs that match their skills. Unless education and training systems respond to ensure that adults can develop and adapt their competencies to respond to changing skills needs, this is likely to have a detrimental impact on the Japanese labour market, both in terms of job quantity and inclusiveness as well as on productivity and growth.'*[45]
>
> OECD, 2021

It is critical that the skills need for offshore wind is considered as part of a broader transition to a green economy, where the offshore wind industry needs are understood in relation to Japan's labour market. Specifically, the barriers to meeting the skills need must be tackled through measures that recognise the interconnection between the labour market, the economy, new offshore wind policies, the growth of new industries and the decline of other industries. Since concrete data on the expected demand for offshore wind related workers is limited for Japan, Table 5 provides an overview of sources that discuss the expected demand for skills across Japan. The recommendations (Section 6) present suggestions to decision-makers to start building up data and quantitative information on the expected skills need.

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[40] Skills gap: this refers to a gap in skills that can be filled by training the existing workforce.

[41] Skills shortage: a skills shortage means that the existing workforce supply is not sufficient in meeting the skills demand and instead the recruitment of more people with the required skills is needed. Skills shortages can be understood as occurring when there are insufficient applicants with the skills, experience, and qualifications required to fill vacancies.

[42] Labour shortage: a labour shortage refers more broadly to the number of people required and not their skills specifically.

[43] Over half of Japan companies suffering from labor shortage: survey (kyodonews.net)

[44] Japan's 2022 Talent Shortage (manpowergroup.com)

[45] Changing skill needs in the Japanese labour market | Creating Responsive Adult Learning Opportunities in Japan | OECD iLibrary (oecd-ilibrary.org)

Table 5: Collection of sources highlighting the expected demand for skills, training, and labour.

Evidence on the expected demand for offshore wind skills, training and labour in Japan	
GWEC	The 'Global Wind Workforce Outlook 2022-2026' indicates that Japan will be a key offshore wind market with a large demand for wind technicians. Based on a predicted installation of 985MW offshore wind over the period 2022-2026, **1,118 technicians** would be needed for the construction and installation phase, and the operations and maintenance phase.[46] It is also noted that jobs in Global Wind Organisation (GWO)-trained roles are expected to significantly rise towards 2025 for Japan, suggesting a potential surge in demand which could be challenging to meet if not suitably prepared for. In addition, the 'Global Wind Workforce Outlook, 2021-2025' highlights that the report only covers the workforce that would need GWO training. Other skills areas such **as training for vessel crews, foundation and cable installation** teams are work areas that would also require training but have not been included in the report.[47] Japan currently has 5-10% of the required GWO standard training capacity to meet its wind installation targets.[48]
REI	In the 'Offshore Wind Power to Support Japan's Energy Needs' report published in 2021, it was estimated that **2,150 people** with sufficient skills and training for building and installing offshore power facilities will be needed in Japan by 2024, and over **8,600** will be needed by 2030. With technological innovations such as the application of artificial intelligence, robotics, digitalisation etc., in remote automated control systems used in maintenance and management, it will be important to hire experts in data science, computer engineering, information technology, and other areas.[49] REI's 2022 'Socioeconomic Analysis of Offshore Wind Power Development in Japan' indicates that the construction of offshore wind power facilities will create **30,000 to 60,000 jobs per year**. Of these, **20,000** would be for workers directly involved in construction work.[50] Currently, the number of workers with expertise and skills suitable for the construction of offshore wind power systems is far fewer than this level of demand.
METI	In the 'Vision for Offshore Wind Power Industry', METI provides a qualitative assessment of the offshore wind skills, training and labour demand.[51] METI outlines the need for the industry, the Government of Japan, and academia to work together to develop the necessary human resources for offshore wind. This would contribute to:

[46] Global Wind Workforce Outlook 2022-2026.pdf (website-files.com)

[47] Global-Wind-Workforce-Outlook-2021-2025.pdf (gwec.net)

[48] GWEC-Global-Offshore-Wind-Report-2022.pdf

[49] Offshore Wind Power Supports Japan Energy : Systems, Infrastructure, and Industries for Mass Adoption | Reports and Recommendations | Renewable Energy Institute (renewable-ei.org)

[50] Socioeconomic Analysis of Offshore Wind Power Development in Japan (renewable-ei.org)

[51] vision_first_en.pdf (meti.go.jp)

	1) The promotion of investment and the formation of a stable supply chain. a. With the goal for **60% of domestic parts to be sourced from within Japan**, there is a need to consider the geography of the workforce and emphasise in-country capacity building to meet these supply chain and local employment goals. 2) Offshore wind power talent development programme. a. The 'Vision' notes the need for actions to support talent in a wide range of fields. b. METI proposes that the industry needs to take an inventory of the required skills and propose concrete measures for acquiring those skills. c. It is expected that **some workers will need to be transferred or redeployed from different industries** in the short-term, with new talent developments over the mid- to long-term.
JWEA	Mitsubishi Research institute (MRI) published an article in August 2022 with the Japan Wind Energy Association (JWEA) journal titled 'Latest developments with the offshore wind public-private council and human resource development measures.' MRI outlines the urgent need for suitable measures to be put into place to support the accelerated expansion of the offshore wind market. Based on the 'Offshore Wind Industry Vision', MRI estimates that by 2030, **12,000 skilled workers will be needed**, and by 2040, **30,000 full-time equivalent workers**. This does not account for part-time workers which would suggest the actual overall estimated number of workers needed is even higher. The article also emphasises the need for the 'Offshore Wind Human Talent Development Program' to be quickly published by the government of Japan.
JWPA	The 'Offshore Wind Skills Guide' highlights the large number of personnel that are required across the offshore wind project life cycle, noting that **the exact estimations for Japan have not yet been made**.[52] The guide offers guidance on the types of roles and what specific types of tasks such a role may require. Moving forward, further clarity is needed for organisations to understand how these job roles can be filled, which this report intends to address. At the Global Offshore Wind Summit – Japan in November 2022 hosted by GWEC and JWPA, skills and training for offshore wind was noted as a key issue and was discussed at the conference.

The above sources present a range of values of the expected demand, and each source has quantified this range differently. A comprehensive assessment of the current skills in Japan is needed to build an accurate forecast model for expected demand according to the pipeline of projects, which is discussed in Recommendation 1.

[52] 洋上風力スキルガイド（第１版）

4. Key international market case studies

This section presents case studies on several international offshore wind markets and the approach they have taken to address their skills needs to provide inspiration and reference points for decision-makers on measures that can support the development of skills for the offshore wind industry in Japan. The selected developed markets are the UK, Denmark, and the Netherlands. The selected emerging markets are the US and Taiwan. The case studies are presented at the country level, analysing their skill measures through a whole systems approach.

4.1. The value of a whole systems approach for skills development

Taking a whole systems approach involves looking at a theme or topic, such as skills development for offshore wind, and understanding how its relationships with other sectors and stakeholders indirectly and directly produce a pattern of behaviour (i.e., skills gap) over time.[53] This approach differs from more traditional 'reductionist' approaches, which seek to understand a question area breaking it down into smaller parts to be analysed in isolation. While a reductionist approach can make understanding complex challenges more manageable, it often results in siloed solutions, which can be less impactful, less efficient (including value for money), missed opportunities to maximise co-benefits, and may result in unintended impacts in other sectors or stakeholders not under direct consideration.

Skills development links to a broad range of complex systems (I.e., the education, political, and economic system); therefore, a whole systems approach that consciously seeks to understand and leverage interactions between these systems is necessary to develop a successful skills development landscape. Taking this approach means bringing together relevant stakeholders from across different systems to develop a shared understanding of the diverse factors that drive or bar skills development and consider the role they have in supporting the offshore wind industry and carbon neutral transition more widely. A whole systems approach enables decision-makers to shift away from linear and siloed interventions, such as assuming the skills gap can be addressed by increasing education facilities and funding, which are unlikely to be effective in isolation. Instead, it enables decision-makers to consider how more holistic joint-up actions across sectors and stakeholders can build a portfolio of complementary interventions to maximise impact.

As there is a multitude of valid approaches to developing a whole systems approach of skills development within Japan, this report abstains from providing our interpretation. Decision makers within Japan will need to communicate with each other to discuss what a whole systems approach means for them and how it can be adapted to provide a foundation of understanding to ensure successful skills development for offshore wind in Japan. This report offers insights in Section 6 which include actions that can be taken to support a whole systems approach for each recommendation. For guidance on whole systems approaches, we adapted the UK National Engineering Policy Centre's 'Getting to net zero: a systems approach'[54] to skills development in Japan. A whole systems approach often requires:

- A simultaneous transformation of interconnected actors within their skills systems (such as the education sector, local prefectures, private companies, and government).
- The need to understand interdependencies between those different components of a system.

[53] Systems Thinking: An introduction for Oxfam programme staff - Oxfam Policy & Practice

[54] Getting to net zero: a systems approach

- The need to understand where the trade-offs exist and where the opportunities exist to incentivise the transition to green jobs.
- Alignment of all relevant systems and factors to the overall goal of creating a strong skills development landscape that can deliver the offshore wind pipeline in Japan.

4.2. Overview and approach to the case studies

The case studies identify the key actors and drivers that have influenced skills-related plans, processes or outcomes. The main drivers for change[55] that facilitate the development of skills as part of a whole systems approach are:

- **Communication:** How have decision-makers communicated the current situation and set out plans to address skills?
- **Education and research:** How have actors facilitated education and research to drive skills development?
- **Collaboration:** How have decision-makers collaborated to facilitate skills development?

It was identified that the coming together of these drivers partly enables change to transform the skills market. **However, it should be noted that no offshore wind market has fully addressed the emerging skills need since skills are a bottleneck for all markets.** The case studies for the developed markets provide useful insights into the role of actors and what they do to drive communication, education, and collaboration, including governments, the industry, and research or education facilities. In emerging markets, the industry has created a significant impact, facilitating greater communication from governments on the role of offshore wind. The case studies demonstrate that when stakeholders connect skills measures to a wider system—whether intentionally or unintentionally—there is stronger momentum between actors through drivers such as communication, collaboration, and education. Skills development seems to stall when there are weak connections between actors, and when the drivers are not effective. The case studies highlight the key actors (who did what), the drivers (how were skills addressed), and an analysis of the significance of the approach taken.

Learning about the successes and failures of these international case studies can provide clarity and offers a comparison of the responsibilities of actors, their steps for change, and the mechanism or policy tools and options that were available to them, which can guide the offshore wind skills development path in Japan.

Figure 7: Key takeaways for decision-makers in Japan on the drivers behind skills development.

[55] There are other relevant drivers that are important for skills development, such as the role of finance, however, this was difficult to assess from publicly available resources.

4.3. The United Kingdom

The UK government has taken a comprehensive approach to skills development by clearly communicating its support to address the skills need in the industry through policies such as the Offshore Wind Sector Deal. Skills are also increasingly addressed in relation to the UK government's plans to reach Net Zero and transition justly through 'levelling up' strategies that address those who are at risk of being left behind.

The clear signalling from the government has created clarity for actors such as educational institutions, the private sector, and the offshore wind industry. Through a whole systems approach, which focuses on communication, collaboration and education, skills development in the UK for offshore wind is strategically tied to overcoming barriers. For example, the UK government has published on the lack of technical skills and the mismatch between what the skills system provides and what employers need. This problem scales up to industry-level challenges, e.g., the UK offshore wind industry struggling to build up the skills for a strong domestic supply chain. To address these skills development challenges, the UK government has committed to transforming further education, with better alignment of technical education and training through the rollout of T Levels. One of the sector deal initiatives will also invest up to £250 million to build a stronger UK supply chain through the establishment of the Offshore Wind Growth Partnership (OWGP).[56] The OWGP supports businesses with the development of the offshore wind supply chain through grant funding and business transformation support. This in turn upskills companies.

To this end, there is strong evidence of collaborative networks between the government, industry, and the education sector, which are mobilising to address skills in offshore wind as part of a future Net Zero economy. To highlight the important role certain actors play, the table below presents a selection of key measures according to a whole systems approach. The table considers the drivers (communication, education, and collaboration) that have created a positive effect on skills development for the offshore wind industry in the UK.

Table 6: Overview of key steps taken by actors in the UK according to the drivers of communication, education and research, and collaboration.[57]

Communication *How have decision-makers communicated the current situation and set out plans to address skills?*	**Education and research** *How have actors facilitated education and research to drive skills development?*	**Collaboration** *How have decision-makers collaborated to facilitate skills development?*
Offshore Wind Sector Deal	**Supergen ORE Hub**	**Government**

[56] Offshore wind Sector Deal - GOV.UK (www.gov.uk)

[57] Carbon Trust research - compilation from various sources with public resources listed in the references section.

- The 2019 deal outlines how the offshore wind industry will work with the government, existing institutions, universities, and industry programmes to develop curricula, increase job mobility across and between sectors, increase apprenticeships and coordinate local efforts for the introduction of T Levels.

North Sea Transition Deal

- Sector Deal for the UK Continental Shelf, which is a region of waters that provides numerous offshore-related jobs. The North Sea workforce will have to align its work with decarbonisation goals and transform its supply chain.
- The research identified that up to 68% of current workers in the offshore oil and gas sector have skills that could be transitioned to the low carbon sector.

Build Back Better

- 2021 report outlining economic growth plans that address the need to level up (just transition) as well as the strengths and weaknesses of the current skills system.
- Offshore wind is discussed as a green job provider and a way to reach net zero.

Green Jobs Taskforce

- Programme set up by the Engineering and Physical Sciences Research Council (EPRSC) in 2001 to provide leadership for academic research on key offshore renewable energy (ORE) areas such as wind power.
- The Hub connects academia, industry, policy and public stakeholders to inspire innovation, with resources such as funding, facilities, web-based tools, and online engagement platforms.

Education Sector

- Numerous universities have created offshore wind-related courses (including the University of Plymouth, University of Hull, University of Strathclyde, University of Oxford, University of Exeter, University of Durham, University of Aberdeen, University of Southampton, and the University of Edinburgh).
- EPSRC provides PhD-level funding to train wind energy researchers.
- As part of the Sector Deal, T Levels will be introduced to provide more specialised training for the highly specialised jobs required in the offshore wind industry.
- The Sector Deal will create Institutes of Technology to develop a standardised curriculum.

- BEIS signed an agreement between the UK and the North Seas Energy Cooperation, which sets a framework for greater cooperation with North Sea neighbours (nine countries and the European Commission).
- Part of the intention is to support the growth of offshore wind. Such cooperation agreements may foster more collaborative approaches to skills development for offshore wind.

Offshore Wind Industry Council (OWIC)

- OWIC is responsible for implementing the Sector Deal, bringing together industry, policymakers and stakeholders to work collaboratively.
- OWIC has a strong focus on people and skills through its publication of skills intelligence reports which provide an analysis of future offshore wind workforce requirements.
- Collaborated with the National Skills Academy for Rail (NSAR), which developed a data driven skills model that tracks and reports on workforce data to agree on clear targets and metrics.

ORE Catapult

- OREC is an innovation centre for offshore renewable energy, bringing together leading

• 2020-2021 Taskforce that actioned parts of the 'Ten Point Plan for a Green Industrial Revolution'. • Published a report detailing the skills need for increasing offshore wind capacity and how the skills need could be addressed. **Skills for a green economy** • 2011 report demonstrating the early planning by the UK government on skills. The main focus was on improving skills provision in the further education sector. • To improve skills development, collaboration between the education sector and private industry was cited as key, as well as encouraging constant learning within the workforce. • Funding was available for 1,000 apprenticeship places for the Green Deal.	**Industry** • Offshore wind developers such as Ørsted contribute to education partnerships in the UK such as Teach First. • Numerous developers have created learning materials for the youth and general public to increase awareness and attract talent into the industry. • Numerous developers provide apprenticeships. **Devolved administrations** • Energy Skills Partnership is a charity, formed through the collaboration of colleges across Scotland to establish training networks and regional skills for the just transition to Net Zero. • Northern Ireland Direct funds the 'SKILL UP' programme to retrain people in sectors such as renewable energy.	UK research and expertise to support the development of skills and knowledge. • OREC promotes collaborative partnerships to address barriers to the deployment of offshore wind. They have often published on the skills challenge, and created resources or partnerships to address them. **OPITO (UK office)** • OPITO launched the UKCS Workforce Dynamics series, publishing a 'Skills Landscape' report in 2019 to explore the changes in the workforce up until 2025, noting the need to shift oil and gas skills to roles in offshore wind. This research will facilitate stronger collaboration between the extractive and renewable industries. • OPITO was granted funding by the Just Transition Fund from the Scottish government to support the delivery of a so-called 'energy skills passport', which will accredit offshore workers and facilitate job-mobility between offshore renewable and extractive industries.

4.4. Denmark

Denmark is often described as a pioneering country of offshore wind, having installed the world's first offshore wind farm at Vindeby in 1991. Nevertheless, offshore wind is not the country's main source of renewable energy as the energy system has a high mix of renewable technologies.

Compared to other European countries, Denmark has a modest 1.7GW of offshore wind capacity installed. Yet, many leading companies in the global offshore wind industry have roots in Denmark, such as Ørsted, Vestas, and Rambøll. Given Denmark's long history of developing the engineering capabilities of offshore wind, the relationships between the government, industry, and educational institutions are close ones. This tripartite model has supported skills development in the offshore wind industry, focusing on highly skilled and specialised roles. This has been achieved by tailoring educational courses to the needs of the industry, with Danish universities having a long track record of working in wind energy research. In addition, companies can influence how future employees are trained as Danish educational institutions work closely with companies to help fill the need for specialists.

To this end, Denmark has harnessed collaboration across several key actors in the offshore wind industry (education and research facilities, and industry) to develop a comprehensive pathway to developing highly skilled offshore wind professionals. The Danish offshore wind market is experiencing a strain with skills, however, as the transition to a green economy requires a larger portion of jobs. Therefore, not only does specialised training have to be scaled up, but also broader education pathways need to direct a larger number of people into renewables and other low carbon careers. Given that Denmark is aiming for a further 7.6GW by 2030, similar to Japan's ambition of reaching 10GW by 2030, Denmark is a relevant case study for Japanese decision-makers, focusing on how to develop highly specialised skills and scale up this approach to meet carbon neutral goals.

Table 7: Overview of key steps taken by actors in Denmark according to the drivers of communication, education and research, and collaboration.[58]

Communication *How have decision-makers communicated the current situation and set out plans to address skills?*	**Education and research** *How have actors facilitated education and research to drive skills development?*	**Collaboration** *How have decision-makers collaborated to facilitate skills development?*
2018 Danish Energy Agreement for 2020-2024 • This policy outlines that Denmark will work towards Net Zero emissions by 2050, setting out milestones for several new offshore wind farms to be built by 2030. • The agreement highlights the need for a green transition in Denmark that will generate jobs in the energy sector.	**Education Sector** • Denmark has dedicated institutions with specialised courses for offshore wind, such as the Danish Technical University, Aalborg University, Aarhus University, and the University of Southern Denmark. • Skills are addressed for offshore wind across the education sector through public research	**The Danish Wind Industry Association (DWIA)** • DWIA plays a leading role in bringing together industry actors to collaborate on common challenges, including skills for the industry. • The association has published the successful skills landscape within

[58] Carbon Trust research - compilation from various sources with public resources listed in the references section.

The Climate Act

- Passed in 2020, the Act legally binds Denmark to achieve climate neutrality by 2050.
- The Act includes a just transition clause, highlighting the importance of helping jobs in its world leading oil and gas sector transition to green jobs.

Danish Energy Agency (DEA)

- The DEA 2022 report outlined that offshore wind serves as the backbone of the economy, with significant job creation potential due to the increasing targets in the country.
- The report presents a socioeconomic assessment of the impact of offshore wind with a case study on jobs expected from the Thor Offshore Wind Farm.

Green Job Reports

- Workers unions in Denmark have published assessments on the green transition and the potential creation of green jobs where around 550-2,200 jobs could be created per year over 10 years for offshore wind, examined up until 2030.

projects, bilateral research projects, summer schools, wind power-related Master's degrees, industrial PhDs, supplementary training, real life cases, career fairs, study project collaborations, company visits, and guest lectures.

- Danish Wind Power Academy has developed a customised technical training course.

Danish Research Consortium for Wind Energy

- A partnership between key universities with the objective of training highly skilled people in addition to achieving research goals.
- The consortium has published strategies and recommendations for how the Danish wind industry can prioritise and excel in certain research fields.
- The consortium serves as the backbone of network activities within the research community, coordinating research and educational activities to support the development of highly skilled workers.

Industry

- Danish companies such as Maersk Training are proactive in providing industry-led training or courses for the offshore wind industry.

Denmark, emphasising the successful collaboration model in Denmark between the industry and educational institutions.

State of Green

- State of Green is a public-private partnership, serving as a one-stop-shop for Denmark's green energy transition. The partnership fosters strong collaboration and communication across key stakeholders to support the offshore wind industry (among other key green industries).
- The organisation has published about projects that are addressing the skills need in the country, such as a mapping project for green competencies in the Danish labour market.

4.5. The Netherlands

The Netherlands presents a good case study for Japan as the country has only recently started to address the skills and training bottleneck in offshore wind despite being a developed market in terms of its strong domestic policy framework for offshore wind. The government of the Netherlands intends to make the country more self-reliant with its energy production. In the recent 'Additional Offshore Wind Energy Roadmap 2030' document, the government communicated its aim to double its offshore wind pipeline, increasing its capacity target from the original 10.3GW to 21GW by 2030.[59] With a current 1.5GW installed capacity and high year-on-year capacity targets, the Netherlands will have to close its skills and training gap quickly and efficiently.

In 2019, via the Netherlands Enterprise Agency (RVO) and TKI Wind op Zee (Top Consortium for Knowledge and Innovation Offshore Wind), the Dutch government commissioned a baseline study to outline the future offshore wind employment landscape. The scope of the study focuses on five construction phases. The study is intended to be used by Dutch stakeholders to further develop education plans and enhance the inflow of future employees to the offshore wind industry.[60] This case study focuses on the steps that the Dutch stakeholders have highlighted as important for developing their skills system. Table 8 shows the findings and recommendations from the employment baseline report which are yet to be implemented.

Table 8: Findings and recommendations from the Netherlands' employment baseline report.[61]

Communication *How have decision-makers communicated the current situation and set out plans to address skills?*	**Baseline** *What does the baseline report do successfully to clarify the current situation on skill development in the Netherlands?*	**Planning** *What needs to be done by actors following the baseline report?*
Employment analysis (2019-2023) of various fields of activities in the Dutch offshore wind sector • This study has been commissioned by the Netherlands Enterprise Agency (RVO) and TKI Wind op Zee to evaluate the	**Baseline steps** • In the Netherlands, the construction of 370 wind turbine generators over five studied construction phases is estimated to create a cumulative 2,480 full-time jobs and 320 recurring full-time jobs in O&M.	• **Education** – Institutions should implement a nationwide educational approach for offshore wind technicians and other staff categories. • **Improve synergies between educators and industry players** – This should be established among education institutes, specialisations, potentials of educating and training foreign

[59] Additional Offshore Wind Energy Roadmap 2030 (rvo.nl)

[60] Employment analysis (2019-2023) (topsectorenergie.nl)

[61] Carbon Trust research - compilation from various sources with public resources listed in the references section.

employment impact of having five more offshore wind farms estimated at 700MW each, from 2019-2024. • The report quantifies activities related to job creation across the project cycle of foundation supply, foundation and turbine installation, array cable installation, installation support, wind farm, operations, turbine maintenance, structural inspection and maintenance, and maintenance and service logistics. • The report concluded with recommendations for relevant actors to take action on skills and training.	• A substantial amount of direct employment in the offshore wind industry is related to EQF (European qualifications framework) levels 1-5. • In general, existing education programmes are serving the offshore wind industry well when looking at the needed functional competencies. • There is room for specialist courses/training to be developed and organised between educational institutions and the industry.	students and professionals, and the enabling potentials of industry-driven applied research for (future) education and training. • **Develop a human capital plan** – The industry should develop a human capital plan to i) secure an influx of students/professionals to the sector (among other factors by raising awareness among the broader public about offshore wind sector careers), ii) indicate career paths within the sector, iii) link more specific employment activities (e.g. on the level of scopes of work) to certain education levels, and iv) express education and training needs. • **Industrial internship/apprenticeship** – The industry should explore opportunities to involve students in the sector as early as possible during their education, not only for inspiration but also for exposure (offshore work requires qualifications such as the proven ability to work at sea and at height etc.).

4.6. The United States

The US presents a strong case study on skills development in a very new offshore market. Offshore wind has recently been announced as a promising future economic area, with federal governments intending to propel this nascent industry to become the global leader in floating wind. It is proposed that by 2030, the US will deploy 30GW of offshore wind, supporting at least 77,000 jobs.[62] The Biden-Harris Administration has made early plans for offshore wind to contribute to

[62] FACT SHEET: Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy | The White House

economy-wide decarbonisation and it is valuable to see announcements on the role of offshore wind in connection with the shift to systems thinking for a just Net Zero transition,[63] which this report also emphasises (Section 5.1).

The National Renewable Energy Laboratory (NREL) completed the first national level assessment of the US offshore wind workforce in October 2022. The assessment shows that stakeholders in the US found value in baseline information that informed them of the current situation. For example, the assessment found that there are significant gaps in the current education system to meet the skills need. The assessment also provides plans for steps moving forward, such as the need for standardisation of training programmes, transferring of skills from similar sectors, alignment of training requirements, and creating initiatives to cultivate a local workforce. These activities are all relevant to Japan and the report also demonstrates the value of baselining and planning for skills development.

Table 9: Findings and recommendations from the US employment baseline report.[64]

Communication *How have decision-makers communicated the current situation and set out plans to address skills?*	**Baseline** *What does the evaluation do successfully to clarify the current situation on skills development in the US?*	**Planning** *What needs to be done by actors following the 'US Offshore Wind Workforce Assessment'?*
Workforce analysis • In 2022, the National Renewable Energy Laboratory in the US published the first national evaluation of the US offshore wind industry's workforce gaps. • **The study estimates that from 2024 to 2030, the offshore wind energy industry will need an annual average of 15,000-58,000 full-time workers.** • State-level commitments have spurred the potential for offshore wind with the key states as follows: California, Connecticut, Delaware, Maine, Maryland,	**Baseline steps** • The report presents an analysis of the current skills situation for offshore wind in the US, with 44 offshore wind-focused programmes reviewed. • The report outlines the expected quantitative skills demand across offshore wind stages (development, manufacturing and supply chain, ports and staging, maritime construction, and O&M) to meet 30GW of offshore wind by 2030 based on economic models. Data is critical for stakeholders to understand the scale of the challenge and to help clarify the problem.	• **Standardisation** – The report emphasises that standard training programmes and safety certificates are required as there are no officially adopted offshore wind energy industry safety training standards in the US. • **Transfer of skills** – The report emphasises the need to transition workers from high affinity industries such as from the maritime sector. • **Education** – There is a need to align training requirements and times with the expected demand, expand existing programmes, bridge gaps in education by coordinating skills

[63] 20190709 OW Employment NL Report - final v1.2 - online.pdf (topsectorenergie.nl)

[64] Carbon Trust research - compilation from various sources with public resources listed in the references section.

Massachusetts, New Jersey, New York, North Carolina, Ohio, Rhode Island, and Virginia. Many of these states have also been quick to publish on the expected skills need within their area and announce support for skills development.	• The report highlights the key gaps expected through a red, amber, and green alignment assessment based on the timing of workforce needs, the presence of education and training programmes, and the offshore wind specific workforce requirements. When these elements are aligned, the assessment is green, meaning no gaps or issues are being addressed. The total absence or lack of workforce programmes causes a red assessment.	development between the education sector and industry, collaborate internationally, and engage students from an early age. • **Workforce initiatives** – The US political and economic policies encourage initiatives that focus on local workforce development, partner with trade unions, offer apprenticeships and promote diversity and inclusion.

4.7. Taiwan

Geographically closest, Taiwan shares many similarities with Japan, including the reliance on oil and coal imports to meet much of the country's energy demand. The offshore wind activities in both Japan and Taiwan began around a similar timeframe and offshore wind has been promoted by both the Japanese and Taiwanese governments as an important industry that will improve their energy self-reliance. The two countries are also already collaborating on some opportunities that could improve the skills and training needs for their offshore wind markets (see Table 4, Wind Power Group and Taiwan Wind Power Training already have some collaboration activities). Contrary to Japan's domestic focus, Taiwan first adopted an open market approach and gradually tightened the project requirements (such as including local content requirements) as the market matured.[65]

In 2016, the Taiwanese government set the highest Feed-in Tariff worldwide, which led to increased engagement with international developers in the Taiwanese offshore wind market.[66] To build up domestic skills, in 2017 the government established the Maritime Technology Innovation Center (MTIC) to expand Taiwan's ocean technology capability, and establish autonomous technology and energy R&D.[67]

The case study of Taiwan presents interesting lessons where, in the limited presence of a domestic history of working in maritime energy and offshore oil and gas, the local workforce relied on training by international developers to meet the global offshore wind safety and competency requirements. The case study

[65] Review of recent offshore wind power strategy in Taiwan: Onshore wind power comparison - ScienceDirect

[66] Review of recent offshore wind power strategy in Taiwan: Onshore wind power comparison - ScienceDirect

[67] Maritime Technology Innovation Center(MTIC)_MTIC Introduction

suggests that close collaboration between local industry and international developers can play an important role, especially in cultivating a competent domestic workforce for a global market over a short time. Japanese decision-makers can take reference from the Taiwanese case study by considering the role of international developers, supplemented with domestic training resources, to upskill the local workforce.

Table 10: Evidence of skills actions in Taiwan that focus on collaborating between local industry and international developers.[68]

Communication *How have decision-makers communicated the current situation and set out plans to address skills?*	**Collaboration** *How have actors collaborated to facilitate skills development?*
Government Limited evidence was found that decision-makers communicated the current situation and set out plans to specifically address OSW skills and training needs. However, the government intends to make Taiwan's economy globally competitive by supporting young workers in new industries (including offshore wind) via the 'Industry Pioneer Pilot Program'. The programme provides support and incentives for youths aged 15-29 to attend offshore wind-related training. **International organisations** Capacity building organisations such as embassies and international ministries are often driving research work on the skills and training need within Taiwan.	The development of the Taiwanese offshore wind workforce has closely been supported by the MTIC in collaboration with international developers and companies such as Maersk. MTIC and Maersk have been actively expanding the GWO training courses in Taiwan. Separately, MTIC has also signed MoUs with Siemens Gamesa Renewable Energy, Ørsted, Vestech Taiwan, Taiwan Cogeneration Corporation and Taiwan Marine Heavy Industry to provide training for the domestic industry. Meanwhile, international organisations such as Ørsted, Siemens Gamesa Renewable Energy, and Arup have also funded and facilitated training support for Taiwanese workers. Some examples are listed below: **International organisations or industry-led education and RD&D** • Ørsted provides guest lectures, Green Energy Scholarships, and student assistance programmes to interested students. • The developer also provides RD&D collaboration opportunities in Taiwan. • The Netherlands Trade and Investment Office (NTIO) launched a programme to cultivate trainers for Taiwan's offshore wind power industry, with National Taiwan University (NTU). **Industrial secondments**

[68] Carbon Trust research - compilation from various sources with public resources listed in the references section.

	• Ørsted has funded training for Taiwanese technicians to go on secondment to the UK to develop their knowledge in technical aspects of offshore wind farm operations and to learn the operational safety standards of Ørsted. This is the first-of-its-kind training secondment programme. The aim is for 22 O&M technicians to receive training from this programme, and the first ten Wind Turbine Generator technicians have been sent. The programme is eight months long, and ahead of going to the UK, the technicians completed their onboarding and language programmes, as well as the GWO safety and technical training in Taiwan. • Siemens Gamesa Renewable Energy has sent 21 Taiwanese employees abroad for 15 months in both Denmark and Germany where they will learn about manufacturing processes for wind turbines and receive nacelle assembly training. **Industrial-led technical consultancy support to local developers** • Arup was appointed by the Taiwanese government, through the Industrial Technology Research Institute to support local developers. The services include extensive offshore wind training courses, technical design reviews, quality assurance, project management, and the development of technical protocols for the Taiwanese offshore wind industry in accordance with international standards.

5. Analysis of how Japan can meet its skills need

5.1. The need for Japan to justly transition the workforce to renewable energy

Meeting the skills need for offshore wind in Japan must be considered within the context of the broader energy transition, meaning the shift away from fossil fuels and carbon-intensive industry, towards renewable energy. Internationally, securing the skills required to enable the energy transition is increasingly being discussed through the lens of a 'just transition', one which works towards an environmentally sustainable economy, contributing to social inclusiveness, and decent work.[69]

A just transition has not yet been widely discussed in Japan in relation to the skills needed to achieve a carbon neutral society and green economy, despite key policy documents citing the need for reskilling.[70][71] It is strongly recommended that decision-makers in Japan apply a just transition framework to skills development plans for workers. Both developed and developing countries have a responsibility to facilitate a workforce transition that enables countries to meet the International Paris Climate Agreement (hereafter, 'Paris Agreement'). Hence, the recommendations provided in the report will be centred on the need for a just transition, based on a whole systems approach, that pays attention to the drivers and actors involved in meeting the skills need within Japan for offshore wind.

5.1.1. What does a just transition for the workforce mean?

The Paris Agreement states that the path to Net Zero must account for 'the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities.' [72] A number of countries have since applied just transition frameworks to reskilling initiatives and energy planning,[73] and the Japanese government is also supporting just transition frameworks internationally.[74]

The concept of a just transition was first developed from the perspective of fossil fuel workers aiming to protect their livelihoods in the face of declining carbon-intensive industries. Since then, the concept has broadened to encompass the transition towards renewable energy and an environmentally sustainable economy. The consideration of dimensions beyond only the skills required for green jobs is imperative to ensure that the risks and benefits of the transition are managed and shared equitably across impacted communities. The just transition principles of ensuring fair and decent work, high quality jobs, and maintaining strong social dialogue with impacted communities, are essential to shaping fair and inclusive green skills and training interventions.[75]

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[69] Guidelines for a just transition towards environmentally sustainable economies and societies for all

[70] ２０５０年カーボンニュートラルに伴うグリーン成長戦略

[71] 「GX 実現に向けた基本方針」が閣議決定されました （METI/経済産業省）

[72] Just Transition of the Workforce, and the Creation of Decent Work and Quality Jobs

[73] 公正な移行―脱炭素社会へ、新しい仕事と雇用をつきりだす

[74] Inclusive and Equitable Framework for a Just Low-Carbon Transition in Resource-Rich Developing Countries.

[75] Just Transition of the Workforce, and the Creation of Decent Work and Quality Jobs

Figure 8: The just transition process entails four key steps.

A number of just transition skill action plans follow a transition process of four key steps (Figure 8[76,77]):

1. **Baselining** - This process should identify existing skills across the workforce, the likely skills needs and industries where workers are likely to face livelihood loss, informed by an assessment of industry drivers.
2. **Planning** - Planning for a just transition of the workforce should follow fair, inclusive and transparent processes, with effective communication between employers and employees to set direction and have plans in place that make clear how workers will be supported to meet the skills need. The planning process should also aim to identify and build synergies across skills and training initiatives and livelihood support programmes.
3. **Implementing** - There are a number of levers which can be used to implement a just transition, including job retraining and skills development mechanisms, financial compensation for workers adversely affected and forums for social participation and dialogue.
4. **Evaluating** - Evaluation should be ongoing and ensure that the interventions are meeting the mutual objectives that should be mutually agreed upon in the planning process. Much of the on-the-ground engagement with workers and institutions will need to happen at local and regional levels, as opposed to the national level, as different communities will have different needs.

5.1.2. A just transition in Japan

The workforce in Japan has already experienced an energy transition and skills shift, where hundreds of Japanese coal mining plants from the 1960s were closed, which resulted in job losses and demonstrated to the government that policies are needed to support workers.[78] Japan's current carbon neutral plans again present the challenge of an energy transition and skills shift. The just transition framework is designed to support this large-scale socioeconomic transformation.

Recent publications in Japan have limited references to the need for a just transition, which refer to the need to protect jobs and regional economies in the Net Zero transition. Local governments and non-governmental organisations (NGOs) in the country have also emphasised the importance of fossil fuel and nuclear power sector workers' jobs, as well as support for municipalities that rely heavily on revenue from hosting thermal power stations.[79] There are historical examples of attempts by local governments, labour unions and industries to transition areas away from fossil fuel economies in Japan in response to energy or economic circumstances, for example in Yubari.[80] However, beyond this, Japan's just transition discourse remains relatively limited and is primarily driven by environmental NGOs, civil society organisations, and communities themselves.

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[76] Strong skill action plan needed to transition from coal to renewable energy

[77] The Transition Plan Taskforce Implementation Guidance

[78] 公正な移行―脱炭素社会へ、新しい仕事と雇用をつきりだす

[79] Just Transitions in Japan

[80] Just Transitions in Japan

Alongside the prioritisation of renewables, including offshore wind, Japan's 'Sixth Strategic Energy Plan' sets out an objective to lower the use of thermal power in the energy mix as far as possible. This, alongside the existing labour shortage in Japan and the need to transfer existing and future workers into the offshore wind industry, presents just transition consideration for workers who will have to transition out of carbon-intensive sectors, including the thermal, nuclear, steel and automotive industries. There are significant geographical considerations, with municipalities who are heavily reliant on carbon-intensive infrastructure facing the loss of tax revenue as these industries decline. There is, therefore, an opportunity to ensure that skills development measures align with the objectives of a just transition and support the managed closure of high carbon employment to enable the shift to the renewable energy industry, including offshore wind.

JUST TRANSITION IN GERMANY[81]

Germany has ambitious climate goals based on the Paris Agreement, aiming for carbon neutrality by 2045. As part of meeting its climate goals, the Federal Government recognised the need to phase out coal-fired power generation because almost one quarter of the electricity produced in Germany comes from lignite (2017 figures), which is harmful to the environment. The region of Lusatia in Germany is one of the largest lignite mining regions with a high number of the workforce in that region employed in the Lusatian lignite mining district.

In Germany, the energy transition is part of a 'macroeconomic modernisation strategy,' where the entire energy industry is undergoing a structural transformation that impacts workers across the energy sector. Focusing on the just transition of workers out of coal mining jobs, several measures were introduced at national, state, and local levels to support workers:

Steps to communicate plans and facilitate collaboration

- The government communicated its plans through its 2050 Climate Action Plan.
- Several funding mechanisms were introduced, one of which was for regional actors to support regional alliances between companies, universities, research institutions and civil society organisations to work together to develop new approaches to unlock the innovation potential in the region.
- Platforms for social dialogue at the national, state, and local level were designed, as well as engagement in the EU Platform on Coal Regions in Transition.

Steps to support education and research into new industries

- Regional economic development initiatives were introduced to research the energy transition for storage technologies and low carbon industrial processes.
- Bottom-up initiatives were created by local workers to coordinate local economic development opportunities through profiling and marketing.

Fundamental to any just transition will be the establishment of social forums to enable worker and stakeholder participation and dialogue. Early planning is cited as being key for an effective transition, indicating that an understanding of the skills required for the future energy system and early implementation of measures to support skills development will be crucial. Finally, the transition can be

[81] Case studies from transition processes in coal dependent communities

framed as a significant opportunity to realise job creation, economic diversification and wider community benefits. This framing can support the identification of synergies with wider economic and social objectives and help to bring the population on board to support engagement with skills and training programmes.

The just transition requires that interventions are inclusive and account for the varying social characteristics of the workforce, including age and gender. Globally, women are underrepresented in the renewable energy workforce, accounting for 32%. In Japan, women represent 44.5% of the workforce, but almost half of these employed women (44.2%) work in part-time or temporary positions and are therefore more vulnerable to economic shocks.[82] There is an opportunity to address and close this gender gap in the energy workforce in Japan by ensuring that skills programmes engage women. The age of the existing and expected future workforce should also be understood to inform interventions–particularly on a regional and local level where some areas with significant offshore wind development potential may have an ageing workforce and will need to identify where and how the required skilled workforce will be developed. [83]

The transferability of skills from carbon-intensive industries to offshore wind can provide a knowledge foundation for effective training, upskilling and transferring of the workforce. [84] Jobs in manufacturing, for example, may be relevant to the manufacturing of wind turbines, while construction jobs may be relevant to the installation of offshore wind turbines. However, the greater labour intensity of renewable energy relative to carbon intensive industries is still likely to result in skills shortages if proactive steps are not taken.[85,86] Muroran City and Hokkaido offer recent examples of how regions can draw on existing skills and infrastructure, such as steelmaking and port infrastructure, to present a case for developing renewable energy infrastructure in a way that has the potential to bring jobs and local economic benefits.[87]

5.1.3. The regional workforce transition in Japan

To plan for a transition, there is a crucial need for regional governments to work with industry to map regional industry trends and the workforce demographic against offshore wind skills needs to better coordinate efforts and achieve each region's future economic potential (see Section 6, Recommendation 1). The following paragraphs provide a high-level summary of regional factors and considerations for the just transition, based on the publicly available literature, but there will be a need for detailed and collaborative workforce and skills assessments as part of the baselining transition process.

The opportunity for offshore wind development, and the scale of loss of livelihood risk for workforces in high emitting sectors, varies by region. For example, Japan's conventional fuel plants are currently in densely populated cities such as Tokyo, Osaka and Nagoya, while potential sites for offshore wind are in regions such as Hokkaido and Tohoku.[88] In line with global trends, many younger Japanese people are

[82] Socio-economic footprint of the energy transition: Japan (irena.org)

[83] Just transitions in Japan (thebritishacademy.ac.uk)

[84] Just transitions in Japan (thebritishacademy.ac.uk)

[85] Just transitions in Japan (thebritishacademy.ac.uk)

[86] Just transition.pdf (unfccc.int)

[87] Just transitions in Japan (thebritishacademy.ac.uk)

[88] Socio-economic footprint of the energy transition: Japan (irena.org)

moving to cities while rural areas face ageing societies, depopulation, and generally fewer job opportunities. In more rural regions of Japan, carbon-intensive activities, such as employment in thermal power stations, account for a relatively large proportion of the total workforce and, therefore, face high risk in terms of livelihood loss in a community. Hokuriku, Kyushu and Tohoku are examples of high-risk regions which also present potential for offshore wind development. However, the average age of the workforce in these regions tends to be higher and so there may still be a skills need if high numbers of the existing workforce retire before being able to transfer to offshore wind.

The regions of Kyushu and Hokuriku have strong manufacturing industries with a relatively young workforce. The role of steelmaking in each region may provide the potential to secure stable low carbon jobs for a younger manufacturing workforce through the production of onshore and offshore wind components. However, the small portion of younger workers in manufacturing in Hokkaido may still leave a future skills shortage given the region's significant renewables potential, where the number of green jobs may need to significantly increase.[89] Construction jobs may also be relevant to the installation of offshore wind turbines and infrastructure, with regions such as Hokkaido and Tohoku having both a high proportion of construction workers and opportunities for offshore wind development.[90]

Other regions, including Kinki and Chugoku do not present large offshore wind opportunities but have a large carbon-intensive workforce. It will be necessary to consider how the transition can benefit these and other regions of Japan. For example, existing skills in steelmaking and shipbuilding in Kinki and Chugoku may support offshore wind elsewhere in Japan through the manufacturing of components. The transition of the workforce from carbon-intensive roles to renewables is seen in other developed economies too. In Germany, for example, a large number of former shipyard workers lost their livelihoods but were able to secure new jobs in building bases and towers for offshore wind farms.[91]

Strong local policies and support to ensure workers' skills remain relevant and are upskilled where necessary will be required to ensure local workforces and communities can take advantage of offshore wind opportunities. Supporting local workforces can be achieved by mapping out the possibilities for the young and ageing workforce in the discussed regions. In addition, there is a need to analyse trends in the region's key industries that are relevant for offshore wind (such as construction and manufacturing) against the transition possibilities and better coordinate efforts to achieve the future economic potential of these regions. This is further discussed in Section 6, Conclusion and recommendations for Japan.

[89] Just transitions in Japan (thebritishacademy.ac.uk)

[90] Just transitions in Japan (thebritishacademy.ac.uk)

[91] Just transition.pdf (unfccc.int)

The risks and opportunities of the energy transition and offshore wind development vary by region within Japan.

A just transition framework identifies risks and opportunities, focusing on the high proportions of fossil-fuel workers and how this maps across to regions with offshore wind potential, and where there are opportunities for skills transferability.

A crucial risk for many regions is the ageing workforce which will limit the number of workers who can transition from fossil fuel industries to the offshore wind sector.

To better understand these regional factors, government and industry must carry out baseline industry and skills assessments to understand the gaps between the existing and future workforce to inform offshore wind sector planning.

Figure 9: Key takeaways of just transition considerations for offshore wind in Japan.

5.2. Barriers preventing skills development

To assess the need for action on skills development, and to identify the most relevant and effective measures, this section assesses the barriers to developing the workforce required for the offshore wind industry in Japan. Given the flourishing activities (outlined in Section 3.1) that are starting to be implemented, these activities must scale across the country and be introduced with a transition framework in mind as discussed in Section 5.1. An analysis of key sources and materials along with stakeholder interviews were used to determine the types of barriers to skills development.

Figure 10: Word cloud generated from keywords noted in stakeholder interviews.

Figure 10 shows a word cloud, which is generated from keywords noted in stakeholder interviews when asked 'from your organisation's perspective, what are the current challenges to ensuring the successful dissemination of skills and training in Japan's OSW sector?'. The most frequently reoccurring keywords signal the word cloud to increase the size of that word. Based on the above keywords, it was clear that several barriers are closely tied together and share commonalities; for instance, the lack of experience in offshore oil and gas contributes to the lack of equipment experience, lack of specialised staff such as surveyors, and the overall lack of skills in offshore industries. Through a causal mapping exercise, we identified four key barriers (B1-B4)[92] that many statements cover. The recommendations from this report focus on how decision-makers should overcome these barriers if the offshore wind workforce is to be successfully developed. The process undertaken to determine these barriers is explained in Appendix 2:.

[92] B1-B4 is a codified name for a 'barrier', which have been numbered 1-4.

Barrier 1: Japan's labour shortage

Japan is facing a labour shortage across sectors which is primarily driven by an ageing population. There is a shortage of human resources in the manufacturing and construction industries. These are the sectors from which we expect workers to transition into offshore wind. In addition, an ageing population with a young workforce is strongly influenced by the location of roles. As such, Japan's labour market is highly sensitive to the population's demography.

Barrier 2: Lack of industry specific knowledge and expertise of offshore wind in Japan

There is a lack of understanding of offshore wind and the skills required to develop the industry at a commercial level. There is room for improvement in actions and investment being put into the renewable energy sector. The lack of industry specific knowledge is compounded by the lack of relevant historical industry knowledge that other countries have used to inform their transition to renewable energy, such as the UK, the Netherlands, and Denmark. Japan does not have the same historical experience in offshore oil and gas to inform the development of its offshore wind industry. This is closely linked to a lack of understanding of the regulation and financing to enable skills development in offshore energy-based industries. This leads to a lack of clarity on what the future training needs are, e.g., should there be a systematic higher education system or short, targeted professional modules? This is exacerbated by the lack of clarity with international offshore wind training standards.

Barrier 3: Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory

Further clarity on the direction and scale of Japan's offshore wind industry will support organisations to invest in developing new skills. Clear offshore wind plans for the coming decades can limit uncertainty and encourage investment in workers. The government must define and communicate its offshore wind industry skills plan, so it can provide direction to the industry within Japan and enable the establishment of new skills programmes. At present, the lack of clarity exacerbates companies' risk aversion to investing in their staff. Companies need to be assured and certain to be able to invest in staff.

Barrier 4: Work-based cultural barriers

Workplaces with conservative company cultures can struggle to adopt modern skills development practices. Processes and bureaucracy in Japan remain arduous. Companies may be hesitant to get involved in a new industry due to the expected work, administration, and extra burden associated with the development of a new industry.

Secondly, it has been common in Japan for workers to remain in one job for their whole working life. This sentiment can make transitioning workers into new and less familiar industries harder, especially if they come from well-established and incumbent industries. Nevertheless, there is a shift. Modernisation is seeing increasing numbers of workers changing jobs more frequently than has been traditional. While this shift may prevent some employers to invest in employees' skills development, it also presents an opportunity. Companies could introduce more flexible working patterns and adopt upskilling approaches where companies collaborate more widely within the energy sector to overcome common challenges that each company otherwise faces individually.

5.2.1. Tackling the barriers strategically

For decision-makers to strategically understand how to tackle the barriers (B1-B4), this report draws on 'The Skills Landscape 2019-2025 Route Map' published by OPITO for the UK skills workforce.[93] The OPITO report explores how the workforce dynamics in the UK will change for the oil and gas industry as the country progresses to its Net Zero ambition (or green economy) by 2050. The analysis from OPITO presents **four strategic components**. The 4Rs are included here to demonstrate that lessons on skills development can be taken from other industries and that the fundamental strategies underpinning skills development are similar. Decision-makers should consider the 4Rs depending on their context; for example, they can ask themselves whether they are within a company and have the responsibility to recruit? Are they working at an international, national, or regional scale where their work contributes to skills development? In sum, the 4Rs are for decision-makers to consider in their skills development strategies. The 4Rs refer to:

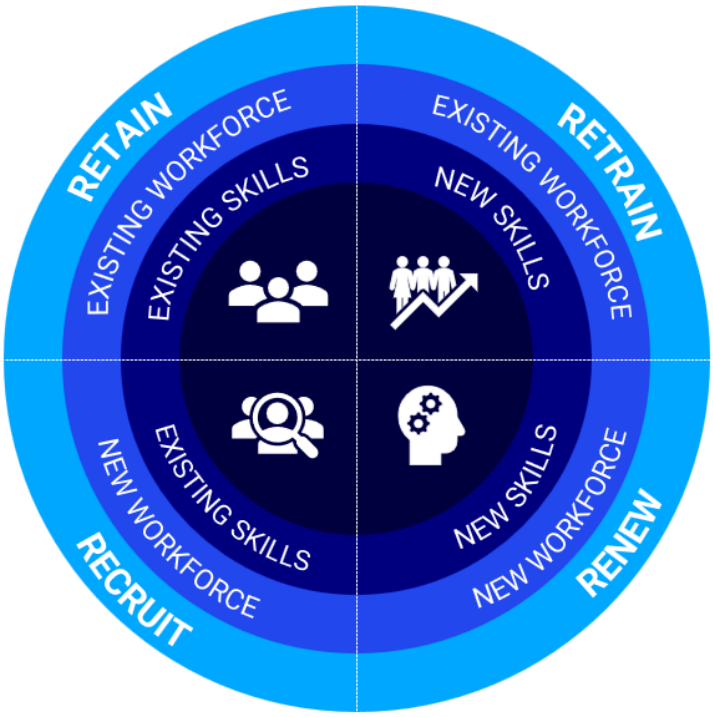


Figure 11: The 4Rs presented by OPTIO to address the skills need.

- **Retain:** How can decision-makers in Japan support the upskilling and reskilling of the existing workforce? This strategy focuses on maintaining the current skills and capabilities of the existing workforce.
- **Retrain:** How can decision-makers in Japan address upskilling requirements needed for the offshore wind industry as it advances internationally? Retraining focuses on identifying skills gaps and upskilling the existing workforce to strategically address these gaps.
- **Renew:** How can decision-makers ensure the workforce can access new skills needed for the future of the industry and society? Renewal focuses on identifying evolving skills or novel trends in the offshore wind industry and connecting that back to where the workforce is today.
- **Recruit:** How can decision-makers increase talent by attracting them into the industry? Recruitment focuses on replacing or growing the existing workforce due to factors sure as the transfer of human resources to another industry, retirement, and pursuing alternative forms of work.

[93] UKCS-Workforce-Dynamics-The-Skills-Landscape-2019-2025.pdf (opito.com)

6. Conclusion and recommendations for Japan

Since 2020, Japan has both accelerated the production of policy statements and delivery towards a green economy. As part of this, renewables and particularly offshore wind are seen as a key technology. Japan is now at a turning point in its journey to be carbon neutral by 2050 with a visible pipeline of offshore wind projects and an opportunity to kickstart a transformation within the existing skills market. To understand what is needed for a transition in the skills market, this report assessed the question:

To what extent is there a need for action on skills development for Japan to meet its large-scale offshore wind deployment ambitions?

The brief answer is that there is significant need for rapid action. For Japan to meet its offshore wind ambitions, decision-makers must examine skills for offshore wind as part of a structural shift that will prepare Japan for a carbon neutral economy by 2050. The research and analysis conducted for this report generated the following key insights:

Good collaboration underpins successful skills markets

The international case studies from Section 4, demonstrate that close collaboration between actors is needed to achieve a just transition towards a decarbonised society and a workforce centred around renewable energy. Reinvigorating cooperation on skills development plans between employers, governments, and the workforce is crucial to a successful transition in the skills market.

Skills plans must be underpinned by a just transition and a whole-systems approach

To meet the need for skills in offshore wind, Japan must take a whole systems approach based on a just transition; an approach that considers the demographic trends, geographic trends, and regional economic and industry trends. The just transition framework also informs decision-makers that there must be communication around: baselining, planning, implementing and evaluating skills development to get skills from a metaphorical 'A' to the desirable metaphorical location of 'B'.

Understanding decision-making spheres of influence supports impactful implementation

This report has been addressed to decision-makers, working at different levels (local to international) and from different perspectives, such as from a company, government organisation, international organisation, or local business perspective. It is key that decision-makers consider their sphere of influence and how they may work with other decision-makers across levels and perspectives so that skills development activities can build up from local spaces to across the whole of Japan, and also translate from national plans to local actions.

Recommendation structure

These recommendations are intended to offer a holistic approach to understanding skills across workforce dynamics, personnel requirements, economic plans, demography and politics. The recommendations are therefore structured by the target audience, timeframe, key actors, key barriers addressed, and suggested steps, and are linked to international case studies.

All recommendations – recommendations are structured according to a time frame of **short-**, **medium-**, or **long-term** time horizons. The **target audience** has been broadly categorised, taking an inclusive view of the types of stakeholders that should consider the recommendation. Building on this, the **key actors/key organisations driving** names specific actors that could be responsible for driving the recommendation. **Key barrier(s) addressed** draws on the learnings from Section 5.2 to demonstrate to

decision-makers that skills development measures need to consider the causal relationships that influence the problem and be designed accordingly to address key barriers. Connected to this is the **just transition step**, which frames the recommendation according to a transition within a whole systems approach, as explained in Section 5.1. The **explanation** then articulates the problem that the recommendation intends to tackle, and the **suggested steps** propose the types of activities that need to be taken to action the recommendation. Lastly, the **international reference** draws on the case studies (Section 4) or literature on the international markets to demonstrate how the recommended activity is supporting other markets.

- **Short-term recommendations** are considered to be the highest priority areas. They identify the immediate need in the skills pipeline and have a timeframe of 1-2 years, meaning action should begin as soon as possible. The short-term recommendations prioritise the 'baselining', 'planning', and 'implementing' steps for decision-makers to gain a clearer understanding of the current situation in the offshore wind industry to inform future plans and facilitate rapid action. These recommendations have been developed based on an analysis of interviews and accessible resources, where stakeholders frequently referred to example steps in baselining, planning, and implementing as being necessary to create clarity and confidence in the direction of skills development for offshore wind in Japan.

- **Medium-term recommendations** have a timeframe of 3-4 years, at which time the need to modernise and future proof skills for the future offshore wind industry will be critical. Even in the most developed global offshore wind markets, such as the UK, planning for the future workforce is still at an early stage. This can be both an opportunity and a challenge for Japan. Decision-makers have an opportunity to leap-frog into a future-looking skills development system for the country if they plan early (within the next 3-4 years). However, it presents a challenge if the skills development system only delivers a workforce for the offshore wind industry of today, which is already experiencing pressure to move to more sustainable, technologically advanced and efficient processes.

- **Long-term recommendations** look at a horizon past five years and urge decision-makers to monitor and evaluate measures as they are planned and implemented to ensure they are meeting their intended goals. With good feedback systems in place, the measures can be rolled out on a larger scale. To scale up skills development for offshore wind, further work is needed to understand the pathways for other technologies such as solar, onshore wind, hydrogen, and alternative fuels in shipping. Scaling up will need to be addressed comprehensively as part of green skills development plans.

Based on the international literature on skills needs from other industries historically, such as the oil and gas sector, as well as future needs to meet a carbon neutral world, this section aligns with broader learnings from other sectors and markets to inform all the recommendations.

Recommendation 1

Take steps to clarify the current situation on skills development for the offshore wind industry within Japan	
Target audience	**Domestic stakeholders:** government, industry associations, local prefectural authorities; private sector related to offshore wind
Timeframe	**Short-term, 1-2 years**
Key actors / Key organisations responsible	• Government agencies of Japan: METI, MoE, MLIT, MHLW, MEXT • Offshore wind industry associations with input from the private sector • Prefectural authorities that currently have offshore wind plans, with input from prefectures that have onshore wind capacity, or high affinity industries to wind
Key barrier(s) addressed	B1 (Japan's labour shortage) B2 (Lack of industry specific knowledge and expertise of offshore wind in Japan) B3 (Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory) B4 (Work-based cultural barriers)
Just transition step	Baselining
Explanation	To tackle B2 and B3, the government of Japan needs to further 'signal' that the economy is looking for a broader transition to renewables and that skills development is a core part of this. The government, with input from key stakeholders such as industry representatives and local authorities, can provide the offshore wind industry and its supporters with clarity on the current skills development situation through a baseline survey. To enable data gathering efforts, more involvement and coordination between ministries are necessary. Broader actions that have been suggested by stakeholders are also recommended to support this baselining effort as part of a whole systems approach, which contributes to tackling B1 and B4.
Suggested steps	**The government should commission a baseline survey to understand the skills required for the future energy system and investigate where the early implementation of measures is possible**. A skills baseline could be achieved through a workforce survey that estimates the existing in-country workforce size and then calculates workforce demand based on installation forecasts and operational capacity. The survey should: • Have a regional focus on regions with strong offshore wind development potential and consider how the international and Japanese labour markets connect with these regions (see Section 5.1).

- Reveal the number and type of existing roles in industries that have a high affinity with offshore wind.
- Consider demographic trends such as an ageing population and the youth.
- Be holistic, centred on just transition considerations by mapping out the possibilities for the young and ageing workforce, and the movement of workers from carbon-intensive jobs to green jobs (see 5.1).
- Take into account trends in key industries that are relevant for offshore wind (such as construction and manufacturing) and relate this to the expected skills need for offshore wind.

Whole systems approach

In addition to a baseline survey, the below measures were considered important by stakeholders to facilitate the offshore wind industry in Japan in the short term with a focus on actions that help understand the current situation on skills for offshore wind within the country.

- To tackle Barrier 3 (Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory), better collaboration and coordination between government ministries are needed. Currently, the ministries that are driving the expansion of the offshore wind industry in Japan are MLIT and METI. Evidence of actions and resources from other key ministries such as the Ministry of Health, Labour and Welfare (MHLW) and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) is missing from this collaboration. Both Ministries would serve as important additions to input on the current situation on skills development for a green economy, where MHLW influences the labour and workforce dynamics, and MEXT can better connect offshore wind knowledge to the education sector.
- Ministries with the help of industry associations should survey existing information internationally to share resources as a starting point for staff working in offshore wind. Resources could entail links to free offshore wind training websites, documents and pamphlets on equipment used in offshore wind projects, or career websites that describe the type of work undertaken. These could be gathered onto a public website available in Japanese to serve as an interim measure to support organisations with any immediate challenges in skills development for current offshore wind projects.
- As part of baselining activities, review the education sector with input from the industry to evaluate the curriculum in light of a transition to a renewables-based economy. Education content should always aim for global offshore wind skills rather than regionally focused training to benefit from existing knowledge and avoid limiting skills for offshore wind to just within Japan when the Japanese offshore wind labour market will depend partially on an international workforce.
- Evaluate the need for support mechanisms to scale up educational resources and infrastructure based on skills roadmaps (see an example by OPITO[94]).
- Discuss skills development in offshore wind as part of a broader transition strategy of the workforce to carbon neutrality, where current resources in Japan indicate an

[94] UKCS-Workforce-Dynamics-The-Skills-Landscape-2019-2025.pdf (opito.com)

	urgent need to increase access to O&M training facilities and transfer talent from high affinity industries.
International reference	As a new market for offshore wind, the US has focused on the need for skills development very early on and has published an assessment of the current and future workforce needs (Section 4.6). The Netherlands also provides an interesting example. where the country requires fast action on skills development to meet its recent increase in offshore wind targets (Section 4.5). This situation is similar to Japan where both countries are taking a centralised approach to develop offshore wind and require fast action to meet offshore wind targets. Hence, it is important to see that the Netherlands Enterprise Agency commissioned a report to outline the future offshore wind employment landscape based on the current situation.

Recommendation 2

Communicate decision–makers' plans on the direction of skills development for offshore wind in Japan	
Target audience	**Domestic stakeholders:** government, industry associations, local prefectural authorities, private sector related to offshore wind
Timeframe	**Short-term, 1-2 years**
Key actors / Key organisations responsible	• Government agencies of Japan: METI, MoE, MLIT, MHLW, MEXT • Offshore wind industry associations with input from the private sector • Prefectural authorities that currently have offshore wind plans, with input from prefectures that have onshore wind capacity, or high affinity industries to wind
Key barrier(s) addressed	B1 (Japan's labour shortage) B2 (Lack of industry specific knowledge and expertise of offshore wind in Japan) B3 (Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory) B4 (Work-based cultural barriers)
Just transition step	Planning
Explanation	In parallel to understanding the current skills development situation for offshore wind within Japan (baselining activities), there is an urgent need to set direction. Communicating strategic plans will contribute to addressing the barriers. Therefore, the government, local prefectural authorities, and industry should input on planning related steps that clarify the direction of skills development. Plans should be underpinned by a whole systems approach that considers impacted communities and plans for inclusive diversity such as promoting more women to enter the industry.
Suggested steps	**A skills roadmap is needed to communicate the strategic plans for skills development and what this will look like for Japan.** Where possible, communication should be informed by data coming out of baselining activities, but to speed up the action, a hypothesis-based strategy is also helpful. The roadmap should address: • How Japan will integrate into the global offshore wind supply chain and complement or compete with international capabilities. • The intended scale and speed to address the skills need, which will depend largely on the ability of the education sector, the public and private sectors, and the government to embrace and manage change collectively.

- Japan's position on its regional capabilities in connection to its neighbours that also have high ambitions and capabilities in offshore wind, such as South Korea and China.
- The role and need for overseas talent with evidence of suitable mechanisms and legislation in place to promote overseas talent, as outlined in the 'Vision for Offshore Wind Power Industry'.

Whole systems approach

To build momentum behind planning, the below measures were considered important by stakeholders to support decision makers with creating plans on the direction of skills development for offshore wind in Japan.

- Industry, academia and government should strengthen platforms that focus on skills planning within Japan (e.g., skills councils) that periodically review roadmaps, targets, and milestones. As part of these platforms, social dialogue needs to be facilitated between key groups on the future opportunities and challenges of skills development for a strong offshore wind industry in Japan.
- Companies working in offshore wind should develop skills strategies (plans) to communicate their skills need and propose actions with clear objectives and tangible commitments to skills development. Where companies are unclear on their strategic direction in offshore wind, dialogue opportunities should be created with industry, government, and academia to address uncertainty.
- The government and the offshore wind industry in Japan can improve their marketing strategy to communicate the industry's value to attract talent and raise the profile of the industry domestically. The government, with the help of industry associations, should market successes and lessons. For example, the Fukushima Demonstration is one of the first cases of decommissioning a floating wind platform, which is a valuable case study for the international offshore wind community.

International reference

The UK, Denmark, the Netherlands, and the US (Section 4) all identified offshore wind as one of the important sectors that will help the country to transition into a green economy and have plans in place to address the skills development as part of this. In particular, the role of OWIC in the UK is to assist stakeholders by clearly articulating the skills needs relating to offshore wind. Such data communicates the changing requirements in the industry to businesses, skills providers and individuals, empowering each of these actors to make plans accordingly. OWIC's efforts are also complemented by the UK government, where the 'Build Back Better' report outlined job estimates and the actions that would be taken to improve the education system for a green economy.

Recommendation 3

Take steps to align with the international offshore wind market on skills	
Target audience	**International and domestic stakeholders**
Timeframe	**Short-term, 1-2 years**
Key actors / Key organisations responsible	• International and domestic standards bodies: GWO, OPITO, STCW • Offshore wind industry associations: GWEC, JWPA, JWEA • Education sector, training facilities • Government agencies: METI, MHLW, MEXT, standards agencies, regulators
Key barrier(s) addressed	B1 (Japan's labour shortage) B2 (Lack of industry specific knowledge and expertise of offshore wind in Japan) B3 (Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory) B4 (Work-based cultural barriers)
Just transition step	Implementing
Explanation	Many companies are uncertain about how the Japanese offshore wind skills market will interact with international skills requirements, preventing them and relevant organisations from investing in their staff to retrain or renew their skills. As illustrated in Table 4, international offshore safety training is already available in Japan. However, international and domestic standards bodies do not seem to be deeply engaged with the offshore wind industry in Japan or vice versa. As such, these bodies have not yet concluded the most suitable training standards for the local context, which need to align with the international offshore wind industry. Standardising offshore wind-related education and training must be addressed immediately to provide clarity on which skills are required for the offshore wind industry within Japan. In addition, implementing a digital skills passport, in line with developed offshore wind markets such as the UK, would offer a practical solution to standardising the skills needed for certain jobs in the industry. The digital skills passports can also enable the transfer of skills from high affinity industries to green jobs.
Suggested steps	• **International and domestic standards bodies should align on common global training standards.** There is a need to review local contexts in emerging and new offshore wind markets to decide what is best practice since historical contexts behind the creation of global standards are heavily influenced by knowledge of the oil and gas industry. As such, existing standards may not

apply to all new offshore markets. Therefore, Japanese standards bodies must discuss with international standards bodies and reflect on the suitability and applicability of current standards if the aim is to enable the speedy rollout of training in new offshore wind markets. This process will also remove duplication of standards and certificates and avoid the creation of new local standards or certificates that already exist internationally. In addition, collaboration on standardising skills development is needed for less familiar offshore wind technologies. For instance, Japan is strongly focusing on floating wind technology and can contribute to new learning in this area.

- **Japan should implement a plan for a digital skills passport if workers will be transferring from similar industries or other markets.** Given that standards, certificates, and training processes are constantly evolving, many policymakers in the energy sector agree that a digital skills passport would mitigate duplication and avoid unnecessary financial and administrative burdens of paying or applying for several similar training certificates, approved by different regulators. A one-stop-shop passport that enables skilled workers to have evidence of their certified skills would streamline skills development in Japan, as well as recruitment, retraining, and renewing measures. A skills passport is fundamental to promoting the transfer of skills from high affinity industries into offshore wind.

Whole systems approach

Stakeholders interviewed for this report have suggested the following steps, underpinned by the key drivers of knowledge sharing, collaboration, education and cross-cutting actions, that will support alignment with international offshore wind markets on skills.

- Leading offshore wind developers operating in Japan should conduct knowledge sharing activities through public forums or through private, more focused workshops with key stakeholders. Offshore wind developers can provide a structured approach to capacity training for offshore wind projects, sharing insights and learnings across the project life cycle, preferably with materials that support newer companies on the skills requirements.
- Based on readily available materials on skills development from international offshore wind markets, industrial associations should drive the co-creation of guidance documents for Japan with strong industry engagement.

International reference

- Offshore wind developers in Taiwan such as Ørsted have conducted seminars at universities across the country, supporting students on courses that provide transferrable skills into the industry. Knowledge sharing from more experienced developers has been critical to aligning skills in the local workforce with industry competency requirements (Section 4.7).
- The 'US Offshore Wind Workforce Assessment' emphasises the need to align global training standards and for domestic actors in the US to officially confirm which they will roll out to clarify the training expectations of workers (Section 4.6).

- Japan can also take reference from the UK's Sector Deal which is supporting a cross-industry digital passport for the offshore energy workforce. By the end of 2023, workers in the North Sea oil and gas industry are expected to own a digital passport with all their training and standards qualifications in one place, which will make it easier for them to transfer to offshore wind, hydrogen, and other energy industries (4.3).

Recommendation 4

Take steps to modernise and future proof skills for the offshore wind industry in Japan	
Target audience	**Domestic stakeholders, with input from international stakeholders**
Timeframe	**Medium-term, 3-4 years**
Key actors / Key organisations responsible	• Government agencies of Japan: METI, MLIT, MHLW and the Digital Agency of Japan • Offshore wind industry associations with input from the private sector • Education sector • International wind industry associations: GWEC, WFO
Key barrier(s) addressed	B1 (Japan's labour shortage) B2 (Lack of industry specific knowledge and expertise of offshore wind in Japan) B3 (Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory) B4 (Work-based cultural barriers)
Just transition step	Planning
Explanation	Japan must prepare for the offshore wind skills market of tomorrow. This is evident through economy-shifting events such as the Covid-19 pandemic, which has seen an acceleration of digital and automation processes in the offshore wind industry. The increasing urgency to shift carbon-intensive activities into carbon neutral activities that are more sustainable will also change the nature of work that the industry undertakes. The pace of change to skills in the workforce is currently uneven, as changes to certifications, remote inspections, and the increasing electrification of logistical operations all move faster than changes to routine operations. These changes to skills will require a human-centred approach, with plans in place that focus on the continued training and upskilling of the existing workforce, while preparing the future workforce for more technologically advanced and sustainable processes in the offshore wind industry.
Suggested steps	**Government, industry, and academia should map out how digitalisation and automation processes will influence the current and future offshore wind workforce** in Japan within the context of a green economy. This planning process needs to consider:

- The type of job roles across the offshore wind project life cycle that are expected to become more digital or automated; e.g., more jobs onshore with the increasing use of artificial intelligence or autonomous robotic systems.
- The digital and automation areas that are particularly well suited for the industry in Japan to lead in the short- to medium-term; e.g., in relation to floating wind.
- The need for a digitalisation strategy that sets out plans to increase access to data on the workforce in the offshore wind industry to facilitate skills development plans. A digitalisation strategy could set a vision for the digital skill requirements of the future workforce in offshore wind.
- The nature of work in the industry as Japan looks to move towards a carbon neutral society and reduce carbon-intensive activities by developing a sustainable offshore wind market.

International reference

The UK is a good case study for plans on modernising the workforce. The government's 'UK Innovation Strategy' outlines how the future of the offshore wind industry will require continued innovation. 'People' are cited as a core pillar that will be supported through skills programmes.

Furthermore, industry actors are preparing for changes to the offshore wind industry, where OREC in the UK has published on the expected increase of robotics and autonomous systems, particularly for O&M work.[95] The Offshore Wind Innovation Hub also estimates that the increasing presence of robotics in offshore wind will shift workers from hazardous environments at sea to onshore control room roles and reduce the cost of energy by 10%.[96] Such plans and studies would help decision-makers in Japan to prepare for the workforce of tomorrow when designing skills development plans.

[95] Creating a robotic A-Team for offshore wind - ORE (catapult.org.uk)

[96] Quantifying the impact of Robotics in Offshore Wind – Offshore Wind Innovation Hub

Recommendation 5

Evaluate skills development measures in Japan and scale up	
Target audience	**All stakeholders,** driven by decision-makers who have a responsibility to evaluate skills plans, processes or outcomes
Timeframe	**Long-term, >5 years**
Key actors / Key organisations responsible	• Government, prefectural authorities • Industry, public and private sectors • Educational sector, training facilities
Key barrier(s) addressed	B1 (Japan's labour shortage) B2 (Lack of industry specific knowledge and expertise of offshore wind in Japan) B3 (Lack of clarity on Japan's future offshore wind industry and decarbonisation trajectory) B4 (Work-based cultural barriers)
Just transition step	Evaluating
Explanation	There is a need to monitor and evaluate measures as they are planned and implemented to ensure they are meeting their intended goals. With strong feedback systems in place, the measures can be rolled out on a larger scale. Implementation of the short-term and medium-term recommendations would enable Japan to address skills development to meet its 'Vision for Offshore Wind Power Industry'. Steps to evaluate skills development measures should be implemented as early as possible, but it remains an important step in the long-term. Furthermore, evaluation measures hold stakeholders accountable to validate the effectiveness of measures on societal goals, such as regional economic growth, diversity and inclusion, and transitioning workers from carbon intensive industries to renewables. To scale up skills development for offshore wind, further work is needed to understand the pathways for other technologies such as solar, onshore wind, hydrogen, and alternative fuels in shipping. Scaling up will need to be addressed comprehensively as part of green skills development plans.
Suggested steps	**Decision-makers**—whether in a private company, public organisation, local authority, or government body—**should design evaluation measures for their plans and actions**. Evaluations should:

- Evaluate the skills development system. A potential worker must be clear on the requirements needed of them, the pathways to get there, and the support schemes to facilitate their development.
- Take into account the changing developments in the country's trajectory to carbon neutrality and adapt plans or actions accordingly.
- Contribute to plans on how Japan will continue to transition into renewables while transitioning out of fossil fuel intensive industries and facilitate the workforce with this transition.

To **enable the scale up of a skills development system**, scaling up activities should include:

- Capacity building mechanisms from the local to the national level, as well as national to international levels such as secondments, internship programmes, and technically focused training schemes.
- Strong data sharing capabilities that inform decision-makers on the quantitative and qualitative status of the workforce and their skills development pathways. This could be achieved through, e.g., industry-government task forces, working groups, or skills councils.
- Consideration for where Japan will build up specialist skills through e.g., investment into specific R&D pathways, specialist education courses and industry-supported PhDs.
- Engagement with international countries, both with local countries within Asia and worldwide with European countries and the US. This engagement should facilitate the identification of value-add opportunities for the Japanese offshore wind industry, in coordination and/or collaboration with the international offshore wind industry.

International reference

- Japan can take reference from the UK, where forums such as the UK's Offshore Wind Industry Council (OWIC) monitor government and industry activities. OWIC publishes annual skills reports that provide key data on the skills trends. Such data has given the industry confidence in business planning and provides the government with evidence of the need for certain measures to support skills development. For example, where there was evidence of a skills shortage in the existing workforce, the education policy focus shifted to apprenticeship schemes to fill a shortage of technical qualifications.[97]
- Denmark provides lessons on building up specialised skills for the offshore wind industry through industry-supported PhDs, with many world-famous companies working in offshore wind from Denmark (Section 4.4).

[97] Offshore wind Sector Deal - GOV.UK (www.gov.uk)

7. References

4C Offshore, 'Global Market Overview, Q3 2022 Slide Deck', (12 September 2022), accessed via subscription on 15 Nov 2022

Agency for Natural Resources and Energy, 'Outline of Strategic Energy Plan', (Oct. 2021), https://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/6th_outline.pdf, accessed 19 Dec 2022

ARUP, 'Chief technical advisor for the offshore wind development program', (2023), https://www.arup.com/projects/taiwan-offshore-wind, accessed 10 Sept 2022

Aura Innovation, 'Skills and Labour Requirements of the UK Offshore Wind Industry', (October 2018), https://aura-innovation.co.uk/wp-content/uploads/2020/04/Aura-EU-Skills-Study-Summary-Report-October-2018.pdf, accessed 19 Dec 2022

BEIS and DfE, 'Green Jobs Taskforce', *GOV.UK* (12 Nov 2020), https://www.gov.uk/government/groups/green-jobs-taskforce, accessed 3 Jan 2023

Chia-nan, L., 'Dutch plan to cultivate wind farm talent', *Taipei Times*, (3 March 2020), https://www.taipeitimes.com/News/front/archives/2020/03/03/2003731967, accessed 10 Dec 2022

Danish Energy Agency, 'Offshore Wind Development', (June 2022), https://ens.dk/sites/ens.dk/files/Vindenergi/offshore_wind_development_final_june_2022.pdf, accessed 12 Sept 2022

Danish Government, 'Energy Agreement for 2020-2024', https://en.kefm.dk/Media/C/5/Energy%20Agreement%202018%20a-webtilg%C3%A6ngelig.pdf, accessed 19 Dec 2022

Danish Wind Industry Association, 'Profile of the Danish Wind Industry: Denmark – Wind Energy Hub', (Sept 2014), https://winddenmark.dk/sites/windpower.org/files/media/document/Profile_of_the_Danish_Wind_Industry.pdf, accessed 12 Sept 2022

Danish Wind Industry Association, 'Wind with Miller', (2001), http://xn--drmstrre-64ad.dk/wp-content/wind/miller/windpower%20web/en/kids/index.htm, accessed 10 Jan 2023

Department for Business, Energy and Industrial Strategy, 'Offshore wind Sector Deal', (4 March 2020), https://www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal, accessed 10 Nov 2022

Department for Business, Energy and Industrial Strategy, 'UK signs agreement on offshore renewable energy cooperation', *GOV.UK* (18 Dec 2022), https://www.gov.uk/government/news/uk-signs-agreement-on-offshore-renewable-energy-cooperation, accessed 18 Dec 2022

Department for Business, Energy and Industrial Strategy, North Sea Transition Deal', (21 March 2022), https://www.gov.uk/government/publications/north-sea-transition-deal/north-sea-transition-deal-accessible-webpage#people--skills-2, accessed 10 Nov 2022

Department for International Trade, ''The Offshore Wind Industry in Taiwan', (February 2022)

DFFV, 'About DFFV', (2023), http://www.dffv.dk/english/about-dffv, accessed 1 Dec 2022

Dronfield, M., Reynolds, J., 'Floating offshore wind: Risks to project development – people skills, and vocations', (14 June 2022), https://ore.catapult.org.uk/wp-content/uploads/2022/06/PN000484-RPT-002-R6-FOW-Future-People-Skills-Vocations-Report_Issued-Version-002.pdf, accessed 3 Jan 2023

Durkovic, A,. 'Japan's First Commercial-Scale Offshore Wind Farm Starts Delivering', *offshoreWIND.biz* (22 Dec. 2022), https://www.offshorewind.biz/2022/12/22/japans-first-commercial-scale-offshore-wind-farm-starts-delivering/, accessed 3 Jan 2023

Economic Council of the Labour Movement, 'Green transition can create thousands of new jobs', (24 Feb 2020), https://www.groennejob.dk/dokumenter/documents, accessed 19 Dec 2022

Energy Skills Partnerships, 'Our Aims', (2023), https://esp-scotland.ac.uk/, accessed 3 Jan 2023

EY, 'Strong skill action plan needed to transition from coal to renewable energy', (14 April 2022), https://www.ey.com/en_in/news/2022/04/strong-skill-action-plan-needed-to-transition-from-coal-to-renewable-energy, (accessed 14 Nov 2022)

Gao, A., Huang, C., Lin, J. and Su, W., 'Review of recent offshore wind power strategy in Taiwan: Offshore wind power comparison', *Energy Strategy Reviews* 38, (Nov 2021), 100747, https://doi.org/10.1016/j.esr.2021.100747

Global Wind Energy Council, 'Global Offshore Wind Report 2022', (June 2022), https://gwec.net/wp-content/uploads/2022/06/GWEC-Global-Offshore-Wind-Report-2022.pdf, accessed 10 Dec 2022

Global Wind Energy Council, 'Global Wind Workforce Outlook: 2021-2025', (May 2021), https://gwec.net/wp-content/uploads/2021/06/Global-Wind-Workforce-Outlook-2021-2025.pdf, accessed 20 Nov 2022

GWEC, 'Global Wind Workforce Outlook 2022-2026', Global Wind Energy Council (28 Sep. 2022), https://gwec.net/wp-content/uploads/2022/09/GWEC-GWO-Global-Wind-Workforce-Outlook-2022-2026-1.pdf, accessed 17 Jan 2023

HM Government, 'Skills for a green economy: A report on the evidence', (2011), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/32373/11-1315-skills-for-a-green-economy.pdf, accessed 10 Nov 2022

HM Treasury, 'Build Back Better: our plan for growth', (3 March 2021), https://www.gov.uk/government/publications/build-back-better-our-plan-for-growth/build-back-better-our-plan-for-growth-html#foreword, accessed 10 Nov 2022

Indirect, 'SKILL UP – the flexible skills programme', (2023), https://www.nidirect.gov.uk/skillup#:~:text=If%20you're%20aged%2018,UP%20%E2%80%93%20the%20flexible%20skills%20programme, accessed 10 Jan 2023

International Energy Agency, 'Japan 2021: Energy Policy Review', (May 2021), https://iea.blob.core.windows.net/assets/3470b395-cfdd-44a9-9184-0537cf069c3d/Japan2021_EnergyPolicyReview.pdf, accessed 17 Jan 2023

International Energy Agency, 'Japan data explorer, Electricity Generation by source, Japan 1990-2021', IEA Electricity Information 2022 https://www.iea.org/data-and-statistics/data-product/electricity-information, Documentation: https://iea.blob.core.windows.net/assets/11289187-9898-42b2-a90f-25e1ab6ee7b5/Ele_documentation.pdf, accessed 2 Mar 2023

International Energy Agency, 'Offshore Wind Outlook 2019', (November 2019), https://iea.blob.core.windows.net/assets/495ab264-4ddf-4b68-b9c0-514295ff40a7/Offshore_Wind_Outlook_2019.pdf, accessed 19 Dec 2022

International Labour Office, 'World Employment and Social Outlook 2018: Greening with jobs', International Labour Organization (14 May 2018), https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_628654.pdf, accessed 17 Jan 2023

International Labour Organization, 'Guidelines for a just transition towards environmentally sustainable economies and societies for all', (2015), https://www.ilo.org/wcmsp5/groups/public/@ed_emp/@emp_ent/documents/publication/wcms_432859.pdf. Accessed 12 Nov 2022

IRENA, 'Socio-economic footprint of the energy transition: Japan', (2022), https://www.greenpeace.org/static/planet4-africa-stateless/2019/04/52eea778-jt-case-studies-report.pdf, accessed 19 Dec 2022

JWEA, '日本風力エネルギー学会誌　特集１　洋上風力発電　官民推進協議会の活動状況（人材育成に焦点をあてて）', 第４６巻　第２号（通巻　第１４２号）, (Aug 2022)

JWPA, '洋上風力スキルガイド_ 第 1 版'（June 2022), https://jwpa.jp/cms/wp-content/uploads/%E6%B4%8B%E4%B8%8A%E9%A2%A8%E5%8A%9B%E3%82%B9%E3%82%AD%E3%83%AB%E3%82%AC%E3%82%A4%E3%83%89_%E7%AC%AC1%E7%89%88.pdf, accessed 5 July 2022

Kiko Network (地球温暖化防止に取り組む NPO/NGO 気候ネットワーク), '正な移行ー脱炭素社会へ、新しい仕事と雇用をつくりだす', (Sept 2021), https://www.kikonet.org/info/publication/just-transition-report, accessed 30 Jan, 2023

Knol, E. and Coolen, E., 'Employment analysis (2019-2023) of various fields of activities in the Dutch offshore wind sector', (July 2019), https://www.topsectorenergie.nl/sites/default/files/uploads/Wind%20op%20Zee/Documenten/20190709%20OW%20Employment%20NL%20Report%20-%20final%20v1.2%20-%20online.pdf, accessed 12 Sept 2020

Kyodo News, 'Over half of Japan companies suffering from labor shortage: survey', (11 Nov. 2022), https://english.kyodonews.net/news/2022/11/fbc691d031c4-over-half-of-japan-companies-suffering-from-labor-shortage-survey.html, accessed 1 Dec 2022

LSE Grantham Research Institute on Climate Change and the Environment, 'The Climate Act', (2020), https://climate-laws.org/geographies/denmark/laws/the-climate-act#:~:text=The%20Climate%20Act%20sets%20a,and%20reductions%20against%20the%20target., accessed 3 Jan 2023

Mabon, l., Chapman, A., McLellan, B., and Huang, Y., 'Just Transitions in Japan', (June 2022), https://www.thebritishacademy.ac.uk/documents/4130/BA1098_JT_AP_-_Leslie_Mabon_-_Proof_FINAL_-_June_2022.pdf, accessed 19 Dec 2022

Maine Offshore Wind Initiative, ' 2022 Main Offshore Wind Talent Analytics', (May 2022), https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/2022%20ME%20OSW%20Talent%20Analysis.pdf, accessed 20 Dec 2022

ManPowerGroup, 'Japan's 2022 Talent Shortage', (2022), https://go.manpowergroup.com/hubfs/Talent%20Shortage%202022/MPG_2022_TS_Infographic-Japan.pdf, accessed 19 Dec 2022

Maritime Technology Innovation Center, 'MITC Introduction', (2023), https://www.mtic.org.tw/EN/Home/Article/fae783a2-c64a-45f3-b74e-52f45de40191, accessed 20 Dec 2022

Maryland Energy Administration, 'MEA Announces Maryland Offshore Wind Workforce Training Grant Program', (8 Sept 2022), https://news.maryland.gov/mea/2022/09/08/mea-announces-maryland-offshore-wind-workforce-training-grant-program/, accessed 21 Dec 2022

METI, 'Vision for Offshore Wind Power Industry (1st)', (15 Dec 2020), https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/dl/vision/vision_first_en.pdf, accessed 17 Jan 2023

METI, '「GX 実現に向けた基本方針」が閣議決定されました', (10 Feb 2023), https://www.meti.go.jp/press/2022/02/20230210002/20230210002.html, accessed 15 Feb 2023

METI and MLIT, '秋田県能代市、三種町及び男鹿市沖海洋再生可能エネルギー発電設備整備促進区域 公募占用指針', (Nov 2020), https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/dl/sentei/akita_noshiro_ko uboshishin.pdf, accessed 3 Feb 2023

METI and MLIT, '秋田県由利本荘市沖（北側・南側）海洋再生可能エネルギー発電設備整備促進区域 公募占用指針', (Nov 2020), https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/dl/sentei/akita_yuri_ko uboshishin.pdf, accessed 3 Feb 2023

METI and MLIT, '千葉県銚子市沖 海洋再生可能エネルギー発電設備整備促進区域 公募占用指針', (Nov 2020), https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/dl/sentei/chiba_choshi_kouboshishin.pdf, accessed 3 Feb 2023

METI and MLIT, '「秋田県八峰町及び能代市沖」,「秋田県男鹿市、潟上市及び秋田市沖」,「新潟県村上市及び胎内市沖」,「長崎県西海市江島沖」海洋再生可能エネルギー発電設備整備促進区域 公募占用指針', (Dec 2022), https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/dl/sentei/kouboshishin_20221228.pdf, accessed 3 Feb 2023

Mey, F., Briggs, C., Dominish, E., Rutovitz, J., Nagrath, K., and Setton, D., 'Case studies from transition processes in coal dependent communities', (2019), https://www.greenpeace.org/static/planet4-africa-stateless/2019/04/52eea778-jt-case-studies-report.pdf, accessed 10 Jan 2023

Ministerie van Economische Zaken en Klimaat, 'Additional Offshore Wind Energy Roadmap 2030', (21 June 2022), https://english.rvo.nl/sites/default/files/2022/07/WOZ-210622022062-Letter-Additional-Offshore-Wind%20Energy-Roadmap-2030.pdf, accessed 12 Sept 2022

Ministry of Economy, Trade and Industry, 'Renewable Energy Purchase Prices, Surcharge Rate, and Other Details related to FIT and FIP Schemes from FY2022 Onward to Be Determined', (25 March 2022), Renewable Energy Purchase Prices, Surcharge Rate, and Other Details related to FIT and FIP Schemes from FY2022 Onward to Be Determined (meti.go.jp), accessed 19 Dec 2022

Nippon Yusen Kaisha, 'NYK to Establish Comprehensive Training Center for Offshore Wind Power Generation in Akita Prefecture', (13 Oct 2022), https://www.nyk.com/english/news/2022/20220930_01.html, accessed 19 Dec 2022

Nomura Research Institute, 'エネルギー市場動向 2021', エネルギー市場動向 2021', (Oct 2021), https://www.nri.com/-/media/Corporate/jp/Files/PDF/knowledge/report/cc/industry_trends/japanreport2021_jp.pdf?la=ja-JP&hash=435015A34F723FC3D1580E9240DC4DBCEB3EC694, accessed 13 Feb 2023

NSAR, 'NSAR's Skills Intelligence Model used to forecast future workforce requirements in Offshore Wind Skills Intelligence Report', (3 Oct 2022), https://www.nsar.co.uk/2022/10/nsars-skills-intelligence-model-used-to-forecast-future-workforce-requirements-in-offshore-wind-skills-intelligence-report/, accessed 20 Nov 2022

OECD, 'Getting Skills Right: Creating Responsive Adult Learning Opportunities in Japan' (2021), chap. 1 'Changing skill needs in the Japanese labour market'. DOI: https://doi.org/10.1787/cfe1ccd2-en

OECD, 'Inclusive and Equitable Framework for a Just Low-Carbon Transition in Resource-Rich Developing Countries', (16 Feb 2021), https://www.oecd.org/dev/inclusiveandequitableframeworkforajustlow-carbontransitioninresource-richdevelopingcountries.htm, accessed 13 Jan 2023

Offshore Wind Industry Council, 'People and Skills', (2021), https://www.owic.org.uk/people-skills, accessed 1 Dec 2022

Offshore Wind Innovation Hub, 'Quantifying the impact of robotics in offshore wind', (2022), https://offshorewindinnovationhub.com/industry_insight/quantifying-the-impact-of-robotics-in-offshore-wind/, accessed 21 Dec 2022

OPITO, 'OPITO awarded £5 million through Just Transition Fund to deliver Energy Skills Passport', (12 Oct 2022), https://opito.com/media/news/opito-awarded-5-million-through-just-transition-fund-to-deliver-energy-skills-passport, accessed 12 Nov 2022

OPITO, 'Workforce Dynamics: The Skills Landscape 2019-2025', (2019), https://downloads.opito.com/downloads/Publications/UKCS-Workforce-Dynamics-The-Skills-Landscape-2019-2025.pdf, accessed 10 Jan 2023

ORE Catapult, 'Creating a robotic A-Team for offshore wind', (20 Jul 2021), https://ore.catapult.org.uk/blog/robotic-a-team-for-offshore-wind/, accessed 12 Nov 2022

ORE Catapult, 'Offshore wind economics for beginners', (2022), https://ore.catapult.org.uk/our-impact/market-analysis-insights/offshore-wind-economics/, accessed 19 Dec 2022

Ørsted, 'Apprenticeships: Committed to helping develop people with the right skills', (2023), https://orsted.co.uk/careers/early-careers/apprenticeships-trainees/apprenticeships, accessed 3 Jan 2023

Ørsted, 'Education, training and R&D', (2023), https://orsted.tw/en/about-us/education-training-and-r-d, accessed 10 Nov 2022

Ørsted, 'Ørsted send first batch of Taiwanese O&M technicians for training secondment in UK', (5 May 2021), https://orsted.tw/en/news/2021/05/first-taiwanese-technicians-training-in-uk, accessed 10 Nov 2022

Ørsted, 'Teach First: Inspiring the next generation', (2022), https://orsted.co.uk/about-us/corporate-responsibility/education/teachfirst, accessed 19 Dec 2022

OWIC, 'Offshore Wind Skills Intelligence Report', Offshore Wind Industry Council (May 2022), https://www.owic.org.uk/_files/ugd/1c0521_9ffe327ec7da4522b7991226db27fee6.pdf, accessed 17 Jan 2023

Oxfam, 'Systems Thinking: An introduction for Oxfam programme staff', (20 Oct. 2015), https://policy-practice.oxfam.org/resources/systems-thinking-an-introduction-for-oxfam-programme-staff-579896/, accessed 26 Jan. 2022

Rampion Offshore Wind, 'Apprenticeship Programme', (2023), https://www.rampionoffshore.com/contact/careers-with-rampion/apprenticeships/, accessed 12 Nov 2022

Renewable Energy Institute, 'Offshore wind powers Japan energy: Systems, infrastructure, and industries for mass introduction', (8 Dec. 2020), https://www.renewable-ei.org/activities/reports/20201208.php, accessed 19 Dec 2022

Renewable Energy Institute, 'Socioeconomic Analysis of Offshore Wind Power Development in Japan', (December 2022), https://www.renewable-ei.org/pdfdownload/activities/REI_SocioEconomicAnalysis_EN.pdf, accessed 3 Jan 2023

RWE, 'Diving into the world of Floating Wind', (2022), https://www.rwe.com/en/research-and-development/wind-power/floating-offshore-wind/floating-wind-education, accessed 19 Dec 2022

Sato, W. and Lin, E,. 'Japanese wind fans bank interest', *Reuters* (13th March 2020), https://www.reuters.com/article/japanese-wind-fans-bank-interest-idUSL4N2B637H, accessed 19 Dec. 2022

Scottish Power, 'Apprenticeship & Training Programmes', (2023), https://www.scottishpower.com/pages/apprenticeships.aspx, accessed 3 Jan 2023

Siemens Gamesa, 'Tripling in Taiwan: Siemens Gamesa massively expand offshore nacelle manufacturing activities', (21 Sept 2022), https://www.siemensgamesa.com/en-int/newsroom/2022/09/092122-siemens-gamesa-press-release-taiwan-offshore-nacelle-manufacture, accessed 13 Oct 2022

State of Green, 'The future green labour market in the making', (19 May 2021), https://stateofgreen.com/en/news/the-future-green-labour-market-in-the-making/, accessed 19 Dec 2022

Stefek, J. et al., 'US Offshore Wind Workforce Assessment', *National Renewable Energy Laboratory* (October 2022), https://www.nrel.gov/docs/fy23osti/81798.pdf, accessed 21 Dec 2022

The White House, 'Fact Sheet: Biden-Harris Administration Announces New Actions to Expand US Offshore Wind Energy', (15 Sept 2022), https://www.topsectorenergie.nl/sites/default/files/uploads/Wind%20op%20Zee/Documenten/20190709%20OW%20Employment%20NL%20Report%20-%20final%20v1.2%20-%20online.pdf, accessed 20 Dec 2022

The White House, 'Readout of the OSTP event at the Global Clean Energy Action Forum: Systems thinking for a rapid and just net-zero transition', (23 Sept 2022),

https://www.topsectorenergie.nl/sites/default/files/uploads/Wind%20op%20Zee/Documenten/20190709%20OW%20Employment%20NL%20Report%20-%20final%20v1.2%20-%20online.pdf, accessed 20 dec 2022

Transition Plan Taskforce, 'The Transition Plan Taskforce Implementation Guidance', (Nov 2022), https://transitiontaskforce.net/wp-content/uploads/2022/11/TPT-Implementation-Guidance-1.pdf, accessed 2 Dec 2022

United Nations Framework Convention on Climate Change, 'Just transition of the workforce, and the creation of decent work and quality jobs', (26 Oct 2016), https://unfccc.int/sites/default/files/resource/Just%20transition.pdf, accessed 3 Jan 2023

US Energy Information Administration, 'Country analysis Executive Summary: Japan', EIA (Oct. 2020), https://www.eia.gov/international/content/analysis/countries_long/Japan/japan.pdf, accessed 17 Jan 2023

Whiteaker, J., 'Offshore wind projects in Japan attract FDI', *Investor Monitor* (August 2020), https://www.investmentmonitor.ai/sectors/extractive-industries/offshore-wind-projects-in-japan-attract-fdi/, accessed 19 Dec 2022

Appendix 1: Methodology

The methodology (Section 1.3) achieves the research goals which are i) to establish a baseline understanding of the existing measures on skills for the Japanese offshore wind industry in comparison with international offshore wind markets, ii) to assess the barriers to developing the workforce required for offshore wind industry development, and iii) to recommend fit-for-purpose skills-related measures for decision-makers to take forward, linked to international case studies and regarding the specific barriers identified.

- **Landscape review of the Japanese and key international offshore wind industries** – this objective was achieved by undertaking desk-based, literature reviews that examined policy documents, public documents, published strategies, and written materials that address offshore wind skills planning in Japan and the select international markets. The scope of materials also included conference materials, speeches, and presentations from events that took place over 2021-2022 such as the Global Offshore Wind Conferences in Manchester, UK, and Akita, Japan to factor in recent discussions and themes around skills development for offshore wind. As for the case study review, this report has selected three developed offshore wind markets – the UK, Denmark, and the Netherlands, and two fast-emerging markets – Taiwan, and the United States (US) to draw on relevant trends that may apply to Japan. The secondary data obtained from the literature review was then supplemented with stakeholder interviews which aimed to verify the observations and solicit first-hand information about the offshore wind labour and skills situation in Japan. Both stakeholders in Japan and across the international markets were asked to describe the current situation on skills measures and outline what tools, mechanisms, or programmes are available.

  Stakeholder interviews

  The Carbon Trust with support from the Renewable Energy Institute, undertook a mapping exercise to identify 19 unique stakeholder categories that have a role to play in the development of the offshore wind market.[98] It is expected that these types of stakeholders are facing or will face a skills need. The Carbon Trust and REI contacted the following categories of stakeholders to seek an interview opportunity, to capture current views on the skills situation in Japan across the offshore wind project life cycle:

  - Government body/public entity
  - Permitting/regulatory authority
  - Legal sector
  - Think-tank / Research institute
  - Educational institution
  - Original Equipment Manufacturer
  - Utility/Developer
  - Manufacturer/supply chain company
  - Financing Entity/Bank
  - Investor
  - Human resource consultant
  - Insurer
  - Trading house
  - Construction company
  - Industry association/Trade body
  - Non-Governmental Organisation
  - Consultancy company
  - Private company (non-supply chain/manufacturing)

[98] This is not an exhaustive list of stakeholder categorises and other types of stakeholders may need to be engaged with to support skills development. The selected categorises are based on the experience of the Carbon Trust and REI.

Nearly 60 contacts at various organisations were identified through the mapping exercise. The study attracted 14 in depth interview engagements, with 1-2 stakeholders engaged for each project stage (cross-cutting; survey/design; manufacturing; assembly and installation; operations and maintenance; decommissioning) to offer a comprehensive view from a variety of organisations who would be impacted from a skills perspective by Japan's plans to increase its deployment of offshore wind.

- **Comparative baseline understanding** – Building on the landscape review, this process examined the available data and existing skills-related studies to establish a comparative baseline between Japan and other international markets (Section 3.1 and 4). The objective was to understand what would be required to produce a comprehensive skills assessment of the offshore wind workforce in Japan and how can clarity be provided to organisations on meeting their skills need. The key activity undertaken here was to identify and document examples about the expected demand for skills in Japan (Section 3.2) as well as good practices of skills development based on a whole systems approach. A whole systems approach recognises that the skills need must be addressed holistically, with measures that factor in key drivers such as communication, education, and collaboration (Section 4.2). Information from stakeholder interviews also contributed to the baseline understanding.

- **Analysis of barriers** – To shift to a green economy and grow the offshore wind industry in Japan, it is assumed that the skills transition faces certain barriers, which prevent decision-makers from implementing their skills-related plans, programmes, or policies. In addition, even when such strategies are set out, intentions may not always translate into successful implementation. Therefore, the Carbon Trust analysed the primary and secondary information on skills development in Japan, identifying four key barriers (Section 5.2). The barriers have been identified through a causal mapping exercise, as outlined in Appendix 2:. These barriers are considered in the recommendations section to inform decision-makers that they must be mindful of these underlying barriers when setting out measures. To verify the assumption on the presence of barriers, the Carbon Trust and the Renewable Energy Institute asked stakeholders to share their views on the current challenges to ensuring the successful dissemination of skills activities in Japan's offshore wind industry, as well as what more needs to be done, and who could be responsible to drive the action.

- **Recommendations for Japan linked to international case studies as example** - As the offshore wind market in Japan is still developing, it is in a good position to utilise experience from the international and fast-emerging markets as inspiration and evidence for skills development. However, not all lessons and best practice will be applicable to Japan. In this final stage, the research builds on the analysed data and case studies to provide fit-for-purpose (such as contextual and socioeconomical background fit) recommendations for the Japanese offshore wind industry to meet their skills need.

Appendix 2: Causal map of barriers

The Carbon Trust created a causal map analysing the links between problem statements, which were gathered through stakeholder interviews and a review of public resources. To identify key barriers and suitable points of intervention These links have been organised into possible pathways of cause and effect.

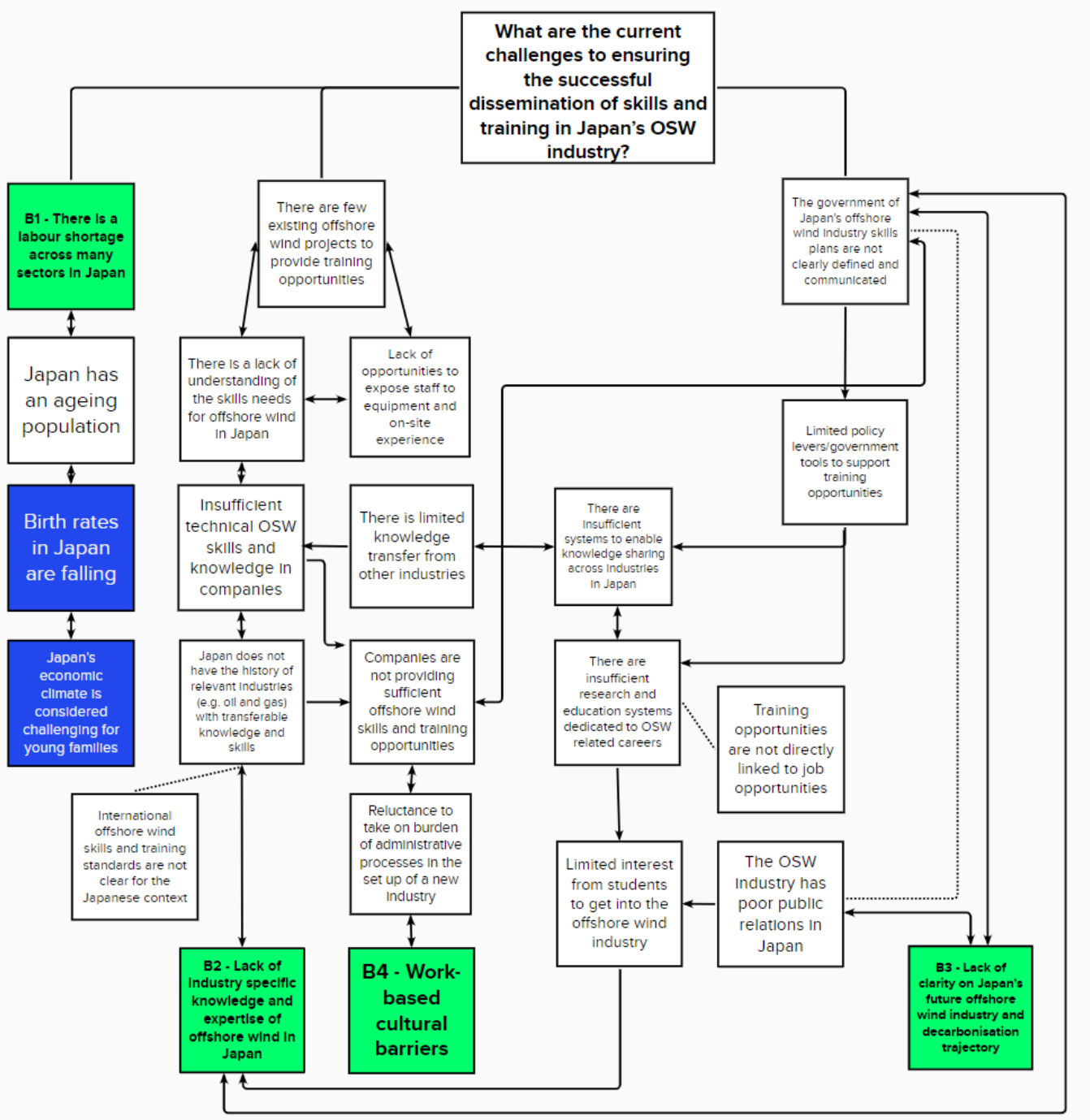


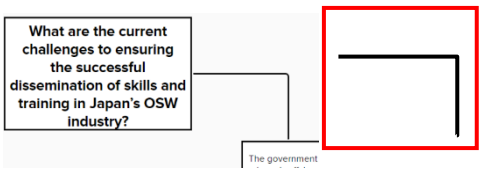
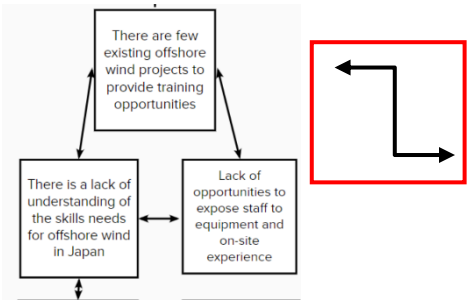
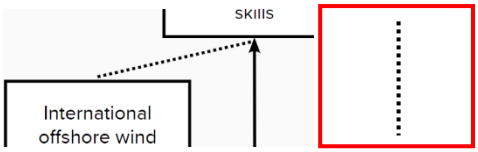
Figure 12: Causal map created on Mural containing keywords and statements from stakeholder interviews and public resources, organised into a map that illustrates the relationship between the issues, their effect, and the identified cause.

Causal map structure

Table 11 below describes the elements within the causal map. The significant takeaway is that the green boxes are the identified barrier which decision-makers should be aware of when designing skills related measures. While the barriers may have further causes (such as B1 – labour shortage), this level of intervention is focused on as opposed to the cause of an ageing population. Focusing on the labour shortage brings the attention of decision-makers to labour-related solutions, as opposed to asking decision-makers for solutions to an ageing population. It is encouraged that decision makers also use mapping techniques as part of their planning activities (Recommendation 2) to understand the relationships between problems, their causes and their effects, to inform thinking on skills development.

Table 11: Explanation of the causal map structure.

Explanation	Examples
The large white text box presents the question to which all statements in the map respond to.	**What are the current challenges to ensuring the successful dissemination of skills and training in Japan's OSW industry?**
The square white text boxes present statements from stakeholders and public resources in response to the main question.	There are few existing offshore wind projects to provide training opportunities
The blue text boxes present additional statements external to the stakeholder responses and public resources to explain certain statements, namely the possible reasons for an ageing population, which contributes to the cause of a labour shortage.	Birthrates in Japan are falling
Based on an assessment of the statements, the green text boxes in bold are the resulting statements after organising the statements according to a cause-effect logic. Statements B1-B3 are existing problem statements from the resources which were then considered to be the key barrier that other problem statements link back to. **B4: Work-based cultural barriers** is a summarised wording of several statements such as 'a conservative working culture' and 'staff feel burdened', and 'there is a lot of work pressure'.	**B4 – Work-based cultural barriers**

A black line with no arrowhead indicates a connection but not a causal relationship. These lines are used to connect the large white text box with the first text boxes that present statements.	
A black arrow with one direction represents that the statement is influenced by the previous aspect and causes the following effect. For example, 'the offshore wind industry has poor public relations in Japan' **which results in** 'limited interest from students to get into the industry.	
A black arrow with arrowheads in both directions implies that the problem is both influenced by and influencing the other aspect. For example, 'there are few existing offshore wind projects to provide training opportunities'. **Why is this the case**? As 'there is a lack of understanding of the skills needs for offshore wind in Japan, and there is a 'lack of opportunities to expose staff to equipment and on-site experience', which all in turn, contribute to there being few existing offshore wind projects to provide training opportunities.	
Black dotted lines imply an indirect causal relationship. For example, 'Japan does not have a history of relevant industries...' This problem is indirectly related to a separate problem of 'international offshore wind skills and training are not clear for the Japanese context'.	

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