AOTEAROA / NEW ZEALAND
DEVELOPMENT OF THE OFFSHORE WIND SUPPLY CHAIN

JUNE 2024

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Foreign, Commonwealth & Development Office (FCDO)

UK Government

CONTENTS

FOREWORD

Urgent action is needed by countries across the globe to respond to the climate crisis. The UK has long been at the forefront of tackling climate change and decarbonising its economy. We were the first major economy to commit to Net Zero by 2050 and the fastest to decarbonise having already halved its emissions since 1990.

Achieving this goal requires an unprecedented transitional change in energy generation, storage and transmission. The UK is in a prime position to support and partner with markets like New Zealand to deliver energy transition needs.

The offshore wind market is expected to grow at pace. The International Renewable Energy Agency, for example, proposes to install 2,000 GW of offshore wind (OSW) capacity by 2050 to meet the 1.5 degrees scenario. The UK has been at the vanguard of the sector's development, with 13.7GW currently installed, accounting for 24% of global capacity in 2022. We are targeting 50GW by 2030 making it one of the most important contributors to net zero in the UK. Innovation in offshore wind has and will continue to enable rapid deployment and reduction of cost, making this low-carbon energy source increasingly attractive.

The UK and New Zealand are both island nations blessed with strong offshore wind resources. While the New Zealand offshore wind market is still in its formative stages, a regulatory framework is set to be introduced in 2024, facilitating the permitting of offshore wind developments. We are keen to support the development of a successful OSW sector in New Zealand.

This report highlights how New Zealand has one of the best offshore wind resources in the world which could produce up to 7GW by 2050, helping to fulfil the New Zealand government's goal to double renewable generation. The UK has also developed a strong ecosystem of offshore wind companies with deep knowledge and expertise. In addition to sharing policy expertise, we want to connect UK developers and suppliers with opportunities to participate in the growth of OSW in New Zealand. In early 2024 the UK Government commissioned Xodus to undertake a high-level overview of existing domestic capabilities in New Zealand that can support the OSW sector, potential gaps where UK supply chain companies could provide support, and barriers which could impede the development of the sector or UK industry participation.

It gives me pleasure to launch this report and to amplify the concluding paragraph of the Executive Summary:

"As the global shift towards sustainable energy accelerates, the offshore wind sector in New Zealand stands as a compelling arena for collaboration and innovation. Despite the complexities, a thoughtful and strategic approach by UK entrants could unlock the immense potential that lies within this market."

Iona Thomas
British High Commissioner to New Zealand

1. EXECUTIVE SUMMARY

The nascent offshore wind industry in New Zealand offers a unique opportunity for collaboration between the UK government and its supply chain with their New Zealand counterparts. This partnership could aid in the successful establishment of the industry, benefitting not only New Zealand by fostering industry growth but also enabling the UK supply chain to actively participate in and contribute to the market as it evolves.

The UK boasts a highly capable supply chain, a result of being the world's second-largest offshore wind market, with 13.9 gigawatts fully commissioned as of 2023. Eager to build on this, the UK government is committed to not only developing to meet its growing domestic needs, which are expected to more than triple by 2030, but also to exporting its expertise and capabilities to global markets like New Zealand.

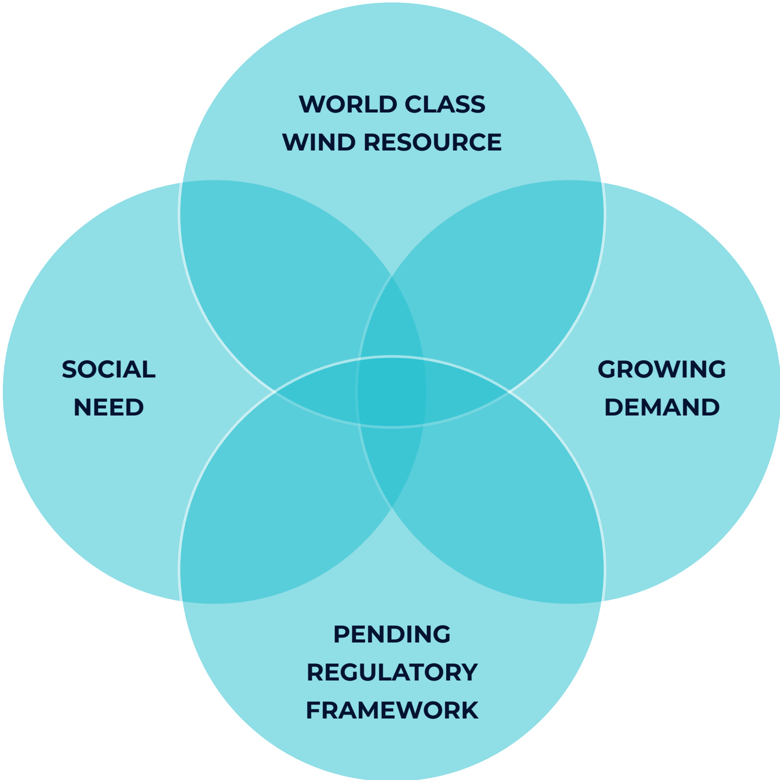


Figure 1: Key Ingredients for Development of New Zealand's Offshore Wind Industry

New Zealand possesses the essential ingredients for the successful development of an offshore wind industry, see Figure 1. These include:

- **Resource:**
  A world-class offshore wind resource, attributed to New Zealand's location in the 'Roaring Forties', with capacity factors anticipated around 50%.

- **Demand:**
  Increasing electrical demand driven by government policies aimed at electrifying the transport and medium process heat sectors and a need to stabilise the existing 'dry-year problem associated with New Zealand's current reliance on hydropower. There is additional potential demand from hydrogen production, to decarbonise domestic sectors that are hard to abate in addition to international export opportunities.

- **Regulatory Framework:**
  A regulatory framework is set to be introduced in 2024, facilitating the permitting of offshore wind developments. The framework is expected to enable a developer led approach to the industry with the government playing a supporting role rather than leading.

- **Social Need:**
  Creation of new industry to transition communities affected by the gradual phase-out of oil and gas. Additionally, there is a growing social concern regarding the expansion of onshore renewables, stemming from competing land uses and the community and visual impacts associated with such developments.

The New Zealand government is proactively engaging with developers and setting up its regulatory framework to ensure a streamlined consenting process to encourage offshore wind development. The expected market is relatively small by global standards, at around 5 gigawatts of capacity, and will primarily seek to provide additional electrification on the road to the country's 2050 goal of doubling renewable energy, or potentially exceeding 10 gigawatts if a hydrogen export market is established.

In addition, the New Zealand government is ensuring that the development of New Zealand's offshore wind industry can progress in tandem with Australia's market. Adopting this strategic stance enables the market to potentially leverage regional economies of scale and the level of demand necessary to be competitive and attract the interest of the global supply chain.

New Zealand, as with other emerging markets, will require additional steps to enable an offshore wind industry, including upgrade of enabling infrastructure, such as energy transmission and ports. In addition, and perhaps more unique to New Zealand, will be the requirement for developers to advise and collaborate with the government on the support required to de-risk projects and secure finance. In a market already heavily reliant on renewable generation, it will be critical for the government to provide the required level of certainty to developers to ensure projects remain viable.

This report analyses both the New Zealand and UK supply chain across 26 categories. It evaluates considerations such as existing and adjacent industry experience, logic in local supply, the resilience of the market and previous export experience to identify potential opportunities for UK supply chain companies to supply or service the various phases of offshore wind development in New Zealand.

The report identified opportunities across numerous project stages but out of the 9 broad categories, 3 were selected as having the highest potential for UK investment:

- Project development / management
- Support equipment and services
- Operations and maintenance

This potential is largely due to the UK supply chain's proven strengths in these areas, combined with minimal barriers to market entry and a high level of compatibility with the New Zealand market, facilitating opportunities for partnerships or joint ventures with local suppliers. This study adopts a pragmatic approach in evaluating these opportunities, also considering possible barriers, threats or weaknesses.

Furthermore, the report underscores the significance of recognising and respecting the cultural heritage and interests of the Iwi-Māori. It proposes the exploration of exporting the UK supply chain through joint ventures or partnerships, ensuring benefits for both UK suppliers and New Zealand.

Despite the nascent state of offshore wind development in New Zealand, the country presents a promising opportunity for the UK. However, there are some challenges, including:

- Navigating the relative uncertainty and regulatory intricacies
- Establishing market entry strategies and effective local partnerships
- Addressing unique socio-environmental considerations.

With clarity from the government, the above challenges can be easily mitigated opening the door to the UK supply chain for this upcoming offshore market. There are key synergies that exist between the markets and enormous opportunities that the UK could maximise.

As the global shift towards sustainable energy accelerates, the offshore wind sector in New Zealand stands as a compelling arena for collaboration and innovation. Despite the complexities, a thoughtful and strategic approach by UK entrants could unlock the immense potential that lies within this market.

2. INTRODUCTION

2.1 Background

New Zealand has robust energy policies that are driving the transition to renewable energy generation and have placed it as a global leader in renewable energy. In addition, New Zealand boasts world class wind resources which have not yet been harnessed. Consequently, there is considerable interest in offshore wind development, with several global offshore wind developers currently active in the country. The New Zealand government is currently working on implementing a permitting system for offshore renewable energy generation. They conducted 2 public consultations on the framework in 2023, ahead of an anticipated release in late 2024. Recent estimates indicate that the offshore wind market could add A$50 billion to New Zealand's GDP by 2050[1] showing the scale of potential in this upcoming energy sector.

The UK government is eager to support New Zealand's energy transition, including the development of a successful offshore wind sector. The UK industry, which is the second-largest developed offshore wind region in the world, is well positioned to share valuable knowledge and experience with the emerging industry in New Zealand.

[1] *https://www.odt.co.nz/business/offshore-wind-farms-could-add-50b-gdp-2050*

2.2 Report Context

The United Kingdom (UK) government, through the Foreign, Commonwealth & Development Office (FCDO) want to provide opportunities for UK companies to participate in the upcoming offshore wind sector in New Zealand (NZ). As one of the most developed offshore wind markets globally, the UK has an established supply chain with significant experience that could be deployed to this upcoming market.

Xodus Group, a leading energy consultancy, has been commissioned to explore the potential for UK companies to support the NZ offshore wind sector. This report provides a comparative analysis of the UK and NZ domestic supply chains. The goal of this work is to provide information to prospective UK companies on where gaps in the current NZ supply chain exist, provide information on possible opportunities, and explore barriers for entry for UK industry participants.

2.3 Methodology

The report has been undertaken through comprehensive desktop research and consultation with key governmental and industry stakeholders in New Zealand. Initially an assessment of the market potential for offshore wind in New Zealand is presented. This is followed by an overview of the current policy affecting offshore wind development in the country. Finally, the UK and New Zealand offshore wind supply chains have been compared and assessed to identify areas of opportunity and associated risks.

2.4 Report Limitations

The New Zealand offshore wind market is in the early stages of development. The government is still exploring feedback from recent consultations to design the framework that will underpin the New Zealand offshore wind industry. Given the early stage of New Zealand's offshore wind market, the following report must be read with the following considerations in mind:

- The scale and timing of the New Zealand market is based on internal Xodus assumptions. These assumptions have been informed through interpretation of publicly available information and interviews with key stakeholders in the New Zealand offshore wind sector.
- Offshore zones suitable for renewable energy generation are not likely to be declared by the government, as has occurred in some other countries. The government is likely to prefer developers nominate areas that are suitable for development. Xodus has used its internal techno-economic site suitability (TESS) LCOE tool to assess possible locations where offshore wind may be developed. This high-level assessment is only indicative and intended to give an estimate of where projects may be developed. Further analysis would be required to assess the full feasibility of any locations identified.
- As part of the TESS assessment, a fixed/floating technology threshold has been assessed based on water depth alone. Further work would be required to confirm the full viability of any projects.
- Only publicly announced projects at the time of publishing have been included in the developer assessment.

3. OFFSHORE WIND IN NEW ZEALAND

3.1 A Global Perspective

In 2023, the global offshore wind sector was dominated by headlines of project delays and cancellations. Despite this, the offshore wind pipeline demonstrated its resilience, with the addition of approximately 6 GW in operational capacity.[2] The total global offshore wind capacity now stands at around 69 GW,[3] and global installed capacity is forecast to reach between 630 GW and 1 TW by 2050.[4] With climate change and the need to shift away from fossil fuels capturing global attention, offshore wind has emerged as a crucial opportunity for large-scale renewable generation.

Technological advancements have unlocked new frontiers for offshore wind deployment in deeper waters and more challenging environments. The offshore wind industry is becoming increasingly competitive with traditional energy sources, due to declining costs, favourable government policies and growing investor confidence. Offshore wind provides significant potential to support the decarbonisation agenda in New Zealand, offering a clean, reliable, and scalable energy solution.

[2] *Data from Clarksons Renewables Intelligence Network*

[3] *Data from Clarksons Renewables Intelligence Network*

[4] *https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/how-to-succeed-in-the-expanding-global-offshore-wind-market*

3.2 New Zealand Market Context

3.2.1 Overview

New Zealand's wind resources are amongst the best globally. It has a vast coastline and strong, prevailing winds which are substantial advantages for developing an offshore wind industry. With over 15,000 kilometres of coastline, and an Exclusive Economic Zone 15 times its land area, the country possesses ample space for offshore wind development in addition to anticipated capacity factors, the average power generated by wind divided by its peak capacity, of around 50%[5] surpassing the global average of 42%.[6]

Despite this immense potential, New Zealand's offshore wind sector is still in its infancy, with no licences for development awarded. However, recent government initiatives and growing public support for renewable energy development are paving the way for a significant increase in offshore wind development. With ambitious climate targets and commitments to transitioning towards a low-carbon economy, New Zealand is poised to unlock its offshore wind potential.

[5] *https://www.windenergy.org.nz/offshore-wind-in-new-zealand*

[6] *https://www.statista.com/statistics/1368679/global-offshore-wind-capacity-factor/*

3.2.2 Energy Supply and Demand

New Zealand's energy portfolio has, for some time, been driven predominantly by renewable energy. In 2022, electricity generation from renewable sources accounted for over 80% of total electricity generated.[7] This total is predominantly built up of hydropower and geothermal, which account for 53% and 18% respectively. The remainder is made up Biofuels, Biogas, Wind and Solar. Approximately 8% of renewable energy generation in New Zealand comes from wind. See Figure 2 for a breakdown of electricity generation sources in New Zealand.

This amount of renewable generation is significant and places New Zealand 10th in the IEA rankings for countries with the highest proportion of renewables in their grid. Despite these impressive metrics, New Zealand has two primary challenges to overcome:

- While renewables provide 83% of electricity generated in New Zealand, as indicated at Figure 2, renewable energy only accounts for 30% of the total energy consumption. This is larger than the average of 12% for countries that belong to the Organisation for Economic Co-operation and Development (OECD), but means there is still significant work required to decarbonise the transport and industrial sectors which are reliant on fossil fuels at 99% and 60% respectively.
- There is a high-reliance on hydropower, which creates the dry-year problem, where generation security is at risk if inflows to the reservoirs are insufficient.

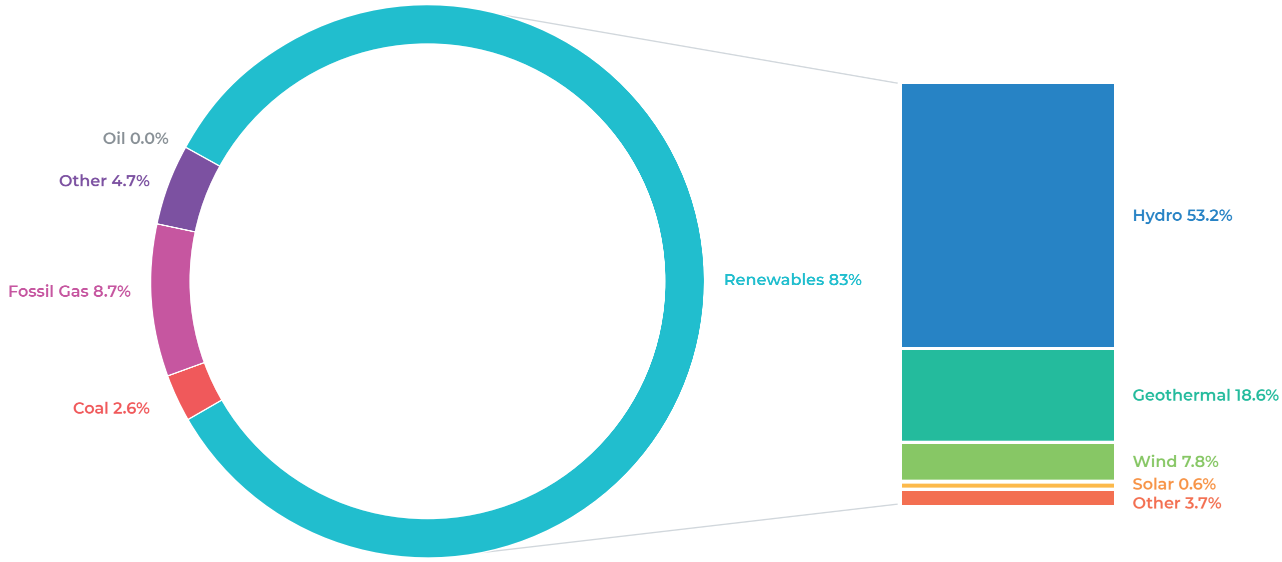


Figure 2: Electricity Generation Mix by Fuel Type[8]

[7] MBIE 23 report, https://www.mbie.govt.nz/dmsdocument/27344-energy-in-new-zealand-2023-pdf

[8] Based on ENZ data. Available at: https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/modelling/.

In the past 2 decades, New Zealand has experienced relatively stable electricity demand, with incremental increases balanced by improvements in energy efficiency. However, projections indicate a high level of growth in both demand and supply from 2025 onwards. This growth is attributed to the government's initiatives to electrify the transportation sector and transition medium-sized heat process plants to electricity.

Transpower, the New Zealand network operator in New Zealand, published "Whakamana I Te Mauri Hiko" in 2020,[9] which explores the potential future energy scenarios for Aotearoa New Zealand. Despite considering several different possible energy futures for New Zealand, the work is primarily focused on the base case 'Accelerated Electrification' scenario. This scenario is defined as 'realistic yet aspirational' and considered the most likely scenario to come to fruition. Under this scenario, as illustrated in Figure 3, a 68% increase in energy demand is forecast by 2050. This is mainly driven by an increase in base demand, a shift to vehicle electrification and an uptake in process heat demand.

These demand scenarios were further updated in 2022 by Transpower as part of Net Zero Grid Pathways (NZGP) programme.[10] They provide insights into how the New Zealand government are viewing and planning for investment to meet its climate goals, including the deployment of offshore wind.

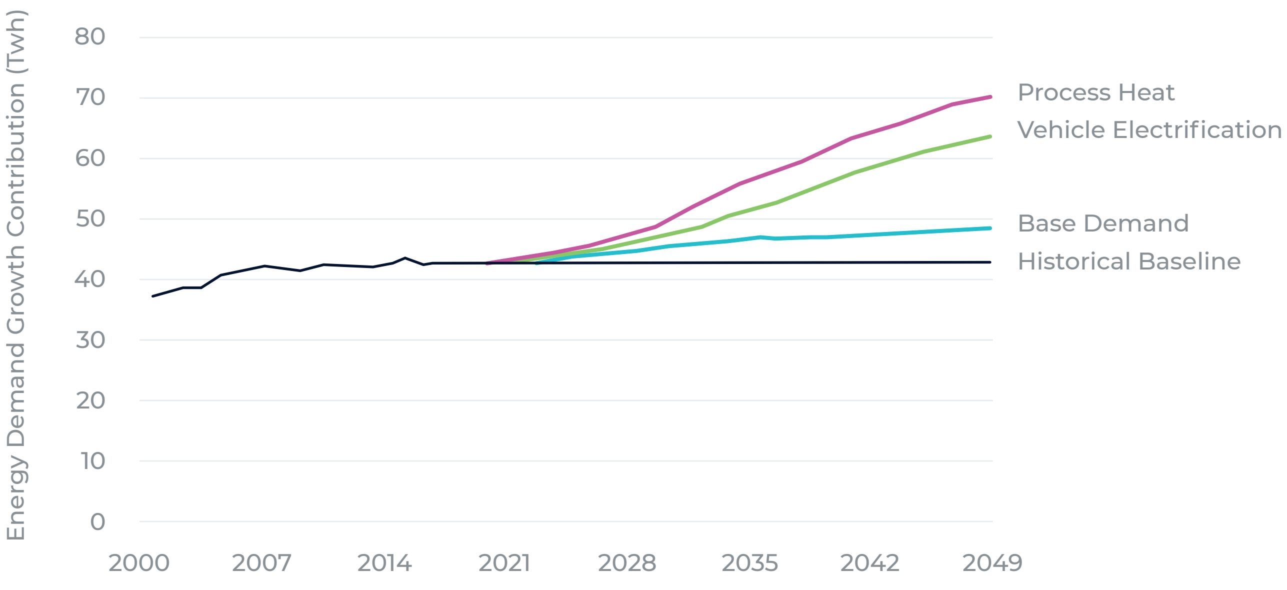
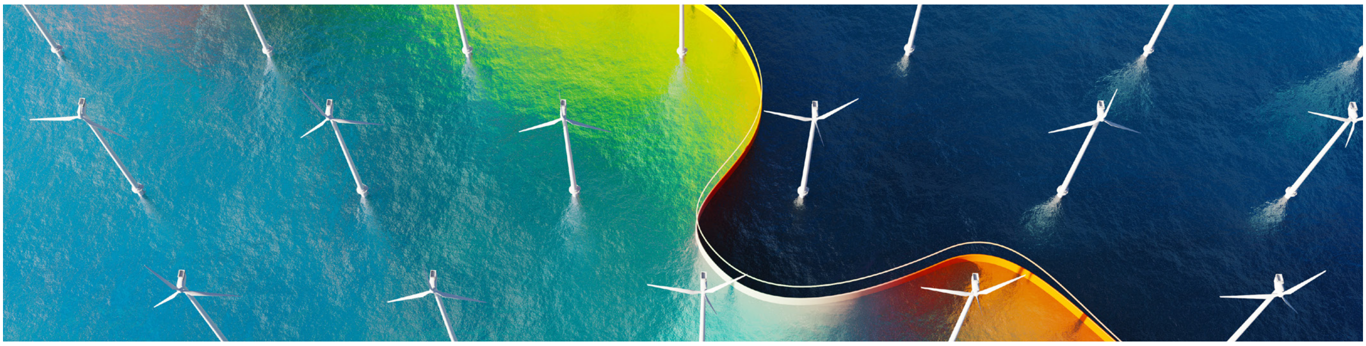


Figure 3: Forecast Energy Demand (TWh) Increase to 2050, 'Accelerated Electrification' Scenario

[9] *https://static.transpower.co.nz/public/publications/resources/TP%20Whakamana%20i%20Te%20Mauri%20Hiko.pdf?VersionId=FljQmfxCk6MZ9mIvpNws63xFEBXwhX7f*

[10] *Net Zero Grid Pathways, Major Capex Proposal (Staged), Transpower, December 2022*



In a 2023 update, Transpower reported that electricity demand was tracking towards the "Accelerated Electrification" scenario,[11] leading to confirmation of a forecast increase in electricity demand of 68% by 2050. Figure 4 shows further detail on this expected scenario through to 2050. With the demand increase, phase-out of fossil fuels and limited growth in hydro or geothermal, most of the increased demand will be met through growth of large-scale solar and wind. Based on this information, it is expected that wind generation will increase from 0.9 GW in 2025 to 6.5 GW in 2050, noting specifically that this comprises both onshore wind and offshore wind.

Despite representing a sixfold increase in wind generation capacity, this potential growth could be considered small in the context of offshore wind globally. Most offshore projects target capacities greater than one GW in size to achieve economies of scale.

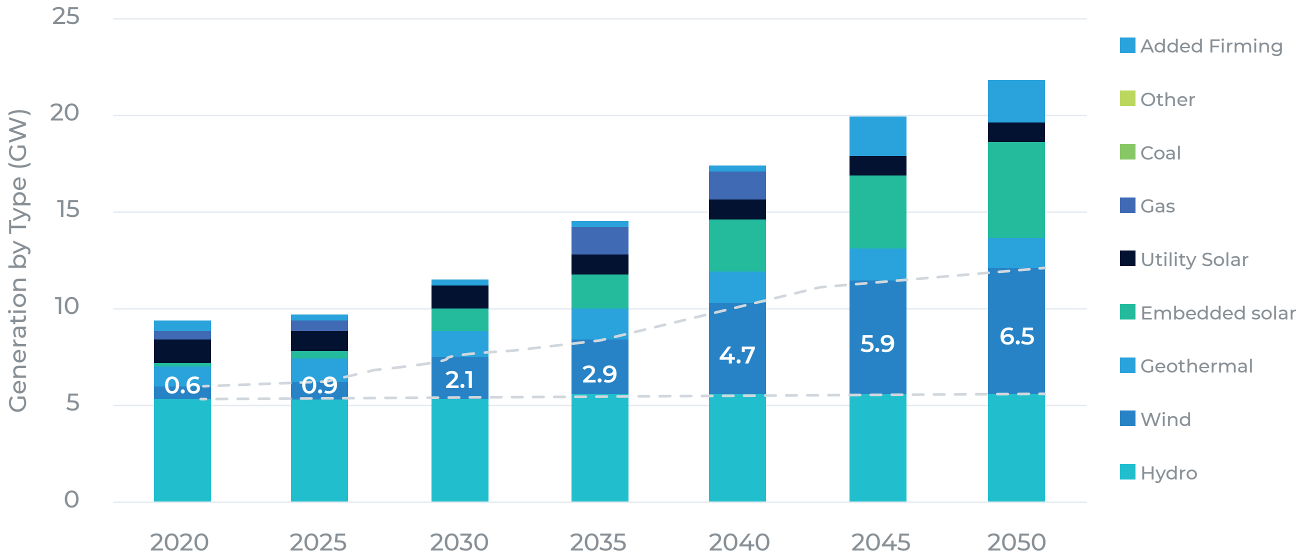


Figure 4: Generation by Type, 'Accelerated Electrification', Whakamana i Te Mauri Hiko Energy Scenario

[11] *Transmission Tomorrow, 2023 Refresh, Transpower*

3.2.3 Hydrogen Potential

The development of a domestic hydrogen economy in New Zealand could provide another driver for growth in offshore wind. Industry and government have developed a substantial body of evidence to investigate the country's possible role, mainly based on its surplus of renewable energy potential. The government is yet to establish a stand-alone hydrogen strategy, with this to be addressed as part of the wider Energy Strategy, due in 2024. In 2023, the Government released the *Interim Hydrogen Roadmap,*[12] to set out the governments emerging thinking on the role of hydrogen as part of New Zealand's wider energy transition.

Previous scenarios from Transpower do not account for the additional demand created by the pursuit of green hydrogen. Transpower has noted that this could assist with decarbonisation of hard-to-electrify areas of the energy system. The Ministry of Business Innovation and Employment's (MBIEs) *"Interim Hydrogen Roadmap"* estimated that under a scenario where hydrogen is used to address near-term domestic decarbonisation could result in an increase in demand by as much as 22 per cent in 2035 and 48 per cent in 2025 over previous estimates.[13] Adding these estimates into the previous demand forecasts results in the potential demand growth illustrated Figure 5.

There are significant possibilities for hydrogen which domestically could be used to meet approximately 8% of New Zealand's energy demand by 2050. Other potential applications including transportation, energy, electricity systems and industry.

Large scale hydrogen export is an alternative scenario that could be considered for New Zealand which would significantly increase electricity demand and increase the scale of proposed build out of offshore wind. New Zealand could export hydrogen globally, specifically to Japan, Korea and Singapore who have reportedly indicated interest in supply from New Zealand.

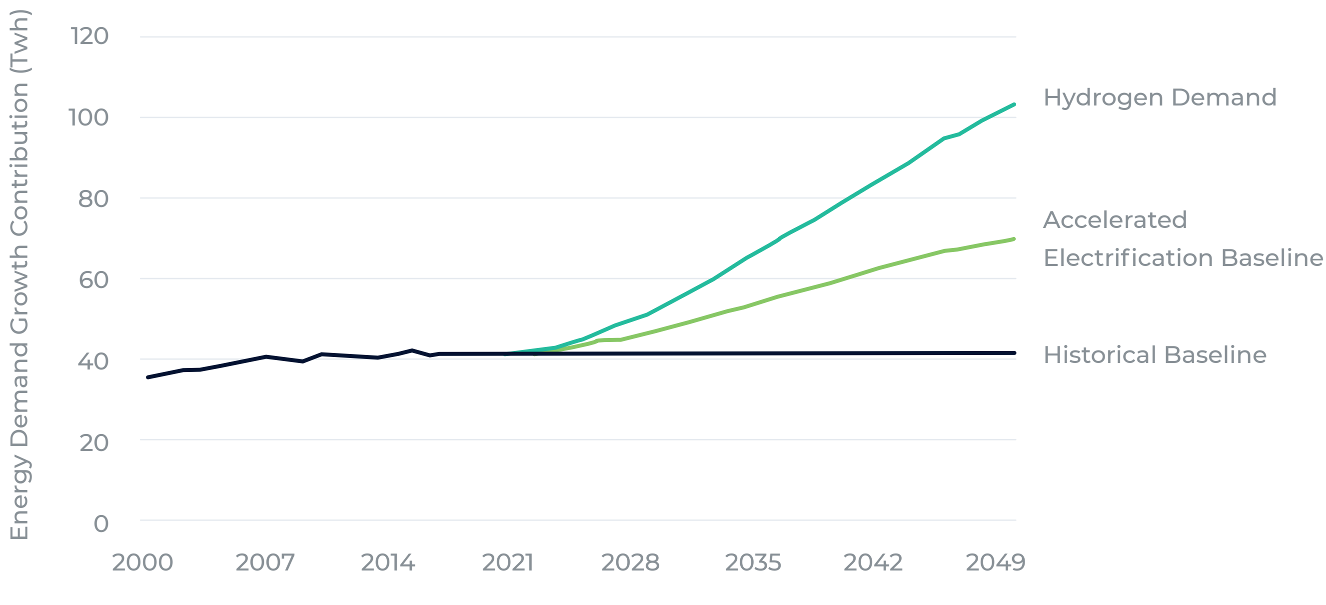


Figure 5: Additional Demand Growth from Hydrogen

[12] *https://www.mbie.govt.nz/dmsdocument/26911-interim-hydrogen-roadmap-pdf*

[13] *https://www.mbie.govt.nz/dmsdocument/26911-interim-hydrogen-roadmap-pdf*

3.2.4 Offshore Wind Potential

To estimate the potential offshore wind pipeline, this study has adopted Transpower's generation capacity estimates[14] which provide an estimate of the forecasted wind build out to 2050. From this total wind build out an estimate of offshore wind build out has been calculated. A range of scenarios have been produced based on the possibility that the public and government may or may not take a more aggressive stance on future onshore developments. Scenarios with and without hydrogen have been developed, as illustrated in Figure 6 and Figure 7. Xodus acknowledge that this approach is high-level and has been developed for the purposes of establishing a credible independent outlook of offshore wind in New Zealand. Actual growth in offshore wind will be dependent on several factors that change over time, such as the commerciality of projects within the context of New Zealand's energy portfolio and the ability of projects to secure environmental and social approvals.

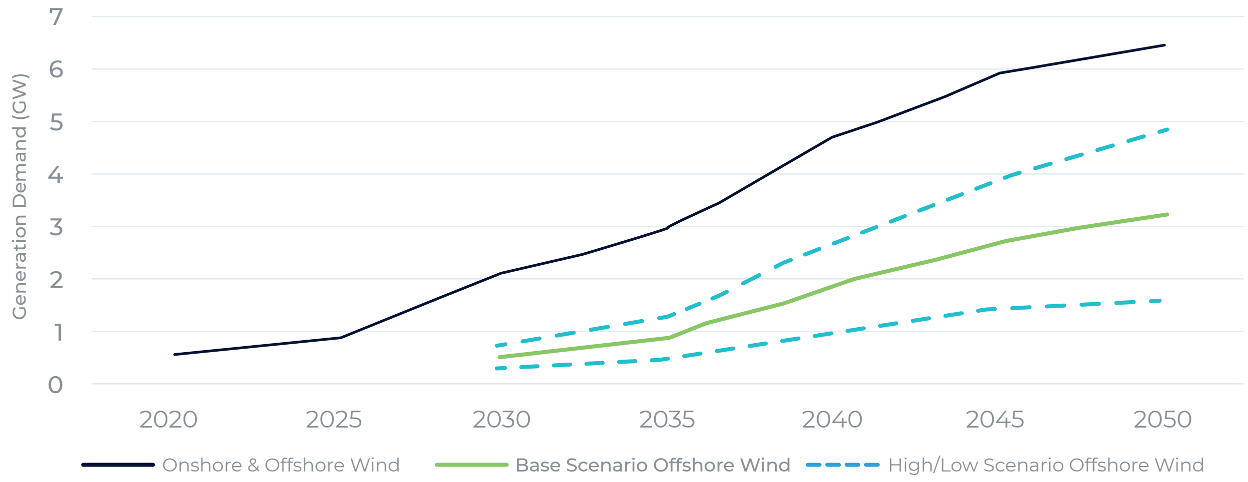


Figure 6: Forecast Offshore Wind Pipeline - Excluding Domestic Hydrogen Demand

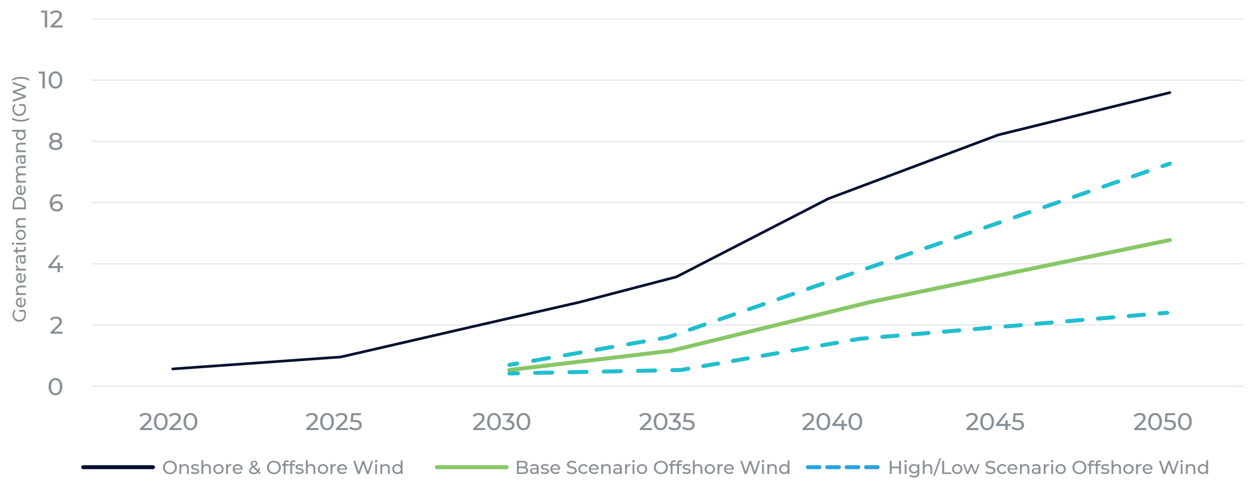
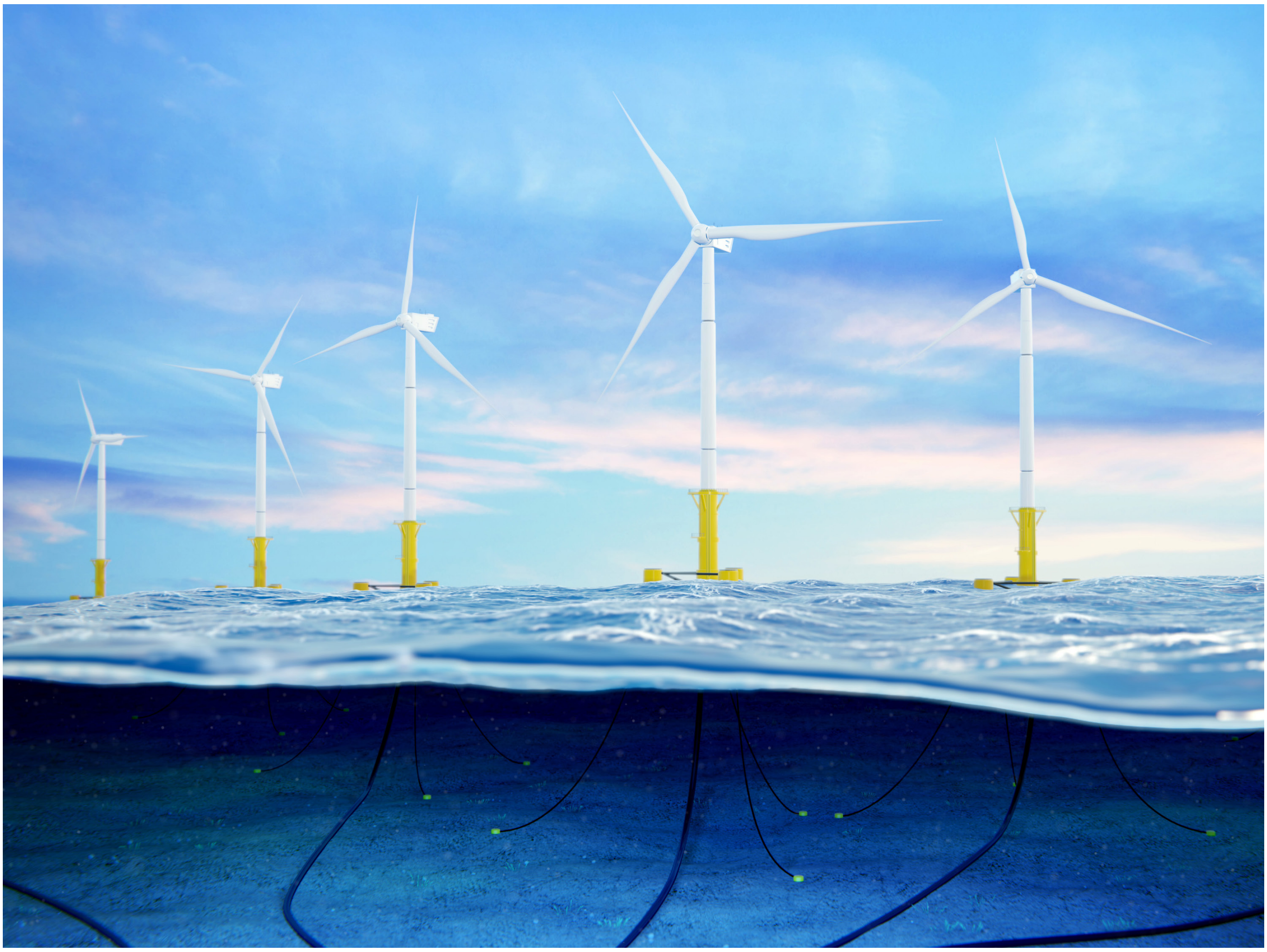


Figure 7: Forecast Offshore Wind Pipeline - Including Domestic Hydrogen Demand

[14] *Transmission Tomorrow, 2023 Refresh, Transpower*

Xodus estimates suggest by 2050, the offshore wind pipeline could be in the region of 2-5 GW excluding domestic hydrogen buildout and 2-7 GW including domestic hydrogen buildout. Large-scale hydrogen export could increase these estimates to well over 10 GW but is dependent on numerous factors coming into play including development of a hydrogen export market and the drop in floating offshore wind levelized cost of energy (LCOE). In the short term, it is likely that onshore renewables will continue to dominate New Zealand's energy portfolio. However, in early-2030, it is expected that offshore wind will experience substantial growth with projects having progressed through feasibility and into commercial development stages. This timeline assumes that a framework is released in 2024 and that the proposed fast-track consenting timeframes are implemented, enabling projects to capitalise on expedited development timelines. It is likely that the baseline buildout estimates will be met predominantly by bottom-fixed offshore wind. Increased buildout scenarios, such as large-scale hydrogen export, would drive development into deeper waters and require the use of floating technology. Over time, as prime onshore areas reduce in availability and with the continued decrease of the LCOE for offshore wind, it its estimated that offshore wind will increase its share in the energy mix. Figure 8 provides an overview of New Zealand offshore wind suitability based on water depth along a comparative LCOE study.



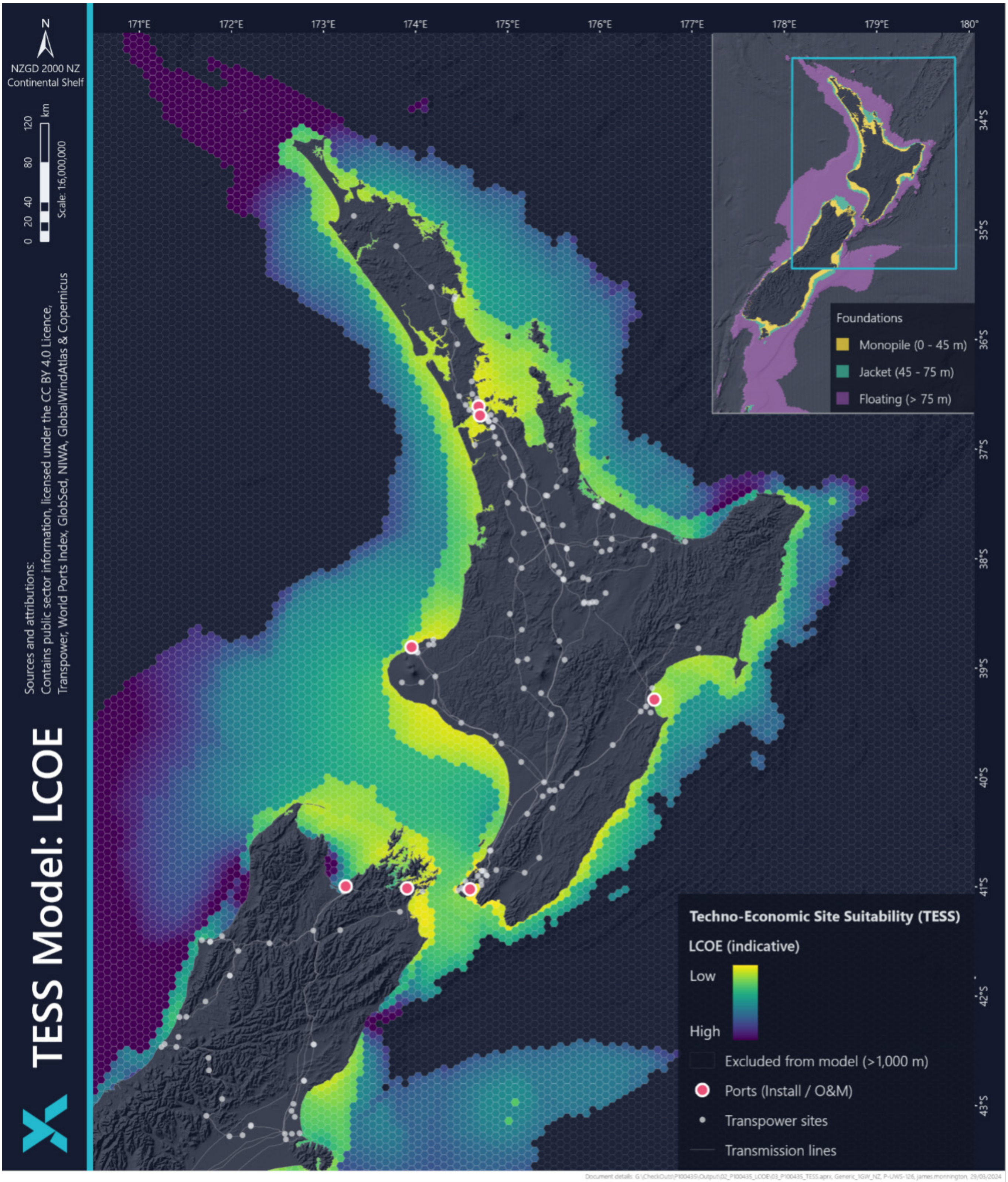


Figure 8: Xodus Techno-Economic Site Selection (TESS) Model Output for New Zealand Showing Fixed/Floating Areas and Comparative LCOE Projections

This comparative LCOE study has been undertaken to give an indicative assessment of site suitability across the Taranaki region of the North Island. The resulting plot shows the optimal location for offshore wind sites in New Zealand and accounts for both fixed and floating developments. The study, which has been performed at a high level, simply provides a comparative view of where the optimal development regions. A full LCOE costing study was out with the bounds of the scope. Further LCOE work has been carried out in other literature with the recently released 'National Impact Study'[15] estimating that LCOE for a typical fixed New Zealand OWF will fall from about $115 to $225 per MWh today to about $72 to $80 per MWh by 2050 (real) which would equate to the approximate current cost of onshore wind.

These projections show the significant potential in New Zealand and highlight the areas of interest for offshore wind, in particular it reinforces the strong interest developers have in the Taranaki region in which it is likely the first projects in New Zealand will be developed. The predicted scale of potential is relatively small compared to Europe and other APAC countries, however, is substantial in relation to New Zealand's energy requirements and industrial activities. Proposed offshore wind developments are aligned with the outcomes of MBIE's consultation processes for offshore wind, which found that smaller (500-1000 MW) projects were likely to be targeted to avoid New Zealand releasing a significant portion of its capacity to a single developer or project.[16] It should be highlighted that 500-1000 MW projects are currently viewed as about the minimum efficient scale for new projects globally and would be considered small for commercial projects looking to leverage economies of scale. The government is also fast tracking its policy to facilitate projects into the feasibility phase so that there are synergies between Australia and New Zealand development pipelines and supply chains. This strategy can be evidenced by several international offshore wind developers all having proposed offshore wind developments in Australia and New Zealand.

To establish offshore wind supply chains, it will be important for the government to grant several project feasibility permits at a reasonable combined scale of 4 to 5 GW. This approach will sustain developer interest and offer redundancy in case some projects do not progress. Moreover, it sets up a pipeline essential for fostering industry development, boosting local content, and enabling flexibility to collaborate with the Australian market over an extended period. It is important to recognise that global wind developers already have a local presence in-country and many are also pursuing projects in Australia.

[15] *National Impacts Study, PWC, March 2024*

[16] *https://www.mbie.govt.nz/dmsdocument/26913-developing-a-regulatory-framework-for-offshore-renewable-energy-pdf*

3.3 Developer Interest

Interest in New Zealand from domestic and international offshore wind developers has grown in recent years. As of February 2024, several offshore wind developers have announced their intention to participate in the New Zealand offshore wind market. As previously discussed, the scale of these projects is likely to change, but the announced interest is a positive sign that developers are ready and willing if the industry development framework is fit for purpose. In addition to offshore wind developers, New Zealand has been viewed as an attractive market for private investment due to its significant and persistent efforts toward achieving net-zero emissions. Collaborating with the New Zealand government, global investment firm BlackRock has launched the NZ$2 billion 'New Zealand Net Zero Fund' to bolster the nation's transition to 100% renewable energy.[17] This fund will facilitate the adoption of green energy solutions like offshore wind and enhance domestic capabilities to support these industries.

Amazon Web Services has disclosed plans to establish at least 3 data centres in Auckland, with a total investment of USD 7.5 billion,[18] while Microsoft has indicated intentions to construct a hyperscale data centre region in New Zealand.[19] The addition of data centres would elevate energy demand scenarios and underscore the importance of offshore wind, as well as energy storage systems.

PROJECT	CAPACITY (MW)	REGION	DEVELOPER(S)
Taranaki Offshore Partnership	1000	Taranaki	NZ Super Fund & Copenhagen Infrastructure Partners
Oceanex 1 – No announced name	1000	Waikato	Oceanex Energy
Oceanex 2 – No announced name	1000	Taranaki	Oceanex Energy
Oceanex 3 – No announced name	1000	Wellington	Oceanex Energy
Waikato Offshore Wind	810	Waikato	BlueFloat Energy, Elemental Group
South Taranaki Offshore Wind	900	Taranaki	BlueFloat Energy, Elemental Group
TBD – No announced name	TBD	Taranaki	Parkwind (Jera), Meridian
TBD – No announced name	TBD	TBD	Sumitomo Corporation

Table 1: Announced Offshore Wind Developments in New Zealand

[17] *https://www.afr.com/world/pacific/new-zealand-blackrock-in-1-9b-green-energy-deal-20230808-p5dury*

[18] *https://press.aboutamazon.com/2021/9/aws-to-open-data-centers-in-new-zealand*

[19] *https://news.microsoft.com/aotearoa-datacenter/*

4. NEW ZEALAND POLICY

4.1 Overview

New Zealand has recently had its first change of government since 2017, with a National-led coalition taking office effective 26 November 2023. Historically New Zealand has pursued ambitious policy goals, such as achieving net-zero long-lived gases by 2050, sourcing 50% of total energy consumption from renewables by 2035 and aiming for 100% renewable electricity by 2030. The new administration has signalled a shift in energy policy approach, while maintaining a fundamental drive towards the transition to renewable energy sources. This shift suggests a more measured strategy, with a target of doubling renewable energy generation by 2050, rather than aiming for 100% renewable electricity. It was anticipated that achieving the last 2-5% of the 100% renewable target would be challenging and cost prohibitive.

The Ministry of Business, Innovation and Employment (MBIE) is the key governmental body in charge of developing the offshore wind framework and to-date have released two consultations. MBIE have committed to releasing a unified New Zealand Energy Strategy by the close of 2024.

4.2 Energy Strategy & Policy

New Zealand's National party has announced 49 actions to be delivered in their first 100 days in office, of which the most notable for offshore wind include:[20]

- Cease work on the Lake Onslow pumped hydro scheme - a project pitched to solve the dry-year problem. This allows for increased renewable generation for offshore wind.
- Repeal the Spatial Planning and Natural and Built Environment Act and introduce a fast-track consenting regime.
- Begin efforts to double New Zealand's renewable energy production, including release of a national policy statement on renewable energy generation.

The National party has shown support for offshore wind with their 'Electrify NZ- Offshore Wind' policy statement. The statement outlines a goal to establish a simpler, more consistent approach to offshore wind regulation to promote certainty and competition, to keep electricity secure and to support a growing New Zealand economy. The document also outlines an intention to fast track the introduction of offshore wind permits so feasibility studies for offshore wind sites can get underway as soon as possible.[21]

The preceding government had pledged to establish a unified New Zealand Energy Strategy by the close of 2024, which would have set the direction and pace of change for energy required for a net-zero carbon economy by 2050. The energy strategy has underlying work streams which will be co-ordinated to support the pathway of the overarching energy strategy. MBIE conducted 5 consultations on those underlying workstreams in 2023 on:[22]

- a plan for managing the gas industry's transition to a low emissions future
- the Interim Hydrogen Roadmap, which sets out the Government's initial views on the future role of hydrogen in New Zealand, actions it is taking to support hydrogen uptake and areas for further consideration
- regulations to enable offshore renewable energy development
- market measures to ensure electricity is affordable, reliable and resilient as we transition to an expanded and more renewable electricity system
- how we will implement the Government's commitment to ban new fossil fuel baseload electricity generation.

It is anticipated that the new government will continue to progress the strategy in some form except for implanting a ban on fossil-fuel baseload electricity generation.

[20] https://assets.nationbuilder.com/nationalparty/pages/18468/attachments/original/1709865255/100-Day_Plan_Complete.pdf?1709865255

[21] https://assets.nationbuilder.com/nationalparty/pages/18445/attachments/original/1696539084/Offshore_Wind.pdf?1696539084

[22] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/new-zealand-energy-strategy/

4.3 Offshore Wind Framework

In the Emissions Reduction Plan May 2022, the Government committed to establish regulatory measures facilitating investments in offshore renewable energy. As a result, the MBIE is actively advancing a regulatory framework for offshore renewable energy. The Framework has undergone 2 public consultations in 2023 and is anticipated to be released late 2024. This framework is expected to operate alongside other existing regulatory frameworks including statutes under the Resource Management Act, Exclusive.

4.3.1 Permitting

Based on consultation the framework is anticipated to be;

- Similar to Australia's Offshore Electricity Infrastructure Act 2021 (OEI Act), which is essentially a merit based framework for licensing offshore renewable energy projects.
  - Unlike Australia, New Zealand will not declare offshore renewable energy zones, rather it will be at the discretion of the developer to choose a suitable area
  - At least for the initial process there will be a formal application round announced, essentially the starting gun.
- A 2-stage permitting process:
  - **Feasibility permits:** grant exclusive rights over a certain area for seven years to test an area's suitability for offshore wind including exclusive rights to apply for a commercial permit. Granted on a 'use-it-or-lose-it' basis.
  - **Commercial permits:** allow an offshore wind farm to be built. Commercial permits are issued after feasibility studies are complete and only to the holder of the feasibility permit for an area.
- A developer-led approach at least in the short-term to secure current investment interest, however a government-led approach would be preferable in the long-term.[23]

In addition to the MBIE feedback in February 2024, Minister for Energy the Honourable Simeon Brown stated at an energy sector breakfast "We're working quickly around having legislation in Parliament this year so that we can set up that regime as quickly as possible, so that we're able to align what New Zealand's ambitions are around offshore wind with Australia's so that we are able to enable that industry to be able to achieve economies of scale."[24] This could be of critical importance to UK entrants wanting to support the New Zealand offshore wind market as it would open the pipeline to Australia.

> **"We're working quickly around having legislation in Parliament this year so that we can set up that regime as quickly as possible, so that we're able to align what New Zealand's ambitions are around offshore wind with Australia's so that we are able to enable that industry to be able to achieve economies of scale."**
>
> **Honourable Simeon Brown, Minister for Energy**

[23] *"Developing a Regulatory Framework for Offshore Renewable Energy", Ministry of Business, Innovation and Employment, https://www.mbie.govt.nz/dmsdocument/26913-developing-a-regulatory-framework-for-offshore-renewable-energy-pdf*

[24] *https://www.russellmcveagh.com/insights/february-2024/new-zealand-s-offshore-renewable-regime-drawing-on-australia-s-approach*

4.3.2 Offtake & Funding

Whilst the government has not taken a formal stance on potential revenue stability mechanisms, like CFDs it has indicated there is a focus on fostering a developer-led renewables market, with the government playing a facilitating role, rather than solely relying on government-led initiatives involving funding, direction, and heavy regulation. MBIE in the briefing for the incoming Minster for Energy 27 November 2023, highlighted the importance of needing to get the settings right to ensure enough generation build takes place at pace including the consideration of de-risking measures such as power purchase agreements and contracts for differences to facilitate investment in new generation.[25]

A key point of concern is the government's current messaging that offshore wind will need to stand on its own against other renewable generation types. This indicates a desire to avoid revenue stability mechanisms, like CFDs. As can be seen in Figure 9, the unsubsidised LCOE of offshore wind sits significantly higher than other generation types, such as utility-scale solar or onshore wind. Despite these higher estimated costs, offshore wind brings additional advantages over other generation types which may justify additional support should the government value these additional merits as worthy of the investment. These merits include diversification, scaling opportunity and ability to compliment other intermittent renewable sources. A purely unsubsidised offshore wind framework is a key risk to its development in New Zealand.

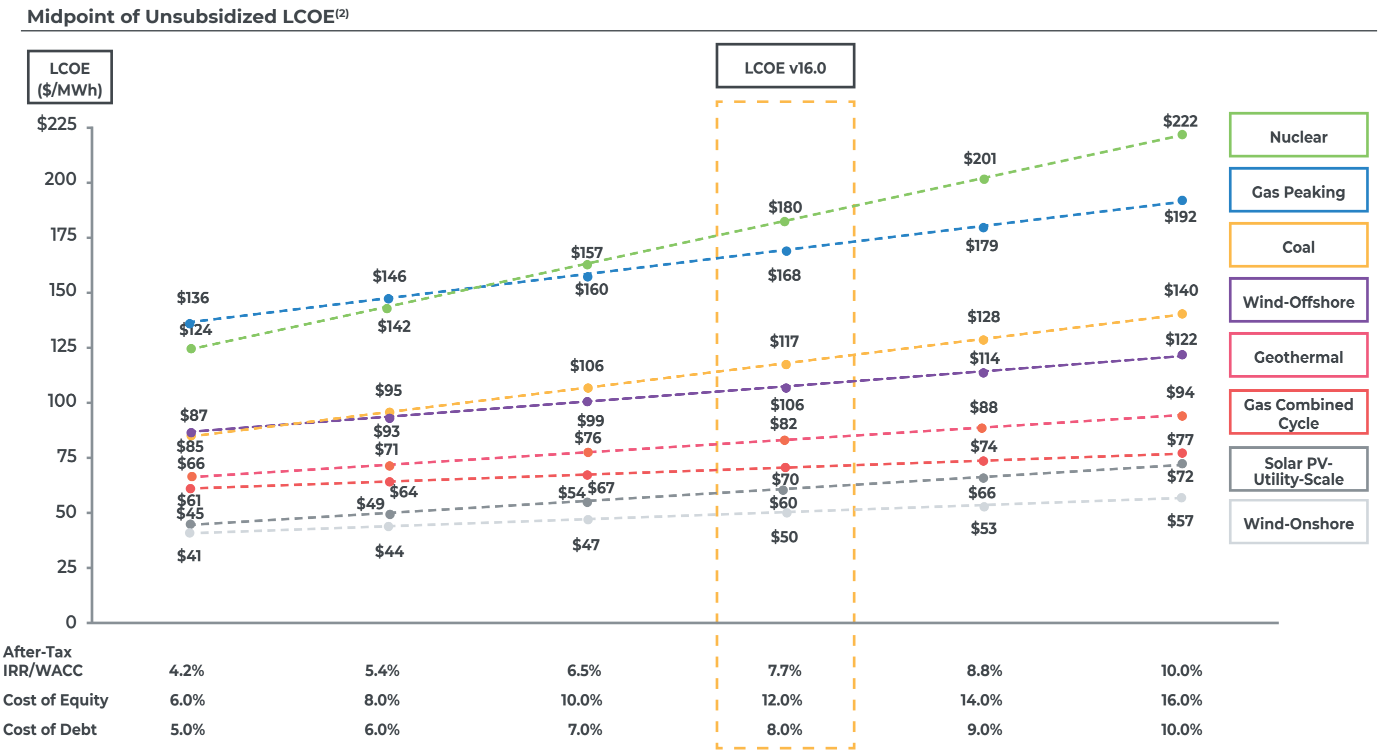


Figure 9: Comparison of LCOE for Various Generation Types[26]

[25] https://www.mbie.govt.nz/dmsdocument/27988-briefing-for-the-incoming-minister-for-energy-proactiverelease.

[26] Lazard LCOE+, April 2023, Lazard.

It is too early in the process and in the establishment of the new government to see this as an immediate deterrent, rather a collaborative journey between the government and developers to understand where the government is best placed to assist in de-risking the projects (financial stabilisation is just one risk) to ensure financial backing can be secured and the industry can succeed.

Project costs will largely impact the required support by government as well as the pricing of power purchase agreements needed to make a positive financial return on the project and pass a Final Investment Decision. The Australian Government has quoted the range of $4 to 5 billion cost for a one-gigawatt project.[27] Using Australian project costs as a yardstick, the NZ Government and developers will need to build a clear route to market to enable projects at this cost level and with headroom for uncertainties expected in a developing industry.

For the UK supply chain this gives a positive message that policy will be released to accelerate offshore wind, providing confidence that the market will develop and scale in line with forecasts. Details released to-date are only indicative and framework details will be formalised once it is officially release.

4.4 Foreign Investment & Trade

New Zealand's Ministry of Foreign Affairs and Trade (MFAT) define New Zealand as one of the most open market economies in the world.[28] As a country who are geographically dependant on trade, MFAT are a strong advocate for international trade rules which, alongside other governmental policies, support sustainable and inclusive economic development.

New Zealand welcomes foreign workforces and investment but prioritises local employment and upskilling. New Zealand has an experienced workforce through existing local industries such as construction, oil & gas, manufacturing and maritime which will have some transferrable skillsets needed to serve an emerging offshore wind industry, however new skillsets and international expertise will still be required. The New Zealand government recognises this by planning to align its offshore wind foreign investment policy with the existing Overseas Investment Act 2005 to ease the administrative burden and maintain legislative coherence.[29]

4.5 Unions

Industries such as maritime have a strong union representation through the Maritime Union of New Zealand (MUNZ). The MUNZ will likely be strong advocates of local crew, workforce and skills building for the offshore wind sector, using and improving on conditions in existing services.

[27] *https://www.dcceew.gov.au/energy/renewable/offshore-wind/building-offshore-wind-industry*

[28] *https://www.mfat.govt.nz/en/trade/nz-trade-policy/*

[29] *"Developing a Regulatory Framework for Offshore Renewable Energy", Ministry of Business, Innovation and Employment, https://www.mbie.govt.nz/dmsdocument/26913-developing-a-regulatory-framework-for-offshore-renewable-energy-pdf*

4.6 Resource Management Act

The Resource Management Act 1991 (RMA) is the governing document dictating the consent process for electricity generation in New Zealand. After only a brief tenure, in December 2023 the current government rolled back the previous Labour-led reforms and repealed the Natural and Built Environments Act 2023 and the Spatial Planning Act 2023 which has resulted in a return to the RMA as the key route for consenting projects.

The Nationals have recently introduced the 'Fast-track Approvals Bill' into parliament on the 7th March 2024. The bill aims to fast track the consenting regime for regional and national projects of significance, in recognition of a recent report by the Infrastructure Commission that shows the cost of consenting projects has increased by 70% and the time taken to get consent as increased by 150% since 2014.[30]

4.7 Māori Rights and Interests

The importance of Māori rights and interests in New Zealand is deeply rooted in the nation's history, culture, and legal framework. Māori are the indigenous people of New Zealand, and their rights and interests are recognised and protected by various laws and agreements, including the Treaty of Waitangi (Te Tiriti o Waitangi), which was signed between the British Crown and Māori chiefs in 1840.

In the development of the regulatory framework for offshore renewable energy MBIE has clarified that it does not intend to eliminate any legally recognized rights and interests held by iwi or hapū. These rights include those protected under the te Takutai Moana Act 2011, Ngā Rohe Moana o Ngā Hapū o Ngāti Porou Act 2019, and the Māori Fisheries Act 2004 in the formulation of offshore renewable energy policy. Moreover, the document outlines that one of the policy objectives is to facilitate Māori participation in a framework that acknowledges the Crown's obligation to uphold the principles of Te Tiriti o Waitangi / Treaty of Waitangi.[31]

It is imperative that UK entrants understand the cultural, spiritual, traditional and historical connections the Māori have to the moana (ocean) surrounding Aotearoa (New Zealand) and ensure the opportunity under development considers enabling iwi and hapū involvement and the creation of genuine economic opportunities for Māori.

[30] *https://www.beehive.govt.nz/release/one-stop-shop-major-projects-fast-track*

[31] *https://www.mbie.govt.nz/dmsdocument/26913-developing-a-regulatory-framework-for-offshore-renewable-energy-pdf*

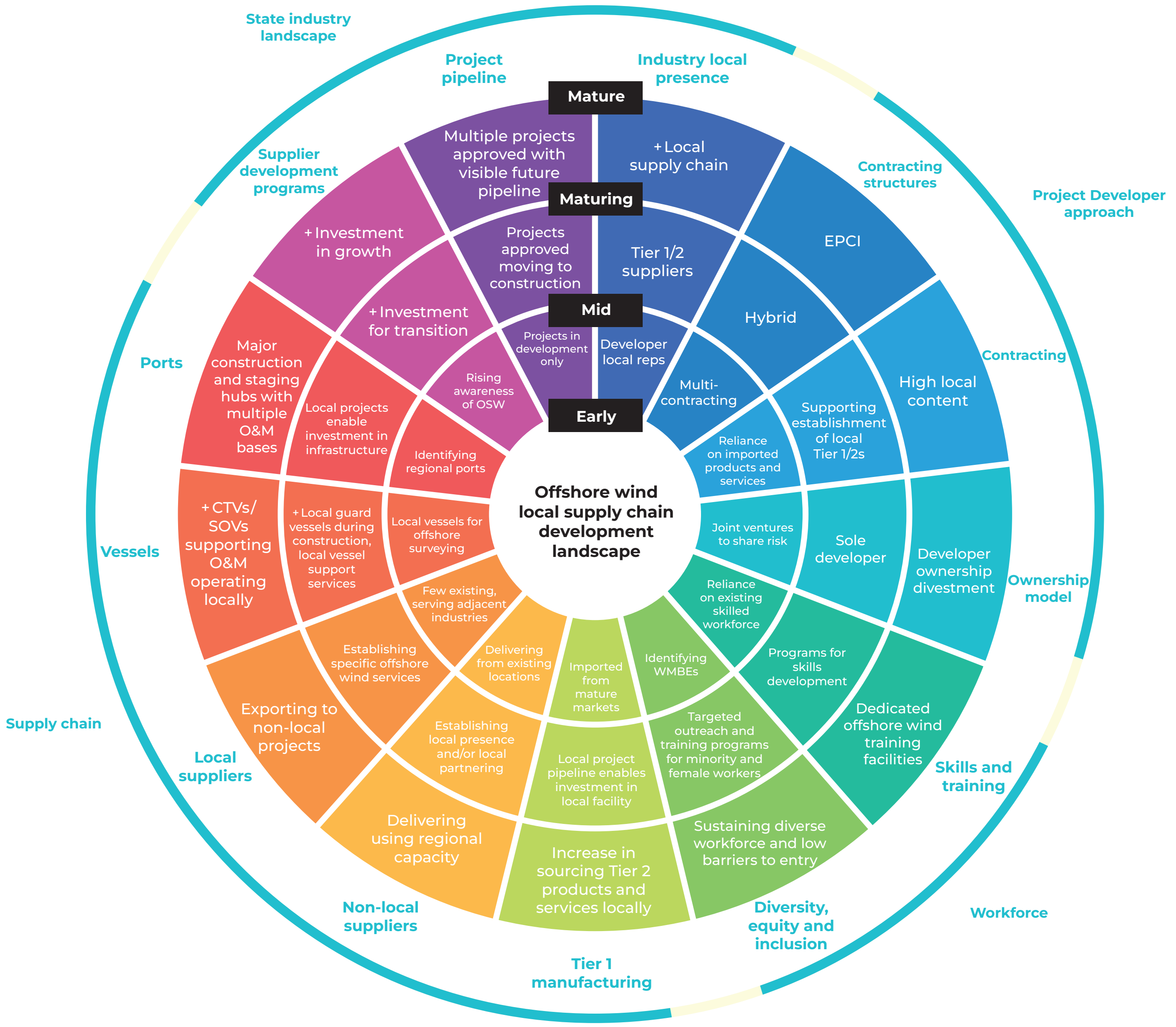
5. SUPPLY CHAIN STUDY

5.1 Overview

The offshore wind supply chain represents a network of interconnected industries and services dedicated to the development, construction, operations, and maintenance of offshore wind energy projects. This encompasses a diverse array of sectors, including manufacturing, transportation, installation, and operation and maintenance.

Figure 10 illustrates Xodus' overview of the local supply chain development landscape for offshore wind. It is important for UK entrants looking to enter the New Zealand offshore wind market to understand the complexities and inter-dependencies of the supply chain.

Figure 10: Xodus Offshore Wind Supply Chain Development Landscape



5.2 Approach

This study has broken down the offshore wind supply chain into its various sub-categories. For each sub-category the existing capabilities of both the NZ and UK supply chains have been assessed. This has been undertaken through external research and using internal knowledge bases. Each sub-category has been assessed and scored according to the criteria outlined in Table 2. Potential gaps and opportunities have been taken forward for further analysis.

Table 2: Supply Chain Assessment Scoring Criteria

SCORING APPLIED TO NEW ZEALAND COMPANIES	
Capability: ***What are the current capabilities in New Zealand?***	
Low	Supply chain does not exist to meet demand (No needs can be met)
Medium	Limited supply capability and capacity to meet demand in parallel sector, or workforce only (Some needs can be met).
High	Mature supply capability and capacity to meet demand (Most needs can be met).
Logic in Local Supply Chain: ***Is there any logic for local suppliers?***	
Low	Limited or no competitive advantage to local suppliers from either existing local supply capability or logistics benefit.
Medium	Some competitive advantage to local suppliers, either from existing local supply capability or logistics benefit, potentially high barriers for entry
High	Competitive advantage to local suppliers from strong local company experience and/or significant logistics benefit and low barriers for entry
Market Resilience: ***How much investment is required and how reliant on offshore wind is the sector?***	
Low	High Investment, with success likely to depend almost entirely on orders from the offshore wind sector.
Medium	Low investment, success will be partly dependent on order book from the offshore wind sector.
High	Low investment that can also meet demand from other major sectors with market confidence
SCORING APPLIED TO UK COMPANIES	
UK Capability to Support: ***What is capability of the UK in this area?***	
Low	Little or no current UK supply capability.
Medium	Some current UK capability, limited in experience and/or competitive position.
High	UK companies have strong experience and competitive offering in supplying to OSW projects.
UK Export Experience: ***What is the UKs experience of export in this area?***	
Low	Few or no UK companies have supplied to non-UK projects.
Medium	UK companies have some experience supplying non-UK projects.
High	UK companies are often contracted to supply non-UK projects.
UK Opportunity in NZ Market: ***How big is the opportunity for UK companies?***	
Low	UK companies face significant capability, logistics or competition challenges to supply NZ market.
Medium	UK capability could fill gap in NZ market, but competition or logistics may be barriers to entry.
High	Gap in NZ market could be filled by UK supply based on experience, track record or innovative offering

5.3 Limitations of Study

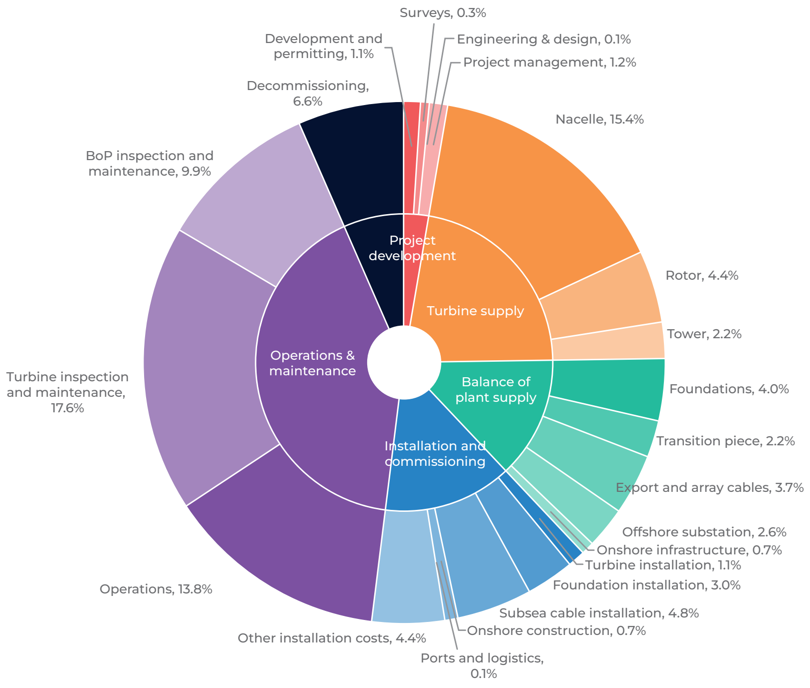
The following study provides a breakdown of the offshore wind supply chain. It has been segmented in to gain maximum insights from available information. Additional focus and granularity have been applied in areas where there are clearer opportunities for UK suppliers, specifically in the context of Tier 2 and 3 organisations. Conversely, less detail has been applied in areas with little to no opportunity for UK involvement. The list of possible providers for each of the below services is not exhaustive and is limited based on the scope of the work requested. There may be errors and omissions in relation to suppliers and detailed provision of services provided by each supplier.

Decommissioning is a crucial phase that warrants consideration however this report does not address decommissioning as projects will not approach this stage for approximately 40 years. Alignment of opportunities with UK suppliers will change over this time.

5.4 Project Breakdown

The capital expenditure (CAPEX) of a typical 1 GW fixed offshore wind project is expected to cost approximately AUD$5 billion[32] with the operating expenditure (OPEX) costing approximately AUD$200 million annually, assuming a 25-year design life. Overall, this results in a lifetime cost of around AUD$10 billion. The following figure represents an indicative lifecycle cost breakdown for a typical 1 GW fixed offshore wind project, showing the various supply chain sub-categories.

Figure 11: Indicative Breakdown of Offshore Wind (Fixed) Development Costs (Source: ORE Catapult, Xodus)



[32] *https://www.dcceew.gov.au/energy/renewable/offshore-wind/building-offshore-wind-industry*

5.5 Project Development / Management

Project development includes all work undertaken by the developer and the services contracted up until the project takes financial investment decision (FID) on the project. These various takes can be broadly broken down into:

- **Development and Consenting**
- **Resource and Metocean Studies**
- **Environmental Surveys**
- **Hydrographic and Geographic Surveys**
- **Engineering and Design**
- **Project Financing**
- **Insurance**
- **M&A**

In addition to the above it includes project planning, procurement, contracting and pre-construction support; and a wide range of other project management, consultancy and supporting services including legal, financial, and recruitment support. For a typical 1 GW offshore wind project developer typically spend A$250m prior to FID. Assuming a buildout of 2-3 GW could create a A$750m opportunity for New Zealand.

5.5.1 Development & Consenting

Development and consenting covers all the work required to design and develop the wind farm from inception until FID. For a typical offshore wind project this takes approximately 5 to 7 years. Offshore wind developers usually possess in-house capabilities around development management and supplement these in-house capabilities with external support from consultancies to cover the various specialties required to develop the full project.

The New Zealand Government is currently developing the regulatory framework that developers will govern offshore renewable developments. In addition to planning consents, a critical aspect of the consenting process is an Environmental Impact Assessment (EIA), which offers a comprehensive analysis of the project's potential effects on environmental and social receptors, aiding decision-makers in assessing project feasibility and identifying measures to minimize adverse impacts. An EIA relies on detailed analyses likely performed by specialist consultancies with local knowledge and expertise, complemented by international offshore wind farm-specific experience.

Throughout the development process, developers are obligated to seek the input of various statutory and non-statutory bodies and individuals. These include a wide range of government-appointed consultees, bodies, and authorities, as well as affected local authorities, those with an interest in the land and sea affected as well as local communities.

Supporting services to project development include legal, insurance and financial services, such as project financing support and mergers and acquisitions (M&A).

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	New Zealand possesses expertise in development, environmental studies, and regulatory approval processes in related fields like oil and gas, major infrastructure projects, and onshore wind. Consequently, it stands well-positioned to cater to this segment of the supply chain. Nevertheless, there may be a need to augment capacity based on anticipated project demands and specific experience in offshore wind farms. Locally based consultancies with global footprint may look to leverage expertise in overseas offices to support local projects.	Iwi Groups, WSP, ARUP, Wood, RPS BOFFA MISKELL, BCD Group, Mitchell Daysh, KPMG, Russel Mcveagh, MinterEllisonRuddWatts, Anderson Llyod, PWC
UK	UK companies have a strong record in development and consenting due to the UK's accumulated expertise in developing the world's second largest offshore wind generation capacity. In addition, the UKs legal and financial capabilities are extensive and have significant experience in managing the various legal and financial aspects of offshore wind development.	Xodus Group, Mott Macdonald, Natural Power Consultants, RPS Energy, Wood, Arup, WSP, Royal HaskoningDHV

5.5.2 Resource & Metocean

Resource and metocean campaigns are integral to offshore wind farm development, providing vital atmospheric and oceanographic data for the engineering, energy production evaluation and construction/operations and maintenance (O&M) planning of the windfarm. These datasets play a key role in de-risking engineering decisions and facilitating significant capital investment, while also guiding vessel selection and operational strategies during construction and operation phases.

Wind speed data is typically collected via a meteorological mast (Met Mast) or a floating LiDAR (FLiDAR) system. Wave and current data may also be collected through the FLiDAR unit or additional wave buoys. Additional information such as temperature, pressure, and humidity are also collected. Measurements are taken for a minimum duration of 1-year (typically 2-years) with the increased duration providing more confidence in the overall data collected. Validation of the equipment and data is a crucial for the project as it can directly influences the design certification and bankability of the final project. The number of Met Masts and FLiDARS is directly proportional to the size of the project and is influenced by various developer decisions.

New Zealand does not have LiDAR buoy manufacturing or supply companies, so they will be required to be imported, with the original equipment manufacturers (OEM) usually partnering with a local vendor for the logistics, operations, and maintenance of the unit.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	• No experience in the manufacture and supply of floating LiDAR buoys. • Beach Energy has agreed to install a LiDAR on its Kupe platform, offshore South Taranaki. • Taranaki offshore partner plan to deploy Floating Lidar supplied by Arkocean partnering with New Zealand Offshore services for the onshore and offshore logistics.	Metcom group, Energy3 Services, NRG systems, NZOS
UK	• The UK offers track record in the design, fabrication, installation and monitoring of resource measurement systems given its significant development pipeline and combination with overall project development services. Moreover, the UK is actively pursuing the expansion of its capabilities and the commercialization of Floating LiDAR Systems (FLS) technology. Roadmaps, such as those provided by the Carbon Trust, offer valuable industry-backed frameworks and incentives for FLS manufacturers aiming to achieve commercial success.	ZX Lidars, RPS, SeaRoc Group, Fugro, Radtech, Partrac

5.5.3 Environmental Surveys

Environmental surveys are conducted to determine the impacts of a wind farm on its surroundings, establishing baselines for assessment and enabling impact modelling. These surveys occur both onshore and offshore and include bird, fish, marine mammal, and habitat studies, among others. They may take 2 years or more to gather sufficient data for consent applications. Vessels and/or aircraft are employed to collect data on species distribution, density, diversity, and numbers.

Environmental surveys are typically undertaken by local companies because there are usually sufficient local expertise with site specific knowledge of potential for the wildlife impacts. Some environmental surveys are usually performed during the geophysical and/or geotechnical surveys, to capitalise on the synergy of an availability of vessel to perform the required works.

Whilst the UK has extensive experience in environmental surveys, New Zealand's biodiversity is substantially different and local Iwi groups and companies with innate understanding of New Zealand's flora and fauna will be best placed to inform these surveys.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	New Zealand companies possess expertise in conducting ecological investigations, assessments, evaluations, and monitoring for various coastal and marine projects and developments. These projects encompass a diverse range of activities such as wastewater treatment plant discharges, industrial discharges, reclamation, dredging, oil and gas facilities, electricity generation, and port developments.	Iwi groups, NIWA, Robertson Environmental, Ecology New Zealand, Cawthorn Institute, University of Otago
UK	UK companies are among the market leaders in undertaking environmental survey work for UK offshore wind farms. UK companies have benefitted from the pre-eminence of the UK offshore wind market.	APEM, ERM, RPS, ESS Ecology, Thomson Ecology

5.5.4 Geological & Hydrographic Surveys

Seabed surveys are crucial for assessing the condition of the seabed at potential wind farm development sites and along export cable routes, with a particular focus on geological conditions and engineering requirements. This data serves as a vital input for various engineering and environmental assessments during the design and development phases. The surveys typically involve 2 main aspects: geophysical surveys, which focus on mapping seabed features, and bathymetry and geotechnical surveys, which examine the physical characteristics of the seabed. These surveys are instrumental in optimising foundation design, refining wind farm layouts, and reducing risks during installation activities.

Geophysical surveys aid in establishing seabed bathymetry, identifying seabed features, and detecting potential hazards such as unexploded ordnance.

Conversely, geotechnical studies employ intrusive techniques like boreholes and cone penetration testing to assess soil/rock properties. The technical methodologies closely align with those used in sectors like oil and gas and require specialized equipment and skilled personnel.

Surveys are typically conducted by domestic companies, partly due to the availability of local resources and partly because certain impacts are site-specific, necessitating detailed local knowledge and expertise. Geophysical vessels are expected to be supplied by the New Zealand market. Geotechnical survey vessels are likely to come from the relatively small pool of global specialist geotechnical vessels, or larger DP2 (dynamic positioning) vessels in the APAC region which are equipped with portable remotely operated subsea drilling units.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	• New Zealand has experience in onshore and nearshore surveys, with some additional experience derived from the Oil and Gas industry in the offshore sector. Local organizations possess the experience and capability to execute most of the services, although specialist international support may be necessary for certain areas and for geotechnical vessel supply.	Southern Express, Offshore & Coastal Engineering, NZ Offshore Services, NIWA, Fugro NZ, ENEGO, DML
UK	• Strong capabilities in the UK for offshore survey activities across the offshore wind and oil and gas market. Geotechnical vessels generally non-UK flagged, but with project management and logistics support sourced locally, with local UK offices for key companies such as Fugro and GEOxyz. (note: ground modelling and analysis is considered part of engineering and design)	Fugro, Gardline, GEOxyz, Ocean Infinity, Sulmara

5.5.5 Engineering & Design

The engineering and design phase spans from concept inception to FID and involves multi-disciplinary efforts. Typically beginning with concept development and pre-Front-End Engineering and Design (FEED) studies, during which multi-criteria assessments, desktop studies, and optioneering are undertaken to provide early concept definition, parameters, and site envelopes.

These initial studies are pivotal as they provide essential information on key development considerations, such as preliminary energy yield, capacity factors, and costs, necessary for understanding the early levelized cost of energy (LCOE) and informing the EIA.

A project will then advance into FEED studies, refining the wind farm design and informing aspects of a investor's business case required for FID. Key considerations during FEED include wind turbine selection (including size, foundation type, quantity, etc.), grid connections, onshore and offshore substations, cable systems, and installation methodologies. The design will also require certification and validation to demonstrate that work has been carried out to the accepted standards. Assuming FID is taken, FEED studies facilitate the procurement, contracting, detailed design and the construction phase of the wind farm.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	• New Zealand companies lack direct experience in the design of offshore wind farms. However, they do have experience in parallel sectors such as onshore wind farms and energy infrastructure. Additionally, some New Zealand companies have parent companies based in the UK or internationally, which possess offshore wind experience	Aurecon, Bureau Veritas, COWI, Fugro NZ, Jacobs, Kent PLC, Logicamms, Wood BECA, Worley, WSP
UK	• UK companies have played a predominant role in designing the majority of wind farms installed within the UK. While the level of UK contribution to in-house design work varies, it tends to be substantial for UK developments but comparatively lower for overseas developments. • Floating wind Technology development. UK is focused on supporting companies develop floating wind technology, aiming to continue to be a market leader in this area, specifically with Scotland being a front runner in floating wind deployment. This includes various components within floating offshore wind, with particular capability on the mooring and anchoring design side.	Xodus Group, Wood Thilsted, Kent PLC Arup, DNV, Gavin & Doherty, Mott MacDonald, ODE, OWC, Atkins, Ramboll UK, Wood Wood Thilsted, Xodus Group, Aker Solutions, AWC Technology, Buoyant Production Technologies, London Marine Consultants, Marine Power Systems

Large developers typically maintain in-house teams for the concept and pre-FEED phase, subcontracting only when local knowledge is needed or when they face resource constraints. In contrast, smaller developers are more likely to subcontract a significant portion of this phase to consultants. The FEED phase, on the other hand, is typically contracted out to specialist engineering firms in the relevant field.

5.5.6 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
DEVELOPMENT AND PROJECT MANAGEMENT	Development and Consenting	Medium	High	High	High	Medium	High
	Resource and Metocean assessment	Existing	High	High	High	Medium	High
	Environmental Surveys	Medium	Medium	Medium	High	Medium	Medium
	Geological and hydrographic surveys	Medium	Medium	Medium	High	High	Medium
	Engineering and Design	Medium	Medium	High	High	High	High
OVERALL	High Potential						

5.5.7 UK Export Opportunity

The UK possesses significant export potential in development and project management services. This potential is underpinned by the UK's vast experience in developing the world's second largest offshore wind generation capacity.

Moreover, there are minimal logistical and financial barriers for UK companies to enter this market. This opportunity is reinforced by New Zealand stakeholder sentiment summarised by MBIE's public consultation for offshore renewables.[33]

Key feedback to this study presented strong support for offshore renewable energy developments, a robust regulatory framework with an emphasis on Iwi involvement and environmental protection, noting that a streamlined consenting framework is ideal. This feedback places a clear need for UK capabilities to support New Zealand and some example opportunities are listed below.

Policy and regulatory framework: A significant prospect arises from New Zealand's status as an emerging market. The UK government, along with seasoned UK consultants who have undergone leasing rounds and gained valuable insights and experience within the UK regulatory framework, leasing application preparation and CfD auctions., now has the chance to export this expertise to New Zealand governing bodies and developers. This information could assist the NZ government to establish and streamline the offshore wind development framework, facilitating efficient consenting processes for offshore wind projects.

Industry Collaboration: Collaboration between government, industry and other stakeholders has been instrumental in advancing offshore wind development in the UK. New Zealand stakeholders have contributed to public consultation unanimously agreed that collaboration and resource sharing in necessary in at least the short-term.[34]

Partnerships and initiatives focused on skills training and supply chain development have supported industry growth in the UK. An opportunity exists to establish a collaboration between the UK and New Zealand, which would allow Small to Medium Enterprises to connect and share understanding of supply chain opportunities and challenges. This would enhance the opportunity for export and increase confidence in the NZ market. A similar lessons-learned approach can be taken in relation to environmental data management, where the UK has sought to streamline access to information and environmental impact outputs in recent years. An example of this is the Crown Estate's Offshore Wind Evidence & Knowledge Hub.

Research and Development Collaboration: UK research institutions, universities, and technology centres can collaborate with NZ counterparts on offshore wind research and development projects. This may involve joint research initiatives, knowledge exchange programs, and collaborative funding opportunities to advance innovation in offshore wind technologies and practices. There are several industry initiatives exemplifying this in the UK, including ORE Catapult, the Carbon Trust and the offshore wind growth Partnership.

[33] *'Enabling investment in offshore renewable energy', Ministry of Business, Innovation & Employment, https://www.mbie.govt.nz/dmsdocument/27251-summary-of-submissions-enabling-investment-in-offshore-renewable-energy-december-2022*

[34] *'Enabling investment in offshore renewable energy', Ministry of Business, Innovation & Employment, https://www.mbie.govt.nz/dmsdocument/27251-summary-of-submissions-enabling-investment-in-offshore-renewable-energy-december-2022*

Project Management and Consulting: Key to maximising the UK opportunity in this area is forming partnerships with capable but lesser-experienced companies in offshore wind, but who have relevant local knowledge of the regulatory frameworks, consenting processes and local stakeholders. Companies with established offices in New Zealand for alternative sectors, and who have UK head offices with wind experience, will be at an advantage in this market. Alternative key areas include support for site assessment, spatial planning, identifying and understanding site constraints and development risks as well as supporting early site concept development.

Floating LiDAR Technology: the UK has an innovative supply chain capacity to enhance FLiDAR System (FLS) technology and improve export opportunity, and New Zealand is a potential export opportunity. For example:

- Worcestershire-based ZX Lidars, supplying sophisticated measurement systems into the offshore wind industry.
- Partrac, based across the UK, which undertakes complex survey and metocean study services, supplying important data for clients to make informed investment decisions.
- UK-based company RPS has partnered with Norwegian energy company Equinor to develop FLiDAR systems for US offshore wind farm research and these same opportunities exist in NZ.

Pre-Feed and FEED: Understandably, NZ suppliers lack OSW specific experience. While in some areas the experience from the oil and gas sector and energy generation is transferable, an adaptation period will be needed and there is unlikely to be enough demand to establish dedicated offshore wind design houses. UK companies with an established footprint in New Zealand for an alternative sector should be able to maximise the opportunity to provide this service.

Environmental and Stakeholder: The UK possesses significant expertise in surveying techniques, environmental data assessment, and understanding the risks and mitigations related to offshore wind turbines. Equally crucial is the UK's experience and knowledge in collaborating with fishing groups and exploring the potential co-location of wind farms with other sectors. Given New Zealand's unique biodiversity and cultural influences, partnering with local Iwi and other sources of indigenous knowledge becomes essential. The opportunity for the UK lies in forming collaborations in New Zealand to apply methodologies, share lessons learned, and integrate actual operational data, adapting their expertise to the specific context of New Zealand.

Finance: Providing finance out of the UK for development projects could unlock the export potential into New Zealand. For example: UK Export Finance provided a £200 million buyer credit guarantee to help finance the Greater Changhua 1 Offshore Wind Farm in Taiwan,[35] unlocking the export potential of the UK's offshore wind sector. Renewable energy companies Seajacks and Trelleborg's applied technologies operation in the UK capitalised on the UK financing support by winning export contracts with Ørsted, the company leading the development of the wind farm. Further opportunities exist in insurance and project financing, including M&A. The UK, particularly London's finance sector, has extensive experience in supporting offshore wind developments. Within the mergers and acquisitions field there are opportunities for UK companies to support this process providing technical and environmental support. For example, Xodus acted as technical and environmental advisor to Stonepeak on the $3billion acquisition of 50% of Virginia Offshore Wind.

[35] *https://www.ukexportfinance.gov.uk/success-stories/powering-offshore-wind-potential/*

Floating Wind Technology Development: With the majority of New Zealand's offshore Exclusive Economic Zone (EEZ) technically suitable for floating wind development, this provides an export opportunity for UK companies, with respect to technology development, IP and know-how in de-risking floating offshore wind development.[36]

The UK is investing over £60 million in floating offshore wind projects to pioneer technology for locating turbines in the windiest coastal regions. This funding will accelerate research and development, focusing on areas like turbine mooring, undersea cabling, and foundation solutions. The aim is to reduce costs and stimulate the growth of the UK's supply chain through the Floating Offshore Wind Demonstration Programme.

Below are some of the recipients of funding from the Floating Offshore Wind Demonstration Programme UK of which their expertise could potentially aid New Zealand in establishing its own floating offshore wind industry.[37]

- SenseWind (Cambridge), Geodis FF (Feltham), Xodus Group (Aberdeen) and the Offshore Renewable Energy Catapult (Blyth): Combining a compact floating foundation with a novel anchoring system attaching it to the seabed and advanced monitoring technology that allows for maintenance to be planned and performed offshore, saving on costs of towing back to shore. A 2 MW or larger turbine will be demonstrated in UK waters.
- Copenhagen Offshore Partners (Edinburgh), SSE Renewables (Belfast), Maersk Supply Service Subsea (London) and Bridon Bekaert Ropes Group (Doncaster): Develop and demonstrate new mooring system technologies, cable protection, floating turbine base design and an advanced digital monitoring system.
- Marine Power Systems (Swansea): Develop a floating foundation with a small footprint and integrated wave energy generator to improve power quality.

[36] *Offshore Wind Technical Potential in New Zealand', GWEC, https://gwec.net/wp-content/uploads/2021/06/New-Zealand_Offshore-Wind-Technical-Potential_GWEC-OREAC.pdf.*

[37] *https://www.gov.uk/government/publications/floating-offshore-wind-demonstration-programme-successful-projects*

5.6 Wind Turbine Generator

The wind turbine generator (WTG) is typically the highest single cost component of the project accounting for about 25% of the project cost. The current power rating of offshore turbines today typically ranges between 10 to 13 MW, with rotor diameters reaching up to 220 meters. This rating has seen significant growth in recent years and is predicted to continue expanding, with prototypes of 14 MW to 20 MW already announced.

The WTG will be supplied by a Tier 1 supplier responsible for designing and manufacturing the wind turbine nacelle, blades, and tower. Currently, there are 3 US and European suppliers (GE Renewable Energy, Siemens Gamesa Renewable Energy (SGRE), and Vestas), along with approximately 10 Asian suppliers (Goldwind, MingYang, CSSC Haizhuang, Dongfang Electric Corporation, Shanghai Electric, XEMC Windpower, Envision, Doosan, Hitachi, and Sinovel).

Fixed and floating wind projects generally employ the same design concept, with only a few variations to account for potential fatigue due to the motion and dynamics of floating turbines. Turbine suppliers typically operate one or 2 assembly and blade manufacturing facilities which service an entire region. Further investment in facilities requires a strong project pipeline to ensure future supply capacity due to the large overhead costs involved.

5.6.1 Nacelle, including Hub & Generator

The hub serves to support the rotor blades of the wind turbine while the nacelle houses all the generating components responsible for converting the rotor's mechanical power into electrical energy. Prior to assembly, the nacelle requires the sub-supply of various components, including the bedplate, gearbox, driveshafts, generators, power take-offs, pitch and yaw bearings, main bearings, nacelle and hub casing, pitch and yaw drive systems, control cabinets, cooling systems, lighting, and anemometry. The hub is typically assembled as a unit with the nacelle and testing by the wind turbine supplier at an onshore assembly area before dispatch.

Currently, there are no Tier 1 WTG OEMs manufacturing nacelles in the UK. However, the 3 European suppliers have announced plans or shown interest in establishing operations in the UK. Additionally, there are several Tier 2 subcomponent suppliers in the UK that have established relationships with the OEMs.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	New Zealand has no experience in the supply of Nacelles, with all onshore WTGs being imported to date.	Nil
UK	The UK does not have any Tier 1 suppliers, however there are several UK companies that supply the sub elements of the nacelle to WTGs suppliers.	Schaeffler, Moventas ABB UK, FT Technologies, Palfinger

5.6.2 Rotor / Blades

The rotor design typically features an upwind turbine design with variable-speed rotors, a hub casting, blade systems, and bearings, usually consisting of 3 blades ranging in length from 90m to 110m, and a pitch system. Blade manufacturing involves the supply of resin, including fiberglass, epoxy resin, carbon fibre, and polyester resin, along with coatings, lightning protection systems, blade bolts, and sensors.

Most offshore blades are manufactured in-house by the turbine manufacturer, with only a few choosing to subcontract the blade manufacturing process to specialist manufacturers such as LM Wind Power in the UK, a leading supplier of rotor blades to the wind industry. Currently, there are only 3 blade manufacturing facilities operating in the UK, primarily supplying the domestic market.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	No Local capabilities, to date all onshore wind farms have had the blades imported.	Nil
UK	The UK has experience and capability in offshore wind blade manufacturing with 2 existing large-scale facilities in operation in Hull and on the Isle of Wight.	SGRE, Vestas

5.6.3 Tower

Wind turbine towers are tapered cylindrical-shaped steel structures designed to support the nacelle and rotor blades of the turbine, providing internal and external access to the nacelle while housing essential safety, electrical, control, and emergency equipment. Tower manufacturing is a multistep process that requires rolling, welding, and coating of steel plates for the main structure, as well as the installation of interior access systems such as ladders, platforms, lifts, lighting, control panels, emergency systems, and health and safety equipment.

Tower designs will differ depending on the type of foundation (floating or fixed bottom), and can have a base diameter of up to 10 m and heights that can reach over 130 m. Although the tower is typically included in the WTG OEM Tier 1 supply package, it is designed and manufactured by a subcontractor of the Tier 1 supplier.

The supply for towers is anticipated to originate from APAC or be localised in New Zealand for the secondary structures. The UK market will directly compete with the APAC region to supply towers, which, being geographically closer, possesses the capacity, capability, and experience required.

Towers are also a low margin commodity and the APAC region offers a cost competitive solution in comparison to European or UK providers. Due to the relatively uncomplicated nature of tower fabrication, there is also potential for localising the supply. However, as the process is highly automated and requires significant investment to establish, it is anticipated that the localised supply will mainly cater to Tier 2 elements for fitting out the inside of the tower.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	No experience in tower manufacturing; all onshore wind towers are currently imported. However, secondary steel and sub-element supply may be possible through numerous steel fabricators in New Zealand.	John Jones Steel, NZ MEP fabricators, Brightwater Steel, Tiara, Dialog Fitzroy, Eastbridge, Steel & Tube
UK	The UK has limited experience in tower manufacture with its sole provider CS Wind closing operations several years ago. Recent investment plans have been paused until further confirmation for a firm capacity pipeline, with facilities to likely focus on nacelles and blades rather than steel towers. There are limited companies that supply the secondary steel elements. There are several companies that provide the safety and access systems.	Hutchisons Engineering, Limpet Technology, Avanti, Uniline, Latchways

5.6.4 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
WIND TURBINE SUPPLY	Nacelle, Hub and Assembly	Low	Low	Low	Low	Low	Low
	Blades	Low	Low	Low	High	High	Low
	Tower	Medium	Low	Low	Medium	Low	Low
OVERALL	Low Potential						

5.6.5 UK Export Opportunity

UK suppliers currently face limited export opportunities for supplying WTG's to the New Zealand market. This is due to the UK's relatively low market share in major wind turbine component manufacturing, except for blade manufacturing. However, this scenario could evolve in the future with the commitments outlined in the Offshore Wind Sector Deal.

This deal aims to increase UK content to 60% by 2030, making offshore wind turbine manufacturing crucial to achieving this target. Consequently, each of the 2 major European offshore wind turbine OEMs has either established, or plans to establish, manufacturing facilities in the UK. Whether these facilities will address supply shortages in New Zealand projects remains at the discretion of the OEM, which may opt to provide supply from various European or APAC manufacturing locations that offer closer proximity. It is anticipated that the UK component manufacturing will remain directed at the UK capacity pipeline and wider European opportunities.

Export opportunities in this sector may arise for UK companies which are established sub element suppliers, such as FT Technologies, the leading supplier of sensors for offshore wind turbines. Additionally, should UK companies currently innovating disruptive technologies—such as lightweight blades and ferrite-based direct-drive permanent magnet generators—advance beyond their current low-medium technology readiness level, they would have a global export market including opportunity in New Zealand.

5.7 Foundations

Foundations are used to support the wind turbine and secure it to the seabed. They also act as a conduit for the electrical cables and providing access for technicians and other offshore personnel to transfer to and from vessels. There are many variations of foundation design which are either fixed or floating.

Foundations are typically supplied via an EPCI (engineer, procure, construct, and install) contractor or directly through a steel or concrete fabricator. Most foundation types have a transition piece which is the upper part of the foundation. The foundations are large procurement components of the project and typically account of 5-20% of project CAPEX depending on whether fixed or floating.

Secondary steelwork is typically required for the foundation which can include access platforms, vessel landings, internal and external work areas, cable entry points and corrosion protection systems. Secondary steel work is typically provided by Tier 2 or 3 subcontractors.

5.7.1 Fixed Foundations

An offshore wind fixed foundation is generally used for a project that is installed in relatively shallow waters, up to around 60-80 m water depth, after which floating wind foundations are typically introduced. There are several types of fixed foundations including monopile, gravity base and jacket.

Monopiles are typically the foundation of choice up to 50 m water depth in soft soil conditions due to ease of installation and cost competitive fabrication. Supply of monopile foundations includes manufacture of relatively simple, but large, cylindrical steel structures. Supply of steel transition piece structures between the monopile foundation and the turbine requires sub-supply of secondary steelwork such as work platforms, boat landing systems, ladders, guardrails, cranes, and j-tubes for cables. The APAC region and Europe currently dominate the supply market through established designs and automated fabricated processes.

Jacket foundations are found in deeper waters up to approximately 80 m in sand, clay, or gravel soil conditions. In water depths exceeding 60-80 m analysis is required to approximate the appropriate transition to floating foundations This analysis is complex and dependant on many site-specific conditions. The estimates provided here are only indicative for this study.

Jacket foundations typically generate greater local content opportunities, due to large labour requirements in the assembly and manufacturing process. In the assembly process, jacket structures require the supply of steel lattice, struts, and nodes as well as sub-supply of components for an integrated transition piece. Jacket foundations also require sub-supply of steel pin piles or suction caissons to secure the structure to the seabed. If jacket offshore wind projects emerge in New Zealand, supply looks to be met by APAC, European and Middle Eastern assembly yards before local content can be established. Lowest cost for pin piles is likely to arise from APAC region.

Gravity base structures are employed in exceptionally challenging seabed conditions where conventional methods such as driving, drilling, or suction installation fail to anchor the substructure securely. These structures, significantly heavier than monopiles and jackets, are mainly feasible up to a maximum water depth of around 40 m. They typically comprise a combination of concrete and steel, ballasted to maintain stability. Due to their size and transportation complexities, gravity base structures are usually fabricated near their deployment sites. While this enhances local involvement, it also poses logistical and installation challenges.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	No specialist foundation capabilities exist in New Zealand however the country has a steel manufacturing industry that allows it to be self-sufficient on current steel demand. All existing O&G facilities in Aotearoa New Zealand have been fabricated overseas . The barriers to entry including cost to establish commercial scale manufacturing facilitates capable of mass serial manufacture, seem insurmountable due to the relatively low GW buildout predicted in NZ, relative to the estimated 1 to 2 GW annual throughput to sustain the economics of a typical fabrication facility. It is envisaged that opportunities exist for NZ to take part in fabrication of secondary and tertiary steel components on these larger structures, of which is still a substantial supply element.	Nil for Tier 1 supply Tier 2 / 3 supply Brightwater Steel, Dialog Fitzroy, Steelcraft
UK	The UK has the capabilities to deliver OSW foundations both jackets and monopiles however historically the trend has been towards the UK struggling to compete in terms of cost with European, Middle Eastern and APAC facilities. Recent Government initiatives are attempting to bring fabrication back to the UK. Additional capabilities lie in the secondary steel and transition piece space. It was recently announced the UK will be home to the world's biggest XXL monopile facility when it comes online in 2024. This facility, owned by SeAH, will produce monopiles up to 120m long, 15.5m in diameter and weighing 3000tons. It will be able to deliver up to 200 monopiles a year.	Harland & Wolff, Global Energy Group, Smulders, SeAH, Wilton Engineering, Harper UK, Texo Group

5.7.2 Floating Foundations

Floating foundations are suitable for water depths that exceed approximately 60-80m. Floating offshore wind allows developers to target areas where wind speeds are typically higher and the socio-environmental impacts are reduced. In water depths unsuitable for fixed foundations, floating foundations are selected.

Being less dependent on water depth floating foundations have the potential to provide access to a larger ocean surface space which allows developers to target areas with higher wind speeds and less potential socio-environmental impacts. The different types of floating foundations include semi-submersible, spar-buoys, tension leg platform, and barges. Floating foundations work by providing buoyancy in conjunction with the mooring system to keep the turbine in place and within the motion dynamics of the structure.

Floating foundations are much more complex than fixed foundations. Floating wind foundations rely heavily on complicated analysis and design to ensure lifelong suitability to the harsh environment they are situated in. Floating foundations can be made primarily of steel or concrete with varying requirements for each foundation type.

The structures are large and complex which require significant design, fabrication, and construction experience to deploy. From a design point of view floating wind technology developers are located worldwide and deploy their solutions through the deployment of intellectual property (IP). The fabrication of the foundations requires significant infrastructure including large quantities of steel/concrete, space, and a technically skilled workforce to deliver the structures.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Similar to jacket-type structures above it is unlikely that NZ would be able to compete based on experience and likely cost. Opportunities likely to exist around the assembly as well as the secondary or tertiary fabrication scopes that would accompany the larger primary fabrication scopes.	Nil
UK	To date no floating foundations have been deployed out of the UK with all existing floating foundations fabricated abroad and towed in. With the increase in the floating pipeline (mainly ScotWind and the Celtic Sea) several UK facilities are gearing up to be ready to meet the needs of this, such as the likes of Global Energy Group. Key areas for investment remain the Port of Nigg and Port of Cromarty Firth.	Global Energy Group, Harland & Wolf, Harper UK, Texo Group, Wilton Engineering

5.7.3 Floating Mooring Systems

Floating offshore wind turbines require mooring systems to secure the floating foundation to the seabed to ensure stability of the entire structure. Using the same design technology used in the offshore oil and gas sector, the mooring systems are selected to meet wave height, water depth, and turbine load requirements. Mooring systems are generally made up of several components including anchors, mooring lines, topside connections, and mooring line attachments known as jewellery (i.e., clump weights, H-links, In -line tensioners, load reduction devices, etc). Mooring lines are typically made up of chain and/or fibre rope.

Mooring systems for floating offshore wind turbines share an overlap in the supply chain with offshore oil and gas, as well as shipbuilding industries as they use similar systems. It is expected that catenary mooring systems made up of chain or hybrid of chain, wire, and synthetic rope will be the first mooring systems utilised for floating offshore wind. As project sites get deeper, and the drive to reduce LCOE continues, it is expected that synthetic ropes and semi-taut systems will begin to dominate the market but requires an increase in the technology readiness level.

The UK has a well-established mooring supply industry capable of exporting. However, the APAC region is likely to outcompete in the supply of chain and heavy steel components due to cheaper manufacturing costs and shorter logistical distances to New Zealand. Some UK providers of heavy mooring equipment have established manufacturing facilities in the APAC region and are likely to continue supplying through these facilities. Some UK providers of heavy mooring equipment have established manufacturing facilities in the APAC region – for example Griffin-Woodhouse and Bridon-Bekaert - and are likely to continue supplying through these facilities.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Non-existent.	Nil
UK	Established on the back of the oil and gas industry. The UK has high capability and capacity to provide mooring and anchor system support, including synthetic mooring line supply from Bridon-Bekaert, engineering and design services, and anchor selection and manufacturing scopes.	Bridon Bekaert, Bruce Anchor, Deep Sea Mooring, First Marine Solutions and InterMoor, Griffin-Woodhouse, Wilton Engineering, Texo Group and Harper UK for local anchor and steel fabrication

5.7.4 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
FOUNDATION SUPPLY	Fixed Foundations	Low	Medium	Low	Medium	Medium	Low
	Floating Foundations	Low	Medium	Low	Low	Low	Low
	Floating Mooring Systems	Low	Low	Low	High	High	High
OVERALL	Medium Potential						

5.7.5 UK Export Opportunity

Fixed Foundations
The UK has the current offerings to support the New Zealand offshore wind energy with detailed design of fixed foundations.

If new manufacturing facilities are established in the UK, supporting XXL monopiles and jacket, export of foundations to NZ would be at the discretion of to the OEM. However, this may be unlikely due to the APAC region being cost competitive and geographically closer to NZ, easing transport and logistics costs. The opportunity for UK suppliers to tap into the New Zealand market may lie in providing Tier 2 and 3 supply elements through establishing a joint venture between UK suppliers and local New Zealand companies. This approach would enable the fulfilment of local content needs and the transfer of intellectual property from the UK, such as the design and manufacture of davit cranes and transition piece ancillary components.

Additionally, UK suppliers could offer support to existing New Zealand fabrication yards seeking to enhance their capabilities for serial manufacturing, including assistance with factory design and innovative practices like robotic welding.

Floating foundations
While there may be opportunities to capture floating foundation design experience and to support the New Zealand market with detailed design, the feasibility of substructures being fabricated in the UK and transported to NZ is limited. Structures would need to be in smaller modular components to ease transport for final assembly in NZ.

Given the strong competitiveness of the APAC region for fabrication in this space, UK suppliers will face significant challenges in exploiting opportunities for this supply category. However, any UK company owning the design would enable an opportunity for UK companies to act as technology licensors to manage this scope of work and form a partnership with a local NZ company for final assembly.
As with fixed offshore wind, the opportunity for UK suppliers to tap into the New Zealand market may lie in providing Tier 2 and 3 supply elements through establishing a joint venture with a local New Zealand company.

Mooring Systems

In addition to detailed design, the UK's existing capability and track record in exporting mooring and anchor equipment and solutions to the offshore energy and floating offshore wind sector opens up the export opportunity to NZ. The cost of transport for these components is reduced due to the size of the equipment, allowing for a large shipment of components, as well as existing engagements with Tier 1 companies in the sector. There is a strong opportunity for UK companies with existing manufacturing facilities in the APAC region to engage in NZ as a new market, particularly in conjunction with floating offshore wind opportunities in Australia.

5.8 Cables

Cables are used to deliver power from the offshore wind turbines, through the offshore substation, to the onshore substation. They also provide auxiliary power to the wind farm and provide fibre communications. Typically, cables are made up of several components including a conductor, sealed layers, insulation, protective coating, and fillers. There are only a small number of cable manufacturers worldwide who have delivered components to offshore wind projects. Cables are typically awarded in EPCI contracts to OEMs and a few specialist installation companies whom have an established relationship with the OEMs.

5.8.1 Inter-Array Cables

Inter-array cables (IACs) are subsea cables which link offshore wind turbines and the offshore substation together on what is typically known as a 'string'. Inter-array cables for fixed wind are static and are typically buried while inter-array cables for floating wind are dynamic and have the potential to be suspended mid water. The layout of the turbines and IACs will determine the exact length of the cables which will vary depending on the project specifics.

Commissioning of the system is performed after testing and termination is completed by the offshore cable installation contractor and this occurs after the cable has been pulled into the offshore substation. Cable components include cable cores, insulation, and protective coating as well as parts supplied by sub-suppliers such as fibre-optics, accessories for electrical termination and mechanical support, such as interface plugs and hang-off clamps, and cable protection systems.

Inter-array cables are typically 33kV and 66KV. The progression to 66Kv was essentially to enable the 8-12 MW turbines to be installed. With Turbines ever increasing in size there is an industry push for high voltage array systems, with 132kV the next likely step.

The UK currently has a well-developed inter-array cable manufacturing capability, such as JDR Cable who are supplying US and European offshore wind projects. The UK has no capacity to manufacture cable cores for subsea cables. Cable cores (conductors) represent about 40% of cable cost. JDR currently imports these from continental Europe.

New Zealand offshore wind projects are expected to source inter array cables from a combination of worldwide suppliers.

CAPABILITY		
COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	There are currently limited capabilities for cable supply in New Zealand. Nexans has a manufacturing facility in New Plymouth that is capable of manufacturing up to 33kV cables. Prysmian also has a manufacturing plant in New Lynn that supports the supply of power cables.	Nexans, Prysmian, NZ
UK	UK experience includes companies such as JDR Cable who are supplying both Vineyard Wind and US Wind projects, as well as several European offshore wind developments.	JDR Cable Systems

5.8.2 Export Cables

An offshore wind export cable is the cable that connects the offshore substation to the onshore substation, enabling the distribution of the generated electricity. The cable includes the subsea portion of the cable running from the offshore substation to the shoreline and the onshore cable running from the shoreline to the onshore substation.

Export cables are made up of several elements including the cable core, conductor, insulation, protective coatings, fibre optic cable, bitumen, polypropylene yarn, and armouring wire. For projects in close proximity to the shoreline and pre-commercial developments, an offshore substation may not be required and lower voltage subsea export cable will be used to connect the offshore wind project directly to the onshore substation.

Currently, there are no manufacturing capabilities for commercial scale offshore wind projects in either NZ or the UK. While the UK does not currently have a strong Tier 1 key supplier for high-voltage offshore export cables, recent investment announcements into new facilities in Scotland and Blyth could open an opportunity for export in the latter part of this decade.

CAPABILITY		
COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	No Capability	Nil
UK	Limited Tier 1 capabilities currently exist in the UK however industry is working towards developing these capabilities domestically.	Sumitomo, XLCC and JDR Cables Systems (both due 2024-2026) Prysmian Wrexham facility for onshore cables.

5.8.3 Cable Ancillaries

Cable ancillaries provide termination and mechanical support for cables when they are installed on an offshore wind project. These ancillaries typically include cable connectors and joints, protection, buoyancy, condition monitoring systems and other critical components which support the offshore wind farms electrical infrastructure. These components are generally supplied by a Tier 2 or 3 subcontractor.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	No Capability	Nil
UK	The UK has well-established industry with strong capabilities in this area based on years of experience in the UKs O&G sector, interconnector market and subsequent transition into offshore wind. Companies such as Balmoral and Tekmar are amongst the global leaders in the cable protection and ancillaries space.	Balmoral, Tekmar, CRP Subsea, Oceaneering. WT Henley, Power CSL.

5.8.4 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
CABLE SUPPLY	Inter Array Cables	Medium	Medium	Medium	Medium	High	Medium
	Export Cables	Low	Low	Low	Low	Low	Low
	Cable Ancillaries	Low	Low	Low	High	High	High
OVERALL	Medium Potential						

5.8.5 UK Export Opportunity

The UK has no current manufacturing capability to supply export cabling to commercial scale OSW projects, with a focus on the provision of inter-array cables. However, this will soon change with several factories coming online in the coming years.

Sumitomo Electric Industries has earmarked area surrounding the Port of Nigg as the location of its $200 million high-voltage subsea cable manufacturing plant. XLCC has received a £9-million grant from Scottish Enterprise and planning approval for their proposed HVDC cable factory in Ayrshire. JDR Cable Systems are also nearing completion on their £130 million high-voltage subsea cable facility. This will accelerate the UKs capabilities in these areas and potentially lead to export opportunities.

It should be noted, however, that current UK demand is met from Europe and APAC and when UK domestic capability comes online it is likely that NZ will be able to leverage these existing supply lines, with only the regional competition factor being a potential barrier.

Supply areas where UK companies have good experience that can be applied to the NZ market include:

- Array cables (JDR Cable)
- Cable protection
- Cable ancillaries
- Testing, jointing and termination.

While there is typically less export opportunity for Tier 2/3 suppliers without a Tier 1 'anchor' supplier, the design and supply of cable ancillaries, protection and testing is similar across subsea array and export cables. UK company First Subsea Ltd, leading designers and manufacturers of Cable Protection Systems for fixed and floating offshore wind farms, is a prime example of this opportunity with recent securing of contracts to supply several offshore wind projects in overseas markets in conjunction with financial support from UKEF.[39]

[39] *https://www.gov.uk/government/news/first-subsea-lands-major-offshore-wind-exports-with-government-support*

5.9 Electrical Infrastructure

Electrical infrastructure comprises the various electrical components (except cables) required to take the generated power and transform it prior to export onshore and export to the grid. For offshore wind this comprises the offshore and onshore substations and the various sub-components that make them up including electrical components, offshore substructures, buildings, and other onshore components. The electrical infrastructure can comprise about 6% of the project cost.

5.9.1 Offshore Substation

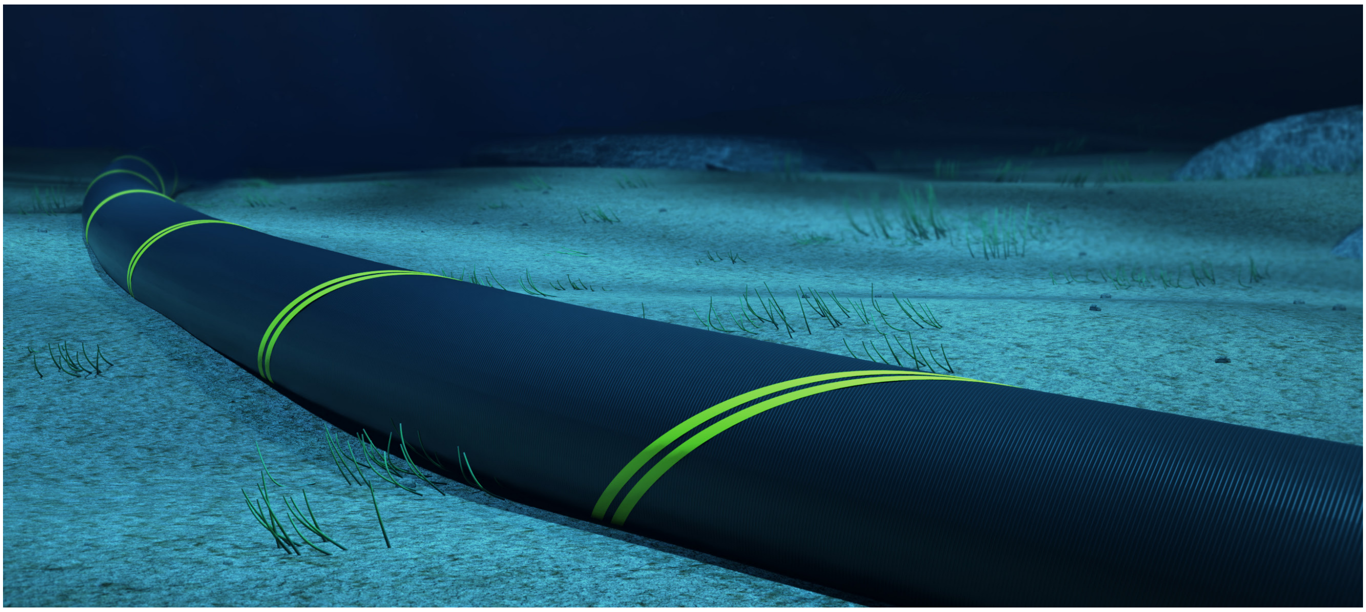
Offshore wind projects may require an offshore substation to transform the electricity generated by the wind turbines for export to the onshore substation. This can be done either by converting from AC to DC or by stepping up the electricity through a transformer, depending on cable length.

Offshore substations include service platforms and equipment for personnel and potentially a helideck and accommodation areas. Key electrical components of the offshore substation include the foundation and topside structure, HV switching equipment, transformers or converters, coils, power electronics, earthing systems and electrical protection items such as clamps and cable trays. Auxiliary requirements may also include cranes, communication equipment, heating and cooling systems, plumbing, standby generators, medical supplies, and helicopter resources.

Offshore substation electrical components are expected to be supplied from Europe and Asia-Pacific to service the development of the New Zealand offshore wind industry, with the foundation and topside infrastructure and assembly likely to be performed in the APAC region or Middle East.

The industry has seen consortia execute the design and subsequent fabrication scope, as exemplified by Bladt Industries and Semco Maritime's previous partnership. The APAC region and suppliers in the Middle East such as Lamprell and Dubai Drydocks have been utilised on European and UK offshore wind projects, with likely similar procurement approaches for NZ. Suppliers in the oil and gas sector in New Zealand would be well suited leveraged experience to support the fabrication of offshore substation Tier 2/3 elements and final commissioning or finishings.

Oil and gas suppliers in the UK have shifted their services and products to adjust to complimentary offshore substation scopes, including fire protection systems, lighting solutions and secondary steel support.



CAPABILITY		
COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	No current capability	Nil
UK	Very limited overall fabrication capability for offshore substations, with equipment and services focused on ancillary scopes, secondary steel and commissioning support. Majority of offshore substation fabrication for jacket and topsides based in wider Europe (Smulders / Iemants, Navantia) and Middle East or APAC. The UK have good experience in Detailed design of structures, substructures and facilities, control and monitoring systems and electrical equipment and facilities. Whilst not founded in the UK, there are Tier 1 suppliers, fabricators and integrators that are established in the UK. Petrofac as example of locally based provider and project managing scopes from the UK. There is potential for scopes within Harland & Wolff and Global Energy Group for fabrication, but competitiveness and scale would be limiting factors.	Petrofac, GE, Siemens Energy, ABB, Schneider Electric, Harland & Wolff, Global Energy Group. **Electrical components:** ABB, CG (Pauwels), GE, Schneider Group and Siemens Power Transmission and Distribution. **Structure:** Babcock, Bladt Industries, Chantiers de l'Atlantique, Harland and Wolff, Heerema, Hollandia, Navantia, SLP Sembmarine and Smulders. **Systems integrators:** Engie Fabricom, Iberdrola, Ørsted, Petrofac and Semco.

5.9.2 Onshore Substation

The onshore substation is integrated into grid infrastructure in order to distribute the electricity that is generated by offshore wind farms. The primary onshore substation structure includes the building, electrical infrastructure, as well as additional facilities such as a workshop, warehouse, access systems, security, fencing, and personnel facilities.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	No capabilities for the Tier 1 supply, NZ has capability and capacity for Tier2/3 supply, i.e Transformer controls, voltage regulators, protection and control systems.	Nil Tier2/3 Tekron International, A.Eberle, RMS Mors Smitt, MTE, HV power
UK	Onshore scopes often included in overall EPCI delivery for Tier 1 companies with bases in the UK, including GE Grid Solutions and Siemens Transmission & Distribution/Siemens Energy. Some electrical equipment sourced from overseas, but largely local capability in assembly and commissioning.	GE Grid Solutions, Siemens Transmission & Distribution / Siemens Energy, Pfisterer, AMPControl, Balfour Beatty

5.9.3 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
ELECTRICAL INFRASTRUCTURE SUPPLY	Offshore Substation	Low	Low	Low	Medium	Medium	Low
	Onshore Substation	Medium	Medium	Medium	Medium	Medium	Medium
OVERALL	Medium Potential						

5.9.4 UK Export Opportunity

Supply areas where UK companies have good experience that can be applied to the NZ market include:

- Detailed design of structures, substructures and facilities
- Control and monitoring systems
- Electrical equipment and facilities supplied to European and APAC Tier 1s.

Currently opportunities may exist in the future for UK companies to design and supply electrical systems and infrastructure required for energy storage, which may be of benefit for projects in NZ.

5.10 Support Equipment and Services

Support equipment and services are the equipment and services necessary to assist a Tier 1 EPCI, Transport and Installation (T&I), or operations and maintenance (O&M) contractors.

The installation of a wind farm requires a large amount of specialised or bespoke equipment in all phases. From the provision of remote vehicles, unmanned survey vessel, Unexploded ordnance (UXO) detection devices and subsea geotechnical drill rigs in the development phases, to the equipment required by the Transport and Installation (T&I) contractor to assist in installing the offshore wind farm components. Examples of equipment and services required to support the installation phase include pile upending, hydraulic driving or vibration hammers, large diameter drilling (LDD), Remotely Operated Vehicles (ROVs), access systems and gangways, trenching vehicles and ploughs, both air and saturated diving, Non-destructive testing (NDT), noise mitigation tools, cable carousels, tensioners and arches, as well as bespoke engineering and spare parts such as valves and vents and control panels.

The requirement for bespoke equipment and services continue to the Operations and Maintenance(O&M) phase, where the WTG supplier and or O&M contractor requires specialised equipment and services to enable inspection, maintenance and repair of the offshore wind components. Example equipment and services needed to support the O&M phase include unmanned aerial drones (UAVs) and blade bugs for blade inspections, as well as ROVs and inspection and testing equipment and technicians. Asset monitoring services that include data acquisition, monitoring and artificial intelligence services as well as the actual supply of the hardware and software is also a major component of the operations and maintenance phase.

On the back of the Oil and gas sector the UK has a developed support equipment and services industry that currently support the UK industry as well as the international offshore wind sector.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Some support capabilities exist in New Zealand. These mostly relate to offshore services that service existing maritime and offshore oil & gas industries, such as remote subsea inspection, trenching and subsequent equipment supply.	BlueRobotics, NZ Diving & Salvage, Seaworks Ltd, Ocean Offshore Maritime Services Ltd, Seaworks
UK	UK has experience and capability in the provision of equipment and support services, established from the O&G sector but built upon in the offshore wind sector. UK experience includes automated and unmanned inspection services (including UAVs, AUVs, blade bug etc), subsea inspection services and equipment (including ROV surveying) and inspection and equipment; UXO survey and clearance.	Osbit Venterra Group, Sonardyne, Utility ROV Services, Roxtec, Eodex, Specialist Marine Consultants, N-Sea Group, Global Marine, Green Marine, Motive Offshore Group, ROVOP, Rigmar Services Rotech, SMD; Cyberhawk

5.10.1 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
SUPPORT EQUIPMENT & SERVICES	Support Equipment & Services	Medium	Low	Low	High	High	High
OVERALL	High Potential						

5.10.2 UK Export Opportunity

The UK has an existing support equipment and services supply chain servicing the UK domestic market, but also has track record in exporting this equipment and or service internationally. The UK will continue to strengthen in this export and will have the opportunity to provide the service or equipment to support the New Zealand market. Two excellent UK company examples exporting this service internationally are;

- UK company OSBIT who provide tailored solutions to the Tier 1 T&I contractors including the full equipment life cycle, from feasibility & FEED studies, to design & build, and through-life support of pile upending frames and grippers, Lifting and handling equipment, trenchers for subsea burial of cables and gangway access systems,
- UK company Cyberhawk who provide end to end solutions to support infrastructure asset management through inspection solutions and services including the design supply and operation of UAVS for visual inspections of WTGs.

5.11 Ports

Ports are key to offshore wind development forming integral areas for various stages of the development. In combination, Ports and T&I is estimated to make up approx. 25% of the cost of the project which for New Zealand would represent a potential pipeline around A$65M – A$330M. Three types of port facilities are required to support fixed offshore wind, with 2 additional functions required for floating:

PORT FUNCTION	PORT FEATURES
Manufacturing & Fabrication	This port facility will house the facilities for manufacturing or fabricating the large components of an offshore wind farm. As the components are extremely large they need direct access to international shipping to facilitate the efficient export to the designated marshalling ports. Typical characteristics of a manufacturing port; • Deep water berth access (≈>10m) with wide berth frontage (≈+150m) to enable handling and cranage of foundations, towers, turbines, blades etc). • Located adjacent to the manufacturing facilities • Transport access road and rail for the importation of smaller equipment as well as transport of oversize and heavy loads. • Large and flat hardstand area to store the completed components for up to 6months prior to export and or dispatch offshore.
Staging, Marshalling & Integration	Unlike manufacturing ports which will be located globally and may only service the manufacture of one or 2 components, the Staging or marshalling port is typically selected based on the vicinity to the offshore wind farm to maximise the efficiency of the installation campaign. There are 2 strategies either single port or multiport when considering staging all the wind farm components, and that decision depends on several key factors; • Size of the wind farm • Size and capacity of local ports • Installation schedule. Multiport is the most common as it is rare to have a local port with the capability and capacity to store extremely large quantities of all the components required. Typical characteristics of a marshalling or staging port; • Deep water berth access (≈>10m) with wide berth frontage (≈+250m) and high bearing capacity (≈+15t/m2) to enable importation for the transportation vessels and loading out of the wind components onto the installation vessels. • Large flat upland storage areas (≈>10-20ha's) with direct berth access.

PORT FUNCTION	PORT FEATURES
Assembly (floating)	Integration is an additional port requirement for floating foundations, and potentially also assembly if the foundations are delivered in large subcomponents rather then shipped whole and floated off on a semi-submersible heavy lift vessel. Assembly requires wide berth frontage (≈+300m), high capacity (≈+15-25t/m2) for the importation of the subcomponents which could weight in excess of 800mt. In addition large adjacent upland area (≈+10-50ha) with bearing capacity (≈+15t/m2) is required to support the assembly of the foundation vis SPMTs and large cranes. The heavy lift berthage is then also required to support the launch of the assembled substructure either vis crane or semisubmersible platform.
Integration (floating)	Integration berthage is required to enable the installation and commissioning of the tower, nacelle and blades onto the floating foundation at the port facility. It requires one or multiple berths to secure the floating foundation and high-capacity quay area to support a heavy lift crane to install the components onto the foundations. Single integration berth characteristics; Wide berthage (≈+250m) due to the diameter of the rotor, deep water (≈>10m) dependant on the draft requirements of the floating foundation and localised high quay bearing capacity (≈25-50t/m2) to support the required craneage.
Operations & Maintenance	The port facility supports the operations and maintenance phase of a wind farm. It will support the vessels utilised to transport the crew to and from the wind farms, warehousing for equipment and the operational base. Port characteristics include: • Berthage and harbour facilities to suit small to medium crew transfer vessels (CTVs) • Berthage and harbour facilities to support Service operation vessels (SOVs) • Victualling services for the vessels • Near by accommodation to house the full time workforce • Warehousing, office and welfare facilities to support daily operations.

New Zealand boasts 5 major ports, accompanied by numerous smaller regional ports. These ports play pivotal roles in the country’s economy, facilitating trade, tourism, and industrial activities nationwide.

The primary exports include agricultural products such as meat, wood, and fruits, with dairy products standing out as the largest export commodity.

NORTH ISLAND	SOUTH ISLAND
North Port	Port Nelson
Port of Auckland**	Port Marlborough
Port of Tauranga**	Port of Lyttleton**
Port of Napier**	South Port
Centre Port Wellington**	
Port Taranaki	**Denotes Major Port

New Zealand will need to implement a multiport strategy to facilitate the growth of offshore wind energy. The current port infrastructure lacks the capacity to support offshore wind projects, as no single port possesses sufficient upland area to meet the logistical demands of a wind farm.

This limitation arises from the ports' original design focus on importing and exporting containers and bulk produce, including dairy and lumber. Wind farms on the western side of the North island, in the regions of Taranaki and Waikato, have been identified as the preferred initial areas by developers, it is likely that Port Taranaki could take a leading role due to the vicinity to the proposed wind farms, with Centre Port and North Port fulfilling additional marshalling requirements.

Expanding or upgrading ports is often capital-intensive, mainly due to the need for high-capacity quaysides during the construction phase. However, given the relatively short duration of this phase and the limited build-out capacity of offshore wind in New Zealand, it may be challenging to justify such investments without assistance from the government or developers if a suitable post-use industry is not identified. O&M port facilities are more conducive to sustainable commercial models due to the approximately 30 year return period.

UK port development for offshore wind has undergone significant expansion and specialisation to support the burgeoning offshore wind industry. This development includes the adaptation of existing ports and the establishment of purpose-built facilities tailored to the unique requirements of offshore wind projects. The UK has targeted strategic investment in port infrastructure, as it is the key to meeting the domestic wind build out targets as well as facilitate export of critical components, such as wind blades. The UK is recognised as a leader in the adaption and build out of ports to support offshore wind, with UKs first purpose-built installation port established in Belfast in 2013.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Some experience with the importation of onshore wind requirements, and some available upland area capacity for marshalling.	Port of Taranaki, Centre Port Wellington, North Port
UK	The UK have good experience in Marshalling and Construction Ports having needed to establish this capability for its own operational offshore wind industry, currently primarily for the fixed offshore wind sector. Additional investments planned for the Port of Nigg and Port of Cromarty Firth will see this capability extended to floating offshore wind. UK has experienced consultancies advising and design the required port infrastructure upgrades, as well as established heavy lift, transport and logistical service companies like Osprey, Alleys and Collet.	**UK example Ports;** Port of Nigg, Port of Cromarty Firth, Able Seaton Port (Hartlepool), Port of Grimsby **UK companies assisting in Port strategy:** Xodus, Mott Macdonald, ARUP **Heavy lift, transport & Port logistic services:** Osprey, Collet, Alleys James Fisher and Sons

5.11.1 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
PORTS	Construction, Marshalling and O&M ports	Limited	High	Medium	High	Low	High
OVERALL	Medium Potential						

5.11.2 UK Export Opportunity

The UK possesses unparalleled expertise in understanding the port requirements essential for facilitating offshore wind projects, including a deep understanding of multi-port strategies. This knowledge will be crucial for New Zealand to effectively implement offshore wind initiatives.

While ports themselves cannot be exported, the UK's companies that service the offshore wind ports have the opportunity to provide this service to the New Zealand market, most likely through collaboration and Joint Venture with local ports service providers. An important opportunity lies in exporting the knowledge and best practices for developing New Zealand's port facilities to support offshore wind ventures. The UK is at the forefront of clean maritime port development for offshore wind and UK companies participating in this industry could provide this knowledge and experience into the New Zealand port market.

As an example;

- UK company Xodus recently supported the Port of Newcastle NSW Australia, with understanding and developing the requirements for port infrastructure upgrades to support the floating offshore wind market in Australia and the wider APAC region.
- UK company MJR are developing charging systems to be deployed in ports to allow CTVs and potentially SOVs to be electric instead of powered by fuel oils.
- UK company Osprey a specialist heavy lift and transport company with experience in the renewable logistic services within ports, having managed over 1,000 offshore wind turbines logistical movements and recently support the Seagreen wind farm with cable logistics.

5.12 Transport, Installation & Construction

This project phase can be divided into 2 primary categories, with the offshore and onshore areas usually distinguished near the landing point of the export cable onshore. Offshore Transport and Installation (T&I) involves transporting all components from manufacturing ports to staging ports, followed by installation at the offshore wind location. In combination, Ports and T&I is estimated to make up approx. 25% of the cost of the project which for New Zealand would represent a potential pipeline around A$65M – A$330M.

Onshore construction includes delivering electrical subcomponents to onshore locations, constructing infrastructure, installing electrical equipment, civil construction, laying onshore electrical cables (either overhead or underground), providing road access, constructing concrete foundations, implementing CCTV/security measures, and installing fencing. Installation contracts typically fall into Tier 1 or Tier 2 packages, except for ports contracts, which generally fall into Tier 2 or Tier 3 categories.

5.12.1 Fixed Wind T&I

The transport and installation for fixed offshore wind utilises the following types of transport and installation vessels.

VESSEL TYPE	DESCRIPTION
Heavy Lift & Transport Vessels (HLV)	Heavy lift and transport, or heavy transport vessel, is a specialised maritime ship engineered for the efficient transportation of large-scale wind turbine components from global manufacturing sites to designated marshalling ports.
Wind Turbine Installation Vessels (WTIV)	A wind turbine Installation vessel is a specialised maritime ship, equipped with a jacking system to raise the vessel out of the water, dynamic positioning system, heavy-duty crane and specialised installation equipment, these vessels facilitate the installation of the WTGs.
Heavy Construction Vessels (HCV)	A heavy construction vessel is a specialised maritime vessel equipped with heavy-duty cranes, dynamic positioning systems, and specialised installation equipment, these vessels facilitate the installation of foundations and OSS topside.
Specialist Heavy Lift (HL)	A Specialist Heavy lift vessel is a specialised maritime vessel equipped with extremely large cranes > 4000MT with some >7500MT with twin cranes.
Cable Laying Vessels (CLV)	An offshore wind cable laying vessel (CLV) is a specialised maritime vessel equipped with carousel(s), tensioners and dynamic positioning systems, these vessels facilitate the accurate and safe deployment of subsea cables.
Construction Support Vessels (CSV) or Offshore Support vessels (OSV)	A construction or offshore support vessel is a specialised maritime ship, equipped with varying equipment such as lighter subsea heavy compensated cranes, ROVs, walk to work systems etc. as well as a dynamic positioning system

The installation of the fixed wind farms at a high level includes the following is and typically performed by T&I contractor(s);

ACTIVITY	DESCRIPTION	VESSEL TYPE
Transportation to Marshalling Port	A 900 MW + farm will require the delivery of 66+ 15 MW foundations, WTGs and cables, as well as 1 or 2 offshore substations, from their international or local manufacturing sites to the marshalling port(s)	HLV
Pre-installation Surveys & Preparation	Pre-installation surveys with ROV and survey instruments are performed to ensure that the cable route, the turbines and jack up locations are clear of any large obtrusive boulders and or debris. The installation of survey arrays can also happen in this face which allow the accurate positioning over the foundations on the seabed.	CSV or OSV
Foundation & Transition Piece Installation	Transporting the foundations from the marshalling port to site and fixing them to the seabed, via Driving, Drilling, Suction or Gravity. Foundations and transition pieces can either be installed by construction vessels holding station via dynamic positioning and or jacking up.	HCV or WTIV
Substation Installation	The substation is likely to be delivered direct to the offshore site, for installation. The Jacket substructure will be installed first and fixed to the seabed, followed by the topside installation via heavy lift and or float over.	HCV, HL or Float over barge
Inter Array Cable Installation	Transporting of the inter-array cables from the marshalling port, or directly loaded on to the vessel at its international manufacture port and installation including burial between the foundations and OSS.	CLV
WTG Installation	Transportation of the towers, nacelle and blades from the marshalling port to site and installing on the foundations. This work due to the small dimensional tolerances required in installation needs to be performed from a stable platform and hence why jack-up vessels are utilised	WTIV
Export Cable Installation	Depending on the length of export cable, it is typically loaded onto the installation vessel at the manufacturing port then installed from the shore side landing location out to the offshore substation	CLV
Commissioning	Multitude of smaller activities, including termination and testing etc. that are performed to confirm that the wind turbines and substation have been installed correctly and are ready for energy production.	CSV

Vessel Market
As the market evolves for offshore wind as per the size of the wind turbines is continuing to increase. It is anticipated that the New Zealand market will be in the range of 15 -20 MW turbines of which there are very limited vessels that are capable of installing these components due to the weight and lift height required. The vessel market is reacting, and new builds and upgrades are anticipated to be entering the market from this year with approximately 13 vessels with committed shipyard orders (Excluding Mainland China and the United States, as they are currently considered closed markets). It is anticipated that this fleet could be undersupplied by approximately 2030 when the New Zealand market is potentially looking to enter the market for construction. The supply crunch is also anticipated for the HCV's, however unlike the WTIV there is potential cross over of vessels from the Oil and Gas construction industry which depending on availability can increase the supply, but due to the increasing larger specification of monopiles and jackets the installation vessels are requiring to become more bespoke and the over demand will most likely occur in the 2030's unless more vessels come to market. The CLV market also will face challenges not because of necessarily the growing size of turbines, but the overall demand of installation from all wind farms expected in the next 10years as they service all WTG sizes.

Transport and Installation contractors
The global transport and installation of wind farms outside of china is currently mostly serviced by Seaway7, Deme, Jan de Nul, Boskalis, Calader, Fred. Olsen Wind carrier, Havfram, Van Oord Heerema Marine Contractors, Allseas, Maersk with the inclusion of Nexans, Prysmian & Deep Ocean who specialise in cable installation only. (Non-Exhaustive list)
Historically, the UK has been home to three major transport and installation contractors: Subsea7 (Seaway7), MPI Offshore, and Seajacks. These companies specialise in the sector and operate various purpose-built jack-ups and heavy lift installation vessels. While MPI and Seajacks have been merged or acquired by companies outside the UK, they still maintain major offices within the country.

Crewing
UK contractors have a proven expertise to deliver large projects and whilst not owning the vessels as per above have a highly developed, trained, skilled offshore workforce with track record.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Other than Nexans & Prysmian who have manufacturing facilities for onshore cables in NZ, there are no larger T&I contractors established in New Zealand and or current vessels that meet the requirements for floating offshore wind farms. Considerations for oil and gas vessels will be given for small scale transportation and service requirements. New Zealand does have some capability in offshore crewing, but is expected to be capacity constrained and will be a mix of NZ, AUS and international specialists that make up the crewing of the vessels.	Nexans & Prysmian for cable installation
UK	Seaway 7 is a market leader in offshore wind EPCI and has a large fleet of specialised wind installation vessels. Another 2 UK founded Transport and installation providers of which have been merged or sold. • Seajacks mergerd with Cadeler which is now being acquired by Eneti, INCJ and Mitsui OSK lines Head quartered out of Japan. • MPI offshore was purchased by Van Ord which is headquartered out of The Netherlands.	Seaway 7 / Seajacks / Cadeler; Van Oord
	The UK has market leading vessel brokerage and chartering services, as well as vessel data and market intelligence services that have expanded the services from shipping and O&G to include offshore wind.	Clarksons, Braemar, GRS group, Lloyds List Intelligence
	Most Tier 1 T&I contractors have established offices in the UK UK has a developed and experience offshore marine labour and technician work force, established off the back of the O&G market and the significant amount of wind installed in the UK.	Northern Marine Manning Offshore Operations Limited Taylor Hopkins

5.12.2 Floating Wind T&I

The transport and installation for floating offshore wind differs from fixed for foundation transport and installation but utilises the same vessels for cables and commissioning. The following is a list of the vessels that differ from the fixed wind T&I requirements.

VESSEL TYPE	DESCRIPTION
Semi-Submersible HLV	Whilst carrying out the same purpose as a HLV, they have the ability to submerge under the water lone and float the cargo off, instead of utilising cranes or SPMT's to offload the cargo. They can be extremely large vessels to cater for the size of shifting entire floating sub structures and or large components of several substructures at once.
Anchor Handling Tugs (AHT)	These specialised maritime ships are design to install anchors into the seabed and or to tow very large structures on open oceans. They are heavy duty vessels with a high bollard pull required to embed anchors and or tow 4500MT semi-submersible structures.
Tug	These are small marine vessels design to manoeuvre ships in harbour and or large designs to assist in manoeuvring and positioning the floating sub structure via pushing and or pulling.

The transport and installation for floating offshore wind at a high level includes the following is and as per fixed wind is performed by T&I contractor(s);

ACTIVITY	DESCRIPTION	VESSEL TYPE
Transportation to Marshalling / Assembly & Construction Port	A 900 MW + farm will require the delivery of 66+ 15 MW foundations, WTGs and cables, anchoring systems as well as 1 or 2 offshore substations, from their international or local manufacturing sites to the marshalling port(s). The major difference to fixed wind is the transportation of the floating foundations, which can be completed as a whole circa 4500MT or in large sections for assembly at the integration port.	HLV & Semisubmersible HLV

ACTIVITY	DESCRIPTION	VESSEL TYPE
Floating Foundation Assembly & Wind Turbine Integration	The major difference to fixed wind is that the floating wind foundation and WTG is assembled at the integration port before being towed offshore in its assembled state.	WTIV maybe used in port for the assembly if onshore crane capability is not available.
Pre-installation Surveys & Preparation	Pre-installation surveys with ROV and survey instruments are performed to ensure that the cable route and the mooring locations are clear of any large obtrusive boulders and or debris. The installation of survey arrays can also happen in this face which allow the accurate positioning over the foundations on the seabed.	CSV or OSV
Anchoring & Mooring	The anchors and moorings are installed in advance of the installation of the floating foundations, as they are required to hold the foundations in location.	AHT & TUG & CSV
Substation Installation	Floating OSS are in development but have a low technology readiness level, most likely delivered direct to the installation site or sheltered water on a large semi-submersible vessel.	HL, Semi-submersible HLV or barge
Floating WTG Installation	The towing and installation of the floating wind turbine units will require 2 to 3 smaller positioning tugboats and one large tugboat to mobilise the unit to site, where the pre-installed moorings will be recovered from the seabed and attached.	TUGS, AHTS, CSV
Inter Array Cable Installation	Post hook-up of the floating units the transporting of the inter-array cables from the marshalling port, or directly loaded on to the vessel at its international manufacture port and installation at site will occur. This is the same for fixed wind except floating will have dynamic as well as static cables.	CLV

ACTIVITY	DESCRIPTION	VESSEL TYPE
Export Cable Installation	Depending on the length of export cable, it is typically loaded onto the installation vessel at the manufacturing port then installed from the shore side landing location out to the offshore substation.	CLV
Commissioning	Multitude of smaller activities, including termination and testing etc. that are performed to confirm that the wind turbines and substation have been installed correctly and are ready for energy production.	CSV / OSV

Vessel Market
The floating wind market is still in its early stages of development with mainly demonstrator projects in addition to the 11-turbine array Hywind Tampen Project. As the market evolves and fixed bottom wind is built out, the sector will move to floating wind which has significant potential. The UK, South Korea, France and Japan are likely to spearhead the next wave of floating wind. As floating does not utilise the WTIV this removes this supply chain shortfall risk, however floating will utilise large Anchor handling vessels which are utilised in the Oil and Gas market for rig shifts and installation of floating facilities. The AHT market has seen limited new build activity recently and if considering the age of the fleet and likely requirement of >15,000bhp this leaves a relatively small pool of vessels <50. Considering the expected growth of floating offshore wind there is an anticipated supply crunch for this fleet, however unlike the WTIV there has been little confirmed order to shipyards to new build.

Transport & Installation Contractors
The transport and installation contractors largely remain the same for fixed and floating, with the additional of Large Anchor handling specialist providers like DOF, Solstad, Siem offshore, Island offshore and ALP Maritime of which are predominately European companies.

Crewing
As per fixed offshore wind the UK has an experienced offshore work force that would be well suited to the floating wind installation, as it is adapted technology from the oil and gas sector.

CAPABILITY		
COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Other than Nexans & Prysmian which is for onshore cable manufacture in NZ, there are no larger T&I contractors established in New Zealand and or current vessels that meet the requirements for floating offshore wind farms. New Zealand has an O&G industry which would be suitable to crew the marine aspect of the vessels, but there would be a significant labour shortage and a % of international specialists is expected.	Nexans, Prysmian for cable installation
UK	UK companies do not own and operate large AHTs UK has a strong vessel market intelligence and brokerage sector Most Tier 1 T&I contractors have established offices in the UK UK has a developed and experience offshore marine labour and technician work force, established off the back of the O&G market and the significant amount of wind installed in the UK.	As per fixed wind

5.12.3 Onshore Construction (Substation & Cables)

The installation of the onshore substation primarily requires the civil construction of the substation infrastructure and the installation of electrical equipment. Additional services required include security and access systems, including CCTV, and fencing. Civil construction services are required for the substation building, concrete foundation, and road access which provides opportunity for local supply. There is a strong opportunity for local supply for additional systems such as CCTV and fencing. Transformer and other main electrical equipment installation would require international expertise, currently coming from Europe.

Onshore cabling is preferably located underground to address local stakeholder concerns in the case of overhead power lines; however, this option is more expensive due to trenching requirements. Onshore cabling installation has overlaps with existing industry and New Zealand has experience in onshore cabling with current onshore renewable projects. Local workforce and contents will be able to support the transport and installation processes required in cable installation, including shore crossing for export cables, onshore substation and operational facilities that will be required.

CAPABILITY		
COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Specialised capabilities exist for onshore substations and cables due to the established onshore renewables industry. There are a several outfits that specialise in onshore substation, transmission and civil construction.	ElectroNet Group, Downer, Connell Contractors Ltd, Omexom, Fletcher, Blackley Construction Building, NKT, Crouchers, Wells
UK	Strong capability in civil construction and EPC for onshore substation scopes, often as sub-contract to main EPCI contractor such as GE Grid Solutions or Siemens Energy. Most work will be undertaken from the local workforce and subcontractors with installation equipment for cabling and onshore substations expected to be existing in the market already.	Jones Bros., Balfour Beatty, J. Murphy & Sons, VolkerInfra, Siemens Energy, GE Grid Solutions

5.12.4 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
TRANSPORT AND INSTALLATION	T&I Vessels	Low	Low	Low	Medium	Medium	Medium
	T&I Contractor	Low	Low	Low	Low	Low	Low
	T&I Personnel	Medium	High	Medium	High	Medium	High
	Onshore Construction	High	High	Medium	High	Low	Low
OVERALL	Medium Potential						

5.12.5 UK Export Opportunity

MPI Offshore and Calader have recently undergone acquisitions and/or mergers, yet they maintain a significant presence in the UK. It is expected that they will continue overseeing major Transport and Installation (T&I) contracts from offices in Europe and the UK. Subsea 7 through its offshore wind specialist Company Seaway 7 is active in the APAC region, with Subsea 7 holding offices in Australia. However, due to New Zealand's relatively small market size compared to the global scale, export opportunities are limited, particularly in vessel supply. It is anticipated that this demand will primarily be serviced off the back of the Australian market. The UK boasts a strong sector in vessel brokerage and market intelligence, with companies like Clarkson's and Braemar ranking in the world's top 10 for this service. There lies an opportunity for this sector to extend its services into the New Zealand market.

The primary export potential for the UK in this phase lies in providing experienced supervision, highly skilled technicians, and potentially marine coordination, logistics, offshore operations, and installation project management services and software.

Onshore construction is likely to rely on local New Zealand capabilities, although there may be capacity constraints, which could potentially be supplemented from the APAC region.

5.13 Operations & Maintenance

The Operations and Maintenance (O&M) phase officially begins after the completion of all wind farm construction. However, in practice, it often commences during the installation campaign, which typically spans multiple years. The O&M phase of an offshore wind project is the longest portion of the project and typically lasts 25-30 years. It accounts for approximately 3% of the total project cost annually which for the estimated New Zealand build out would represent approximately A$50m - A$300m per annum. As these values are annual they represent a significant portion of the overall project lifetime expenditure. The owner of the wind farm manages all operational activities with the turbines typically under warranty with a wind turbine supplier between 3-10 years.

During this warranty period, the wind turbine supplier generally has a service agreement to provide maintenance technicians. After this warranty period, the wind farm owner will either continue to maintain the farm using the service company, use another third-party provider or take on the maintenance team directly. The balance of plant is typically handled under a separate service contract and either managed in house or, more often, subcontracted to a specialist inspection, maintenance, and repair contractor.

Maintenance is generally completed in lower metocean condition months when wind yield is less, and weather conditions are more suited for personnel travelling offshore. Transmission assets such as the substations and export cables are typically transferred to an Offshore Transmission Owner (OTO) within 18 months of construction.

5.13.1 Health, Safety & Training

Health, safety, and training is a key component to ensuring project personnel are working safely and harmoniously within the guidelines of the project, area, and associated infrastructure. It is anticipated that a number of training providers who already deliver similar offshore training in the oil and gas industry will be able to be certified in offshore wind training programs, such as the standards set by the Global Wind Organisation (GWO). GWO is anticipated to continue as the industry standard training for anyone working on or around the offshore wind turbines during the construction and O&M phase of a project.

During the O&M phase of the project it is anticipated that most of the offshore personnel (largely technicians) will require GWO training. For vessel and maritime personnel, the New Zealand offshore oil, gas and maritime industry is well placed to transition as workers already hold most of the training requirements which are expected for this new local industry.

Standards set under the Offshore Petroleum Industry Training Organisation (OPITO) and Maritime New Zealand are anticipated to continue to be required following training standards set on international offshore wind projects. Training for the onshore transmission scope of an offshore wind project is also anticipated to be similar to other large electrical transmission projects currently in the country.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Health, Safety and Training capabilities exist but are limited providers in adjacent established New Zealand offshore industries. It will be possible for these service providers to pivot to support Health, Safety and Training to offshore wind.	Wood Training, Bureau Veritas, Dynamic Ratings, Atlas Professionals, ARA Marine, Te Pukenga, Vertical Horizonz.
UK	UK have existing capabilities in offshore wind training, certification and safety inspection for its own operational offshore wind industry.	AIS Survivex, CWind, Maersk Belay Rope, Taskmasters

5.13.2 Operations & Logistics

The operations and logistics portion of the project requires a main operations and maintenance base to ensure the continuous operation of the offshore wind farms. Operations and logistics occurs both onshore and offshore and will require crew transfer vessels, service operation vessels and helicopters to operate between the operations base and the project site. The systems required for operations and logistics include weather forecasting and metocean data tracking, marine planning software, communication equipment, and asset tracking and safety planning systems.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Capabilities exist but are limited providers in adjacent established New Zealand offshore industries such as oil & gas, maritime and shipping. It will be possible for providers to pivot to support offshore wind operations and logistics.	Advanced Flight, GCH Aviation, Kingston Offshore, Midwest Helicopters, New Plymouth Underwater, NZ Offshore Services, ISO Ltd, Ocean Infinity, PHI International NZ, Diesel Marine, OCS, Serco, TIS, Seaworks, Southern Express, Qube, Colemand Group.
	NZ has a shipbuilding history and would be capable of building the CTVs required to service the offshore wind farms.	Circa Marine, McMullen & Wing, Salthouse boat builders, Stark Bros
UK	Operations and logistics are a strength of the UK supply chain with many companies experienced in this area of fixed wind, floating wind and oil and gas projects. This includes elements of transitioning asset integrity and management services from the oil and gas sector, as well as digitisation scopes. The UK also has experience in the design of CTV's and SOVs.	Worley (3Sun), Enermech, PD&MS Group, Stowen Group, James Fisher, North Star Renewables, Bibby Marine, Graig Shipping PLC, Green Marine, BAR Technologies, Chartwell Marine

5.13.3 Turbine Maintenance & Service

Offshore wind turbines require regular inspection and maintenance, and emergency repairs. This will cover the main turbine components including nacelle refurbishment, replacement or repair, blade inspection or repair, and any other large component repair. Typically, turbines are attended by teams of 2-3 technicians per turbine. The contract for these teams is held generally by the project operator or by a third-party labour hire provider.

CAPABILITY

COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Capabilities for major maintenance such as turbines is limited in New Zealand. Currently capability is based around the onshore wind and renewable industry.	AB Industries, Ashhurst Engineering and Construction, Dynamech Ltd, ElectroNet Group, Siemens Wind Power and Gamesa, Sika.
UK	Existing track record for the UK supply chain on turbine servicing, inspection and maintenance, including through UK-based larger Tier 1 suppliers such as Siemens Gamesa and Vestas. Opportunity for innovations and digital solutions have been leveraged by UK companies, including build out of drone inspection services.	Equans, Global Wind Service, Ventus Energy, Certex UK, Mistras Group, Skytech, Cyberhawk Innovations Siemens Gamesa, Vestas, GE Renewable Energy

5.13.4 Balance of Plant Maintenance & Service

The balance of plant maintenance and service covers all components other than the main WTG, including substations, foundations, array cables, export cables, scour protection and corrosion protection systems. The maintenance ensures the operational integrity and reliability of all wind farm assets, except the wind turbines. Regular inspections are required to be undertaken to ensure that potential issues are mitigated and avoid any loss of generation.

This portion of work requires crew transfer vessels, support vessels, and ROVs to transfer crew to the site and perform inspections above and below the water surface. It also includes the repair or replacement of any of the balance of plant components.

CAPABILITY		
COUNTRY	EXISTING CAPABILITY / EXPERIENCE	SAMPLE COMPANIES
NZ	Capabilities for Balance of Plant Maintenance is varied given the wide variety of services required. Some foundations, substation and cable maintenance capabilities exist in New Zealand, however major maintenance work such as transformer replacement will require international suppliers to support.	Goodman Energy, Electronet, Omexom, Northpower, Seaworks, Pringle Beleski & Associates and Ventia.
UK	Extensive subsurface and foundation maintenance, monitoring and repair capability based on oil and gas sector experience and previous track record across UK offshore wind portfolio. Some in-house capability for Tier 1s on the cable system or mooring side. Significant support for local vessel and logistics provision, survey and corrosion monitoring support.	PD&MS, Briggs Marine, Leask Marine, James Fisher, Green Marine, Rigmar Services, ROVOP.

5.13.5 Gap Analysis

		New Zealand			UK		
	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
OPERATIONS AND MAINTENANCE	Health Safety & Training	Medium	High	Medium	High	Medium	High
	Operations / Logistics	Medium	High	Medium	High	Medium	High
	Turbine Maintenance and Service	Low	Medium	Medium	High	Medium	High
	Balance of Plant Maintenance and repair	Low	Medium	Medium	High	Medium	High
OVERALL	High Potential						

5.13.6 UK Export Opportunity

The UK holds strong potential to export Operations and Maintenance expertise into the New Zealand market. This potential can manifest either through direct investment, involving the deployment of its own personnel and resources in New Zealand, or through collaborative partnerships with local companies in New Zealand, leveraging their knowledge. It's worth noting the probable imposition of high local content requirements in this phase, reminiscent of the recent wind policy statement 3 from the Victorian State government in Australia, mandating 80% local content. Supply areas where UK companies possess substantial experience, applicable to the New Zealand market, include:

- Training and certification services for offshore workers
- Provision of specialist technicians
- Operations support including control room and condition monitoring equipment and software
- Data and digitalisation services including data interpretation, machine learning and AI, digital twins
- Automated and unmanned inspection services including UAVs, AUVs, blade bug, etc.
- Subsea inspection services and equipment including ROV surveying
- Inspection and equipment
- Turbine access systems
- CTV and SOV design, operation and equipment supply.

It is anticipated that this export opportunity could be effectively pursued through a Joint Venture partnership with local New Zealand providers. For instance, a UK vessel designer such as Chartwell Marine, which emphasises partnership in its business model, could collaborate with a New Zealand shipbuilder to manufacture their designs.

Alternatively, a specialised UK Operations and Maintenance service provider like James Fisher could form a partnership with a local service provider in Taranaki or other expected regions, leveraging local knowledge and Iwi partnerships while understanding the necessity for skilled workforce transition, whilst applying their expertise and experience in executing maintenance operations domestically in the UK.

5.14 Supply Chain Analysis Summary

The following table summarises the results of the comparative analysis. Of the 9 supply chain elements assessed, the 3 with the highest potential for UK companies are:

- Development and Project Management
- Support Equipment and Services
- Operations and Maintenance.

		New Zealand			UK		
SUPPLY ELEMENT	SERVICE OR SUPPLY	CAPABILITY	LOGIC IN LOCAL SUPPLY	MARKET RESILIENCE	CAPABILITY	EXPORT EXPERIENCE	OPPORTUNITY IN NZ MARKET
Development and Project Management	Development and Consenting	Medium	High	High	High	Medium	High
	Resource and Metocean assessment	Existing	High	High	High	Medium	High
	Environmental Surveys	Medium	Medium	Medium	High	Medium	Medium
	Geological and hydrographic surveys	Medium	Medium	Medium	High	High	Medium
	Engineering and Design	Medium	Medium	High	High	High	High
Wind Turbine Supply	Nacelle, Hub and Assembly	Low	Low	Low	Low	Low	Low
	Blades	Low	Low	Low	High	High	Low
	Tower	Medium	Low	Low	Medium	Low	Low
Foundation Supply	Fixed Wind	Low	Medium	Low	Medium	Medium	Low
	Floating Wind	Low	Medium	Low	Low	Low	Low
	Floating Wind Moorings	Low	Low	Low	High	High	High
Cable Supply	Inter array cables	Medium	Medium	Medium	Medium	High	Medium
	Export cable	Low	Low	Low	Low	Low	Low
	Cable ancillary	Low	Low	Low	High	High	High
Electrical Infrastructure Supply	Offshore Substation	Low	Low	Low	Medium	Medium	Low
	Onshore Substation	Medium	Medium	Medium	Medium	Medium	Medium
Support Equipment & Services	Support Equipment & Services	Medium	Low	Low	High	High	High
Ports	Construction, Marshalling and O&M ports	Medium	High	Medium	High	Low	High
Transport and Installation	T&I Vessels	Low	Low	Low	Medium	Medium	Medium
	T&I Contractor	Low	Low	Low	Low	Low	Low
	T&I Personnel	Medium	High	Medium	High	Medium	High
	Onshore Construction	High	High	Medium	High	Low	Low
Operations and Maintenance	Health Safety & Training	Medium	High	Medium	High	Medium	High
	Operations / Logistics	Medium	High	Medium	High	Medium	High
	Turbine Maintenance and Service	Low	Medium	Medium	High	Medium	High
	Balance of Plant Maintenance and repair	Low	Medium	Medium	High	Medium	High

6. OPPORTUNITIES & RISKS ASSESSMENT

To further enhance the supply chain gap analysis and identify opportunities and risks for UK entrants, a SWOT-TOWS assessment has been implemented. This aims to build on the previously undertaken analysis and transform the information into action-focused recommendations for the UK supply chain.

6.1 Methodology

A SWOT-TOWS is a variation of the more commonly used SWOT analysis and will be used to provide a more strategic action-focused assessment of the New Zealand market for UK entrants (Figure 12).

The SWOT-TOWS analysis summarises the internal and external perspectives of the NZ offshore wind market from the perspective of the UK supply chain which can subsequently be used to generate strategy recommendations for UK companies considering this market. The outputs of the SWOT-TOWS assessment can be found in Section 6.3.

Figure 12: SWOT-TOWS Analysis

6.2 SWOT-TOWS Results

External Factors (NZ Offshore Wind Market)

OPPORTUNITIES

Limited pipeline will challenge domestic investment in many areas, likely lead to significant opportunity for experienced supply chains.

- Initial 'developer-led' approach likely to offer increased need for development / survey services and opportunity for multiple projects advancing in parallel; Supply chain could target key players.
- Clear absence of NZ supply chain for Cable Ancillary and Service Equipment supports a business case for UK's strong capabilities and export experience for these services.
- 'Piggy-back' approach with Australia – provides opportunity for additional demand capacity and regional market entry approach for UK suppliers – greater business case.
- 'Merit-based' system proposed will be favourable for UK suppliers, who are used to a merit approach in bidding and supply chain reporting requirements.
- Streamlining consenting framework gives UK suppliers some clarity and opportunity to compare to environmental and consenting approach and similar challenges back home. Opportunity to share best practices and lessons learned.
- Low barriers to in terms of doing business and overall market entry.

THREATS

- Offshore wind pipeline constraints driven by competition from onshore and limited immediate demand in a grid already heavily composed of renewables.
- Hydrogen required as offtake/export alternative for more significant build-out – space to watch for UK suppliers in the sector, however, build-out and cost reduction uncertainty positions this as long-term solution only.
- 'Piggy-back' approach with Australia will drive opportunity and could create additional market competition UK entrants from global supply chain.
- Unclear consideration on subsidy support approach – impacts on competitiveness from a developer and Tier 1 perspective, assuming this will be pushed down into the supply chain through procurement strategy.
- New governmental repeal of O&G exploration ban, adding to offshore wind pipeline uncertainty and associated impacts.
- Little capacity for additional increase in electricity prices leading to potential for public concern which will increase competitiveness pressure for OW.
- Grid connection as potential bottleneck
- Government concerned on creating a monopoly by awarding too much capacity to a single developer. Developers need to be mindful on commercial consequences of economies of scale.
- NZ strengths across all Development and Project management services, as well as T&I and O&M capabilities of personnel resourcing, onshore construction, HSE & Training and Operations/Logistics will pose entry risks. UK companies will need to displace local capabilities to gain market share. Additionally, high logic in O&M services being established locally places long term UK opportunities at risk.

INTERNAL FACTORS (UK SUPPLY CHAIN)

STRENGTHS

- Development & Project Management services, particularly development, consenting, resource assessment and engineering and design services.
- Increasing capabilities in manufacturing of monopiles, blades and cables.
- Significant floating wind moorings including anchors, mooring lines, topside connections, and jewellery.
- Extensive cable ancillaries experience both export and inter-array.
- Well established support equipment and services offering.
- Successful development of UK ports and operational management experience.
- Transport and Installation personnel and offshore construction experience.
- Operations and maintenance specialties including health and safety training and operations and logistics support.
- Successful development of SMEs to increase local content.

WEAKNESSES

- Wind turbine supply capabilities particularly around supply of the nacelle assembly.
- Shortage of skilled workforce for size of UK pipeline.
- Lack of foundation (particularly floating) fabrication facilities.
- Cost competitiveness compared to Europe, Middle East and Asia.
- Geographical separation between UK and NZ.

SO STRATEGIES

- Leverage skilled workforce noting the low barriers to entry for UK skilled labour and supplementing through synergies and transferable skills from other sectors.
- Utilise existing UK experience in areas such as port development, T&I experience to transfer to NZ. Opportunities for partnerships between UK and NZ ports to share knowledge and experience, and further opportunities for UK equipment providers to leverage existing APAC footprint to supply the NZ market.
- Leverage the existing UK offshore wind experience in areas that can aid NZ developers to win, including de-risking project development, identifying strong project concepts, and overall design and engineering strategies

WO STRATEGIES

- Focus on exports of non-material items such knowledge, operational experience and industry development. Identify key equipment supply chains by UK companies already present in APAC that are able to supply mitigate the geographical distance between the UK and NZ.
- Explore the potential to establish a dedicated NZ business entity to align with the country's objectives for a strong domestic industry
- Leverage mutual strengths of UK and NZ. Focus opportunities around areas of experience transfer, lessons learned across consenting, project design and overall de-risking ahead of large-scale component supply.

ST STRATEGIES

- Consider collaboration with UK supplier utilising the existing UK experience to mutually enhance capabilities.
- Consider a potential MoU between the governments of New Zealand and the UK to jointly develop critical infrastructure. This could include: grid developments, port infrastructure or alternative offtake solutions such as hydrogen.
- Develop SMEs to maximise opportunity for local-content and utilise experience from UK in wider supply chain support services to help local development.
- Promote focus on regional market entry opportunity for UK companies to justify investments and mitigate offshore wind pipeline constraints and uncertainty in NZ. Consideration of wider market opportunities for UK suppliers supporting both offshore wind and oil & gas.

WT STRATEGIES

- Focus on exports which are unable to be provided by global supply chain, such as experience and specific services which is unaffected by pricing trends.

6.3 Key Themes / Recommendations

Throughout the analysis six key themes emerged; each is further described in detail in this section.

1. **Leveraging UK Capabilities to fill Capability Gaps in NZ**

The UK supply chain capability can be utilised to support the NZ offshore wind supply chain in the following areas:

- Project development, site and project risk assessments and overall fixed and floating engineering and design services.
- Grid connection and management expertise gained through UK's offshore wind integration process and challenges.
- Bespoke installation equipment and support services through extensive project execution track record. This includes components such as cable protection systems.
- Health and safety and wider quality management services.

For the project development and engineering design services, the current limited offshore wind pipeline in NZ could be seen as a barrier to longer term and sustainable market entry that is typically required for companies to establish a substantial local presence. A regional approach that combines similar opportunities in Australia or a partnership-led approach can help mitigate some of these elements. It should be assumed that local suppliers will be able to gain expertise and experience in this area quickly, including through the support of overseas offices in the case of larger engineering firms with a NZ footprint.

While some of the NZ planned projects have stated ambitions to begin construction before 2030, the overall timeline for market entry for the installation services and equipment manufacture is at least 5 years off. This should give UK companies time to form partnerships, identify key opportunities, sub-contractors and clients and understand their overall approach to NZ vis-à-vis the wider region.
With little to no logistical challenges in terms of visas or right-to-work for UK skilled, youth and senior leadership to enter and work in NZ there are no barriers apart from geographical distance to UK companies wanting to build a physical presence in NZ. The general cost competitiveness of the APAC region for component and equipment manufacture will continue to be a market entry challenge for UK suppliers, including the significant distance between both markets, unless they have existing facilities and sourcing partnerships in the region that can be leveraged. Particularly the bespoke equipment – such as cable trenching or davit cranes – may see involvement from UK counterparts with execution or delivery from APAC. Wider Australia and NZ partnerships with local suppliers here can support UK companies to further understand existing capability and cost parameters.

2. Leveraging UK Capabilities to fill Capacity Gaps in NZ

Capacity gaps in the NZ supply chain are likely to arise from a lack of skilled workforce on the project management, installation, and O&M side. Whilst Tier 1 contractors would look to set up local training plans or recruit from the wider region for the main vessel or installation scopes, UK suppliers can look to fill these gaps through targeted partnerships and personnel locally, bringing in relevant experience in QHSE, project management or scopes such as Marine Warranty Surveyors. As previously noted, NZ is considered low risk in terms of importing relevant UK experience.

The overall lack of long-term pipeline and uncertainty on project timings will again be a barrier and risk, with the wider region being able to fill potential gaps if needed. The timeline of first projects only starting in the early 2030s means there is sufficient time for early workforce development actions locally in NZ to anticipate and address any gaps in key areas as well and prepare for requirements in the O&M space.

It is unlikely that the UK will be competitive in terms of importing physical components to NZ. As UK component manufacturing capabilities grow in it is likely that the wider global supply chains will look to markets such as NZ to backfill their orders.

3. Collaboration between New Zealand and the UK

The UK government is placing considerable focus on offshore wind domestically with strong targets and funding that are providing confidence for investment in the supply chain. New Zealand could leverage this governmental experience to increase offshore wind targets given the considerable opportunity NZ has in terms of offshore wind potential. A key risk is that a change in government could lead to a shift in priorities and provide more uncertainty to UK companies considering inward investment in the NZ supply chain.

Another key export opportunity area is the best practices and lessons learned to be shared between UK and NZ governments and industry stakeholders, particularly those around addressing deployment barriers, collating, and sharing environmental data and monitoring as well as approaches to skills and supply chain development.

One example for this is the Crown Estate's Offshore Wind Evidence & Knowledge Hub aimed at establishing an open environmental data portal to support the streamlining of the UK's offshore wind consenting process. This knowledge hub will cover access to previous environmental impact assessments, marine and site data, key industry and academic literature on relevant topics and work across multiple stakeholders for a holistic overview. Whilst NZ may currently be looking at a smaller capacity development pipeline than the UK, early efforts to capture and maintain industry knowledge can help mitigate against repetition or additional efforts later.

Additional initiatives from industry bodies that serve as example of discussion and best practice points are:

OWIC Workforce and Skills Workstream

The Offshore Wind Industry Council (OWIC) are currently developing an industry wide plan to support the development of people and skills in the UK offshore wind industry. The purpose of the plan is to create quality jobs, develop high-level skills and build a diverse workforce for the future that is required between now and 2030, to support delivery of the UK's clean energy, net-zero, and energy security targets. OWIC have established several working groups (each focusing on different areas such as Investment in Talent, Education, Diversity etc.) which have cross-sector representation to ensure that the entirety of the offshore wind supply chain is involved in the discussion and considered in the final plan recommendations.

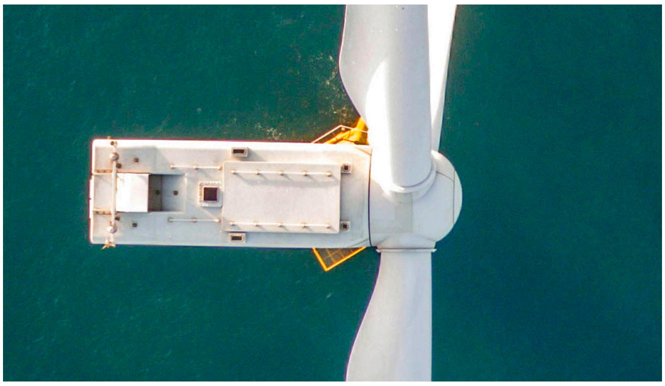
UK Offshore Wind Clusters and the Cluster Builder

There are 8 different clusters in the UK, 2 in Scotland and 6 in England. The Offshore Wind Cluster Builder, an independent resource programme set up by Scottish Enterprise, worked with small and medium-sized enterprises (SMEs) in Scotland to promote opportunities and address challenges in the offshore wind sector. The Cluster Builder acted as a link between the 2 clusters in Scotland, supporting them to work together to support SMEs in Scotland. Despite the efforts of the programme, the Clusters still operated in competition. To tackle this, it was announced in January 2024 that the 2 clusters will merge to make one Scotland wide support system.

Across the rest of the UK however, the Clusters continue to work in silos. Each cluster focuses on promoting businesses in their own geographical area and works in competition with the others. While it is important to upskill and promote SMEs in each individual region, there should be greater communication and coordination between the clusters. If Clusters work together, they will be able to provide more streamlined services to their SMEs and in turn support the creation of a more robust supply chain which can not only support the UK but markets across the globe.

4. Collaboration with Māori

New Zealand has a unique history and indigenous population that the upcoming offshore wind industry and potential UK entrants will need to be aware of. While not perceived to be a barrier to entry for UK participants it is important to note the rights and interests of Māori in the development of the offshore wind supply chain.



5. Collaboration between Developers

Despite the impressive offshore wind potential in New Zealand, the pipeline is likely to be quite small comprised of moderately sized projects. This is challenging for both the developers and the supply chain. Developers require larger projects to achieve economies of scale, typically >1 GW and multiple smaller projects will squeeze a limited supply chain and prevent inward investment based on uncertainty. Collaboration between developers will be necessary to drive success and grow the offshore wind supply chain in New Zealand. This is already evident by the partnering of overseas, more experienced developers in offshore wind development, with local partners from associated industries to jointly develop and execute projects in New Zealand.

However, on a wider market basis with continued growth of the capacity pipeline, or at a regional Australia-New Zealand level, collaboration between developers can also be used to discuss and de-risk key barriers to offshore wind deployment. Examples of this can be leveraged from the UK, with FCDO and other institutions support sharing lessons learned and best practices. Example industry partnerships are outlined below:

Offshore Wind Industry Council (OWIC)

The Offshore Wind Industry Council (OWIC) is a strategic partnership between the UK government and the offshore wind industry. It was established to drive the long-term growth and success of the offshore wind sector in the United Kingdom. OWIC serves as a forum for collaboration and decision-making, bringing together key stakeholders from government, industry, academia, and other relevant organisations. Pathways to Growth (P2G) is the Sector Deal's workstream, facilitated through OWIC, focused on identifying and addressing the key environmental and consenting challenges that will be a barrier to the UK meeting its offshore wind 2030 target and playing its full role in delivering net zero. P2G complement and enhance the work of existing work programmes and strategic groups and is creating a clear road map for with commitments to meet 2023 net zero targets.

Scottish Offshore Wind Energy Council (SOWEC)

The Strategic Investment Model (SIM) was established between the wind industry and the Scottish Government. It provides a framework within which common industry and Government offshore wind interests can best be identified and modelled so that required investment can be brought forward in a timely fashion. This will be done to support and grow a Scottish supply chain that is able to prosper and win work from a future pipeline of offshore wind projects by focusing on the strategic investment needed to capture these opportunities. The aim is to have the private sector also invest in renewable energy developments.

- Development of ports to support large scale manufacturing has been identified as the first area requiring focus and finance. Having suitable infrastructure in place is crucial to the success of offshore wind in the UK. Upgrading and preparing ports for renewable projects takes time, and therefore plans for investment should take place at the earliest opportunity to ensure that infrastructure is ready.
- The SIM Development Group includes government and all developers involved in offshore wind in Scotland. It was highlighted very early in the development of the group that all relevant players should be invited to participate in the activity. Coordination and collaboration have long been acknowledged as crucial to the success of offshore wind; however, the practicalities of transparent collaboration are complex and difficult due to the nature of competition in the industry.

6. Support for Small and Medium-Sized Enterprises (SMEs)

Offshore wind developers, Tier 1, and Tier 2 contractors rely upon smaller companies to manufacture many of the sub-components essential for delivery of the wider supply chain. As previously mentioned, SMEs are fundamental to ensure a robust and resilient supply chain. In the UK, as with any other market, there are gaps in the supply chain that need to be filled by SMEs, hence the UK has developed support programmes to nurture these opportunities.

Given the limited opportunities for large-scale component manufacture in NZ, development of these SMEs could be essential for building a sustainable offshore wind industry. The experience the UK has established could provide valuable support for NZ and also provide an avenue for SMEs to break into the NZ market to help deliver offshore wind in NZ and the wider APAC region. Organisations such as the Offshore Wind Growth Partnership (OWGP), Offshore Wind Industry Council (OWIC), and Scottish Enterprise have accelerated and transformed businesses so that they are ready to succeed in the offshore wind industry. The success of these programmes has been a result of them targeting SMEs which historically have been rooted in adjacent sectors such as oil and gas. Certain programmes are now also supporting start-up companies. This targeted support required for SMEs may be mirrored in New Zealand, however there is currently a lack of SME-focused support programmes specifically for offshore wind given its early status.

The Offshore Wind Growth Partnership (OWGP) is a UK government-backed initiative designed to support the growth of the offshore wind industry. The partnership is funded by the Department for Energy Security and Net Zero (DESNZ) and delivered by the Offshore Renewable Energy Catapult (ORE Catapult), which is the UK's leading innovation centre for offshore renewable energy. OWGP provides financial support, expertise, and resources to help companies within the supply chain enhance their capabilities, improve productivity, and seize opportunities in the offshore wind market. This support includes funding for research and development, innovation projects, and access to industry expertise and networks. To date, OWGP has supported over 270 projects, created

724 jobs in offshore wind and awarded over £19m in funding to UK companies. Key support requirements include:

- Visibility
  - SMEs cannot fill gaps in the supply chain if they don't know where the gaps lie. Pipelines, plans and timelines should be easily accessible, and it should be clear what is required and when.
- Engagement
  - SMEs need the opportunity to be connected to other suppliers because they could add value to their offering by working together. Developers, governments, industry, those who have come before should share data and lessons learned so the industry can grow as one. SMEs should be engaged with as early as possible.
- Collaboration
  - Cross-border cooperation is essential, and New Zealand should continue to prepare using lessons learned from established markets such as the UK.
  - Collaboration can also build the workforce, for example, through sharing training facilities. On building that workforce, New Zealand should be prepared to focus on engagement with schools and universities, training and upskilling programmes and apprenticeships.
- Market Intelligence
  - SMEs benefit from having access to training and support programmes, such as those mentioned above.
- Matchmaking and networking support
  - Meet the Buyer and Meet the Developer events provide excellent opportunities for SMEs to engage with the industry.
- Support with business development & finance
  - Due to their size, SMEs often struggle to know how best to grow their business, be it through a lack of market knowledge or through a lack of financial support.

6.4 List of Acronyms

ACRONYM	DESCRIPTION
ABB	Asea Brown Boveri Ltd.
AC	Alternating Current
AHT	Anchor Handling Tug
AHTS	Anchor Handling And Tow Support Vessels
APAC	Asia Pacific
AUS	Australia
BEIS	of Business, Energy & Industrial Strategy
CCTV	Closed-Circuit Television
CEO	Chief Executive Officer
CFD	Computational Fluid Dynamics
CIP	Copenhagen Infrastructure Partners
CLV	Cable Laying Vessels
COP	Copenhagen Offshore Partners
CSV	Construction Support Vessel
CTV	Crew Transfer Vessel
DC	Direct Current
DESNZ	Department for Energy Security and Net Zero
DOF	Department of Fisheries
DP2	Dynamic Positioning
ECA	Energy Efficiency & Conservation Authority
EEZ	Exclusive Economic Zone
EIA	Environmental Impact assessment
EIS	Environmental Impact Statement
EPC	Engineering Procurement Construction
EPCI	Engineering, Procurement, Construction and Installation
ESIA	Environment and Social Impact Assessment
FCDO	Foreign, Commonwealth and Development Office
FEED	Front-End Engineering and Design
FID	Final Investment Decision
FLS	Fatigue Limit State
FTA	Free Trade Agreement
GE	General Electric
GIDI	Government Investment in decarbonising industry fund
GW	Gigawatts
GWO	Global Wind Organisation
HCV	Heavy Construction Vessel
HL	Heavy Lift
HLV	Heavy Lift Vessel
HV	High Voltage
HVDC	High Voltage Direct Current
IEA	International Energy Agency
INZ	Infrastructure New Zealand
IP	Intellectual Property
ISO	International Organization for Standardization
JV	Joint Venture
LCOE	Levelized Cost of Energy
LDD	Large Diameter Drilling
M&A	Mergers and Acquisitions
MBIE	Ministry of Business, Innovation and Employment

ACRONYM	DESCRIPTION
MCA	Multi Criteria Assessment
MFAT	Ministry of Foreign Affairs and Trade
MoU	Memorandum of Understanding
MUNZ	Maritime Union of New Zealand
MW	Megawatts
NDT	Non-Destructive Testing
NZ	New Zealand
NZGIF	New Zealand Green Investment Finance
NZGP	New Zealand Government Procurement
O&G	Oil & Gas
O&M	Operations and Maintenance
OCS	Offshore Constitutional Settlement
OECD	Organisation for Economic Co-operation and Development
OEI	Offshore Electricity Infrastructure
OEM	Original Equipment Manufacturers
OSS	Offshore Substation
OSV	Offshore Support Vessel
OSW	Offshore Wind
OFTO	Offshore Transmission Owner
OW	Offshore Wind
OWGP	Offshore Wind Growth Partnership
OWIC	Offshore Wind Industry Council
PPA	Power Purchase Agreement
PWC	PricewaterhouseCoopers
QHSE	Quality, Health, Safety and Environment
RAG	Red-Amber-Green
RMA	Resource Management Act
RMS	Root Mean Square
ROV	Remote Observation Vehicle
SAF	Sustainable Aviation Fuel
SGRE	Siemens Gamesa Renewable Energy
SME	Subject Matter Expert
SOV	Service Operating Vessels
SOWEC	Scottish Offshore Wind Energy Council
SWOT	Strengths, Weaknesses, Opportuinities and Threats
T&I	Transport and Installation
TBD	To Be Determined
TESS	Techno-economic Site Suitability
Tier 1	Tier 1 suppliers are direct suppliers to the project.
Tier 2	Tier 2 supply to, or are subcontractors to Tier 1's.
Tier 3	Tier 3 supply to, or are subcontractors to Tier 2's.
TW	Terrawatt
UK	United Kingdom
UKEF	United Kingdom Export Finance
US	United States
USD	American dollars
UXO	Unexploded Ordnance
WTG	Wind Turbine Generators
WTIV	Wind turbine installation vessel

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