FLOATING OFFSHORE WIND CENTRE OF EXCELLENCE

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FLOATING OFFSHORE WIND CENTRE OF EXCELLENCE

FOW COST REDUCTION PATHWAYS

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Date: 24/09/2024

Reference: PN000647-RPT-006

Status: Public

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DOCUMENT HISTORY

Revision	Date	Prepared by	Checked by	Approved by	Revision History
Rev 1	09/09/2024	Mohammad Yousef, Cameron Wilson	Tom Quinn	Andrew S-Darling	First issue
Rev 2	24/09/2024	Mohammad Yousef, Cameron Wilson, David Maxwell	Tom Quinn	Andrew S-Darling	Update following stakeholder feedback

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NOMENCLATURE

AR	Allocation Round
CAPEX	Capital Expenditure
CfD	Contracts for Differences, a UK mechanism which guarantees wind farm owners a tariff which is fixed (expressed Real £ terms and understood to rise with currency inflation) for the first 15 generation years.
CoE	Centre of Excellence
CPI	Consumer Price Index

CRMF	Cost Reduction Monitoring Framework
CRP	Cost Reduction Pathways
DECEX	Decommissioning Expenditure
DEVEX	Development Expenditure
EIA	Environmental Impact Assessment
FEED	Front End Engineering Design
FOW	Floating Offshore Wind
GVA	Gross Value Added
HVDC	High Voltage Direct Current
IGP	Industrial Growth Plan
LCOE	Levelised Cost of Energy (the notional electricity sales price which, if applied and inflated each year, results in a nominal NPV of £0)
Nominal	Considering inflation from 1 January 2024 onward
NPV	Net present value, as at 1 January 2024, of future Net Cashflows, discounted at the stated discount rate
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OPEX	Operating Expenditure
ORE	Offshore Renewable Energy
RAS	Robotic and Autonomous Systems
TNUoS	Transmission Network Use of System
WACC	Weighted Average Cost of Capital

EXECUTIVE SUMMARY

Floating Offshore Wind (FOW) has the potential to deliver large-scale and cost-competitive electricity in markets across the globe. However, to maximise its role in delivering Net Zero, the Levelised Cost of Energy (LCOE) for FOW must be reduced to a level comparable with other low-carbon energy supplies. The FOW Cost Reduction Pathways project identifies an intermediary milestone of £96/MWh (2012 prices) for the clearing CfD price of First of a Kind (FOAK) gigawatt-scale projects deploying in 2033, and a long-term target of £70/MWh (2012 prices) by 2050. A range of drivers and enablers of cost reduction will impact the "cost reduction pathway" for FOW. Understanding these drivers and their impact on the cost reduction pathway for FOW is critical to ensuring the right enabling actions are taken to drive down the cost of this technology. Developing and communicating an understanding of these drivers and pathways is also key to maintaining confidence and support for the commercialisation of the technology. Additionally, it is vital to ensure key enabling actions required to reduce costs are progressed in a concerted and coordinated fashion.

This study uses the Offshore Renewable Energy (ORE) Catapult's in-house cost and economic model to capture a snapshot of project cost estimates for a small-scale demonstrator project and commercial-scale wind farm. A rigorous approach to cost estimates has included extensive stakeholder engagement with players across the industry including from the public sector, supply chain and the development community. Forecasting costs for projects that have not been designed yet, and for which equipment does not exist at scale, is an inherently challenging task. However, a realistic view of a possible pathway to commerciality has been created.

The cost trajectory outlined in this report is dependent on the realisation of a series of enabling actions. Of particular importance is the deployment of demonstrator projects which has been evidenced clearly in this analysis. These lead to cost reductions for future projects as experience and lessons are learned rapidly when projects are tested at scale at offshore locations. It also results in contractors, insurers and lenders becoming more comfortable with the risks involved, reducing the cost of borrowing for developers which has a significant impact on LCOE.

However, demonstrator projects are not only important from a cost perspective. They also provide the supply chain with an opportunity to develop track records and the confidence to invest in scaling up when commercial projects start procurement exercises. Without this lower risk starting point, companies will struggle to compete in supplying multi-GW projects. Analysis suggests that the loss of competitive edge could cost the UK economy £2.5 billion in Gross Value Added (GVA) in the period to 2035. The total opportunity sits between £12 and £22 billion direct and indirect GVA, with tens of thousands of jobs created. This does not include the value of exports, which the UK could capture if it maintains a first-mover advantage.

Sustaining cost reduction beyond demonstrator projects is coupled with the volume of deployment and the ability to optimise designs and approaches through innovation. This research has identified several critical drivers of cost reduction and the scale of their impact as outline below.

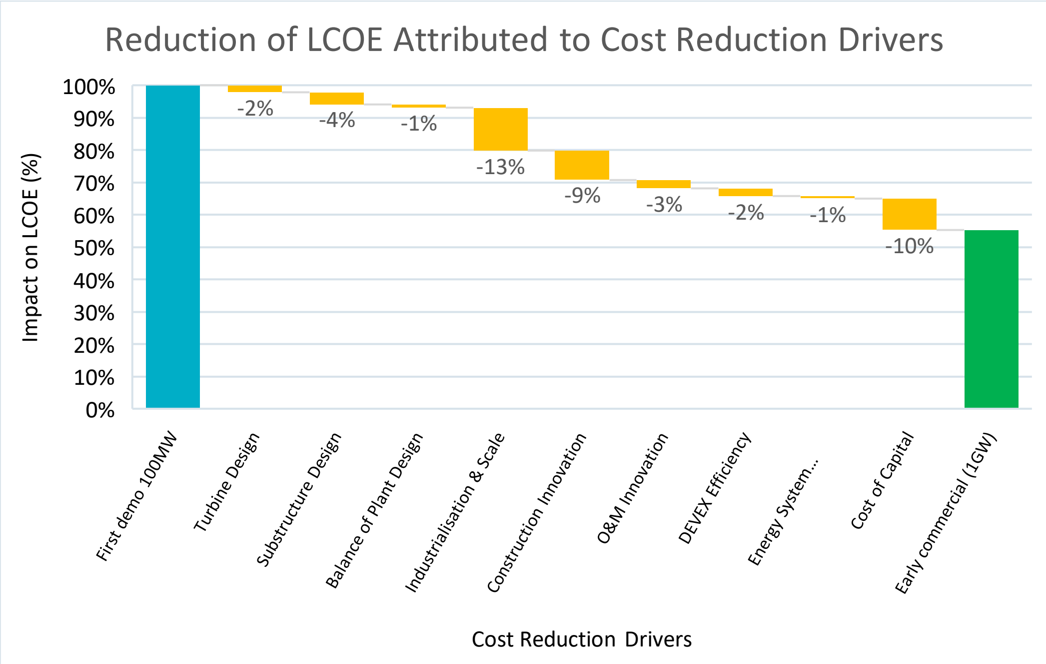

Figure 1: A waterfall chart to display cost reduction through the lens of cost drivers.

Importantly, the necessary volume of deployment is itself heavily reliant on the existence of appropriate port infrastructure which is critical to deploying projects at scale.

As well as a quantitative assessment of costs and related cost of energy calculations, a qualitative analysis is included in the report to outline the step changes from innovation, processes, economies of scale and reductions in financing costs. This provides context for specific areas which need to be investigated further to realise FOW's full potential.

The AR6 auction results, notably GreenVolt's successful bid at £139.93/MWh (2012 prices) for 400MW capacity, offer key insights into the evolution of the FOW sector. GreenVolt, at large-scale (>500MW), differs significantly from smaller, earlier-stage demonstrators, as its size plays a pivotal role in accelerating supply chain development, reducing costs and moving the sector towards an industrial scale. However, its strike price incorporates unique factors, such as its status as an INTOG wind farm, its financing structure, and execution strategy, and should not be seen as the new market standard, with future auction rounds expected to attract higher strike prices for demonstration projects. While GreenVolt's success is a positive step toward FOW commerciality, ongoing investment in smaller demonstration projects is crucial for testing technologies, refining processes, and ensuring long-term cost reductions. The AR6 results emphasise the importance of a diversified project pipeline to mitigate risks, sustain sector growth and ensure diversity of expertise in the supply chain.

Consequently, securing early certainty on the AR7 FOW budget and auction parameters is essential to maintain progress in the sector, as is clarifying how this might develop in the years ahead. Additionally, consideration could be made to alternative mechanisms beyond the current CfD structure to better support test and demonstration projects. These smaller-scale initiatives are vital for fostering innovation, reducing risks and bolstering the supply chain for FOW, but they require a more radical approach to funding and policy support. Without such measures, the industry may struggle to advance the technologies and methodologies necessary for long-term cost reduction and scaling.

1 INTRODUCTION

1.1 Background

In collaboration with the Floating Offshore Wind Task Force, the Offshore Renewable Energy (ORE) Catapult delivered the Cost Reduction Pathways and Monitoring Framework (PR55) project on behalf of the Floating Offshore Wind Centre of Excellence (FOW CoE). The project aims to provide detailed insights into the cost reduction pathways for FOW in the UK to 2035 and beyond. The study assessed developments specific to FOW in areas including technology and innovation, industrialisation (supply chain and infrastructure), economies of scale and learning rates (learning by doing). It also assessed broader macroeconomic factors such as inflation and cost of capital (including project financing risk).

In addition to these cost reduction pathways, the project developed an approach for a qualitative and quantitative Cost Reduction Monitoring Framework (CRMF). This framework, if implemented, would allow industry and government to clearly track the industrialisation of the sector and associated cost reduction in the short and medium term, ensuring directed support can be provided in a rapid but sustainable manner, and in return play a critical role in the delivery of a cost effective Net Zero as well as enhancing UK energy security.

The cost reduction pathways were developed based on a "bottom-up" techno-economic analysis of example FOW projects. The model employed representative reference sites to effectively model the cost of future offshore wind developments. The reference projects costs are for 108MW and 1008MW projects taking FID in 2025 and 2030, respectively. For simplicity, these are referred to as the 100MW and 1GW projects for the remainder of the report.

The cost model utilised the identified cost drivers to assess how different project cost elements change over time, which shall in turn drive changes in the overall Levelised Cost of Energy (LCOE). A cost driver is a factor which impacts the LCOE of FOW. Each cost driver was considered and modelled specifically in the context of a cost reduction pathway model. Each driver used will act as a lever that, if altered, will impact the final LCOE of the representative FOW projects of focus. This model has produced the outcomes outlined in this report, but also provides a resource for use in future project activity.

1.2 ORE Catapult

ORE Catapult acts as an independent, centralised, forward-thinking organisation at the heart of the offshore renewable energy industry, working closely with partners across industry and academia to develop new ways of working and prove, de-risk and develop promising new technologies. This report has been compiled by ORE Catapult using internal modelling informed by related industry engagement.

1.3 Floating Offshore Centre of Excellence (FOW CoE)

In an effort to boost the floating offshore wind industry, ORE Catapult has established the FOW CoE to develop an internationally recognised initiative to reduce the cost of energy of FOW. The FOW CoE will accelerate the build-out of floating sites, create opportunities for the supply chain, and drive innovations in manufacturing, installation and O&M. FOW CoE is seeking to ensure that FOW specific risks and opportunities are considered in the short term, alongside the broader risks and opportunities for the offshore wind industry in the UK and more broadly. The FOW CoE is a collaborative programme between industry, academia and stakeholder partners https://fowcoe.co.uk/.

2 METHODOLOGY

This study has incorporated a combination of previously developed UK deployment scenarios, bottom-up cost modelling, industry consultation and learning rate analysis. The methodology is outlined here and described in detail in the body of this report. The key steps are:

1. Define two FOW representative reference projects (demonstration-scale and utility-scale) in the UK that will serve as a vital benchmark for establishing base cases. The reference projects provide a real-life standard for evaluating and comparing prices, as well as the technical assumptions. The two reference projects have been defined with costs estimated at a point in time and then extrapolated over several years. The two representative FOW projects are:
    - Demonstration-scale projects of 100MW (taking FID 2025 - 2029).
    - Commercial-scale projects of 1GW (taking FID 2030 - 2050).

   Using the two reference projects of 100MW and 1GW indicates how costs may change over time, but in reality, they do not cover the full range of possibilities. The UK will likely see several intermediate project sizes (300-600MW) on the road to full commercial-scale. Once commerciality has been reached, project size will not be limited to 1GW, so there is potential for further cost reduction driven by economies of scale for multi-GW projects.
2. Identify and assess current and future cost drivers for utility-scale FOW projects.
3. Development of ORE Catapult's PR55 FOW Cost Model.
4. Stakeholder engagement, including the supply chain, industry and project partners, to inform the cost model's technical, cost and financing assumptions:
    - Bottom-up cost modelling: stakeholder engagement with supply chain and industry.
    - Top-down cost modelling: stakeholder engagement with project developers.
5. Identify and assess the cost drivers and their impact on LCOE.
6. Estimate learning rates for cost drivers throughout the project cycle - Development expenditure (DEVEX), capital expenditure (CAPEX), operating expenditure (OPEX), and decommissioning expenditure (DECEX).
7. Incorporate the deployment scenarios (PR54 project) input to inform the UK and global deployment forecast.
8. Employ a cash flow model to output LCOE in 2012 and 2024 prices along with other financial metrics.
9. Develop a Gross Value Added (GVA) model to assess macroeconomic benefits for the UK.
10. Review of cost modelling outputs and findings with the CoE partners.
11. Finalise the PR55 FOW Cost Model.
12. Develop the Cost Reduction Monitoring Framework proposal.

3 UK FUTURE DEPLOYMENT SCENARIOS

This report section details the input into the ‘Cost Reduction Pathways and Monitoring Framework’ study from a parallel piece of work - the ‘UK Future Deployment Scenarios’ study.

The UK Future Deployment Scenarios study models four different scenarios representing differing levels of ambition and realisation of the UK's OSW and Net Zero targets, as summarised in Table 1 below.

The methodology utilised in the project comprised of a “bottom-up” and “top-down” approach working in combination to reach the 2050 deployment target. The “bottom-up” approach focused on existing project data to determine the short- to medium-term deployment trajectory. The “top-down” approach, on the other hand, considered general trends and long-term ambitions to build a vision of medium- to long-term deployment. The output is a unified deployment scenario through to 2050 which incorporates both approaches.

Table 1: UK deployment scenarios description.

2050 Deployment Target (GW)	Scenario description
100	Base Case Scenario – This is the central case, which reflects a common target employed across the industry. This deployment figure is also found in multiple other studies.
75	Low Ambition Scenario – A target which will require minimal change from the status quo to facilitate this level of deployment.
115	IGP Aligned Scenario – Informed from ongoing work on the OSW IGP, a joint industry collaboration.
125	High Ambition Scenario – This represents a high-case scenario which aims to illustrate the maximum ambition level that the industry can endure before the enabling actions, as identified in this study, transition to hard constraining factors and begin to impede OSW deployment.

The approach used in the UK Future Deployment Scenarios Study consisted of three components;

1. Cost modelling provided from the Cost Reduction Pathways and Monitoring Framework study for FOW and ORE Catapults’ Cost Reduction Pathways (CRP) model for fixed-bottom.

2. A GIS model created by an independent consultancy.

3. The deployment scenario model.

The following figure outlines how the components of the methodology interact with each other.

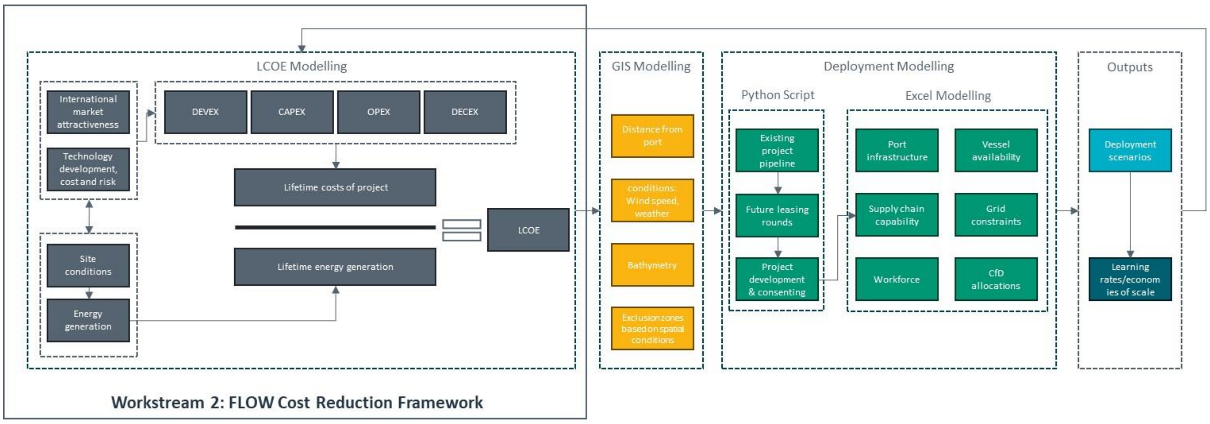

Figure 2: Overview of the UK Future Deployment Scenario's model functionality.

LCOEs for reference FOW and fixed-bottom wind farms were developed from the cost modelling conducted as part of the Cost Reduction Pathways and Monitoring Framework study. These figures then fed into the GIS Modelling as part of the UK Future Deployment Scenarios study to determine how many GWs are available, and at what LCOE, for deployment.

A Python script was then developed to model fixed-bottom and FOW leasing rounds as part of the "top-down" approach. The script assumed that the projects with the lowest LCOE are installed first, rather than having leasing rounds for specific technologies.

The deployment scenario model then incorporated this "top-down" part as informed by the leasing round module, GIS model and Python Script. A consenting timeframe was also applied to each scenario to account for the rate at which projects move through the pipeline.

The existing project pipeline was used to inform the "bottom-up" part of the model. This was informed by the 4C Offshore database to consider which projects are most likely to go ahead in the period through to 2040.

The "top-down" part of the model was then combined with the "bottom-up" part to form each deployment scenario through to 2050. The deployment scenarios developed in the UK Future Deployment Scenarios study were then fed back into the Cost Reduction Pathways and Monitoring Framework study to produce the final LCOE figures for the reference sites considered.

3.1 Gross Value Added (GVA) Analysis

Gross Value Added (GVA) is the additional value added to the macroeconomy as a result of new investment. The analysis contained in this report quantifies the wider economic benefit to the UK as a result of investment in FOW. The GVA analysis finds that there will be a considerable GVA generated from UK FOW projects alone from the 115 GW Scenario (aligned to the Industrial Growth Plan (IGP) report).

The UK deployment scenarios are translated from GW to monetary values, with a portion of each deployment target allocated to FOW deployment. These monetary deployment figures serve as one of the key components for the GVA analysis conducted in this study.

An important note here is that this study uses direct and Indirect GVA figures only. Induced GVA is not included.

Figure 3 below is the cumulative discounted GVA for FOW projects in the UK. The GVA analysis indicates that the demonstration-scale projects will deliver supply chain investment, leading to additional macroeconomic benefits for the UK of £2.5bn over the same time period as below (discounted, assuming the same pipeline of FOW projects are developed in the future). This does not include the economic benefits realised from exports, which would be possible with expertise developed as a first mover.

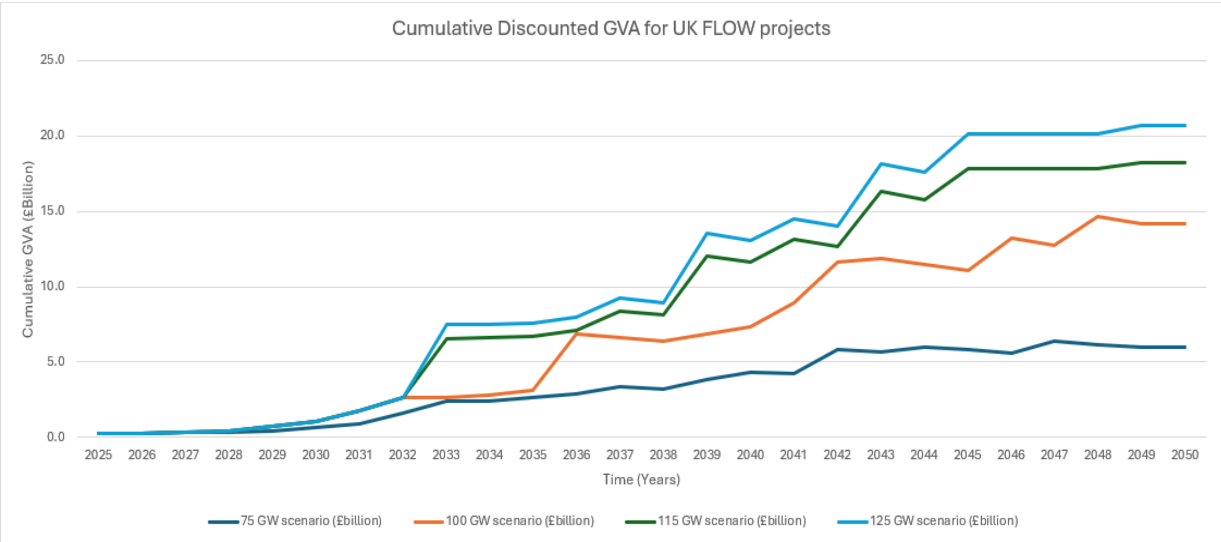

Figure 3: The cumulative discounted GVA for FLOW projects in the UK (2025 – 2050).

4 KEY COST DRIVERS

The Cost Reduction Pathways (CRP) model is built from the bottom up, running through the costs of a FOW project on a line-by-line basis. These costs fall under the DEVEX, CAPEX, OPEX, and DECEX expenditure headings. Each project lifecycle phase and its associated costs are summarised below.

- DEVEX – The development phase of a project covers activities up to the point of FID. Activities here include those needed to secure planning consents, and to define key project design considerations.
- CAPEX – This phase occurs between FID and the works completion date when a wind farm is ready to be commissioned. In this phase capital (e.g., turbines, cables, substructures) is purchased and assembled, with the CAPEX phase representing the biggest upfront cost of any project lifecycle phase.
- OPEX – This phase covers the operating lifetime of a wind farm. O&M costs are the greatest expense here. O&M is the combined functions which support the ongoing operation of turbines, balance of plant and associated transmission assets. The focus of key activities during the operational phase include ensuring safe operations, maintaining wind farm physical integrity, and optimising electricity generation to maximise project revenues. Additional costs associated with this project phase include insurance costs and the servicing of debt.
- DECEX – This phase occurs at the end of the operating life of a wind farm and covers costs associated with the removal of turbines, moorings, anchors, cables, and other supporting infrastructure.

For final project LCOE to be impacted cost drivers must either affect:

1. Expenditure experienced throughout any of the four project lifecycle phases, or;
2. Revenues achieved during the operating lifetime of each FOW project of focus.

The cost drivers considered in this work are listed in Table 2, alongside the variables they directly impact. It should be noted that although not explicitly detailed, market factors will invariably impact some or all of the cost categories described.

4.1 Wind Farm and Technology Design Optimisation

The design of turbine technology, balance of plant systems and overall wind farms has evolved considerably over the past 10 years, leading to significant reductions in LCOE. Critical drivers include the increase in turbine size, increased electrical system voltages, and optimised substructure and mooring system designs.

4.2 Innovation and Optimisation in Component Production, Assembly and Project Construction

Lowering the cost of key components can significantly reduce the CAPEX of FOW projects. Design optimisation (as described above) is one factor which drives this, but other important factors linked to the industrialisation of FOW technology will also drive reductions in project costs.

4.3 Innovation and Optimisation in Operations and Maintenance

Cost associated with the ongoing operations and maintenance of a large offshore wind project comprise a significant proportion of total lifecycle costs. It is anticipated that innovation and optimisation of these methodologies over time will contribute towards a reduction in cost in FOW LCOE.

4.4 Reductions in Project Development Costs

Despite DEVEX costs taking up a small portion of project expenditure in comparison to CAPEX and OPEX; cost savings in this area can be made by implementing the following:

- Improvements in FEED.
- Improvements in Data Gathering, Analysis and Evaluation.
- Reduction in Development Timelines.

4.5 Energy System Integration Costs

Integrating large offshore wind projects with the UK energy system has typically involved a direct connection into the UK's National Grid. Both securing and utilising this connection has charges associated with it. However, a range of alternative offtake options are becoming available to large offshore wind projects, and in addition, the approach to the development and connection charging for the National Grid is being reviewed in the context of the large scale of offshore wind the UK shall need to deploy to deliver a cost-effective Net Zero. This cost driver covers a range of such cost and revenue opportunities and considers how these may evolve over time.

4.6 Finance, Insurance, and Inflation

There are several external macroeconomic factors that will have an impact on the final lifetime costs of a FOW project. In this instance, the three most influential are the Weighted Average Cost of Capital (WACC) , insurance costs, and inflation which impacts commodity costs beyond that of consumer price index (CPI) inflation.

Table 2: Cost drivers and their associated variables.

Cost Driver	Relevant Subcategories	Associated Variable(s)
Wind Farm and Technology Design Optimisation	Turbine Design Optimisation	CAPEX, Energy Generation
	Substructure Design Optimisation	
	Mooring and Anchoring System Technology Design Optimisation	
	Electrical System Technology Design Optimisation	
Innovation and Optimisation in Component Production, Assembly and Project Construction	Economies of Scale in Production and Procurement	CAPEX
	Innovation and Optimisation in Manufacturing Processes	
	Innovation and Optimisation in Marshalling, Assembly and Construction	
	Use of New and Recycled Materials	
	Supply Chain Competition	
Innovation and Optimisation in Operations and Maintenance	Innovation and Optimisation of Operations and Maintenance Methodologies	OPEX, Energy Generation
	Optimisation of Project Availability and Generation	
Reductions in Project Development Costs	Improvements in FEED	DEVEX
	Improvements in Data Gathering, Analysis and Evaluation	
	Reduction in Development Timelines	
Energy System Integration Costs	Transmission Connection and Usage Charging	Market Factors
	Energy System Balancing/Management Costs/Revenues	
	Alternative Offtake Costs/Revenues	
Finance, Insurance, and Inflation	Weighted Average Cost of Capital	Market Factors
	Insurance	
	Inflation and Critical Commodity Cost Changes	

5 COST REDUCTION

In conducting stakeholder engagement regarding cost estimates it has emerged that there is a significantly wide range of opinions and disparity in how costs may develop over time. This reflects the current uncertainty in the market and range of technologies and wind farm site conditions being investigated by floating wind developers. In general, organisations which had progressed further towards FID had a higher estimation of final costs.

5.1 Conditionality

The opportunities for cost reductions in FOW identified in this report are conditional on the following assumptions:

1. **Learning rates:** Cost reduction through learning is driven by deployment rates. A cumulative global deployment capacity of 4,000MW is assumed to be installed before learning rates are applied as deployment across the markets will not deliver learning immediately and to avoid modelling unrealistic cost reductions in the early days when doubling of capacity happens very quickly. A global deployment capacity of 4,000MW is expected to be passed by 2029. It is assumed that China will not be sharing as much learning feedback with the industry, and therefore, China was excluded from the global deployment rate assumed in this analysis. The cost model differentiates between the global and UK deployments and accordingly applies learning rates related to the UK in specific areas. We assume the 100MW projects are built before the 1GW project, which provides project-specific cost reduction. The learning rates applied in the analysis are broadly aligned with the feedback provided by the project developers.

2. **Turbines:** Turbine costs are assumed to be sufficient for OEMs to recoup R&D costs, but that there is adequate capacity in the turbine market (limited or no supply bottlenecks), which could otherwise drive costs higher. Pilot project costs are higher to account for the lower volume of turbine components procured. These costs could be reduced if the procurement was part of a wider supply contract alongside commercial-scale projects. The Front End Engineering Design (FEED) costs are also higher for the pilot projects on a £/MW basis as detailed studies to understand turbine integration will be required. For the 1GW project, the assumption agreed with the initial steering group was to model 18MW turbine models. There were some valid suggestions late in the project to change this to 15MW models, but this would have required a significant remodelling exercise, which was not possible in the project budget or timescale.

3. **Standardisation of substructure design:** A steel semi-submersible substructure design is assumed in the reference projects as this is considered to be a suitably representative substructure design for projects deployed in the short and medium term. The assumption for the 2033 1GW project is that the turbine OEM and substructure designs have been trialled in a pilot project, and the integration is well understood by both parties and the contractor.

4. **Vessel availability:** Costs for installation and O&M assume vessels are available, and day rates (aligned with supply chain and developer views) take the presumed shortage into

account.

5. **EPCI factor:** Costs are assumed to be inflated from our bottom-up model when contracting becomes finalised. The assumption is that EPCI contractors price-in infrastructure, market and technical risks to final project costs. For the 1GW project, we assume a CAPEX uplift of 8% compared to the base model for the initial projects. This will require EPCI contractors to be confident in the majority of project delivery risks. It is worth noting that the EPCI uplift is based on related feedback provided by project developers. As more commercial-scale projects are delivered, we assume no additional EPCI uplift will be required, with all EPCI costs included at a component level in the cost model.

6. **Geographical, metocean and environmental considerations:** The majority of FOW site development in the short and medium term in the UK will take place within the ScotWind leasing areas. The metocean, water depth, and seabed typology conditions within these areas vary, with sites in the Northeast Scotland region being considered as suitably representative of the seabed and environmental conditions for projects built from the late 2020s to mid-2030s. Costs for projects with more challenging metocean conditions will be higher than outlined in this report.

7. **Port infrastructure:** There is likely to be significant development of this port infrastructure over the coming 5-15 years in the UK to support the growing scale of deployment of fixed and floating wind. Port infrastructure will be developed to support both fixed and floating wind project construction, operations and maintenance. Our forecast assumes sufficient investment has been made and UK ports are capable of delivering fabrication and assembly. Land rental includes some uplift to account for this investment, but it is not assumed that all of the payments will be paid back from one project. The Celtic Sea requires significant development of port infrastructure. Therefore, a higher baseline cost in the Celtic Sea is anticipated, and the region is arguably much more in need of demonstration projects.

5.2 CAPEX Overview

Figure 4 below are the main outputs from the cost model (CAPEX figures). The light blue shaded area shows the cost pathway for 100MW demonstration projects, which do not reduce significantly as learning rates are not applied until 4GW of global capacity is breached in 2029. Some cost reduction is assumed, which is driven by EPCI contractor uplift being reduced as risks become better understood.

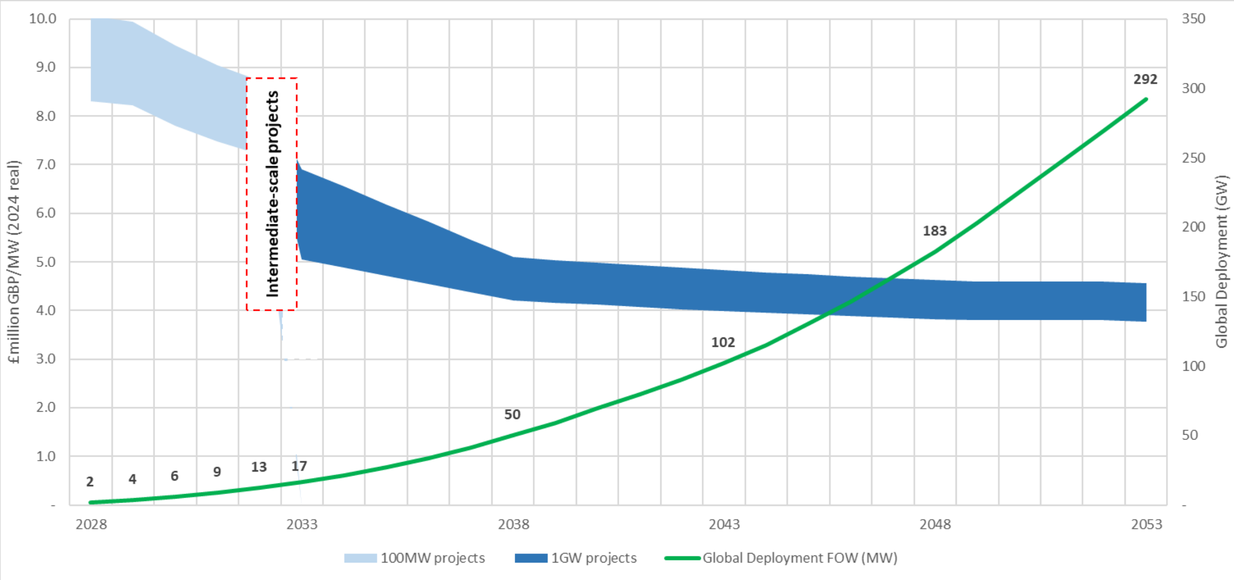

Figure 4: CAPEX cost reduction against global deployment. Note: Global deployment (green line) are projects reaching FID, China is excluded from the global deployment rates.

The dark blue shaded area shows the primary output of the FOW Cost Reduction Pathways project and relies on the assumptions and conditionality outlined above.

Firstly, it must be reiterated that the projected level of cost reduction is directly linked to the rate of deployment. Such a deployment trajectory is reliant upon the conditions outlined above being in place, and without these there is a significant risk of deployment being delayed and cost reduction being slowed. Given the level of uncertainty on project costs, Figure 4 shows the shaded areas which captures the range of costs provided by stakeholders. As previously mentioned, costs could reduce further as was experienced in the bottom-fixed market, as turbines and wind farms became bigger, and technological innovation coupled with low interest rates accelerated cost reduction.

The main message here is that once the UK starts developing and delivering GW-scale commercial FOW projects, it would be optimal to maximise the capacity able to clear with each CfD budget by having projects able to bid in with competitive strike prices. The alternative is either a limited number of wind farms built or a larger CfD budget at a cost to taxpayers. However, the situation with AR4 (projects handed back) and AR5 (no bids) needs to be avoided and can come as a result of over-competitive auctions or incompatible auction parameters. Supporting more early-stage demonstrator projects to progress in the short term is a far more economically advantageous course of action. These will come at a higher cost per GW deployed, but will have a minor impact on consumers given the relative size of demonstrator projects compared to the UK's total generating capacity.

Comparing the results of this quantitative assessment with the historical data observed in the fixed-bottom market allowed for a comparison of cost reduction across the two technologies. Fixed-bottom technology experienced approximately a 50% cost reduction when scaling from 1GW to 36GW of global deployment over 13 years, which compares to a ~50% cost reduction in FOW over 9 years for the same scale of deployment, as illustrated in Figure 5 below. It is worth noting that FOW depicted in the blue line in Figure 5 only reflects costs for 1GW projects and not multi-GW which is included in fixed-bottom data. Therefore, there is potential for further FOW cost reduction to drive this towards parity with fixed-bottom.

As part of a sensitivity analysis, a potential cost trajectory has been modelled to provide an indicative view of how cost reduction would be realised in the absence of demonstration projects. Using figures derived via stakeholder discussions, initial CAPEX costs for utility-scale projects taking FID in 2030 could be 30% higher in the absence of demonstration projects. It should be noted that the above scenario is hypothetical and the deliverability of any such project would face considerable uncertainty.

The sensitivity analysis found a significant cost reduction for 1GW utility-scale projects taking FID in 2030 where demonstration-scale projects have been deployed starting in 2028. Demonstration-scale projects are crucial for driving down costs and boosting the UK economy by incentivising investment in the supply chain. The demonstration-scale projects also play an important role in accelerating a UK-based supply chain, O&M capabilities, and capitalising on first mover advantage. Our GVA analysis indicates that the demonstration-scale projects will deliver supply chain investment, leading to additional macroeconomic benefits for the UK of £2.5bn (discounted, assuming the same pipeline of FOW project are developed in the future). This does not include the economic benefits realised from exports, which would be possible with expertise developed as a first mover.

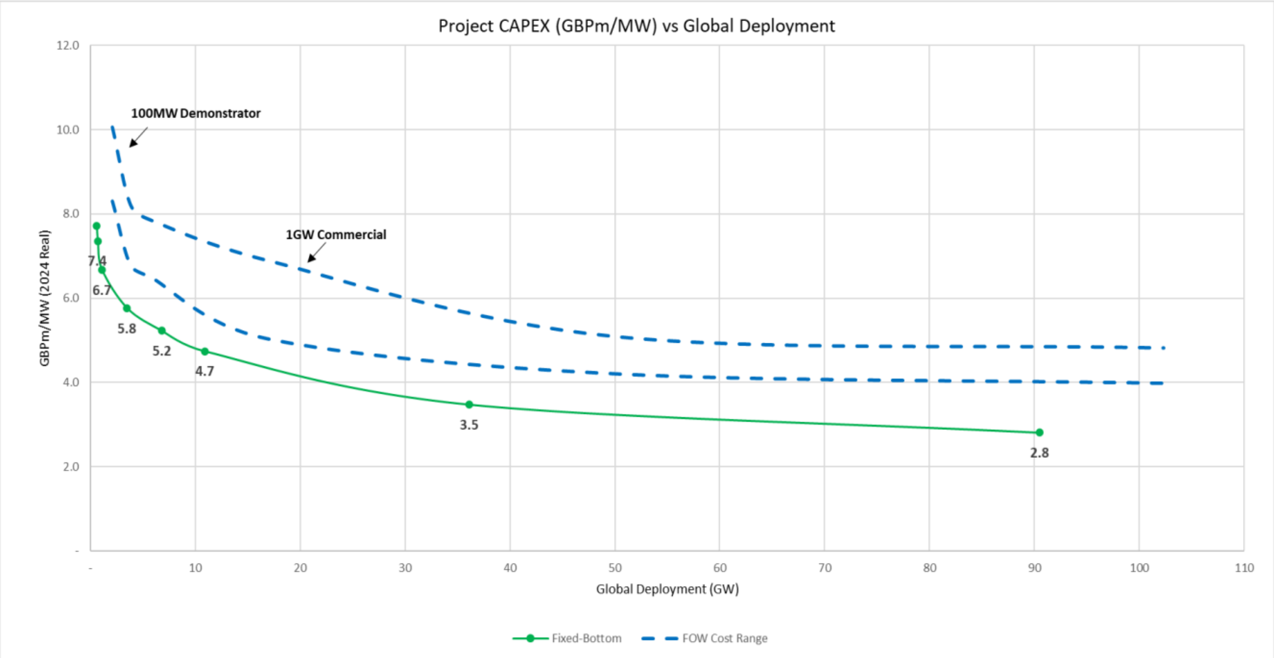

Figure 5: Comparison of fixed-bottom and FOW CAPEX cost reduction against global deployment. Note that the blue line only reflects costs for 1GW projects and not multi-GW which is included in fixed-bottom data. Note: China is excluded from the global deployment.

5.3 Contract for Difference (CfD) Strike Price Estimates

Given the timing and structure of offshore wind projects, with high upfront CAPEX and long asset life, discounting plays a major role in how projects are valued.

In the current model, the respective discount rates applied to the 100MW and 1GW projects are 10% and 8%. These provide an LCOE in line with the Administrative Strike Price (ASP) set for AR6 for the 100MW project. However, feedback from some in the industry is that these discount rates are too low, with the weighted average cost of capital currently estimated at around 13-14% for 100MW FOW projects, for developers without access to lower-cost debt financing. This would increase LCOE for the first demonstrator projects in excess of £200/MWh (in 2012 terms) and make current ASPs uneconomic. Figure 6 shows the modelled CfD strike price required to make NPV equal to zero with a range of discount rates for the 100MW project (2028) and 1GW projects (2033-2043).

There is an upside to this view on two fronts. First, bank interest rates (risk-free rates) could drop from 5% today to the Bank of England target of 2%. Second, as insurers, contractors and lenders become more comfortable that risks are being managed, the cost of debt will reduce. This may be accelerated if targeted innovation programmes demonstrate the reliability of components alongside greater efficiency and sustainability within the supply chain.

Figure 6 displays the calculated CfD price required for projects to break even (NPV=£0). This shows the progression of LCOE reduction for the same projects, but using a range of discount rates. This highlights the importance of reducing the cost of capital for floating wind projects, by making lenders comfortable with the risks involved. This will primarily be achieved through deployment and real-world testing of demonstrator sites. Also, on the chart is the Administrative Strike Price (ASP) for FOW in the upcoming CfD allocation round. This suggests that developers need to have access to relatively cheap debt and be able to deliver at the costs estimated earlier in the report. In section 7 we assess the implications of the AR6 results published in September 2024.

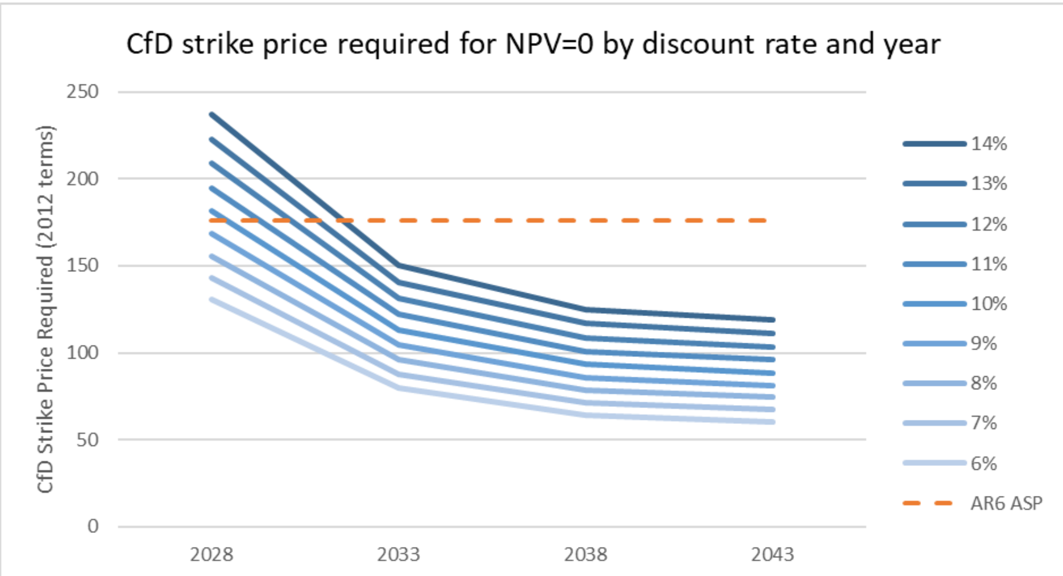

Figure 6: Modelled CfD strike price required for NPV=0 with a range of discount rates for the 100MW project (2028) and 1GW projects (2033-2043).

Figure 7 shows cost reduction from a different perspective, linking step changes to cost reduction drivers. While pure economies of scale have a major impact, we cannot ignore the role of innovation in turbine and substructure design, and improvements in marshalling and fabrication techniques.

Figure 7 also shows the cost reduction in terms of LCOE, a 45% reduction when moving from the first demonstration-scale to commercial-scale project.

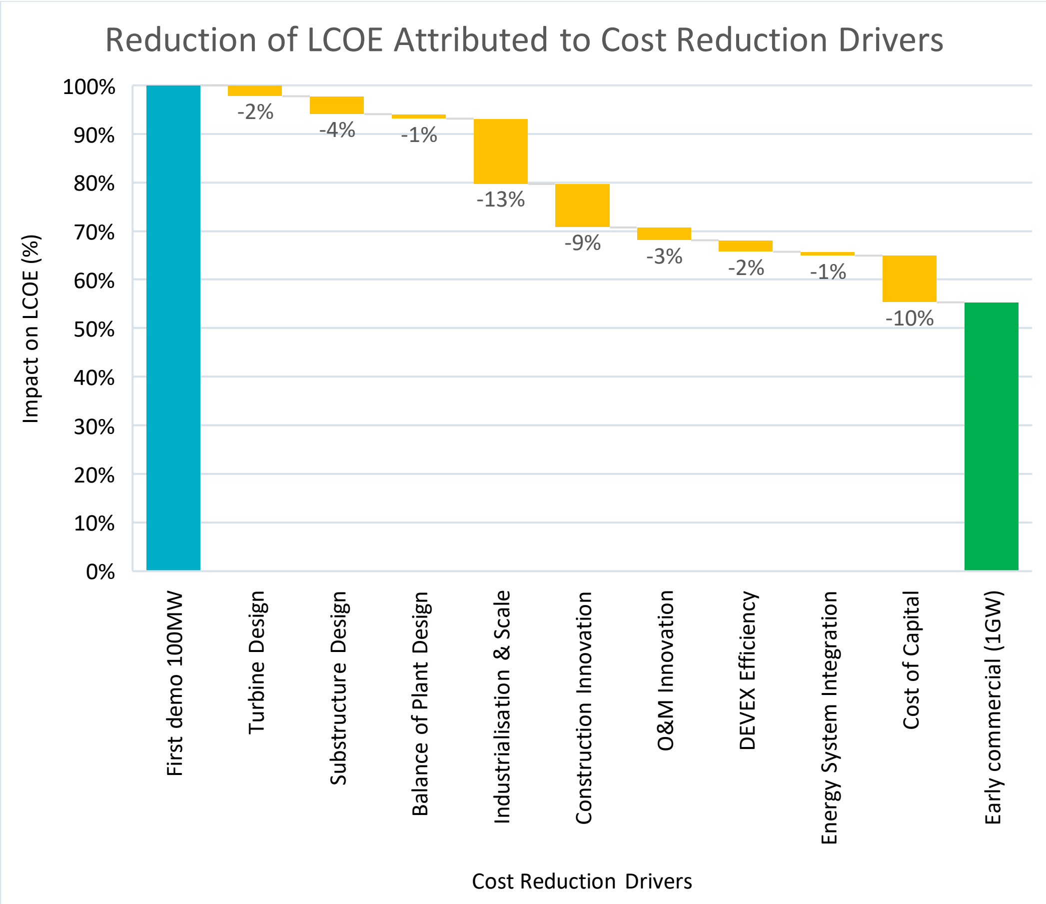

Figure 7: A waterfall chart to display cost reduction through the lens of cost drivers.

6 QUALITATIVE ASSESSMENT

Much of the qualitative insight captured for this study was acquired through the same stakeholder interviews that were conducted to gather developer and supply chain views on specific line items within the cost model and how they evolve over time. Additional insight was also sought through a range of relevant reports and the Offshore Wind Innovation Roadmaps[1]. While the quantitative assessment captured the main cost figures of focus as well as assumptions that should be implemented in the cost model, the qualitative assessment captured what actions or events could occur over time to alter the costs of FOW as deployment increases and projects scale up over time. In addition to the views that were captured during stakeholder interviews, response sheets were also sent to respondents to capture their views on how the full range of cost driver subcategories evolve, that of which would have been too time-consuming to do via the interview format used for much of this study. Furthermore, insight from subject experts from within ORE Catapult was also sought.

The main time periods of interest regarding the evolution of each cost driver subcategory was from 2025-2030 (early-stage projects), and from 2030 onwards (GW-scale projects). As was anticipated, much of the insight captured beyond 2030 rarely spanned further than 2035 due to the level of uncertainty that is associated with speculating on developments more than a decade into the future.

Despite each cost driver and their relevant subcategories being subject to significant variation on how they evolve over time, certain cross-cutting issues were observed throughout. Examples here include the view that:

- The point of full FOW commercialisation will likely be several years beyond 2030.
- Standardisation and design convergence throughout the range of FOW components is crucial to support long-term cost reduction. This was especially true when focusing on substructures.
- The current pace of turbine scale-up will be detrimental to cost reduction and accelerated FOW deployment. This is because of the likelihood of supply chain struggling to keep up with associated supporting infrastructure requirements. Continued rapid scale up will also be detrimental to component standardisation and design convergence.
- Even with a fall in raw material prices, OEMs will maintain elevated costs to recover from several years of heavy commercial losses.
- Early-stage FOW projects will pay a premium for capital due to the lack of interest from OEMs and supply chain in small order volumes. It is expected that the offshore wind industry as a whole will remain a sellers’ market for a number of years.

[1] https://ore.catapult.org.uk/what-we-do/innovation/owih/

Key Findings
Wind Farm and Technology Design Optimisation • Turbine prices likely to remain elevated so OEMs can recover from years of heavy commercial losses. • Turbine scale-up to continue in the future, but at a slower rate seen in previous years. • Substructure cost evolution is one of the hardest cost areas to predict due to the wide range of potential design options and the variation in costs seen across each of these designs. • Post 2030 substructure cost reduction will mostly be enabled via substructure industrialisation and greater availability of portside fabrication facilities. • Substructure mass per MW should reduce on average 1.25% per year between 2030-2045. • The majority of mooring system cost reductions between 2025-2030 will come from the use of synthetic materials in hybrid systems (i.e., part synthetic, part steel). • Post 2030 mooring system cost reduction will be aided by the increased order volume, allowing for learning rates to have a considerable effect on respective costs. • The lion's share of cost reduction in electrical system technology will not be expected until key technology step changes are experienced throughout the 2030's. High Voltage Direct Current (HVDC) transmission will aid cost reduction at far-from-shore FOW sites via electrical loss minimisation while floating substations accommodated by high voltage dynamic export cables will eventually be required as the cost of substation platforms at greater water depths become prohibitive.
Innovation and Optimisation in Component Production, Assembly and Project Construction • Order volumes for critical FOW components (substructures, moorings, anchors, dynamic cables, etc) will not see significant increases pre-2030 that will give project developers sufficient buying power to lower per unit costs. • Post 2030, orders of increased volume and consistency will provide supply chain with better visibility that give project developers greater purchasing power. This effect is particularly pronounced when looking at the purchase of steel. • Pre-2030, limited learnings and improvements will be made in FOW manufacturing processes. • For manufacturing processes to be optimised, they must be repeated many times which will not be possible before the deployment of GW-scale projects post-2030. • Continued increases in turbine size will likely result in port infrastructure and the supply chain failing to keep pace. Thus, it is of the utmost importance that a staged approach is taken to give the supply chain time to adapt to step changes in turbine capacity. • Action now which upgrades port facilities and increases wet storage availability will be needed to support cost reduction. • Standardised contracts with EPCIs reduce costs associated with the mitigation of infrastructure and technical risks. • Post 2030 it is anticipated that the most promising materials for enabling the circular economy will see their recycling supply chains scaled up significantly. • Beyond 2030, it is believed that supply chain constraints will persist for some time while assuming that supply/demand margins will be approximately in line with those found in fixed-bottom wind.
Innovation and Optimisation in Operations and Maintenance • A transition from tow-to-port to in-situ repairs will be seen post 2030 as the technology readiness of in-situ solutions improve. • Technologies which could be seen on early FOW projects pre-2030 include Robotic and Autonomous Systems (RAS) solutions which will reduce the number of labour hours required to carry out O&M activities, thus reducing OPEX costs.

• Efforts will be made over time to decarbonise O&M vessels pre-2030. It is highly probable that the use of low and zero carbon vessels will increase O&M costs initially, with industry and government decarbonisation ambitions being the main factors driving their application. • Throughout the 2020s sensor technology and condition monitoring improves to enable the implementation of enhanced preventative maintenance for GW-scale FOW projects post 2030. • Although not exclusive to FOW, wider wind farm control will also have a role in enhancing project performance in terms of yield maximisation. • Power-to-X applications can open the possibility of utilising curtailed FOW generation. However, it is unlikely to become commonplace until the mid-2030s depending on market and policy reforms.
Reductions in Project Development Costs • The impact of improved FEED studies pre-2030 will be minimal in terms of cost reduction due to the lack of design convergence within the industry that will support more streamlined FEED processes. • When FOW projects head towards the GW-scale post 2030 the need to explore alternative technologies should reduce and will make the extent of pre-FEED and FEED studies more limited. • From 2025-2030 - to assist with more evidence-based decision-making and improving the ability in understanding and addressing the environmental issues associated with FOW - the industry will need to make use of different sensors and technology platforms. • As GW-scale projects are deployed from 2030 onwards - and as more trials are conducted to validate and de-risk new smart monitoring technology - industry will gain certainty from regulators that will allow developers to adopt new ways of monitoring. • From 2025-2030, in terms of FOW-specific environmental risks, there are a number of opportunities to address current knowledge gaps and areas of uncertainty to reduce consenting timelines and DEVEX costs. These areas include research in acoustic and electromagnetic field emissions as well as FOW co-location with commercial fisheries. • When looking further ahead in the 2030's, it is incredibly difficult to predict the extent to which action taken today will impact the consenting processes that are used in more than a decade's time.
Energy System Integration Costs • From 2025-2030 and beyond 2030, the main factors that will affect Transmission Network Use of System (TNUoS) charges are changes to price control periods and government energy policies, changes to charging/modelling methodologies, and the generation and demand landscape at a given time. • Energy system balancing will be heavily influenced by changes to wholesale electricity pricing structures (e.g., zonal pricing) and the introduction of supporting solutions to improve grid flexibility (e.g., energy storage, demand side response, green hydrogen production via electrolysis). • Alternative offtake costs/revenues will not be financially viable in the short-term under the current market conditions. Therefore, maintaining revenue certainty through CfDs will remain critical as FOW's primary route to market. However, beyond 2030, one possible market reform that could support revenue being obtained via power-to-X applications is the introduction of constraint management plans.
Finance, Insurance, and Inflation • Regarding WACC evolutions over time, this will be influenced by Bank of England interest rates, improved debt terms through the lender community becoming more accustomed to FOW, and the risk premium for the cost of equity decreasing as the technology matures. • The degree of insurance risk assigned to FOW will heavily depend on the success of early-stage projects. • As far as the effects of inflation on FOW costs are concerned, future modelling assumptions will be based on official government targets as they are made.

Table 3: Qualitative Assessment Summary

7 IMPLICATIONS OF AR6 RESULTS

The AR6 auction results, specifically the GreenVolt project's successful bid at £139.93/MWh for 400MW capacity, provide critical insights into the evolving FOW sector. While the outcome highlights the progress made in bringing FOW closer to commercial viability, it also raises important considerations regarding cost trajectories and the broader implications for future projects.

The primary distinction between GreenVolt and the demonstration-scale projects modelled in the Cost Reduction Pathways study is the scale and maturity of the respective projects. GreenVolt, at >500MW, is significantly larger than the smaller, earlier-stage demonstrator projects, and this scale is crucial for accelerating the development of the FOW supply chain and the ability to deliver at a higher volume. Larger projects like GreenVolt play a pivotal role in scaling up supply chain capabilities, reducing costs and moving the sector towards an industrial scale. In contrast, smaller demonstration projects remain vital for testing and advancing specific technologies or methodologies. They reduce uncertainty, help lower costs through iterative learning and allow for the testing of new designs and installation methods in real-world conditions, which is essential for the long-term cost reduction of FOW technology.

It is important to emphasise that the £139.93MW/h strike price for GreenVolt should not be seen as the new market standard for FOW. This price likely reflects specific conditions unique to GreenVolt, including its size, status as an INTOG windfarm, financing structure, execution strategy and potential strategic motivations. As we look towards future auction rounds, in particular AR7, we expect projects like Pentland, Blyth 2, and Erebus to return to the fray. Unsuccessful in AR6, there is no reason to suggest that the economics of these vital demonstration scale projects will be any different in AR7. Therefore, it is reasonable to anticipate that strike prices could rise again in the next auction round, making the AR6 FOW result an outlier rather than a trendsetter in early FOW projects.

Whilst the success of GreenVolt is a positive development, it does not diminish the need for ongoing investment in demonstration projects. These smaller-scale initiatives are crucial for validating various design configurations, installation methods, and other technical aspects that will drive cost reduction through learning and standardisation. Without this foundational work, the industry risks stagnating, with fewer opportunities to innovate and refine processes, which are key to achieving the economies of scale necessary for FOW to become cost-competitive with other low-carbon energy sources.

Moreover, the AR6 results highlight the importance of a diversified project pipeline. Relying too heavily on a single large-scale project carries concentration risks. If a single project encounters difficulties, it could delay broader progress in the sector and limit opportunities to test and refine different approaches. Other demonstration and stepping -stone projects are also critical in providing a broader and more regular pipeline of project activity over the coming years, enabling the supply chain to invest in scaling up. A range of different, smaller projects also brings with it the benefit of increasing the likelihood that work is shared more broadly across the supply chain. This allows lessons and experience to be learned and shared more widely, meaning that the sector as a whole will benefit more rapidly.

In conclusion, while the AR6 results represent a significant milestone for FOW, they should be viewed in context. The AR6 FOW strike price is not necessarily indicative of the current market price, and the importance of ongoing demonstration projects remains paramount. For FOW to reach its full potential in delivering cost-competitive electricity and contributing to Net Zero, a concerted effort is needed to continue testing, validating and scaling up diverse project configurations. The lessons learned from AR6 will be valuable in shaping the strategies and expectations for future auction rounds.

8 COST REDUCTION MONITORING FRAMEWORK

Floating Offshore Wind (FOW) has the potential to deliver large-scale and cost-competitive electricity in markets across the globe. However, to maximise its role in delivering Net Zero, the Levelised Cost of Energy (LCOE) for FOW must be reduced to a level comparable with other low-carbon energy supplies.

This report provides a credible vision of how FOW can progress to commerciality. By utilising the Offshore Renewable Energy (ORE) Catapult's in-house cost and economic models, the project captured key costs estimated for small-scale demonstrator projects and large-scale commercial wind farms. An extended version of this report underscores the critical role that a Cost Reduction Monitoring Framework (CRMF) can play in accelerating the deployment of FOW, reducing risks, and maximising opportunities for UK content, ultimately helping unlock this emerging industry's full potential.

To optimise future auction rounds, an evidence-based assessment of current and expected future costs must be carried out on a regular and enduring basis. An independent report would allow policymakers to set CfD budgets and parameters to maximise deployment and provide the supply chain with a view of steps needed to remain competitive as costs come down. Importantly, the CRMF would provide the industry with an empirical understanding of our progress as a market to reduce cost and risk, growing confidence in the process, and helping to ensure the market develops in strong and sustainable way.

In 2014, the Offshore Wind Programme Board initiated the Cost Reduction Monitoring Framework (CRMF) for fixed-bottom offshore wind. CRMF aimed to track the industry's cost reduction progress towards a target LCOE of £100/MWh (in 2012 terms) for projects that achieved FID in 2020. The framework was designed by ORE Catapult in conjunction with the Crown Estate.

The success of fixed-bottom offshore wind has been underpinned by a rapid reduction in cost over time. The LCOE target of £100/MWh was achieved in AR2 in 2017 which saw bids of £74.75 and £57.50/MWh for projects delivered in 2021/22 and 2022/23 respectively. CfD strike price bids reached the lowest level of £37.35/MWh in AR4 in 2022 (Offshore Wind Scotland, 2022). This has supported an accelerated deployment of fixed-bottom offshore wind; in 2013 just 3.5GW was deployed, and by 2023 the total UK fixed-bottom deployment had reached 14.7GW (Durakovic, 2022).

The Cost Reduction Monitoring Framework for Floating Offshore Wind is different in that it must take account of the nascent nature of FOW in the maturation of policy, technology and industrialisation. The FOW CRMF will be tailored to the unique demands and characteristics of FOW, whilst building on the strong foundation set by CRMF for Fixed-Bottom.

The full report demonstrates an outline of how a CRMF for FOW could be developed which includes:

- Monitor forecasted and actual project costs over time.
- Provide qualitative and quantitative feedback on the effectiveness of delivering FOW projects to provide focus on where the industry is ahead or falling behind
- Guide policy and CfD auction parameters to support a reliable route to market
- Define intervention plans to support the FOW industry, such as infrastructure investment models

- Scope and steer design and scale of technology innovation programmes
- Quantify the conditionality of cost reduction pathways – driven by global, as well as UK deployment.

As outlined in the recommendations in this report, a CRMF for FOW is a critical mechanism that requires broad support from across the spectrum and should be pursued as a priority.

9 RECOMMENDATIONS

The following recommendations are proposed to accelerate the cost reduction and successful deployment of FOW technology in the UK:

1. **Deployment of demonstration and pre-commercial projects:** Demonstrating and pre-commercial scale projects are crucial to driving initial cost reductions and incentivising investment in the supply chain, technologies, and infrastructure. The deployment of demonstration-scale projects will allow the industry to gain practical experience in both the deployment and operation of FOW projects, learning lessons and building confidence, which is essential and will enable significant cost reduction in multi-GW projects. CfD auction parameters should be set to support the deployment of multiple demonstrator or pre-commercial projects in different regions of the UK, ensuring a route to market for projects in the years ahead.

2. **Ports and manufacturing facilities:** the development of ports and manufacturing facilities needed to support large-scale FOW projects in the UK is fraught with various limitations, risks, and opportunities. These issues are more apparent in the context of FOW, but they also overlap with the challenges, risks, and opportunities that the broader offshore wind sector in the UK faces. Specifically, this entails ensuring that the UK can continue to deliver increasingly large offshore wind farm projects that employ progressively larger wind turbine technology. In addition, the success of the FOW deployment industry heavily relies on the development of dedicated port infrastructure, as it requires port facilities that differ significantly from those used in conventional shipping and port operations. Therefore, the timely development of such infrastructure is crucial.

    a. **Steel manufacturing:** the UK's capacity and capability for large-scale primary steel fabrication is currently limited but expected to increase as large-scale steel fabricators are attracted to the UK to produce wind turbine towers and monopiles. The increased capacity and capability are relevant to FOW and could be utilised for manufacturing steel substructure components for FOW. However, additional capacity is needed to ensure the UK can secure a significant share of the substructure component manufacturing market for UK projects alone.

    b. **Concrete manufacturing:** the UK has a reasonable capacity and capability for concrete material supply and construction. In the case of FOW, these sites will be ports with large areas for storage and direct access to a quayside for loading out complete substructures. A few facilities in the UK have the potential to be converted and utilised for this purpose.

3. **Innovation investment:** continue support for innovation through schemes like the CfD and other appropriate funding avenues. Innovation investment will play a key role in unlocking areas of the UK's supply chain and challenge areas, and this should be integrated into project development processes, incentivising the inclusion of novel solutions. Support of demonstration programmes is particularly important as the lack of demonstration opportunities for full-scale floating platforms limits innovation and design iterations. Areas of focus for innovation are designing for industrialisation, new methods of on-site installation

and major repairs, and reduction of project risk (and cost of capital) thorough physical testing and validation of components prior to deployment.

4. **Consenting time and environmental requirements:** to streamline or even maintain the current development timeline, significant investment is required to adequately staff consenting bodies, and modernize the process to reduce the total resource requirement per application. It is necessary to strive to reduce project consenting timelines and the effort required from individual developers in EIAs. By supporting the rollout of streamlined data collection methodologies, the environmental impact of FOW projects can be better ascertained, and steps taken to offset any negative environmental impacts. The development of technologies such as smart monitoring can be used to reduce environmental survey times, and improved approaches should also be sought in the coordination and communication between project developers and regulators of environmental impact expectations. One way in which this could be done is via the introduction of data sharing platforms and initiatives.

5. **Grid infrastructure investment:** the deployment of FOW projects of increasing scale over the coming decade is highly dependent on the timely construction of critical grid infrastructure. This includes both land-based and subsea networks, and major challenges including in procurement and planning must be overcome quickly to ensure a timely build-out of FOW.

6. **Development of Cost Reduction Monitoring Framework:** as FOW technology matures, costs will reduce and UK consumers will benefit from cheaper, cleaner electricity. To optimise future auction rounds, an evidence-based assessment of current and expected future costs must be carried out on a regular and enduring basis. An independent report would allow policymakers to set CfD budgets and parameters to maximise deployment and provide the supply chain with a view on steps needed to remain competitive as costs come down the curve. It would also give the wider FOW industry a credible view on our progress as a market to reducing cost and risk, growing confidence in the process. This monitoring exercise should be carried out regularly and could include metrics on local content spending to identify areas of strength and which suppliers need further support.

10 CONCLUSION

The UK is well-positioned to take the lead in cutting-edge FOW technology, which will create tens of thousands of new jobs, attract billions of pounds in inward investment, and foster a significant export opportunity. By supporting a thriving supply chain and investing in ports and manufacturing facilities, the UK has the potential to become a world leader in FOW technology, reducing the cost of this technology and enabling the delivery of large-scale FOW projects.

One of the advantages of FOW farms is that they can be installed in deeper waters, farther from the coast, where wind speeds are higher and more reliable. Even with the development of deeper-water fixed foundations, the UK will need FOW to meet net zero targets. The UK's emerging FOW sector already has two operational projects that generate power off the coast of Scotland, namely Hywind Scotland and Kincardine.

In addition to its prowess in FOW, the UK is already a leader in offshore wind, boasting the largest installed capacity in Europe. Offshore wind offers a reliable, cost-effective source of electricity and will be critical in the decarbonisation of the UK's power system, with the goal of achieving net-zero carbon emissions by 2050.

The quantitative assessment in this study provides a credible pathway for cost reduction in FOW. However, it is conditional on a series of assumptions being met that act as key enablers for cost reduction. Therefore, to maximise the opportunities set out in this cost reduction pathway, significant progress must be made to ensure these key enablers are accelerating at the pace required to realise the potential of FOW in the UK.

In this assessment, representative projects were developed to allow an understanding of how costs change with location, project scale, substructure design, alongside other factors. The evolution of costs in the medium and long-term shall be largely driven by the cost drivers identified in the project.

Using two reference projects of 100MW and 1GW indicates how costs may change through time but in reality, does not cover the full range of possibilities. The UK will likely see several intermediate project sizes on the road to full commercial-scale. Once commerciality has been reached, project size will not be limited to 1GW, so there is potential for further cost reduction driven by economies of scale for multi-GW projects.

The assessment highlights the critical importance of demonstration-scale projects in driving initial cost reductions and incentivising investment in the supply chain to maximise UK economic impact. Significant reduction in costs is seen for 1GW utility-scale projects taking FID in 2030 when demonstration-scale projects have been deployed starting in 2028.

The demonstration-scale projects also play an important role in accelerating a UK-based supply chain, O&M capabilities, and capitalising on first mover advantage. **The GVA analysis indicates that the demonstration-scale projects will deliver supply chain investment, which leads to additional macroeconomic benefits for the UK of £2.5bn** (discounted, assuming the same pipeline of FOW projects are developed in the future as in the counterfactual scenario).

Comparing the results of this quantitative assessment with the historical data observed in the fixed-bottom market allowed for a comparison of cost reduction across the two technologies. Fixed-bottom technology underwent approximately a 50% cost reduction when scaling from 1GW to 36GW of global deployment over 13 years, which compares our modelled ~50% cost reduction in FOW over 9 years for the same scale of deployment.

The qualitative analysis outlines the step changes from innovation, processes, economies of scale and reductions in financing costs. This provides context for specific areas that need further investigation to realise FOW's full potential.

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