



COST
REDUCTION
MONITORING
FRAMEWORK
2016

“UK PROJECTS THAT REACHED FID IN 2015/16 ACHIEVED LCOE OF £97/MWH”

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FOREWORD

“Offshore wind has been a great UK success story. The industry has delivered on its commitment to reduce costs, providing a critical contribution both to carbon reduction and to national energy supplies, whilst creating thousands of new jobs.

But that is, in turn, a result of the commitment by Government and industry to work together. The Government has provided a legal and regulatory framework that is designed to encourage the development of an efficient and secure low carbon energy generation market. On its side, the offshore wind industry has set out ambitious cost reduction targets and delivered these earlier than anyone thought possible.

This is a story that is just beginning. There is significant scope for further cost reductions through innovation in engineering and development of the UK supply chain. This will help to build a sustainable industry that will benefit the UK for decades to come.”



Jesse Norman

Jesse Norman
Minister for Industry and Energy
Department for Business, Energy and Industrial Strategy

ABOUT OWPB

The Offshore Wind Programme Board (OWPB) brings together industry and government to find and implement solutions to barriers which have the potential to impede the viability and deliverability of offshore wind in the UK.

The OWPB reports to the Offshore Wind Industry Council and is working to drive deployment, bring down costs and build a successful, competitive UK-based industry.

ABOUT ORE CATAPULT

ORE Catapult was established in 2013 by the UK Government and is one of a network of Catapults set up by Innovate UK in high growth industries. It is the UK's flagship technology innovation and research centre for offshore wind, wave and tidal energy and helps to reduce the cost of offshore renewable energy, supporting the growth of the industry and creating UK benefit.
ore.catapult.org.uk

■ Front cover and inside cover images courtesy of DONG Energy

1 EXECUTIVE SUMMARY

In 2012, the UK Government recognised the potential of offshore wind if it could rapidly bring down costs. It tasked industry with a root and branch review of how to bring down costs and set a target for the UK's offshore wind industry to bring the Levelised Cost of Energy (LCOE) for offshore wind down by a third to £100/MWh by 2020.

This report shows that this target has been achieved four years ahead of forecast, with the latest industry data – gathered by the Offshore Renewable Energy Catapult on behalf of industry and government – showing rapidly reducing costs, and high confidence in offshore wind's ability to go on delivering cost savings through technology innovation and continued collaboration across the sector.

The findings of the report show that while we have seen cost reduction thanks to the early adoption of larger turbines, increased competition and the lower cost of capital, industry is now embracing new opportunities and the cost of offshore wind energy will continue to fall over the next decade.

Cost data gathered from the sector shows that UK projects reaching Final Investment Decision (FID) in 2015/16 are achieving an average Levelised Cost of Energy (LCOE) of £97/MWh; a 32% reduction from £142/MWh for projects reaching FID in 2010/11.

Key Findings :

- UK projects that reached FID in 2015/16 achieved LCOE of £97/MWh
- Technology developments have made the largest contribution to cost reduction
- Competition at developer level has driven down costs in the supply chain
- Risk profile and the cost of capital is reducing as confidence in the sector develops
- The level of UK content in projects is an increasingly important consideration for developers

The early achievement of the 2020 target demonstrates that offshore wind can play a significant role in the UK's low carbon future. In 2017 the UK Government will run a 2nd Contract for Difference (CfD) auction round and has committed to further rounds with decreasing administrative strike prices to help ensure cost reduction. The survey of industry has highlighted that competition between developers is playing an important role in ongoing cost reduction, with industry confident that these auctions will deliver further cost reductions from those identified in this report.

Recommendations for the OWPB:

1. Ensure further cost reduction beyond 2020 and maximise UK economic benefit through an agreed set of cost reduction priorities, timescales and monitoring process for collaborative actions across the sector.
2. Work with government to encourage and support investment in the UK supply chain. This should be built on a coordinated approach to industrial strategy, maximising the supply chain synergies between fabrication, assembly, port infrastructure, operations and maintenance and other sectors.
3. Identify and exploit opportunities to reduce development, consenting and deployment risk in the UK. Consider improved coordination of government policy implementation (energy and environment) and review successful policy and regulation from other European markets that could enhance the UK framework.
4. Continue to work with government via the Offshore Wind Industry Council (OWIC) on plans for further CfD auction rounds and longer term visibility of the market that would enable it to achieve its maximum potential.

Details of the findings and specific recommendations are included in the CRMF 2016 Qualitative Assessment Report and the CRMF 2016 Quantitative Report, available at <http://ore.catapult.org.uk/crmf>.



“The target of £100/MWh for offshore wind has been achieved
4 YEARS
ahead of forecast”

2 INTRODUCTION

2.1 BACKGROUND

The Cost Reduction Monitoring Framework (CRMF) takes a structured approach to assess the progress of cost reduction in UK offshore wind projects against key milestones. It was initiated in 2014 by the Offshore Wind Programme Board and the members of the Offshore Wind Industry Council. The framework was designed by ORE Catapult in conjunction with The Crown Estate. Progress is tracked against milestones that assess the potential of innovations in technology, supply chain and finance to support cost reduction.

CRMF is focussed on the UK market but incorporates evidence from activity worldwide, particularly in the EU. This is the third year that the CRMF has been implemented and the use of a consistent approach allows direct year-on-year comparisons that provides the sector and policy makers with a firm basis for informed decisions.

2.2 FRAMEWORK

The CRMF comprises a qualitative and a quantitative assessment:

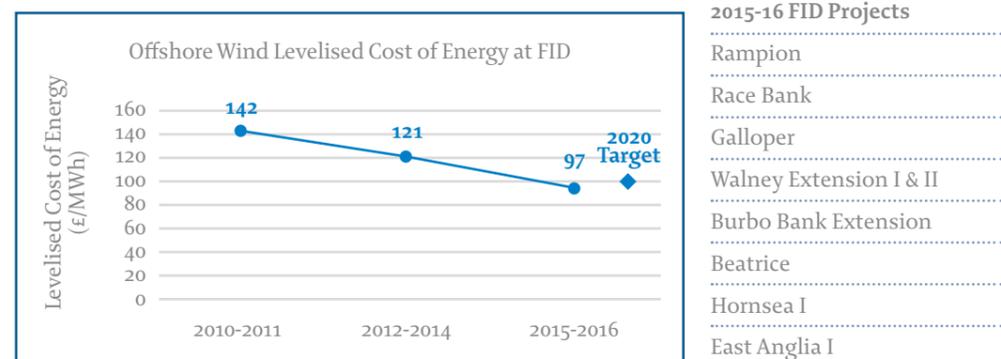
- The quantitative assessment uses owners' project-specific data declared at FID and Works Completion to calculate an industry average LCOE.
- The qualitative assessment uses primary market research (questionnaires and interviews) and secondary market research (existing data and analysis) to assess industry progress against pre-agreed milestones and provides an outlook towards 2020 targets.

To ensure anonymity of commercially sensitive data, the Quantitative Assessment can only be carried out when there are sufficient projects reaching FID or Works Completion in the given year. For CRMF 2016 both a Quantitative Assessment and a Qualitative Assessment were conducted.

3 RESULTS

3.1 QUANTITATIVE ASSESSMENT RESULTS

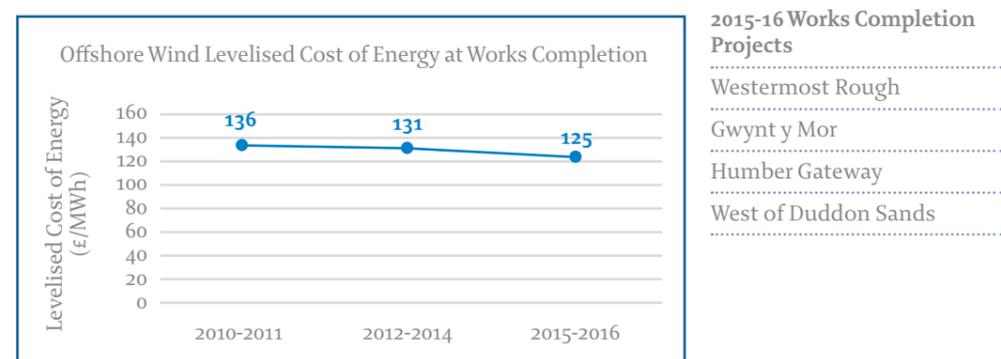
The Quantitative Assessment concluded that projects reaching FID in 2015/16 achieved an industry average LCOE of £97/MWh¹. The following chart shows how the average for 2015/16 compares with the averages for projects reaching FID in 2010-11 and 2012-14:



Data was also gathered for projects that reached Works Completion in 2015/16. These projects reached FID several years earlier than the 2015/16 FID project sample and typically use turbines rated between 3MW and 4MW compared to the 2015/16 FID project sample which is dominated by turbine ratings of over 6MW.

Each data point is an average of at least three projects but as the period from FID to Works Completion varies between projects there is not a complete match between the projects that make up the FID samples and the projects in the Works Completion samples.

The industry average LCOE of £125/MWh for projects reaching Works Completion in 2015/16 shows that cost reductions were already happening ahead of the introduction of larger turbines.



¹ Costs are stated in 2011 real terms to remain consistent with the £100/MWh target.

3.2 QUANTITATIVE ASSESSMENT METHODOLOGY

ORE Catapult commissioned KPMG to conduct the Quantitative Assessment following the process used in the 2014 Quantitative Assessment. An LCOE calculator was populated by the owners of projects that reached FID or Works Completion in 2015 and 2016. This captured the high level Capex, Opex and generation data for KPMG to analyse. This was complemented by a qualitative interview with each of the developers. In this interview, KPMG asked a series of questions about environmental, regulatory and technical factors to establish the context for the cost reduction being observed in the offshore wind market. The sample of projects included in the assessment is shown in the following table:

2015-16 FID Project Name	Capacity	FID date
Rampion	400MW	May 2015
Race Bank	546MW	June 2015
Gallopier	336MW	October 2015
Walney Extension I & II	649MW	October 2015
Burbo Bank Extension*	256MW	December 2014
Beatrice	588MW	May 2016
Hornsea I	1,197MW	February 2016
East Anglia I	714MW	February 2016

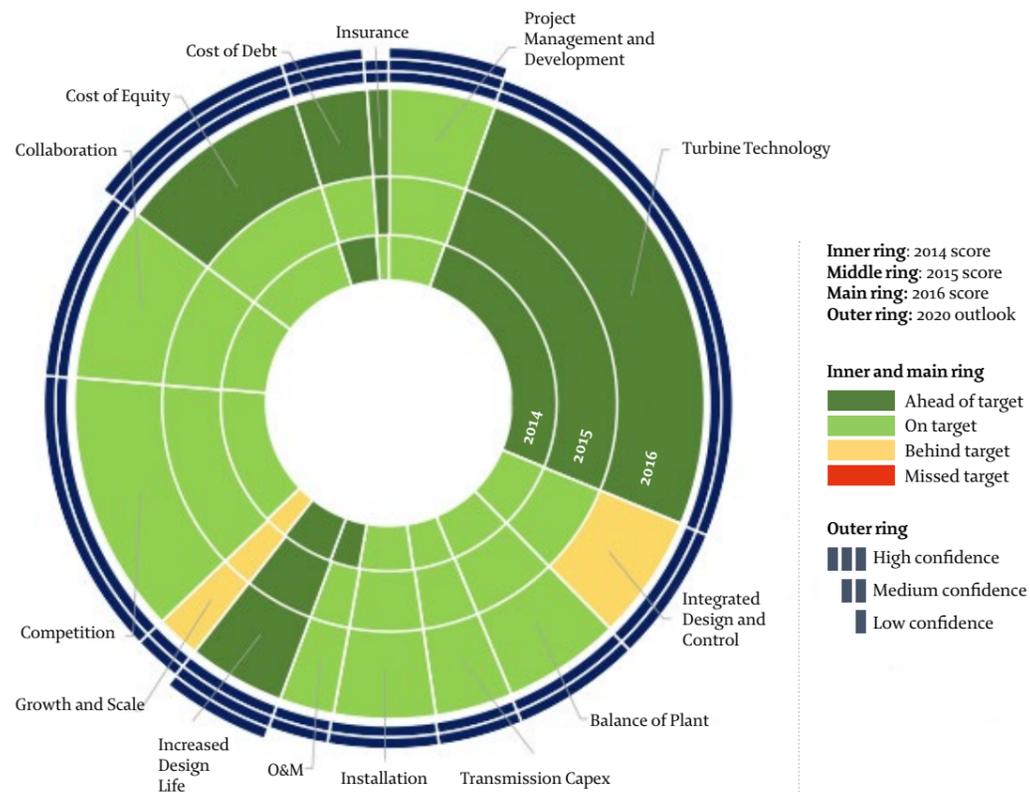
* Burbo Bank Extension reached FID in December 2014 but is included in this assessment as it was not included in the previous quantitative study for 2012-2014.

2015-16 Works Completion Project Name	Capacity	Works Completion date
Westernmost Rough	210MW	May 2015
Gwynt y Mor	576MW	May 2015
Humber Gateway	219MW	May 2015
West of Duddon Sands** (50% weighting)	389MW	October 2014

**West of Duddon Sands was included in the Works Completion sample with a 50% weighting. This was to preserve the confidentiality of responses taking into account overlap of existing and historic ownership,

3.3 QUALITATIVE ASSESSMENT RESULTS

Cost reduction progress was measured for 70 cost reduction indicators. Each area was assessed against a set of milestones that lead to a 2020 target for that indicator. The 70 indicators are weighted by cost reduction potential and consolidated into 14 top level indicators that are shown in the diagram below:



Early deployment of higher rated turbines

The implementation of 6MW to 8MW turbines has been achieved ahead of target and the Turbine Ratings indicator remains the largest single contributor to cost reduction. There is potential for further cost reductions from turbine related integrated design and whole farm control systems. Without evidence of demonstration activity in these areas, the Integrated Design and Control indicator has been assessed as behind target.

Reduction in cost of capital

Confidence in the sector has continued to increase with both cost of debt and cost of equity ahead of target. The evidence gathered confirmed that a reduction in cost of capital has contributed to the overall reduction in LCOE.

Growth and scale

Growth and Scale remains behind target and whilst the forecast of 10GW installed by 2020 is in line with targets, the uncertainty over the Levy Control Framework (LCF) beyond 2020/21 has resulted in the overall assessment of Growth and Scale being behind target for the third year running. The UK Government took the positive step of announcing further auction rounds in November 2015 but it took a year before the timetable was announced. For smaller new entrants to the supply chain this lack of certainty is difficult to manage.

The full outputs of the Qualitative Assessment can be found in the two outputs:

- CRMF 2016 Qualitative Assessment Report²
- CRMF 2016 Qualitative Assessment Evidence Log³

3.4 QUALITATIVE ASSESSMENT METHODOLOGY

The qualitative assessment data gathering was carried out between August and October 2016 with a representative selection of developers, supply chain and finance organisations. The assessment included evidence from 48 consultations via questionnaires and interviews.

The main consultation was carried out ahead of the UK Government’s announcement of the second auction round. However, the size of the auction is in line with previous announcements so is unlikely to have had an impact on the perception of growth and scale but will have helped to reduce uncertainty in the short term.

The qualitative assessment provides strong supporting evidence that aligns with the results of the quantitative assessment. However, the major drivers (turbine ratings and cost of capital) have had a proportionately greater impact on LCOE than forecast when CRMF was designed three years ago. A reassessment of cost reduction potential for each area should be part of any future cost reduction framework.

4 FINDINGS

4.1 TECHNOLOGY

Improvements in technology ranging from larger rated turbines to innovations in installation have had the largest impact on LCOE.

The deployment of 8MW turbines at Burbo Bank Extension is a major achievement and most projects that reached FID in 2015/16 are planning to use 7MW or 8 MW turbines. There is also scope to evolve these platforms to gain further benefits through optimised rotor diameter and enhanced control systems.

² CRMF 2016 Qualitative Assessment Report and Evidence Log are available at <http://ore.catapult.org.uk/crmf>

³ <https://www.gov.uk/government/news/government-sets-out-plans-to-upgrade-uk-energy-infrastructure-and-increase-clean-energy-investment>

The potential for improved electrical infrastructure is being realised with several projects that have reached FID, contracted to use 66kV array cables. Distributed lightweight transformers are providing lower cost alternatives to larger bespoke substations. Where developers have sufficient pipeline, standardisation of substations is also making strong progress.

Good progress has been made in the development of lower cost foundations suitable for a wider range of site characteristics. The demonstration sites (Blyth Offshore Demonstrator and European Offshore Wind Demonstration Centre) are in the early stages of construction and will demonstrate gravity base and suction bucket foundations respectively.

The UK has been successful in winning some of the jacket fabrication contracts but the small scale of the longer term pipeline of orders provides a challenge for fabricators. Visibility of a more consistent pipeline would give fabricators the confidence to engage with designers to enable further efficiencies during fabrication activities.

4.2 COMPETITION

Increased competition at developer level has played a significant role in cost reduction. The pipeline of developed sites is several times larger than the allocation available and has forced developers to deliver cost efficiencies. This has put pressure on the supply chain where reduced margins are being seen. Innovation driven supply chain competition has supported competition at the developer level, and together that has driven material change in the economics of offshore wind.

Whilst the increased level of competition is a direct driver of cost reduction, there is evidence that it is a barrier to collaboration between developers. Vertical collaboration within the supply chain has increased where developers are seeking to refine procurement costs ahead of the CfD auctions.

4.3 COMMERCIAL IMPACT

The offshore wind industry has grown rapidly in the last five years. Technology has evolved, supply chains have been built through expansion, cross-sector entrants and developer in-house capability. Having been through a period of growth, a period of consolidation is commencing, at both the turbine OEM level (Gamesa and Siemens Wind Power, GE and LM Windpower), in the supply chain (NKT and ABB) and in the installation contractor market.

Whilst there is potential for over-consolidation to reduce competition, this is not believed to be the case so far and all areas assessed have sufficient competition to increase efficiencies and encourage innovation.

4.4 UK CONTENT

There has been an increased focus on the level of UK content in offshore wind projects in the last year. The supply chain plans that were a requirement of the CfD process are now moving into implementation and the CRMF consultation highlighted a range of views from the supply chain. Evidence was presented that highlighted success stories in the UK supply chain; JDR Cables have won contracts for array cables across Europe, Siemens Wind Power opened the Hull blade manufacturing facility, Babcock have been successful with substation topside manufacture, BiFab and Harland and Wolfe have won contracts for jackets and CS Wind are expanding their capability to include offshore towers. The MHI Vestas Offshore Wind facility on the Isle of Wight supplied the 80m blades for the V164-8.0 MW Burbo Bank Extension project. There is also a continued high level of UK content in the development and operational phases.



Vehicles (SOVs) with new vessels delivered and further orders made in 2016.

The quantitative assessment reviewed the impact of exchange rates and commodity prices and whilst these remain important factors in overall project costs they were not of major significance compared to the impact from improvements in technology, supply chain and finance.

These successes are balanced by a view from consultees that the level of UK content could be increased as part of an ambitious UK Government industrial strategy. This would strengthen cross sector synergies and target skills and infrastructure support at areas of high growth potential in UK and global markets.

4.5 MARKET IMPACT

The downturn in the oil and gas sector has led to an increased supply of non-specialised installation vessels and has resulted in lower vessel day rates. Combined with a deployment rate that is lower than forecast five years ago this has led to a slowdown in the procurement of new specialist vessels. The exception to this is in the area of Service Operation

5 CONCLUSIONS

The ambitious 2020 Levelised Cost of Energy (LCOE) target of £100/MWh for offshore wind has been achieved four years ahead of forecast. Further opportunities for cost reduction are being developed and LCOE for offshore wind will continue to fall over the next decade. UK projects that made a Final Investment Decision (FID) in 2015/16 achieved an average Levelised Cost of Energy (LCOE) of £97/MWh; a 32% reduction from £142/MWh for projects reaching FID in 2010/11.

The reduction in LCOE has been driven by the development of turbines with higher power ratings, increased competition and the lower cost of capital as the risk profile of the sector improves. In a significant year, 7MW and 8MW turbines have become standard for new projects and the announcement of the 2nd CfD auction round has helped to provide visibility for the sector.

Further significant cost reductions can be achieved over the next decade from technology innovation and collaboration across the sector. It is recommended that an agreed set of cost reduction priorities, timescales and monitoring process for collaborative actions across the sector are put in place. This will help secure offshore wind's leading role in the UK's low carbon future and maximise UK economic benefit through supply chain growth.

DISCLAIMER

Whilst the information contained in this report has been prepared and collated in good faith, ORE Catapult makes no representation or warranty (express or implied) as to the accuracy or completeness of the information contained herein nor shall be liable for any loss or damage resultant from reliance on same.

CONTACT

Offshore Wind Programme Board

ore.catapult.org.uk/who-we-work-with/offshore-wind-programme-board



ORE Catapult Inovo

121 George Street,
Glasgow,
G1 1RD, UK
T: +44 (0)333 004 1400
F: +44 (0)333 004 1399



ORE Catapult National Renewable Energy Centre

Albert Street, Blyth,
Northumberland,
NE24 1LZ, UK
T: +44 (0)1670 359 555
F: +44 (0)1670 359 666



ORE Catapult Fife Renewables Innovation Centre (FRIC)

Ajax Way,
Leven,
KY8 3RS
T: +44 (0)1670 357649

ore.catapult.org.uk | info@ore.catapult.org.uk
