Hornsea Project Two:

Supply Chain Plan

January 2017

Project Summary

Company Name	DONG Energy Power (UK) Ltd	Authorised Representative	[redacted]
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Project Name	Hornsea Project Two	Project size (in MW installed capacity)	Consented up to 1800MW
Project commissioning date	Anticipated 2021 or 2022	Project location	89km east of East Riding of Yorkshire coast in the southern North Sea
Ownership structure	100% DONG Energy A/S		
Maturity of project	Hornsea Project Two (HOW02) received planning consent from the Secretary of State in August 2016. HOW02 has grid connection agreements in place with National Grid with connection dates between October 2020 – October 2021. [redacted] HOW02 intends to apply for a Contract for Difference (CfD) during the allocation window in 2017 to allow for onshore construction to commence in 2018 and, depending on a successful application, the project could be fully operational as early as 2021. Survey work and engineering design work have been carried out throughout 2016 with further engineering, design and procurement work also underway to facilitate the scheduled construction dates. HOW02 will build upon the experience and knowledge DONG Energy has gained during the successful Hornsea Project One (HOW01) development and supply chain engagement. Certainty for the supply chain will enable suppliers to take important investment decisions early, bringing significant benefits to the UK and creating supply chain opportunities for export.		

[redacted]

All Acronyms and Abbreviations used in the document are in **Annex GGG**

0 Introduction

1. DONG Energy (DE) is one of the leading energy groups in Northern Europe, employing around 6,700 employees in Denmark and over 850 in the UK, see **Annexes A** and **E**. We have installed more than 20 offshore wind farms since 1991 with a total installed capacity of approximately 3.6GW. In the UK we currently have nine operational wind farms, with a total capacity of approximately 2.2GW. We currently have six projects under construction, including four in the UK, which will deliver an additional 3.8GW by 2020. In total, DE is responsible for around 6% of renewable generation in the UK, [redacted]

2. We are developing, constructing and / or operating offshore windfarms in the UK, Denmark, Germany and The Netherlands and have recently entered the US and Taiwan. We have installed just over a quarter of the current global offshore wind capacity and have taken action to further develop the industry and build a sustainable UK supply chain. We are committed to driving down the cost of offshore wind by increasing scale, implementing standardisation and delivering projects on time and on budget.

3. Hornsea Project Two (HOW02) is an opportunity to build upon the success of Hornsea Project One (HOW01) and DE's vast offshore wind experience. HOW02 will enable the continued development of opportunities for UK companies to compete whilst creating a step change in innovation and enhancing skills in offshore wind through the creation of long-term, sustainable jobs. [redacted] contain additional information on the scope of HOW02, project timelines, location and ownership structure.

4. DE is focused on developing a strong UK supply chain and skills offer and has already achieved this through:
   - The development and delivery of a UK Offshore Wind Tower facility at CS Wind in Campbeltown, Scotland and continued use of UK contractors such as Offshore Structures Britain (OSB) in Teesside and JDR Cables in Hartlepool;
   - The use of the very first UK manufactured blades from the Siemens Hull factory at our Race Bank project and future blades at HOW01 (see Section 31 and **Annex CC**);
   - The development of an East Coast Hub for Operations and Maintenance (O&M) in Grimsby supporting Westermost Rough, Race Bank and HOW01 offshore wind farms;
   - The intended delivery of a range of skills initiatives which will be implemented at local and regional levels across the UK such as Teach First and Project Aura (see **Annexes BBB and EEE)**;

5. This supply chain plan sets out the specific targets that we will strive to achieve in the delivery of HOW02. The document sets out the minimum that we believe we can achieve based on a range of flexible opportunities from the development of Hornsea Project Two. In reality, we are confident we can deliver more. The plan is applicable across all capacity bids for HOW02.

6. All information included in this plan is provided in good faith and to the best of our knowledge. However, it should be noted that it is possible the plans outlined in this document are subject to change or revision due to market conditions and factors beyond DE's control.

1 Competition

1.1 Competition targets

DONG Energy has set the following UK Content (UKC) and competition targets for HOW02 with the aim of supporting the development of a competitive, export-ready UK supply chain for offshore wind:

- **Achieve at least 50% UKC, based on the BVG methodology;**
- **Collaborate with suppliers across tiers and across the UK to develop a sustainable and competitive offshore wind supply chain offer;**
- **Identify, develop and share (e.g. via project specific supply chain events) opportunities to increase UKC and export opportunities for UK suppliers;**
- **Assign a dedicated full-time UK based employee, as a Supplier Development Manager, with the sole role of identifying and supporting UK suppliers through the DE tender process and development of the supply chain;**
- **Continue to employ a multi-contract approach to the development and construction of our offshore wind projects.**

1.2 Overview of DE credentials and philosophy

7. HOW02 will be a hugely significant project with far-reaching implications for offshore wind. Decisions taken across our existing portfolio of projects, especially HOW01, have been taken and implemented with HOW02 in mind. It should be noted that HOW02 will only be able to achieve what we envisage for the project because of the groundwork that has been laid by other DE offshore wind projects.

8. HOW02 is an opportunity to build upon the success of HOW01 and DE's considerable expertise and outstanding record. Our global presence allows lessons and experience to be shared between offshore wind farm projects, suppliers and countries. This experience has helped to shape the development of offshore wind and its supply chain in the UK, with an emerging potential to increase UK exports.

9. DE is a multi-contract developer (see Section 1.8) which enables us to retain full control of our supply chain. We do not subcontract overarching construction contracts - we have full access to all aspects of the contracts we place and are consequently able to ensure all DE requirements are met to the highest standards. Our proactive and hands-on approach allows us to uniquely monitor and influence the wider supply chain. This insight enables us to identify areas in need of improvement, especially where there may not be sufficient competition (which could negatively affect pricing). By directly engaging with suppliers we can help lower barriers to entry for new suppliers, encouraging greater competition and thus helping to drive down prices. This has significant positive implications for the cost reduction of offshore wind.

[redacted]

11. As previously stated, DE measures the UKC of our projects in line with the agreed industry standard established by the BVG Methodology. However, it should be noted that the BVG methodology does not capture the indirect, and potentially more important, effects of globally competitive UK suppliers supplying to projects outside the UK – for example, DE will be using UK manufactured blades at our German project Borkum Riffgrund Two.

12. DE writes into all its major contracts that our suppliers must track and measure their UKC levels for the components or services that they supply to DE projects. UKC levels are reported by suppliers to DE for contracts over £10m, using the BVG methodology.

13. The UKC and financial impact figures outlined in this document are based on 2016 data. This should be considered when making any comparison to future assessments.

1.3 Encouraging broader supply chains by supporting new entrants to the sector

14. Through our pipeline of offshore wind projects, DE is supporting the development of a competitive supply chain and we are proud of the UKC levels achieved for our projects under construction. Building on this, we expect to deliver at least 50% UKC through the delivery HOW02.

15. DE will continue to work closely with Tier 1 and Tier 2 suppliers to ensure we are sufficiently aligned to help encourage new sub-suppliers to enter the market. This will be done by sharing information about our projects with suppliers and sub-suppliers to help them understand DE needs and our requirements for success.

16. To help achieve this goal, HOW02 will employ a Supplier Development Manager to liaise between the project team, suppliers and other stakeholders, such as government bodies, to ensure information is properly shared with all interested parties.

17. Our large pipeline of projects has already enabled us to contract and support a number of new and existing suppliers to build capacity in the UK, for example:
    - Siemens, Hull (see Section 1.5.1);
    - Mitsubishi Vestas Offshore Wind (‘MVOW’), Isle of Wight (see Section 1.5.1)
    - Granada Material Handling, Rochdale (see Section 1.5.1)
    - CS Wind (see Section 1.5.2)
    - Offshore Structures Britain (‘OSB’) Middlesbrough (see Section 1.5.3);
    - Wilton Engineering, Middlesbrough (see Section 1.5.3)
    - JDR, Hartlepool (see Section 1.5.4)
    - Tekmar, from Newton Aycliffe near Teesside (see Section 1.5.4)

- DeepOcean, based in Darlington (see Section 1.5.4)
- Babcock International, Rosyth, Scotland (see Section 1.5.5);
- Atkins, Epsom (see Section 1.5.5);
- Balfour Beatty and Murphy (see Section 1.5.6);
- WSP, Middlesbrough (see Section 1.5.6);
- DE East Coast Operations Hub in Grimsby (see Section 1.5.8), and
- O&M suppliers e.g. Babcock Helicopters (see Section 2.7.2).

1.4 Identifying and removing barriers to entry for new supply chain companies

18. We have worked closely with suppliers to help improve competitiveness and overcome barriers to entry. We have approached this in a number of ways, for example by:
    - sharing our experiences in offshore wind to help reduce supplier costs and optimise cable designs (Section 1.8);
    - splitting our contracts into smaller contracts (or 'lots') to enable new suppliers to develop and bid (Section 1.8), encouraging specialist suppliers to bid and enter the marketplace;
    - spending time with suppliers on our standard Terms & Conditions to improve understanding of DE requirements (Section 1.8);
    - encouraging and supporting Original Equipment Manufacturer (OEM) through ongoing dialogue to work with new sub-suppliers and, where possible, help remove barriers to entry (see Section 1.8); and
    - facilitating discussions between our Tier 1 suppliers and potential sub-suppliers, especially with regard to potential use of UK steel
    - utilising government expertise to help facilitate discussions with suppliers where necessary (Section 1.6).

19. We regularly meet with the Department for International Trade (DIT) (formerly UKTI) to discuss supply chain opportunities and provide progress updates. This correspondence allows DE to continually assess new potential suppliers whilst also sharing new project opportunities that are on the horizon. An example was the award of the Reactive Compensation Station (RCS) topside supply contract to Babcock International in Rosyth, Scotland who DIT had identified as a possible supplier to DE.

20. A good example of how we have helped lower barriers to entry in the supply chain is our approach to the Transition Piece ('TP') / Monopile ('MP') package where we implemented an innovative contracting strategy to create and support new suppliers. [redacted] This approach also has also encouraged specialist suppliers to bid and enter the marketplace, see Section 1.5.3.

1.5 HOW02 and the opportunity for increased competition

21. Based on our expert analysis and taking account of timing, size and scope, we have identified a number of supply chain pathways to deliver at least 50% UKC for HOW02 over a capacity range up to 1800MW. We propose to meet this target by maintaining and developing a range of flexible options and opportunities and by working directly with OEMs and the extended supply chain. Experience we have gained through the development of our UK portfolio, specifically HOW01, will enable us to identify where we can bring additional competition into the UK supply chain and support UK suppliers to become global champions of offshore wind. The underlying long-term driver for DE is cost reduction.

22. This section sets out in detail the opportunities and options where we can develop competition in the supply chain, for example:

- potential to strengthen competition between Wind Turbine Generator (WTG) OEMs (see Section 1.5.1);
- opportunity to purchase towers from a UK facility (see Section 1.5.2);
- progressing opportunities for increased UKC on foundation supply and develop the market for the production of secondary steel (see Section 1.5.3);
- progressing opportunities for increased UKC on foundation supply (see Section 1.5.3);
- deepening the supply chain opportunity with existing offshore substation suppliers to engage and cooperate in the design maturation phase for offshore substations (see Section 1.5.5);
- continuing to deepen and embed the local construction market for the construction of onshore substations (see Section 1.5.6);
- opportunities for increased levels of hyperlocal and regional Tier 2 and Tier 3 companies to support Tier 1 contractors for the installation of wind turbine generators, array cables and export cables (see Section 1.5.7), and
- opportunity to develop more competitive local supply chains to support our local O&M bases (see Section 1.5.8).

1.5.1 Next generation Wind Turbine Generators (WTG) supply

23. WTGs represent the single largest cost component for any offshore wind project and a reduction in their overall cost would have positive implications for the Levelised Cost of Electricity (LCoE) of future offshore wind projects. Increasing competition amongst WTG suppliers is one of the most effective ways of achieving cost reduction.

24. DE was instrumental in working with Siemens to develop and deploy the 3.6MW WTG which has been deployed at the Walney, London Array, Lincs and West of Duddon Sands offshore wind farms.

25. DE was also closely involved in the development of the 6MW wind turbine, deployed for the first time commercially at DE's Westermost Rough project, which was a world-first and a game-changer for offshore wind, see Paragraph 94 for more information.

26. Furthermore, DE was instrumental in working with Siemens to bringing forward the Siemens facility in Hull to supply blades and electrical equipment for Race Bank and HOW01 and other UK offshore wind farms**.** This was significant for creating a new UK manufacturing facility and creating major new employment opportunities.

27. It was recently confirmed that the Alexandra Dock facility will provide approximately two thirds (~180 items) of the blades for Race Bank. These will be the first blades produced by the facility. More information available in **Annex CC**.

28. For HOW02, we are hopeful the project can make use of this facility and that majority of blades can be sourced from the UK. However, this is obviously dependent on the choice of WTG OEM for the project.

29. In addition, by selecting the new 8MW turbines at Burbo Extension, Walney Extension and Borkum Riffgrund Two projects, DE enabled MVOW to commit to ramping up a full scale blade production facility on the Isle of Wight undertaking both domestic and overseas projects supplies.

30. Since a significant proportion of any offshore wind project spend is on WTGs, DE has an internal team (see Section 1.8) who look specifically at how to drive down costs for this component, whether through innovation or by assisting suppliers to develop their products so there is more competition within the marketplace. DE continuously looks at the market to identify opportunities to improve the supply chain.

31. To ensure sufficient competition, DE has worked closely with both Siemens and MVOW on recent projects, even using both suppliers at Walney Extension (see **Annex BB)** and we are currently collaborating with both to ensure continued opportunities to increase competition in the future.

32. On 8 September 2016, DE announced the successful installation of the first of MVOW's 80m blades at Burbo Extension. The blades were designed, tested, and manufactured on the Isle of Wight and assembled at the MVOW pre-assembly facility in Belfast. By selecting MVOW for Burbo Extension DE has enabled further competition between suppliers, helping to reduce the cost of electricity generated by offshore wind whilst reducing risk by ensuring there is more than one supplier able to commercially supply this component to the sector.

1.5.2 UK Towers supply

35. DE has been working to identify, develop and deliver an offshore wind tower solution since January 2015. In doing so we have explored multiple opportunities across the UK alongside a number of respected international suppliers.

36. On 15 December 2016, DE signed an agreement with CS Wind for the provision of 95 UK manufactured offshore towers the majority of which are for our HOW01 and Walney Extension offshore wind projects.

37. This is a significant milestone for the industry and DE's support of this tower facility has helped boost competition for this component, which we expect to have positive long-term implications for cost. DE's work with OEMs on this will have benefits for the wider offshore wind industry and not just DE. By doing this, DE adopted a more active role in the supply chain than a developer would typically take and we have worked proactively with our chosen OEMs to develop and establish a UK tower facility for offshore wind.

38. It will be the first facility in the UK that can manufacture towers for offshore wind turbines and will be located adjacent to CS Wind's current facilities in Campbeltown, Scotland. The site will be able to produce at least 50 towers a year.

39. DE has been the main driver behind this development by:

- Exploring numerous opportunities over the last year to develop a UK facility for the manufacture of offshore wind towers
- Securing 95 towers for upcoming DE projects, including HOW01 and Walney Extension and other UK projects
- Helping safeguard 70 jobs at the CS Wind facility
- Facilitating further expansion and deepening of the UK's offshore wind supply chain with the potential to export to future projects overseas

[redacted]

41. By supporting the development of an offshore wind tower manufacturing facility in the UK, DE has helped remove barriers to entry for the supply of this particular component and boosted competition in the supply chain by bringing a new supplier into the offshore wind tower market, one which could supply future UK and European offshore wind projects.

1.5.3 Monopile / Transition Piece (MP / TP) and Foundation supply

42. Foundations represent the second largest cost component for an offshore wind project. The supply chain for this component is already relatively mature in the UK because of DE's proactive approach in the past. This means there is now a greater number of UK suppliers who are able to bid competitively to supply UK and non-UK offshore wind projects.

43. A number of concepts exist within the package – traditionally the MP/TP has been deployed by offshore wind developers, however, new concepts such as Suction Bucket Jackets (SBJs) are emerging which could be deployed at future projects and allow offshore wind to eventually move into deeper waters. We will explore both concepts in this section.

44. The UK foundation industry has risen to the challenges set by offshore wind and seized the opportunity to deliver new capacity at scale. DE has played a key role in developing the offer for these components, partly because of our long history working with the supply chain since the first Walney projects in 2008.

[redacted]

46. The second step focused on utilising our extensive knowledge of MP/TP designs and conveying these to the supply chain by prioritising high quality and safe production methods. Because DE is responsible for the design of the MP/TP components, we know which parts of the product to focus on and where to work with suppliers to adjust designs to accommodate their needs and vice-versa. This iterative process means that we have been able to continuously integrate new UK suppliers into our supply chain and redesign our foundations to meet the strengths of the UK supply chain's offer. This has subsequently allowed a range of small and medium sized suppliers from across the steel industry to see the potential in developing products for offshore wind. As a result a variety of potential offshore wind sub-suppliers for these components exist in the UK today.

47. DE's commitment to Offshore Structures Britain (OSB) has helped boost competition and strengthen the UK supply chain. DE was aware of the TAG Energy Solutions site in Teesside and when it became known the facility was experiencing financial difficulty, we suggested to our preferred MP supplier, EEW, and TP supplier, Bladt Industries, that together they should explore the potential for using the site for the manufacture of UK TPs as a joint venture (JV).

48. EEW and Bladt took the decision to develop the site in Teesside as part of a JV on the understanding that DE would provide initial demand for TPs through our two near-pipeline projects (Burbo Extension and Walney Extension), with an option for a third project (HOW01) contingent on the performance of the new facility.

[redacted]

50. In January 2015, DE placed a first order at OSB for 16 of Burbo Extension's 32 TPs. This was a perfect opportunity for the new site to ramp-up its production capability. With DE understanding the challenges faced by a new manufacturing plant, the order was placed early so the new facility did not have to meet challenging time constraints during the production of the components.

51. This was followed by an order for 40 TPs for Walney Extension and in January 2017 DE placed a third order with Bladt to provide 96 TPs for HOW01. OSB will produce 56 of these. More information is available in **Annex O**. DE is also currently exploring if OSB could supply components to any of its non-UK projects in the future.

[redacted]

53. The orders placed by DE at OSB for our Burbo Extension, Walney Extension and HOW01 projects reflect OSB's now solid standing as a competitive and reliable TP supplier. By filling OSB's capacity through these three orders, DE has helped the site ramp-up and establish itself as a major supplier to the offshore wind market.

54. We also believe that there are numerous potential synergies between the OSB facility and the wider UK steel sector. Because of our strong knowledge about steel fabrication, OSB and DE have been able to help mature the offers to offshore wind from Tier 2 and Tier 3 UK steel suppliers, [redacted].

55. To further develop competition in the TP package, DE recently facilitated an agreement between our HOW01 TP supplier Steelwind and UK engineering facility Wilton Engineering. Wilton Engineering will supply secondary steel to TPs provided by German company Steelwind.

56. Wilton Engineering is already an established supplier to the offshore (including Oil and Gas) industry. Current plans propose they would undertake coating of the TPs at OSB and are in discussions with a number of UK steel suppliers to utilise UK steel for the fabrication of their secondary structures. Wilton Engineering has a strong reputation within the Oil and Gas industry and it is envisaged they will transfer their skills to offshore wind. For HOW01, we will source 20 (out of 116) TPs from Steelwind with Wilton Engineering as the main, new, UK sub-supplier.

[redacted]

58. This is an important contract as it shows DE are willing to support diversification from other industries into offshore wind, thus boosting competition in the sector. It will also be a significant contract for Wilton Engineering which could help them establish themselves to supply other offshore wind projects in the future.

[redacted]

62. [redacted]We are also seeking to identify new TP subcontractors and DE and DIT are working closely with our suppliers to develop these opportunities. It should be noted that the foundation concept choice has not yet been made for HOW02 and there is scope for potential change in this package.

63. In addition, we will ensure we implement all the learnings and experience we have gained from our interactions with the UK's steel supply chain in relation to the production of foundations. Many of the same suppliers will be relevant for the offshore substation.

64. To recap, we are currently developing options to increase UKC even further, either through:

    a. sourcing as many TPs from OSB and Steelwind/Wilton Engineering (incl. associated supplies) as reasonably possible, or

    [redacted]

1.5.4 Array Cable supply

65. The array cable market in Europe is highly competitive with several suppliers capable of producing 33kV / 66kV Array Cables, including UK based supplier JDR Cables who DE have worked with on a number of projects.

66. To date, DE has predominantly used 33kV components but there is an ambition to develop a 66kV option. However, it is not yet possible to say whether this could be an option for HOW02 but DE is working to ensure there are as many competitive options as possible available. The choice of cable would depend on the size of the project awarded.

67. In June 2015, DE signed a framework agreement with JDR Cables for the supply of array cables from their facility in Hartlepool. This agreement included two call-off agreements for Race Bank and HOW01. For Race Bank, the associated equipment (including hang-offs, connectors and terminators) and commissioning services were all contracted to JDR Cables, whilst the cable protection system was awarded to Tekmar. Installation of components will be undertaken by Darlington based DeepOcean (more details provided in Section 1.3.7). These three companies are all based in the north-east of England and have worked closely together on a number of projects.

68. The framework agreement has been significant from a competition perspective as it provided UK supplier JDR Cables with long-term comfort in what was still a nascent industry. This confidence allowed them to invest and further establish themselves as a competitive offshore wind supplier, broadening the number of prospective suppliers available to offshore wind projects.

69. This was demonstrated when, in November 2016, HOW01 awarded JDR Cables their largest ever contract to provide array cables to the project, see **Annex I**. In total, they will provide 242km of array cable. This represents another vote of confidence in JDR as the leading supplier of array cables for offshore wind projects, not just in the UK but potentially around the world.

70. DE will continue to collaborate closely with JDR Cables to ensure they can remain a competitive supplier and can provide array cables for future projects including HOW02. Our collaboration will focus on developing both technical and commercial elements in order to improve cost competitiveness. It is expected to make JDR Cables an even more attractive prospect for the UK domestic market but will also improve their prospects for exporting array cables and related services to non-UK offshore wind projects, see **Annex U.** DE is currently running an EU tender for our European projects where it is hoped JDR will participate.

[redacted]

1.5.5 Offshore Substation supply

73. In May 2015, following an extensive procurement process, DE awarded a multi-million pound contract to UK company Babcock International based in Rosyth, Scotland for fabrication of the world's first offshore Reactive Compensation Station (RCS) for HOW01. An RCS helps to mitigate losses in a High Voltage Alternating Current (HVAC) transmission system where losses increase further from shore. The RCS was one of Babcock International's first contracts for offshore wind and it is anticipated that the award will help cement their place as a UK company supplying the offshore wind industry. As previously mentioned, Babcock International (see [redacted] and **Annex S**) was identified as a potential supplier via our collaboration with DIT. One reason Babcock were awarded this contract was their ability to deliver technical competencies at a competitive cost.

74. To maximise UK expertise on this package for HOW01, we encouraged bids from as many UK suppliers as possible at the contract tender stage. Babcock, who had previously limited experience in offshore wind, won the bid with the most competitive overall offer. Babcock was identified as a high-potential supplier, offering a strong technical solution at competitive prices.

75. In addition, we have worked closely with Epsom based UK engineering consultancy Atkins on design of the offshore substation for HOW01. Atkins was also involved in the design of the platforms for Burbo Extension, Race Bank and Walney Extension. By replicating the same substation design across a number of DE projects, we were able to lower the design costs associated with this component.

[redacted]

77. For HOW02, we plan to run a supplier competition to support our selection of the supplier for the offshore substations. The commercial competition will feed into our contract award decision.

1.5.6 Onshore Substation construction

78. The onshore substation construction market is relatively mature in the UK with a limited number of well-established suppliers who have considerable experience working on the onshore aspect of offshore wind projects. We work closely with UK suppliers through our local supply chain events, see **Annex K**. As a result of our procurement process, we have recently contracted Balfour Beatty and J Murphy for civil works of the onshore substation and installation of the onshore export cable for HOW01. We have also worked closely with WSP, Middlesbrough on onshore substation design.

79. For HOW02, we would expect to use a UK supplier, as it makes logistical sense and it will minimise cost.

1.5.7 WTG, Offshore Substation, Array Cable and Export Cable installation

[redacted]

81. In order to promote greater competition in the UK supply chain for the installation of array cable and export cable, DE has actively engaged with different contractors to try and expand our supply base with the intention of developing alternative installation options. DE had dialogue with numerous potential contractors with the purpose of sharing knowledge about our offshore wind installation plans. We have explained what capabilities (i.e. for vessels and equipment) are required in order to win contracts with DE. For example, the contractor installing inter-array and offshore export cables at Burbo Extension was previously not an active supplier to the offshore wind sector but entered the market following encouragement by DE. This has helped increase competition within the package which has had positive implications for cost and LCoE reduction.

82. It is now possible to contract with a number of competitive UK suppliers for both the array cable and export cable installation packages. For example, DeepOcean, based in Darlington, has worked on a number of recent DE projects and in November 2016 was awarded the array cable installation contract for HOW01. See **Annex T** for more information.

83. Additionally, we see real opportunity for local and regional Tier 2 and Tier 3 companies to support Tier 1 contractors for the installation of onshore export cables, array cables and other relevant civil works. As undertaken for previous DE projects, we will use our supply chain events to highlight opportunities for HOW02 and facilitate discussions with Tier 1 suppliers.

1.5.8 Operations and Maintenance (O&M)

84. DE has plans to develop a further three major UK offshore wind O&M hubs across the UK to service our offshore wind farms:

- Birkenhead near Liverpool (for Burbo Bank and Burbo Extension);
- Barrow (for Barrow, Walney and Walney Extension), and
- Grimsby for our east coast UK projects, more details below.

85. On 22 September 2016, DE announced plans for a multi-million pound investment in Grimsby to create the UK's largest offshore wind O&M hub (the East Coast Hub). Subject to planning approval, the new facility will be developed in the town's Royal Dock and will initially support Westermost Rough, Race Bank and HOW01, see **Annex HH.** It is envisaged it would support HOW02.

86. The East Coast Hub also includes plans for a Marine and Helicopter Coordination Centre ('MHCC') which will be split between two centres [redacted] The MHCC will be capable of providing 24-7 offshore operations support to both DE's UK and non-UK projects.

87. On 20 June 2016, we announced our intention to build a new O&M facility at a site in Kings Wharf, in Seacombe near Liverpool. The facility will consist of a new office and warehouse building on a currently disused site. It will serve the existing Burbo Bank and the Burbo Extension offshore wind farm, currently under construction. Up to 75 jobs will be created during the construction of the facility, whilst around 45 people will be permanently employed at the site once operational. See **Annex W.**

88. DE's long-term commitment to these areas will help the development of more competitive local supply chains around these O&M hubs. We have already seen a number of offshore wind suppliers set up new offices in these locations surrounding our own sites, which has increased the competitive offer available in the local O&M supply chain. We would also expect local companies to develop their offers as offshore wind supply chains mature in these regions. This is already evident in Grimsby and the Humber, especially in the Fish Docks and Royal Docks areas.

89. As with our work in the construction phase, DE is constantly striving to improve O&M efficiencies across our portfolio of projects. We work collaboratively to support new suppliers in what is a burgeoning part of the sector. DE has already invested a significant amount in O&M facilities and their supporting infrastructure. For example, working closely with regional partners, we invested in new lock gates at Grimsby's Royal Docks as part of an £11m investment plan relating to the development of the Westermost Rough offshore wind farm.

90. We will continue to work with relevant LEPs, local authorities, local government and potential suppliers to identify the most competitive providers of components, spares, tools and other services throughout the operational phase of the project and build upon the positive relationships developed during the development and construction of HOW01.

91. Where possible we will also employ local people – currently at Westermost Rough around 90% of the site team are from Grimsby or wider Humber region.

92. DE has already invested a significant amount into Grimsby and The Humber, see Paragraph 198 and the Regeneris Socioeconomic Report, **Annex Z,** for more information.

93. An important aspect of how efficient our O&M phase will be is agreed during the construction phase when we, as the project developer, sign a Turbine Supply Agreement (TSA) with our chosen OEM.

94. DE's chosen WTG supplier(s) will perform in-warranty operations during the specified warranty period and undertake maintenance for an agreed duration. For HOW02 we will work closely with the chosen WTG OEM during this period to develop the necessary skills and knowledge for DE staff to ensure the right levels of support exist following the expiry of the warranty period.

95. The aim of this is to create the right conditions for competition development in the area of post-warranty maintenance, which we expect will help achieve long-term cost reduction.

[redacted]

1.6 Sharing best practice and lessons learned

97. DE has vast expertise in the offshore wind sector and our knowledge has been frequently shared with the wider industry. A good example of this was our deployment of the first 6MW turbines at the Gunfleet Sands Demo Project and the data harvested from them. These turbines are now widely used across the sector and their implementation and the information attained from their demonstration has paved the way for further technological developments and a more competitive supply chain, in addition to the significant efficiencies enjoyed by deploying larger turbines on a commercial scale.

98. We work actively with a number of UK government departments, in particular DIT and the Department for Business, Energy and Industrial Strategy (BEIS), not only through frequent dialogue but also enabling learning experiences such as visits to our offshore wind farms and also by supporting conferences in the UK and abroad, such as the International Festival for Business 2016 (IFB2016).

99. We have also supported DIT in their activities in other non-UK markets in order to encourage export opportunities for UK companies: in October 2016 DE's Dutch representative spoke at an event organised by DIT and attended by a number of UK companies looking to supply offshore wind projects in the Netherlands

100. DE has pioneered a number of different financing models for offshore wind projects, attracting a number of institutional investors to the sector. Westermost Rough, for instance, the first offshore wind project to deploy the Siemens 6MW turbine was also able to attract both equity and debt investors to take full construction risk on the project, under the management of DE. DE has used similar models across its other offshore wind projects and will continue to explore innovative financing solutions for offshore wind projects in the future.

101. DE has a structured approach to ensuring that Lessons Learned are formally fed through to subsequent projects, and the supply chain provider, see [redacted].

102. To ensure we collaborate effectively with the industry, to raise awareness and share experiences, DE takes a leading role in a number of industry fora, see **Annex R**:

- Co-Chair Offshore Wind Industry Council (OWIC);
- Board Member of the Offshore Wind Programme Board (OWPB);
- Board Member of Renewable UK (also member of various working groups);
- Offshore Wind Accelerator (OWA);
- Offshore Renewable Catapult;
- Offshore Wind Week, see **Annex JJ**.

103. DE has been an active member of the OWA since 2009 and has had a significant influence on the content and direction of the programme. Examples of collaboration projects include Pile Soil Analysis Project ('PiSA') (more information available in section 2.7), the Suction Bucket Demonstration at Borkum Riffgrund in Germany and BEACon (more information in Section 2).

104. Recently, DE led the joint Government and industry (led by the Offshore Wind Industry Council – 'OWIC') '*Strategic review of UK east coast staging and construction facilities*' which was published in August 2016. BVG Associates undertook an in-depth review and analysis of the port requirements of the offshore wind industry and the existing port infrastructure (including future development plans) on the east coast of the UK. The report is included as **Annex J.**

1.7 Improving awareness of commercial opportunities among current suppliers and new market entrants

105. We work hard to highlight commercial opportunities to suppliers, for example we:
    - Hold regional supply chain events (see Paragraph 108)
    - Work closely with LEPs, business networks and Local Authorities (see Paragraph 109)
    - Collaborate with DIT and Trade Associations to support industry events (see Paragraph 111)
    - Maintain websites where supply chain companies can register interest (see Paragraph 112)

106. It is important for us to collaborate openly with existing and potential supply chain companies. To improve our collaboration and engagement for HOW02, we will assign a UK-based full-time Supplier Development Manager to ensure full engagement and cooperation between UK suppliers, the DE procurement process and other important stakeholders.

107. We hold regular regional supply chain events to support the development and construction of our offshore wind farms. **Annex K** sets out the supply chain events we have held for the projects that are currently in construction. We track the attendance of these events and at our most recent supplier event, for HOW01, over 100 attendees took part, including five Tier 1 suppliers who have been awarded contracts on the project.

108. For HOW02, like other DE UK projects, we will hold at least one supply chain event in the region.

109. By working with regional partners, such as LEPs and local authorities, we facilitate opportunities for local and regional suppliers to meet with our engineers and procurement teams to discuss the project needs and understand how best to tender for work. **Annex M** sets out some of the Regional Business networks DE has worked with and **Annex N** sets out our competitive tendering process.

110. Some of the local partners we have worked with or plan to work with in the future include:
    - North West Business Leadership Team (NWBLT)
    - Grimsby Renewables Partnership
    - The Bondholders
    - Team Humber Marine Alliance
    - Humber Local Enterprise Partnership
    - Liverpool Local Enterprise Partnership
    - Furness Enterprise

111. DE actively promotes and supports supply chain opportunities at industry events and conferences, these include, see **Annex L**:

- Renewable UK Global Offshore Wind, Manchester 2016
- Offshore Wind Connections, Bridlington 2016
- International Festival for Business, Liverpool 2016 (see **Annex Y**)
- EWEA conference, Hamburg 2016
- Renewable UK Marketplace, Liverpool 2016
- Offshore Energy, Amsterdam 2016

112. DE has also supported international delegations from other countries with an interest in offshore wind. In September 2016 DE hosted separate delegations from the Taiwanese Government and another delegation from a number of US states, including Massachusetts and Maryland. Both delegations visited Grimsby. Further delegations are planned in 2017.

113. DE has project specific websites for each of our projects, including HOW02. Websites contain key information about DE projects and information on how to become a DE supplier, see **Annex AA**.

1.8 Encouraging competitive procurement processes and more open competition across the supply chain – Product Line

114. One of the strategic priorities for DE is to reduce the cost of electricity in order to make offshore wind as cost efficient as other technologies. As a result of this strategy, the 'Product Line' ('PL') was established in 2014 with the purpose of reducing cost of electricity by developing standardised technology concepts and platforms, so called 'modules', that can be replicated across wind farms and thereby help to drive down the cost of electricity. When establishing the Product Line, DE was inspired by methods for cost reduction used in more mature industries, such as the automotive industry.

115. PL is staffed with experts from different areas of DE, including Engineering, Procurement, HSE and Quality Department and Concept and Layout. Specialists from these different departments form project teams within PL that run a portfolio of different projects with the aim of reducing module costs for DE wind farms (e.g. turbines, foundations, cables, substation and components). [redacted].

[redacted]

118. PL not only develops new technologies, products and concepts, the department also procures the components from DE's suppliers. PL has established multiple procurement teams whose work is dedicated to specific elements of the wind farm, such as the WTGs, foundations and cables, and has the sole purpose of reducing cost across DE's different wind farms by securing that the most cost-efficient solutions are used throughout the portfolio.

119. These teams, consisting of both procurement experts and engineers, work with suppliers to ensure cost-reduction across DE's pipeline of wind farms. The practice of using the same team to procure a specific component of the wind farm (for example turbines) over a portfolio of wind farm projects has the advantage of ensuring that procurement expertise is replicated across projects, allowing for consistent interaction with our suppliers without reducing competition or access to new entrants whilst also allowing access to the wider portfolio with the prospect of potential opportunities for export. In other words, commercial and technical cost reduction opportunities are systematically identified and turned into well-defined improvement initiatives by PL.

120. A PL success was realised with the introduction of a second WTG supplier. DE now use turbines from both Siemens Wind Power and MVOW at our wind farms under construction. DE believes that using multiple suppliers encourages competition in the supply chain, helping drive price down and performance up and thereby reducing the cost of electricity of offshore wind.

121. Another PL success was in 2014 when DE awarded UK company Atkins a contract to design five substations for use at three UK projects (Race Bank, Burbo Extension and Walney Extension). In 2015, Atkins was awarded a further contract for three substations for HOW01. This was significant as it ensured DE did not spend unnecessarily on different offshore substation designs at different projects. By procuring a standardised offshore substation design, this meant it could be repeatedly deployed across a number of DE projects.

122. Our competitive procurement strategy takes a systematic approach with the following principle steps:
    - Market engagement and strategy engagement
    - Pre-qualification
    - Long list, formal tender launch
    - Short list
    - Supplier award

123. To enable procurement efficiencies, DE adopts a 'Multi-Contract Procurement Strategy ('MCPS') as we consider it to be the most cost effective and efficient procurement and construction approach and strategy for a capital-intensive project like an offshore wind farm.

[redacted]

125. To ensure equal access to contract opportunities is available to suppliers, we offer comprehensive feedback to any unsuccessful tender and we have held a number of ‘Feedback Sessions’ with suppliers to help them understand where they may have either exceeded expectations or fallen short during their work on a DE project. [redacted].

2 Innovation

2.1 Innovation targets

HOW02 will represent a new milestone in the development of the next generation of offshore wind, and contribute significantly to the cost reduction trajectory. Given HOW02's distance from shore, innovations in the project will be critical in delivering the project at a competitive cost. Across our projects, we will pursue innovation particularly in the following areas:

- **Work with relevant suppliers and partners to develop an integrated energy storage solution for offshore wind farms;**
- [redacted]
- **Collaborate with industry fora and wider relevant organisations such as Universities to develop and deliver further innovation in offshore wind**

2.2 DE overview and philosophy

126. DE is a developer – we specialise in the development, construction, operation and decommissioning of offshore wind farms. This requires the handling of a huge number of interfaces and risks with almost all aspects of environment and society.

127. DE undertakes a significant amount of independent in-house innovation via PL, see Section 1.8; however, we also rely on innovation from the supply chain as well as collaborative innovation with independent organisations such as universities and other academic institutions.

128. Internal and external Research & Development ('R&D') activities are crucial for us in the process of developing, trialling and implementing new technologies which will contribute to cost reduction, improve health and safety and deliver increased efficiency throughout the construction and operation phases of our projects.

129. HOW02 will facilitate the continued development of opportunities for UK companies in the supply chain, creating a step change in innovation whilst helping the industry mature and competitively develop. DE's approach to offshore wind aims to document and share expertise between projects, see [redacted]

130. The size, scale and distance from shore of HOW02 presents many exciting challenges and opportunities which could be solved through innovations in offshore wind. These cover a wide range of areas, from the development of new components to the improvement of new installation techniques. Such innovation is essential to allow the more efficient development of Round 3 sites, such as HOW02, which are further from shore and in more challenging offshore conditions than earlier projects. HOW02 will allow us to build on what has already been achieved on previous projects like HOW01 whilst also developing solutions to newly encountered challenges.

131. DE's approach desire to achieve cost reduction drives our innovation strategy. [redacted] R&D is extremely important to DE and we approach it by identifying specific challenges and/ or objectives which we would like to better understand. To ensure that we have full visibility of all development areas (and where needed can integrate these as seamlessly as possible) our structure relies on five R&D roadmaps based to reflect the various aspects of offshore wind farms, see **Annex KK**:
    - Wind and waves (see Section 2.3;
    - Wind Turbines Generators (see Section 2.3.1)
    - Foundations and geoscience (see Section 2.4.1);
    - Electrical systems and grid connections (see Section 2.5.1), and
    - Logistics (O&M and installation) (see Section 2.6.2)
132. DE is able to deploy state-of-the art technology at earlier stages compared to other developers due to our ability to understand, handle and mitigate development risk. DE has a long history of being at the forefront of technological developments in offshore wind and is willing to take on the responsibility of bringing the most innovative solutions to the market and implement them commercially.
133. In the future, DE will utilise its unique position and experience to ensure that HOW02 is built using with cutting-edge technological solutions which take into account installation time, ongoing product development and associated development risks.
134. The concept of "integrated design" (i.e. the interplay between different components) is particularly important in helping us to deliver these innovations. For example, the interaction between wind turbines and foundations is considered holistically, which is critical in helping optimise the whole system, from blade to seabed.

2.3 Wind and Waves

2.3.1 BEACon

135. Together with The Carbon Trust OWA, we pioneered the development and first commercial installation of dual-doppler radar technology used in the offshore wind industry. Traditionally wind measurements have been conducted locally on a met mast by means of a cup anemometer or a ground-based LiDAR (see Section 2.3.2). The BEACon project, which was developed for wind hazard research, has the potential to measure wind speeds in a three-dimensional grid covering an entire wind farm. It represents major progress in wind resource assessments and will have a significant impact on the future design and assessment of offshore wind farms. Improved layouts mean increased wind yields and optimisation of future projects.
136. The BEACon project is the first of its kind in the industry and DE, through the innovative use dual-doppler radars, has raised the understanding of complex wind flows in offshore wind farms.

137. This will have a major impact on several aspects of the layout design and operations of an offshore wind farm. The short-term impact will deliver cost reductions through better wake modelling, wind farm-level power curve verification and lighter foundations as well as enabling a new level of wind farm control. The long-term potential for the utilisation of the data obtained in the BEACon project continues to expand as the vast amounts of data is analysed and it will continue to provide LCoE reductions for several years throughout DE future assets. **Annex MM** contains more details.

138. It is likely that data collected by BEACon at our UK projects will shape our plans for HOW02.

2.3.2 Light imaging, Detection and Ranging (LiDAR) and Floating LiDAR (FLiDAR)

139. LiDARs allow the accurate measurement of wind speed and wind direction with laser technology. Since 2010, DE has deployed more than thirty LiDARs, including fixed ground-based LiDARs, nacelle based LiDARs, and floating LiDARs (FLiDARs). Lidar technologies are now part of DE's 'standard measurements package'.

140. Both ground-based LiDARs and nacelle-based LiDARs have been tested by DE in-house and the results from our internal R&D projects have challenged wind industry standards in areas such as power curve verification and energy yield assessments. DE has supported and promoted the use of ground-based lidars to widespread acceptance throughout the industry

141. Deployment of LiDARs and FLiDARs has meant we can undertake improved wind assessments at our project sites, which will help us choose where to locate turbines for the maximum possible wind yield. This ensures each turbine becomes more efficient, as does the project.

142. Data collected from existing LiDARs in the proximity of HOW02, will be used to optimise the design of the project by providing a more accurate picture of wind speeds at the site, see **Annex LL**.

2.4 Wind Turbine Generators (WTGs)

2.4.1 Innovation in WTGs and Towers

143. DE has repeatedly demonstrated itself to be a leader and pioneer when it comes to introducing next generation and larger WTG platforms to the offshore wind industry. We have been first to commercially deploy the most innovative WTG products, now seen extensively in the global offshore wind market. Examples include the Siemens 6MW WTG first deployed on Westermost Rough and the MVOW 8MW WTG now installed on Burbo Extension, see Section 1.5.1.

144. A turbine with a higher power rating and larger rotor blades captures more energy from wind and enables a higher energy yield. Consequently, fewer turbines are required to meet a project's planned generating capacity. Fewer turbines mean a reduction in construction and operation cost spend with shorter installation times due to fewer overall turbine positions. There are further upsides with reduced balance of plant O&M activity required during the operational phase. There are, of course, increased risks involved with using new technology and a number of challenges identified within the current regulatory frameworks.

[redacted]

2.5 Foundations and geoscience

2.5.1 Pile Soil Analysis Project (PISA):

150. In 2015, DE, as lead partner under the OWA programme, worked with UK company Environmental Scientifics Group Ltd to undertake a pioneering comprehensive pile testing campaign. The initiative tested 28 piles on two different onshore sites in order to assist the development of new design methods for offshore wind farms. The estimated impact of PISA on HOW01 is a reduction of approximately 27,000 tonnes of steel, which will have a considerable benefit in terms of cost reduction for the project. See **Annex NN** for further information.

2.5.2 Innovation in Foundations

151. Innovation in foundation installation will help facilitate the development of more efficient equipment, methods and vessels which will allow a faster installation process during the construction phase.

152. We are in dialogue with suppliers (both manufacturers and installers) about the opportunity to reduce costs and deploy new technology. Discussions have covered all elements of the foundations, including investment plans for next generation installation vessels, sea fastenings and other installation tools.

153. DE has been exploring the use of two foundation concepts for HOW02: MP/TP and jacket foundations (including SBJs). Ultimately, the choice of the foundation solution for the project will depend on the site, turbine characteristics and the potential cost benefits from deploying the foundation concept in question. See Section 1.5.3 for more information.

154. As discussed, the PISA (Pile Soil Analysis) project, together with Carbon Trust OWA and other partners undertook research to challenge existing foundation design standards with a view to reducing costs, see **Annex NN**. In addition, DE participates in the following scientific partnerships:

- JaCo (Fatigue in jacket joints etc.)
- PISA-II (Extension of existing PISA project with desktop study on layered soils)
- GOAL (OPC Grout in piled jackets)
- CROWN project on Thermally Sprayed Aluminum, funded by Innovate UK, headed by The Welding Institute (TWI) (DE is a member)
- General membership of TWI

[redacted]

156. Continued investment in local and international fabrication sites for the fabrication of secondary items such as platforms and boat landings is expected for HOW02.

157. DE continues to develop a SBJ solution and HOW01 is planning to use an area of the site to install SBJs, ahead of the first full-scale commercial deployment of a new component in offshore wind at our Borkum Riffgrund site in Germany. It is hoped the use of SBJs will allow the industry to move into deeper waters in the future. By committing to installing 58 SBJs (out of 174) for HOW01, DE is planning to develop expertise in the UK supply chain for what is a relatively new concept and component.

158. DE is participating in several R&D projects co-funded by the Carbon Trust, aiming at increasing the theoretical fatigue life of welded connections. The concept is that the wall thicknesses of the steel plates can be reduced, resulting in a direct cost saving through reduction of steel required. However, there is also a potential indirect saving due to increased competition for the provision of components since more steel plants will be able to deliver the specified qualities and dimensions.

159. DE intends to engage in dialogue and collaborate with the potential suppliers of jackets and their sub-components at an early stage in the project where the design can be tailored to suit the capabilities and avoid the limitations of the supply chain, thus allowing more UK suppliers to tender. Through this dialogue, it is also hoped that valuable feedback regarding how design optimisation for more cost efficient fabrication in industrialised countries can be achieved will be shared i.e. consideration of automisation of welding and other labour-intensive processes.

2.6 Electrical Systems and Grid Connections

[redacted]

2.6.2 Innovation in Array Cables

165. For over five years, DE has supported Carbon Trust led initiatives exploring 66kV array cable solutions for offshore wind farms. Once realised this will be a significant factor in helping to reduce costs for large offshore wind farms with large wind turbines. Activities have included exploring consequential changes to the wind turbines, assessing suitability of offshore substations as well as collaborations with cable manufacturers (such as UK company JDR Cables) who were incentivised to develop, test and certify 66kV submarine cables. Work on these initiatives is ongoing at present.

166. As previously mentioned, whilst the 33kV array cable market is highly competitive, the market for 66kV array cables is limited. To stimulate further innovation within this module, DE is pursuing a collaboration programme with two suppliers, JDR Cables (Teesside, UK) and Nexans (France) to jointly develop new ways to reduce the cost of electricity by developing innovative solutions for the supply of array cables, see **Annex FF**.

167. The collaboration partnership will consider a range of initiatives such as:
    - implementing more efficient manufacturing processes (reduction of tolerances and cut-offs);
    - improved cable design (implementation of a different official design standard), and
    - enhanced cable delivery methods (depending on installation vessel and approach).

168. We expect this collaboration to have a significant impact on cost reduction for this package.

[redacted]

2.6.3 Innovation in Offshore Substations

[redacted]

171. In addition to working with HVAC platforms, DE also plans to optimise the foundation design for offshore platforms. This will be done by drawing from DE's extensive experience in developing foundations for WTGs. As the MP/TPs and SBJs increase in size due to the increasing WTG sizes these types of foundations can potentially also be used for HVAC platforms.

2.6.4 Innovation on Export Cables and Onshore Substations

172. For Race Bank, export cable specialist Jan De Nul (JdN) was contracted for the Export Cable Installation package and is using the new cable installation vessel "Isaac Newton" (10,500 tonnes) on the project. The cable loading capacity of this new vessel is more than double of the capacity the vessels used the first UK offshore windfarms in 2009. As a result, the vessel can carry much more cable and subsequently undertake a more swift and efficient installation campaign.

173. For the cable installation in the intertidal area, JdN and Mott MacDonald, working closely with DE, developed two new trenching tools: "Moonfish" and "Sunfish". These machines were specifically developed for the unique ground conditions and protected saltmarsh areas nearshore at the Race Bank site, see **Annex TT**. These tools have set a benchmark in terms of limiting the environmental impacts of construction work related to offshore wind farms through innovation and forward thinking. Without the deployment of this unique and innovative technology the project would not have been able to undertake this particular aspect of the construction phase so successfully.

174. One reason for selecting JdN was their unrivalled in-house technical expertise. DE and JdN worked in a collaborative way to design and then fabricate these bespoke tools from scratch. The tools needed to be able to successfully meet the environmental restrictions but also to achieve the deep burial requirements of the local port authorities required to safeguard marine traffic in the area. These two issues combined to create a "perfect storm" of technical requirements. Only through innovatively rethinking the problem from scratch could a successful solution be implemented.

175. The development and use of this technology at Race Bank received special recognition through the 'Innovation in Project Design' award presented to JdN at the IHS Dredging and Port Construction Awards 2016. The award is given to the most innovative project for and the category includes offshore, near shore and coastal projects. More information is available at: http://www.ihsdpcawards.com/categories

[redacted]

177. In terms of turbine installation, DE is exploring options with suppliers for using new turbine installation vessels with the intention that these will be available for HOW02. The aim is to support the development and delivery of new vessels with improved specifications suited to offshore wind.

178. This may include improved crane capacity, jacking capacity and deck load capability. This is to ensure the vessels are capable of installing the next generation turbines whilst still able to transport the same number of turbines per trip. DE will look to implement lessons learnt from other projects. These will be based on data retrieved from the Daily Progress Reports of recent installation campaigns as well as business intelligence data collected from on-site installation experts. Given the obvious synergies in site location and size, HOW01 will feed into this.

[redacted]

2.7 Logistics (O&M and installation)

2.7.1 Innovation in Array Cable installation

181. A new range of cable installation vessels has been developed to undertake work in the sector. DE has employed newly developed vessels and tools to ensure that the latest technological solutions in the market are utilised on our projects, as has been the case at Burbo Extension, Race Bank and Walney Extension. These vessels, for example the “Siem Aimery” (4,500 tonnes), are larger and have the ability to operate in more challenging weather conditions, providing superior vessel availability during construction. This means fewer ‘weather days’ where work cannot be undertaken and therefore more condensed, more efficient construction programmes. This has positive cost implications as these expensive vessels will generally need to be chartered for less time.

182. Larger vessels are also better equipped to handle the increasing demand for flexibility in the installation package as they have the capability to load continuous lengths and cut cables from one deck whilst simultaneously installing cables from another deck. In addition, new vessels typically have better HSE equipment, especially for crew transfer to foundations and between vessels.

[redacted]

184. DE has been involved in developing innovative risk based submarine cable burial assessment methods that allow cable burial depths to be adjusted depending on the nature of the seabed, the risk of exposure of the cable and the risk of damage due to an external impact with anchors, fishing gear or similar. The use of the cable burial risk assessment helps reduce costs of submarine cable installation operations as cables then only need to be buried to a minimum depth for protection where necessary.

2.7.2 DE Innovation in Logistics and Operations and Maintenance (O&M)

185. HOW02 will use experiences from O&M setups at Race Bank and HOW01. Due to their significant distance from shore, these two wind farms will pioneer the use of Service Operated Vessels (SOVs) in order to shorten the response time when unplanned maintenance is required.

186. The SOV approach will also ensure a safer working environment for DE turbine technicians by allowing a 'walk to work' approach for accessing turbines: SOVs use motion-compensated gangways for turbine technicians to access the turbine platforms without disruption from weather conditions or sea swell. Transforming the way wind farms are supported in the O&M phase, SOVs are able to accommodate up to 60 crew and technicians while remaining at sea for long periods.

187. DE is collaborating closely with vessel suppliers to develop and deploy these SOVs for our needs, demonstrated by the deployment of this innovative approach at Race Bank and HOW01. Given its location far from shore and being in close proximity to HOW01, it is realistic that the O&M phase for HOW02 would also be supported by the use of SOVs.

188. Similarly, it is likely HOW02 will build on the use of helicopters at other DE projects like Westermost Rough, Walney Extension and HOW01 to support the O&M phase of the project. A contract for helicopter support at Walney Extension for an initial period of 60 months was placed with Babcock Helicopters in July 2016 for the provision of helicopter transportation services for transport and helihoist of personnel and goods between the helicopter base and Walney Extension offshore wind farm. The contract has two extension options of 12 months each meaning it will cover the construction as well as the operation phase of the project.

[redacted]

190. Using SOVs and helicopters to facilitate O&M of offshore wind projects are relatively new concepts. Improvements in design, access, Health and Safety and vessel/helicopter technology are expected to occur as each new project adopts the same strategy. These support strategies for O&M can help reduce technician travel time and therefore increase the amount of time technicians can spend servicing and maintaining our wind farm projects. This will have a significant upside for how efficiently projects can be operated and subsequently there are positive implications for lowering the LCoE.

191. DE is also undertaking an internal project to explore the feasibility of developing offshore accommodation capability near to the HOW02 site at some point during the lifetime of the project. Although the concept could be trialled at HOW01, HOW02 could be the first project in which this new concept is deemed to be a viable option and commercially implemented.

192. As HOW02 is 140km from shore, it is envisaged crew would reside on hotel ships or 'flotels' and be ready on site to service the wind farm. This would be the next logical step in improving technician time efficiencies for the offshore wind industry and again is expected to have significant positive implications for cost over the life of the wind farm.

193. Another area where DE is looking to innovate in O&M relates to the inspection of our offshore wind project infrastructure. For HOW02 DE would be looking to commercially implement drone inspections of our turbines and other offshore wind components. This is expected to reduce inspection times for technicians, thus improving efficiency through innovation.

194. DE is also looking into how we use 'big data' and advanced analytics to assess project behaviour and predict trends (especially how to foresee potential failures and downtime) in order to minimise costs. This approach prioritises preventative measures over treatment.

2.8 DE role in sharing best practice and lessons learned

195. By working with industry partners in the UK, such as Carbon Trust OWA, Offshore Renewable Energy (ORE) Catapult and across Europe (with partners such as Wind Europe, ETIP Wind, and International Energy Agency (IEA)), we are work effectively with the industry to obtain good visibility of development and innovation in the sector and feedback lessons learnt into the wider development of offshore wind, see **Annex R** for more detail on industry fora DE is involved with and **Annex KK** for the innovation pathways.

3 Skills

3.1 Skills Targets

DONG Energy (DE) has adopted a holistic, cross-project approach to delivering its skills programme. However, the development of HOW02 and the size and location of the project mean it is integral to these plans and will allow us to implement our strategy as we envisage:

- **DE to extend partnership with University Technical Colleges ('UTCs') in the Humber;**
- **DE to establish a standalone apprenticeship scheme across UK projects and HOW02 to support a DE east coast UK programme for 4 apprentices a year;**
- **HOW02 will aim to facilitate an increased focus on STEM subjects. STEM focus will be focused by assigning funds from the DE East Coast Community Fund, to which HOW02 will contribute. Contributions will be contingent on a successful project Financial Investment Decision (FID).**
- **DE will be a key partner of The University of Hull's 'Project Aura' initiative, which aims to support the development of offshore wind in the UK through focusing on areas critical to the sector, including R&D and Talent Pipeline development.**

3.2 DE overview and philosophy

196. As the global leader in offshore wind, DE is committed to helping develop the skills required to deliver the UK's offshore wind ambitions, specifically in the regional areas in which we operate. We acknowledge the importance of a holistic approach which can allow skills to develop across different age groups and across a variety of subjects, from the provision of STEM subjects in primary schools to the support of PhDs at universities.

197. DE is committed to ensuring our staff are trained to the highest levels which will help them do their job safely and to the best of their ability but will also help the UK to remain at the forefront of offshore wind. The HOW02 project represents a significant part of this ambition and a sufficiently skilled workforce is essential to deliver the project on time, to budget and with health and safety as a priority throughout both construction and operation phases.

198. DE is committed to ensuring that those involved in the project receive the right training in order to ensure they are upskilled for their roles at DE but also be prepared and qualified for future employment opportunities, either in offshore wind or other sectors

199. In addition, by supporting the development of a skilled workforce which can cater for the needs of offshore wind, DE will help create more efficient, less risky projects. Improved productivity will help the industry to develop and mature more quickly, with a significant bearing on cost reduction.

200. In November 2014, DE commissioned Regeneris to explore the positive impacts that projects which have been developed, constructed and operated by DE have had on both locally and nationally but with particular focus on The Humber region, see **Annex Z**.

201. Based on early assessments for the O&M phase of HOW02, DE estimates the project could require around 100-130 personnel to support the project.

3.3 The planning process and assessment of skills requirements

202. HOW02 undertook an assessment of skills and employment opportunities as part of the HOW02 Socioeconomic chapter of the Environmental Impact Assessment (EIA) documents submitted to The Planning Inspectorate in 2013. This included a forecast of potential economic benefits associated with HOW02, including employment demand forecasts for each phase of the project (encompassing direct, indirect and induced roles). We outlined the intent to develop a comprehensive skills and employment strategy during a number of events held at schools and colleges in the Humber region, see **Annex UU**.

203. For HOW01, a Skills and Employment Plan was developed, approved and implemented in conjunction with local councils and Local Enterprise Partnerships ('LEP') see [redacted]The plan covers careers fairs and presentations, advertising of project roles and regular information sharing with relevant stakeholders.

204. A similar plan has been developed for HOW02, with project specific skills and employment and covers the following activities:

- communicate demands effectively;
- communicate strategic messages about general skills demands to the LEP;
- promote job opportunities locally;
- communicate with businesses to identify skills needs, and
- identify skills development needs.

205. More information is available here: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001195-Appendix%20T%20-%20Supply%20Chain%20and%20Employment.pdf

3.4 DE skills and education initiatives

206. DE is already a major UK employer. As of 4th January 2017, DE's UK headcount is 852. This has grown rapidly since DE's first employee in the UK in 2004. During this time, DE has been active in developing skills in offshore wind. This has included partnerships with Universities, apprenticeship schemes and working with University Technical Colleges (UTCs). More information on this is provided throughout this section and with reference to how DE will provide further future development opportunities for skills and training in offshore wind and related industries.

207. As previously mentioned, DE takes a holistic cross-project approach to skills and training initiatives. Consequently, the initiatives detailed below will be centrally established and implemented by DE rather than led by a specific project. It is essential that DE is engaged across the education spectrum, from primary schools to university level and beyond. However, many aspects of these initiatives will be relevant, both in terms of timing and geography, to our activities for HOW02. **Annexes AAA and UU** highlight the activities already undertaken with local schools and colleges by HOW02.

208. An overview of our skills initiatives is provided below. The development and delivery of HOW02 will be an integral part in helping deliver these.

3.5 STEM skills fund

209. Community Benefit Funds (CBF) are discretionary and voluntary initiatives designed to provide funding to communities located close to wind farms and other types of infrastructure. DE runs Community Benefit Funds (CBF) for Burbo Extension (£225,000 per annum for 25 years) and Walney Extension (£600,000 per annum for 25 years), see DE UK's CSR Report, **Annex ZZ,** for more information.

210. As part of DE recognition of the importance of skills and training, and following consultation with local communities close to our projects, the Walney Extension CBF has ring-fenced £100,000 per annum for use exclusively on skills and training initiatives.

211. It is widely acknowledged that the UK will have a shortage of skilled people in science, technology, engineering and maths (STEM) to meet the UK's future employment needs. With this in mind, each year, up to £100,000 of Walney Extension's CBF will be set aside for the "STEM Skills Fund" with the objective is to provide educational and learning opportunities for people within the CBF application area in order to help to improve their skills and employment opportunities. This will be known as the Walney Extension STEM Skills Fund.

212. There will be three tenets to this:

- Hardship Fund – £20,000 per annum available to support students facing financial difficulties for course fees or transport to courses (note this will not just be for STEM related courses). This fund is paid to selected college/s within the funding area and students will be able to apply directly to the college/s. Three grants of £6,666 each have now been approved for three colleges (Lancaster & Morecambe College, Blackpool & The Fylde College and Furness College).
- STEM Engineering Courses – £45,000 per annum available to support the costs of additional (i.e. beyond existing fully funded Government places) BTEC/HNC/BEng (ordinary or honours degree) courses in Engineering at Furness College (details to be finalised).

- STEM Educational Fund – £35,000 per annum available on offer to experienced organisations that can develop and deliver extra curriculum STEM training and/or education courses or a programme of targeted events. Funding will be available for up to two years. As of 31 August 2016, six applications from five organisations had been received. Applications were strong but the bid from the Royal Academy of Engineering to support a project entitled "*The Furness Education & Skills Partnership / Barrow Engineering Project*" was selected.

213. As part of our commitment to ensuring STEM subjects are continually supported, especially in the areas which need to develop skills in these important subjects, DE will commit £75,000 per annum for 20 years to the development of STEM initiatives on the east coast of the UK. Though discussions are at an early stage, DE will look to replicate the initiatives already established on the west coast and will focus efforts on Hardship Funds, STEM Engineering Courses and establishing a STEM Educational Fund. The DE East Coast Fund opened for applications in December 2016.

214. DE will look to work closely with local organisations and expertise in order to ensure the above programmes can be implemented as comprehensively as possible.

3.6 Teach First

215. Teach First is a national programme which aims to combat educational inequality in the UK by placing graduates in teaching positions at primary and secondary schools serving low-income communities around the country. Teach First also aims to ensure that disadvantaged pupils are well represented at the UK's top universities. To do this they also aim to match young people with mentors who can supply the necessary advice and practical opportunities throughout their time in sixth form. The overall objective is to help students be more ambitious, informed and successful in their choices. More information is available at https://www.teachfirst.org.uk.

216. Teach First partners with schools, universities, charities, businesses and individuals. It works with comprehensive secondary schools around the country, including schools in Hull, Grimsby and Liverpool, areas where DE is active. As plans currently stand, DE will be supporting the Teach First programme from 2017 and an announcement to launch the partnership will be made in one of the areas above early in 2017.

217. In addition to a financial contribution, DE will support teachers in the programme and pupils at the schools involved in 3 ways:
    - mentoring 1-2 STEM teachers a term for schools in the Humber and Liverpool;
    - mentoring pupils 18 months before they apply to university to support STEM applicants, and
    - working with teachers on offshore wind or energy related assignments over holiday periods e.g. developing new teaching material
    - See **Annex BBB** for more information on DE's partnership with Teach First

3.7 University Technical Colleges (UTCs)

218. UTCs are schools for 14-19 year olds. They aim to deliver innovative, high-quality education which combines technical, practical and academic learning. The aim is to offer more than the traditional GCSE and A Level curriculum. More information is available at http://www.utcolleges.org/about/overview

219. Throughout the development stage of the project, HOW02 was actively engaged with the Humber UTC. Since DE's acquisition of SMartWind and HOW02, this good relationship has continued – in June 2016 HOW02 sponsored a mechanical workshop at the college.

220. DE previously committed support and time to the UTC by supporting recruitment events, providing documents and information to the UTC to enable students to learn about offshore wind in the UK.

[redacted]

222. As part of our ongoing skills agenda, DE will be looking to increase our involvement with UTCs in the UK and especially in the areas where we operate. Initially, we will focus on our relationship with the Humber UTC and, depending on the success of the initiative, potentially roll-out the programme to other UTCs near our UK operations.

223. As part of this initiative, DE also has plans for discussions with the Ron Dearing UTC in Hull and how DE can support this new institute.

3.8 Apprenticeships

224. In 2011, DE supported 8 apprentices in training to become offshore wind technicians on the Walney Extension and London Array offshore wind farms, see **Annex DDD**. DE sponsored each apprentice with approximately £10,000 per annum. In Autumn 2014, 7 of the apprenticeships successfully completed the scheme.

225. The scheme involved:

- 3 year course at Swale Skills Centre;
- 3½ week course at Siemens training centre in Newcastle, and
- 1 year on the job training with DE O&M teams at London Array and Walney Offshore Wind Farms.

226. Internal assessment shows that by 2018, DE will require a total of approximately 190 technicians to support its UK operations, with approximately 90 estimated for the West Coast and just over 100 estimated for the East Coast.

227. DE will therefore implement a new apprenticeship scheme in the UK, the first phase of which we will aim to have setup this year.

228. The first phase of the scheme will support 4 apprentices. The scheme will then be expanded and rolled-out for DE's other UK operations in the future.

229. It is hoped that, should the scheme prove to be successful, DE will extend the scheme, and expand it to cater for other future DE projects, including HOW02. Where possible, DE will look to use local training providers and colleges and early discussions are being held with these bodies.

230. In order to ensure these apprenticeships are implemented in the optimum way for the apprentices and for the business, DE will appoint an apprenticeship specialist as a full-time member of staff.

3.9 University collaboration

231. DE supports collaboration with university students through Bachelor and Master student projects in the UK, Denmark and Germany by providing an opportunity for students to work closely with DE staff, helping them to tackle real and current challenges faced by the industry. DE believes that collaboration with university students in engineering and other technical faculties is essential to help develop and support the next generation of skilled employees.

232. DE is currently collaborating with a Geoscience MSc student at the University of Southampton, who is working on a thesis project entitled "*Processing and Inversion of Ultra High Resolution 3D data to assess the spatial distribution of sediment's properties on a paleochannel system*". It is hoped the project will help develop improved non-intrusive site investigation tools and increase knowledge acquisition earlier in project development phases, reducing uncertainty and limiting risk at earlier stages of project timelines.

233. Since 2010, DE and Durham University have formally collaborated to drive innovative research across the energy and renewables sector. DE has supported Durham University with [redacted] The partnership supports a number of initiatives for energy research, including a DE Professor of Renewable Energy at the School of Engineering and Computing Sciences at the renowned Durham Energy Institute (DEI). [redacted]

234. Annual workshops between the university and DE help determine potential collaboration activities which could benefit future DE projects like HOW02.

235. DE is also working with the Professor of Offshore Geotechnics at Department of Civil Engineering at Oxford University. The work has the objective of helping to reduce the capital expenditure of the construction phase as a result of implemented improved structural design tools related to the installation of monopile foundations for offshore wind

236. DE has also collaborated with a number of Danish universities to support BSc, MSc and PhD programmes and their supporting technical papers, see **Annex RR.**

3.10 DE careers events, advice and local engagement

237. HOW02 has already engaged with activities aimed at disadvantaged groups including working with Scunthorpe and Grimsby job centres. The project has also undertaken a number of visits to schools and colleges in the Humber, see **Annex AAA**.

238. DE has worked closely with local authorities, Local Enterprise Partnerships (LEP), schools, colleges and other training providers in the Humber and east coast UK regions. In February 2016, DE worked with the MP for Great Grimsby to hold a careers fair at The Grimsby Institute. Representatives from DE, Race Bank, Westermost Rough and HOW01 were all present to meet with students and over 100 individuals attended the event. As part of this event, DE developed the "Routes In" pamphlet to reflect the varied roles that exist within the sector, see **Annex CCC**

239. DONG Energy has appointed UK recruitment specialist Atlas to undertake recruitment for a number of DE projects including HOW01. In April 2016, Atlas held a special recruitment event for HOW01 in Grimsby in order to ensure as many positions were accessible to local people as possible. Atlas has since held another event for DE recruitment in Liverpool in November 2016.

240. Furthermore, to ensure the local populations are aware of DE vacancies, we ensure adverts for available employment opportunities are placed in local newspapers. **Annex FFF** shows the advert which was placed in the Hull Daily Mail (and jobs portal), Scunthorpe Telegraph, Grimsby Telegraph and Local World (jobs) online site

241. In July 2016, following the recruitment activity outlined above and subsequent interview and assessment workshops, employment offers were made to 20 technicians to work on Race Bank. 11 of these (55%) were from the Humber region (predominantly residents of Hull, North Lincolnshire and North East Lincolnshire). DE will strive to replicate this approach for future projects including HOW02.

3.11 Project Aura

[redacted]

[redacted]

3.12 DE contribution to industry fora for skills

245. DE is involved in and supports a number of industry fora for skills and training development:
    - Renewables Training Network (RTN) Group
    - Renewable UK Skills and Employment Strategy Group (SESG)
    - Offshore Wind Programme Board (OWPB) – Skills Workstream
    - ORE Catapult and Offshore Innovation Hub
    - North West Business Leadership Team (NWBLT) – Skills Task Force
    - RUK Offshore Renewable Energy Emergency Forum (OREEF)
    - RUK Health and Safety Committee
    - G9 Offshore Wind Health and Safety Association (G9)

3.13 DE staff training

3.13.1 Operations & Maintenance

246. DE has strict training and certification requirements for all staff with specialised roles and especially those undertaking work offshore. Technicians working offshore on DE projects must undertake the Global Wind Organisation (GWO) Basic Safety Training (BST). These include training modules in:
    - Offshore Medical
    - Manual Handling
    - Fire Prevention & Fire Fighting
    - Working at Heights
    - First Aid at Work
    - Offshore Sea Survival

247. The Westermost Rough O&M base is located in the Royal Docks in Grimsby and currently employs 54 members of staff at the site. In August 2016, it was announced that the Race Bank O&M site would also be located here. As previously mentioned, recruitment for roles commenced in June 2016 and as part of this, candidates undertook a two-day assessment.

248. As outlined above, successful candidates will receive extensive training to ensure they have the right skills to undertake their roles efficiently and safely.

249. In addition to the above, DE technicians with no prior experience can be expected to receive the following training before they are fully qualified:

Technician type	Training type	Duration
L1-4	DONG Energy in-house	1 week
	Turbine supplier specific	6 weeks
	On the job training / secondment to existing ops	16 weeks
L5	DONG Energy in-house	1 week
	Turbine supplier specific	8 weeks
	On the job training / secondment to existing ops	10 weeks
L6	DONG Energy in-house	1 week
	Turbine supplier specific	12 weeks
	On the job training / secondment to existing ops	28 weeks

3.14 Marine and Helicopter Coordination Centre (MHCC)

250. DE will centralise all MHCC activity for wind farms under construction at one centre, [redacted]. The Centre will employ 10 staff, 2 lead specialists and one manager. The role of the MHCC is to coordinate and direct all marine and helicopter traffic associated with DE projects in the UK and abroad as well as ensuring that all offshore personnel transfers are monitored (in 2016 there were over 250,000 transfers associated with DE projects). The staff working at the MHCC will undertake in-depth and specialised training to ensure they are well equipped to deal with the challenges of the role and to develop their careers within DONG Energy.

251. Recruitment for these roles took place in 2016, with 45% of the staff for the MHCC coming from the Grimsby area and 72% of staff coming from the wider Humber region (including Hull).

ANNEXES

A. DONG Energy Background
[redacted]
D. Map of Hornsea Development Area
E. DONG Energy in the UK leaflet
[redacted]
I. Hornsea Project One JDR Cables Contract – Press Release November 2016
J. East Coast Review
K. DONG Energy Supply Chain Event Details
L. Conference Participation
M. Regional Business Networks
N. DONG Energy Competitive Tendering Process
O. Hornsea Project One Bladt / OSB Press Release January 2017
[redacted]
R. Industry Fora
S. Case Study: Babcock International
T. Hornsea Project One contract with DeepOcean – Press Release November 2016
U. Case Study: JDR Cables
V. Case Study: OSB
W. DONG Energy to build O&M Facility in Merseyside – Press Release July 2016
[redacted]
Y. DONG Energy at the International Festival of Business 2016
Z. Impact of DE Investments in the Humber Area (a report by Regeneris Consulting)
AA. How to Become a DONG Energy Supplier
BB. Case Study: DONG Energy WTG Suppliers for Walney Extension
CC. First blades from Siemens Hull factory to Race Bank – Press Release December 2016
[redacted]
FF. Cable Array Cost Reduction Analysis
[redacted]
HH. DONG Energy East Coast Hub – Plans and Announcement
[redacted]
JJ. Offshore Wind Week 2016 – Events and Programme
[redacted]
LL. FLiDAR Overview and Use on DE Projects
MM. BEACon
NN. Pile Soil Analysis ('PISA') Project
[redacted]
RR. DONG Energy R&D within electrical engineering
[redacted]
TT. Details on Sunfish and Moonfish (ROW01)
UU. Hornsea Two Schools Events
[redacted]
ZZ. DE CSR report 2015
AAA. Hornsea Two UTC Presentations and Hornsea Two Educational Presentations
BBB. Teach First
CCC. Routes in Leaflet
DDD. DONG Energy Apprenticeship Schemes
[redacted]
FFF. ROW01 Recruitment Advert June 2016
GGG. Acronyms and Abbreviations